Local contents versus fiscal policy in extractive industries ☆

Murat Issabayev[a], Islam Rizvanoghlu[b,*]

[a] *Business School, Suleyman Demirel University, Kazakhstan*
[b] *Department of Economics, University of Houston, TX, USA*

Abstract

This paper develops a simple framework to analyze the links between local contents (LC) promotion associated with FDI in extractive industries and several elements of fiscal policy in a resource-rich host country. Though usually the owner of the natural resources underground is the host government (HG), the main operator in the upstream is mostly a multinational corporation (MNC), which possesses requisite skills to extract resources. We build a game in which these two players negotiate on how to share the profit by means of various fiscal elements. As the goal of HG is obviously not restricted to maximizing resource revenue, it also needs to design a tax system consistent with diversification needs of domestic economy, that is, by developing a LC program. Due to the trade-off between two policies and to accomplish both goals, the HG needs to enforce MNC on how to perform an optimal LC plan. Our principal finding is that, there is an optimal LC that maximizes domestic welfare and it is higher for the resource rich countries that are able to supply better quality inputs. We characterize the optimal LC policy and its interaction with income-tax rate. As a policy experiment, we analyze the effects of world oil price on the incentives of HG as to which policy to implement. To that end, our finding is that as world resource price increases, the optimal LC level remain constant, but optimal tax rate becomes more progressive. With another words, the fiscal policy is predicted to prevail the LC policy in the advent of higher resource prices.

Keywords: local contents, PSA, resource extraction, spillover, FDI

JEL: ..., ..., ...

☆We would like to thank .... All remaining errors are ours.

*Corresponding author: University of Houston, Department of Economics, 77204, Houston, TX, USA. Tel: 713-743-4709

Email addresses: murat.issabayev@sdu.edu.kz (Murat Issabayev), irizvanoghlu@uh.edu (Islam Rizvanoghlu)

1. Introduction

Natural resources, such as fossil fuels and minerals, generate huge revenue windfalls for resource-rich countries. These revenues are important source of funds for economic development programs, especially in developing countries. It is important to recognize that these countries owning the natural resources underground usually lack technological knowledge to extract them; hence they have to attract multinational corporations (MNCs). Upon entering into the resource-rich host country, a rent-seeking MNC signs a long-term contract, product sharing agreement (PSA), with a host government (HG) that describes how to allocate oil revenues by means of various forms of fiscal instruments. These instruments may include royalties, equity sharing rules and tax rate imposed on profit earned by MNC. In addition, a HG inviting a MNC to invest in domestic economy, whether it is an extractive or manufacturing industry, is not confined to maximizing tax revenues only. Instead, it wants to maximize the sustainable flow of resource rents and promote local content in order to increase the domestic absorptive capacities. In order words, HG can introduce a local content (LC) policy to increase the amount of local inputs sourced by MNCs.

Local content has become a widely discussed issue in many industries recently. It could be addressed to the development of local human skills through educational training, technology transfer from foreign partners, local producers via establishing joint-ventures, the job provision to a local workforce by creating backward and forward linkages, and, last but not least, to national infrastructure development. Broadly speaking, a local content policy is an additional obligation imposed on foreign partners, besides the direct tax revenue collected from its share, and aimed to boost the economy of the host countries. With this regard, Norway is the first country that successfully implemented local content in the oil industries as a development policy plan in the early 70s and served as a role model for other resource-rich countries. Since then, almost all resource-rich countries have imposed requirements of local content promotion on MNCs as part of their contribution to the domestic economy.

Nevertheless, despite the huge efforts by government officials in most of these host countries to promote local contents, its enactment has created a more challenging environment for the subsoil operations.

Although the HG is an undisputed owner of those resources underground, the operators in the resource sectors are mostly MNCs that have the right requisite skills (technological knowledge, human and physical capital) to extract those resources. Hence, the HG faces many decisions. It must decide: how to allocate equity shares from the project between the MNCs and the host country? How to design a tax system to increase the budget revenue? How to use the oil revenue consistent with local development policies? In short, the HG must possess fiscal alternatives dealing with these kinds of issues. Related to this, it is also important to point out that the HG faces a trade-off between generating tax revenue from those MNCs and requiring them to participate in local content promotion consistent with development policies. The common metrics to judge the spillover effects in this case could be economic growth, industrial growth, welfare, or surplus analysis. Therefore, in this paper we propose a model to characterize the optimal local content requirements that maximizes the welfare of a resource-rich host country.

There is vast literature on the design and implementation of local content policies for natural resource countries. However, we should also note that promotion of "local content in the extractive industries" is analytically similar, with few crucial differences, to generation of "spillover effects or value-added from FDI in various industries for the host nation". Therefore, both empirical and theoretical literature related to "spillover effects" of FDI in non-extractive sectors also is capable of providing insights about the effectiveness of local content policies in resource-rich countries. The empirical literature provides conflicting evidence on the benefits of spillovers from FDI. There are studies advocating FDI always creates spillovers (Blomström and Sjöholm (1999), Gorg and Strobl (2001)), and there are others who argue the contrary (Aitken and Harrison (1999), Haddad and Harrison (1993)). The

empirical findings are not very different for extractive industries either. The recent empirical studies on the LC policies for fossil fuels and minerals in African countries (Fessehaie (2012), Bloch and Owusu (2012), Ovadia (2016), Kolstad and Kinyondo (2017), Adedeji et al. (2016), Tordo et al. (2013)), Ngoasong (2014)) argue that sub-optimal design and poor implementation of these policies undermine their effectiveness.

Although there is a vast empirical literature on LC policies for extractive industries specifically or spillover effect of FDI for various industries, analytical studies modeling and characterizing the optimality of these policies are still scarce. In that regard, an early analytical contribution of Grossman (1981) is noteworthy. Using partial equilibrium framework with competitive firms, Grossman (1981) builds a formal model where final goods producers (foreign or domestic) can choose to purchase domestically or internationally produced inputs. However, these firms tend to use internationally produced inputs, as the domestic counterparts are technologically inferior. In order to create demand for domestic inputs, HG adopts LC policies that require certain fraction of those inputs to be procured domestically. Grossman (1981) finds that LC policies will lead to higher domestic input price, due to the increase in demand imposed by these policies. So, on one hand, the HG is trying to introduce a policy that aims to benefit input suppliers, but on the other hand this policy will hurt final-good producers (by increasing cost of production) and eventually the consumers (by making them to pay higher prices for the final good). Thus, in overall these policies reduce the welfare. Later, Richardson (1993) showed that adverse affects of these LC policies may be mitigated in a setting where high cost of domestic inputs induce foreign firms to follow a vertical integration in domestic market by investing in the input producing sector.

More recent theoretical studies (Lopez-de Silanes et al. (1996), Belderbos and Sleuwaegen (1997), Lahiri and Ono (1998), Qiu and Tao (2001), Lahiri and Ono (2003), Lahiri and Mesa (2006), Veloso (2006), Kwon and Chun (2009)) utilize strategic trade models to characterize the local content policies and their effects on domestic economy. Unlike previous models

that assume perfectly competitive markets, where economic profit is always zero, later studies consider oligopolistic markets where strategic behavior of the firms result in positive economic profits. Thus, loss in consumer surplus as a result of higher final good prices is partially or fully offset by an increase in producer surplus earned by domestic input producers. Lahiri and Ono (1998) find that welfare maximizing LC requirements are low when foreign firms are significantly more efficient than domestics firms. In other words, the loss in consumer surplus to due to high final good price is stronger than the gain in producer surplus since cost of production spikes when domestic input is procured. In this paper, we focus on local content policies for extractive industries that produce a tradable commodity whose price is determined by demand and supply in world market. Therefore, no matter how low is the cost of extraction of this commodity using the foreign inputs, the commodity is still sold at world price both domestically and abroad. In other words, unlike other sectors, such as automobiles, the MNCs do not help to achieve lower price for the product in the domestic market and thus are not able to generate consumer surplus.

Kwon and Chun (2009) take a different perspective and find that MNCs can actually transfer technology, establish its own input supplier and thus become a vertically integrated firm in host country as a response to high LC requirements. While this may seem feasible for an industry that will produce and supply the product indefinitely, it may not be a reasonable decision when total quantity of commodity to be extracted is fixed. Therefore, in this paper we don't consider the possibility of technology transfer and vertical integration.

Qiu and Tao (2001) argues that when faced with high LC requirements, MNCs will choose to relocate their investments to other countries. In other words, the choice of location for FDI strictly depends on the magnitude of the LC policies pursued by HGs. They also conclude that by adopting higher LC requirements, HGs will attract less efficient MNCs only. This is due to the fact that only less efficient ones are willing to procure technologically inferior domestic inputs and endure high cost of production, since they will be hurt relatively less

than more efficient MNCs. In our paper, we assume that MNCs do not choose between different locations, since natural resources (especially large reserves) are usually geographically concentrated and therefore MNCs do not have much choice about the location. Instead, we will assume that they can either choose to operate in a host country where natural resources are abundant, and thus extraction is less costly if foreign inputs are used or their home country where resources are almost depleted, and therefore cost of extraction is high even the most state-of-art technologies are employed.

Although above-mentioned studies provide insights about spillovers created by FDI, or local content policies specifically, all of them are focusing on non-extractive industries. However, the channels through which LC policies create value-added for welfare are slightly different for extractive and non-extractive sectors. For a traditional manufacturing sector, tax revenues collected from profits earned by MNCs are an important source of funds for HG and also crucial for welfare. Therefore, any LC policy that leads to higher cost of production and thus lower profits for MNCs has a negative effect on welfare through lower tax revenues. However, for the extractive industries, this effect is secondary. Resource-rich countries, owning underground resources but lacking technology to extract them, usually invites MNCs to perform extraction by signing a PSA that grants certain fraction of before-tax profits to the host country. In that case, any LC requirement that reduces profitability of the extraction will have a primary effect on government revenues (and thus welfare) through the amount of equity share collected. Moreover, as we mentioned before, MNCs will not generate any additional consumer surplus by providing cheaper commodity in domestic market, since resources are sold at world market price regardless of extraction cost in one single country. In that regard, we can claim that optimal LC policy models available in the literature may not be relevant for extractive industries. Besides, to our best knowledge, current literature (except Macatangay (2016)) does not provide theoretical explanation about the design and effectiveness of LC policies in extractive industries. Macatangay (2016) builds a theoretical

model to characterize the optimal LC policy for extractive industries. In his model, a foreign firm decides what fraction of its inputs to be procured locally, given that domestically produced inputs are technologically inferior to their foreign counterparts. Macatangay (2016) finds that there is a natural level of local content, even without a specific LC policy, but it is lower than welfare-maximizing level desired by host country. Although Macatangay (2016) is the closest study to ours, we still have few differences. Macatangay (2016) derives optimal LC policy while keeping the quantity of natural resources to be extracted fixed, which makes it impossible to account for the change in tax base as a result of LC policies. In other words, as a response to LC policies imposed by HGs, MNCs may decide to adjust production level, which will in turn affect the taxable profit generated in the extractive industry. To capture this effect, in our model we allow the MNC to choose the quantity of resources to be extracted based on given world price for the extracted resource, input prices, production function and LC requirement. Besides, we are also exploring the interplay between LC policies and tax rate imposed on MNC. Lastly, unlike any other study in the literature, we calculate the optimal LC policy through a Nash-bargaining between HG and MNC.

The aim of this paper is to search for the optimal LC policy and explore its interaction with other fiscal instruments, such as corporate income tax rate. We also study the response of optimal LC policies, and thus behavior of domestic welfare, to the changes in natural resource prices. The basic model developed to address these questions consists of two stages. In the first stage, given the level of LC requirement imposed by the HG, the MNC determines the optimal level of natural resource to maximize its profit. Without any LC requirement, the MNC will definitely choose to procure only foreign inputs that are technologically superior to domestic ones. In stage two, the MNC and the HG bargain over the element(s) of the fiscal policy given the profit-maximizing level of extraction in a standard Nash-bargaining setup. Later, we solve for the optimal LC policy that maximizes domestic welfare giving the tax rate and optimal level of extraction.

Our paper is a contribution to the growing literature on LC policies in extractive industries. The main contribution lies in formal explanation of the trade-off between LC policy and fiscal policy that the HG of resource-rich counties, especially less developed (LDC) ones, face. We demonstrated the trade-off between fiscal policy and LC policy both theoretically and computationally. On the other hand, since the main operators in the upstream are MNC, this trade-off between two said policies also lies on the shoulder of them. To the best of our knowledge, this is the first paper that attempts to model this ordinary negotiation processed between the HG and the MNC on how to set both equilibrium income-tax and optimal local content requirement that maximizes the domestic welfare. More precisely, unlike previous studies, this paper analyzes the above phenomena from government's perspective rather than focusing on firm competition in the domestic market. However, this "public-private" relationship is the first issue that needs to be considered at the outset, especially in a LDC. Our computational results show that with an increasing world oil price the HG aiming to maximize domestic economy is predicted to heavily focus more on fiscal policy rather on LC requirement.

The outline of the paper is as follows. In next section, we build a two-stage model to solve for the optimal LC policy and introduces the relevant policy question about the world oil price and its impact on local contents decision. The conclusion summarizes the main findings of the paper and suggests further extensions for future work.

2. Model

To get a better sense of the game played by the HG and the MNC, we begin with an introduction of the most common tax instruments in Production Sharing Agreements (PSA) and their impacts on local contents. This should help us clarify how various types of tax elements at different stages of the game influence the MNC's incentives to extract the resources and promote local contents.

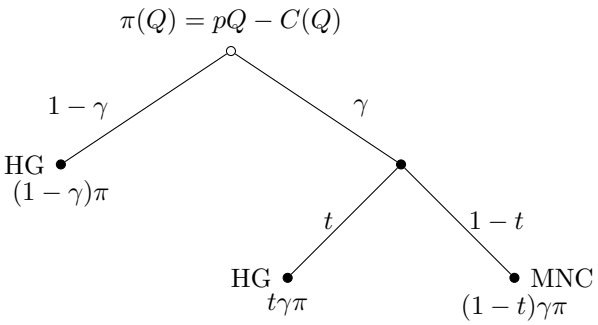


Figure 1: Allocation of cash flow generated by resource extraction

As it is expressed in Figure 1, once the resources are extracted and sold, HG and MNC split the pre-tax profits ($\pi = pQ - C(Q)$) in accordance with equity sharing rule specified in PSA. If MNC is entitled to γ fraction of equity, HG collects $(1-\gamma)\pi$ and the rest, $\gamma\pi$, is considered profit earned by MNC. Moreover, MNC is obliged to pay corporate income tax for the profit earned, therefore HG receives another payment, $t\gamma\pi$, as tax revenue. In total, HG's payoff is equal to the sum of two payments, whereas MNC's total payoff is only after-tax profit.

$$U_{HG} = (1-\gamma)\pi(Q) + t\gamma\pi(Q) \quad (1)$$

$$U_{MNC} = (1-t)\gamma\pi(Q) \quad (2)$$

We assume the resource price to be exogenous and a production function of crude oil to be of Cobb-Douglas form.

2.1. Production and cost

The MNC extracts natural resources underground using inputs manufactured both in the host country and abroad. Hence, in our context local contents will refer to the procurement of inputs in every phase of a supply chain in the extractive industries. For simplicity, let's assume production function is in the form Cobb-Douglas and a single input, s, is used to

extract Q amount of resources:

$$Q = Q(s) = s^{\alpha} \quad with \quad \alpha < 1$$

Notice we assume that a production function exhibits decreasing returns to scale. This is to capture the fact that as the natural resources underground are depleted extraction becomes more difficult. As for the cost of production, we adopt the following cost specification for input s:

$$C(s) = (\delta k + (1 - \delta)k^f)s$$

The input used in the production function can be procured domestically or internationally. In our model, s represents quality-adjusted quantities, whereas k and k^f represent the price MNC has to pay for the input in host country or abroad, respectively. It is reasonable to assume that unit cost of this input is lower abroad ($k > k^f$). The rationale behind this assumption is that natural resources, such as oil, gas, gold or silver are mostly concentrated in less developed countries. Besides these resource-rich countries are mainly characterized by low industrial base (Tordo et al (2013)), which implies that local service companies and/or local suppliers generally are not able to provide the specific inputs to the MNCs to meet professional industry requirements subject to international standards. If given a choice, a MNC will definitely choose to procure only high-quality inputs supplied in foreign markets. However, given the mandatory LC requirement (δ) enforced by HG and inabilities of local suppliers to provide high quality world standard inputs to foreign partners, MNCs will face higher unit cost of inputs (r):

$$r = \delta k + (1 - \delta)k^f > k^f$$

2.2. Profit maximization problem of MNC

The goal of the MNC is to determine the optimum level of inputs that maximizes its profit given the exogenous resource price and the LC policy adopted by HG. To determine the optimal procurement of inputs used during resource extraction, the MNC will solve the following problem as:

$$\max_{s} \pi = p\alpha^{s} - (\delta k + (1-\delta)k^{f})s \tag{3}$$

$$s^{*}(\alpha, p, r) = [\frac{\alpha p}{r}]^{\frac{1}{1-\alpha}} \quad \text{where} \quad r = \delta k + (1-\delta)k^{f} \tag{4}$$

Plugging the optimal level of input demand into production function yields the optimal level of resource extraction:

$$Q^{*}(\alpha, p, r) = [\frac{\alpha p}{r}]^{\frac{\alpha}{1-\alpha}} \tag{5}$$

Since α measures the returns to scale, in other words, the level of difficulty of resource extraction, the optimal level of extraction is higher for the countries where resources are abundant and thus extraction is easy. Besides, there is a negative relationship between the optimal level of extraction and LC requirement. If HG imposes higher δ, MNC will lower the extraction level since it will be facing higher unit cost of extraction. Lastly, unsurprisingly if the price of resource increases in the world market, the MNC will have an incentive to extract more for a given the LC requirement.

$$\frac{\partial Q^{*}}{\partial \alpha} < 0, \quad \frac{\partial Q^{*}}{\partial \delta} < 0, \quad \frac{\partial Q^{*}}{\partial p} > 0$$

2.3. Bargaining over tax rate

Once optimal profit is generated, it is time to allocate the share of profit to each player. The players are also concerned with the equity share from pre-tax profit and income taxes

charged on the share profits pertaining to the MNC. The players will be negotiating on corporate income tax according to Nash rule. Loosely speaking, we may assume that the HG organized an auction for several MNCs from different countries and the winner was supposed to form a Joint-Venture based on sharing rule specified in the PSA between the MNC and the HG of the resource-rich country. Therefore, before the full operation starts, both players will negotiate on income tax according to the Nash rule as:

$$\max_{t\in[0,1]}\{(1-t)\gamma\pi - d_{MNC}\}\{t\gamma\pi - d_{HG}\} \tag{6}$$

In case bargaining fails, each player gets their respective payoffs from their alternative options. These are d_{MNC} and d_{HG} for MNC and HG, respectively. For the MNC, it could be the payoff from an investment in home country where cheaper inputs will be used, but underground reserves are almost depleted, therefore extraction is more difficult. Given the tax rate and equity-sharing rule in home country, the outside option of MNC can be defined as following:

$$\begin{aligned} d_{MNC} &= (1-\bar{t})\bar{\gamma}\pi^f \\ \pi^f &= ps_f^{\alpha^f} - k^f s_f \end{aligned} \tag{7}$$

where s_f is the profit maximizing level of inputs given α_f and k^f in the home country of MNC. Since resources are almost depleted in the home country, extraction of resources is more difficult, $\alpha_f < \alpha$, but the technology is superior, thus the unit price of input is lower, $k^f < k$. It should also be noted that tax rate ($\bar{t}$) and equity sharing rule ($\bar{\gamma}$) abroad can be different than the one offered by HG.

As for the HG, the alternative option is the extraction of the resources by local firms lacking technological skills and abilities of MNCs. Hence we can define the outside option

of HG as following:

$$\begin{aligned} d_{HG} &= (1-\bar{t})\bar{\gamma}\pi^d \\ \pi^d &= ps_d^{\alpha} - ks \end{aligned} \tag{8}$$

where s_d is the profit maximizing level of inputs given α and k as a unit cost in host country[1]. Given the outside options of MNC and HG, we can solve for the Nash bargaining problem specified in Equation (6) and find the equilibrium tax rate:

$$t^* = \frac{\pi\gamma - d_{MNC} + d_{HG}}{2\pi\gamma} \tag{9}$$

Notice that if HG's outside option is equal to the outside option of the MNC, the optimal equilibrium corporate income-tax paid by the MNC will be equal to 50 %. Since normally the range of income-tax varies within 20%-30%, it is reasonable to assume that the MNC's outside option is larger than the outside option of the HG, $d_{MNC} > d_{HG}$. Comparative statics with respect to outside options for each player provides theoretically consistent results. Higher the outside option for the HG (MNC), higher (lower) is the rate of income tax to be paid by the MNC. Provided that $d_{MNC} > d_{HG}$ holds, the income tax change with respect to the profit is positive. So a higher profit is predicted to induce the HG to raise corporate income taxes on the MNC.

$$\frac{\partial t^*}{\partial \pi^*} = \frac{d_{MNC} - d_{HG}}{2\gamma\pi^2} > 0 \tag{10}$$

Taking derivative of equilibrium level of tax rate with respect to LC requirement (δ) reveals that HG is facing a trade-off. Assuming that $d_{MNC} > d_{HG}$ holds, if HG requires a

[1]A domestic firm is extracting resources using domestic inputs only and also subject to pre-specified long-term tax rate and equity sharing rule

greater fraction of inputs to be procured from domestic suppliers (higher δ), it should be ready to accept lower income tax rate.

$$\frac{\partial t^*}{\partial \delta} = \frac{\partial t^*}{\partial \pi^*}\frac{\partial \pi^*}{\partial \delta} = \underbrace{\frac{\partial t^*}{\partial \pi^*}}_{>0 \text{ by } Eq\,(10)} \overbrace{\underbrace{(\alpha p (s^*)^{\alpha-1}(\frac{\partial s^*}{\partial \delta}) - r(\frac{\partial s^*}{\partial \delta})}_{=0 \quad \text{by } FOC\text{: } \frac{\partial \pi^*}{\partial s^*}=0} + \underbrace{s^*(k^f - k))}_{<0 \text{ since } k^f < k}}^{\frac{\partial \pi^*}{\partial \delta}<0} < 0 \tag{11}$$

Since local inputs are technologically inferior to their international counterparts, procuring local content increases the cost of extraction for MNC, and thus lowers the profitability of the project. In that case, HG will have to sacrifice some of its bargaining power and accept lower tax rates in order to keep the project attractive to the MNC.

2.4. Welfare maximization problem of HG

Coming back to our main research questions: What will be the impact of local contents requirement on the host country's welfare? Or alternatively what is the optimal (welfare-maximizing) level of local content (δ)? To answer these questions, we will maximize the welfare of HG given the optimal level of input (s^*) and equilibrium level of income tax rate (t^*) both as a function of LC requirement (δ). For that purpose, we assume the welfare of the host country consists of two parts - government revenue and profits of local suppliers - as follows:

$$W_{HG} = U_G + \pi^{SUP} \tag{12}$$

To distinguish profits of foreign firm and local suppliers, we add superscripts "MNC" and "SUP", respectively. The HG collects tax revenues from the profit earned by MNC and claims a constant share of equity as specified in PSA. Besides, the cost of extraction to the MNC is sales revenue to local suppliers[2]. In that case the expression given in Equation (12)

[2]For the sake of simplicity, we assume that the profit to local suppliers is equal to the revenues from

can further be extended as:

$$W_{HG} = (1-t)\gamma\pi^* + t\gamma\pi^* + k\delta s^* \tag{13}$$

HG will set the LC policy that maximizes the welfare, W_{HG}. In that case, the impact of local content requirements on the host country's welfare is:

$$\max_{\delta} W_{HG} = (1-t(\delta))\gamma\pi^*(\delta) + t\gamma\pi^*(\delta) + k\delta s^*(\delta) \tag{14}$$

$$\frac{\partial W_{HG}}{\partial \delta} = \underbrace{(1-\gamma)\frac{\partial \pi^*}{\partial \delta}}_{(-)} + \underbrace{t^*\gamma\frac{\partial \pi^*}{\partial \delta}}_{(-)} + \underbrace{\gamma\pi^*\frac{\partial t^*}{\partial \delta}}_{(-)} + \underbrace{\delta k\frac{\partial s^*}{\partial \delta}}_{(-)} + \underbrace{ks^*}_{(+)} = 0 \tag{15}$$

First three components of Equation 15 represents the fact that higher LC requirement increases cost of production, lowers profit earned by MNC and thus decreases tax revenues and equity share allocated to HG. Last two components on the other hand represents the effect of LC policy on profit earned by local suppliers. Higher LC requirement leads to lower inputs (domestic and foreign combined) demanded by MNC. However, higher δ also means higher fraction of these inputs are procured locally. Thus the overall effect of LC policy on the profit earned by local suppliers will depend on the magnitude of fourth and fifth components on Equation 15.

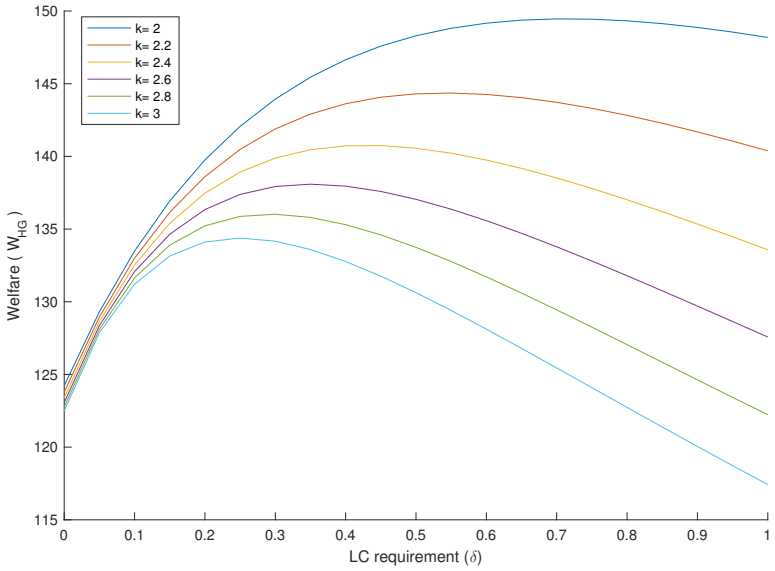
Apparently the sign of derivative ($\frac{\partial W_{HG}}{\partial \delta}$) is ambigous, therefore there is a possibility for an interior solution. Due to the complexity of Equation (15), we cannot derive a closed form solution for the optimal level of LC (δ^*). However, we calibrate the model to solve for the optimal level of LC computationally and explore its interaction with other variables. For calibration, we will mostly draw examples from crude oil. Most of the PSAs split oil

input manufacturing. Alternatively, we can assume a certain profitability rate for the local suppliers and thus include only a fraction of sales revenue in welfare. However, this modification will not invalidate our findings, as long as that fraction is constant.

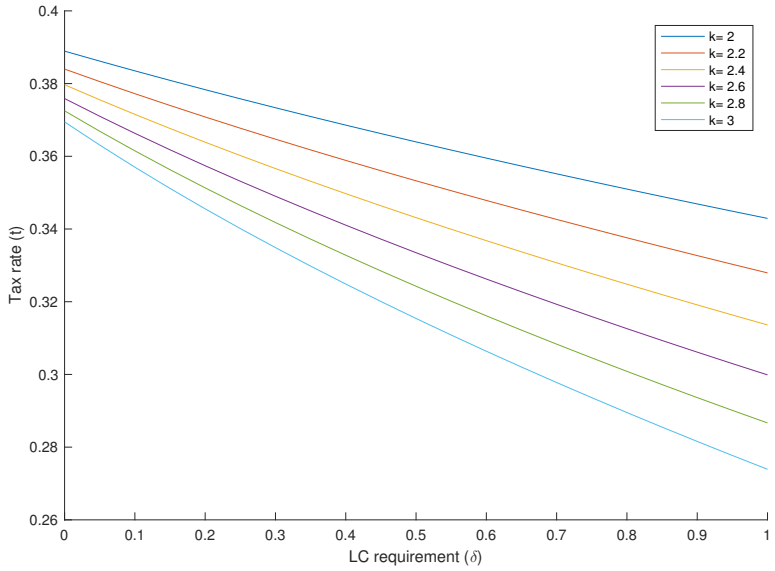
profits equally ($\gamma = 1/2$), and long-term crude oil price in the world market is around \$60 ($p = 60$). Based on the production model we are using in this paper, the average cost of extraction is equal to αp at the optimal level of resource extraction and input demand. Assuming that average cost of extraction for oil is around \$20 for conventional reserves, it would be reasonable to assign $\alpha = 1/3$. It is important to remember that α also represents the difficulty of extracting reserves according to the production function. Therefore, for unconventional (such as shale oil) and almost depleted reserves we assume $\alpha_f = 1/4$, i.e total production is less even if the same number of units are used. Regarding the unit cost of input, without loss of generality[3], we set $k^f = 1$ and then calculate optimal level of LC for varying values of k. In our computations, we vary k between 2 and 3. In other words, we look at the cases where cost of domestically manufactured inputs vary from %100 to %200 more than the cost of foreign inputs. Lastly, we assume that average tax rate abroad ($\bar{t}$) is 30% and the average equity sharing rule ($\bar{\gamma}$) is 1/2. The choice of $\bar{t}$ and $\bar{\gamma}$ affects only the outside option of MNC during the bargaining and it will create only a level effect on tax rate, however it will not change the relationship of tax rate with respect to other variables.

As it is shown on Figure 2(a) there is an interior solution for the welfare-maximization problem of HG. An increase in LC requirement does not always lead to lower welfare. As a matter of fact, for low levels of δ, a marginal increase in LC requirement improves welfare. It is still true that any LC requirement ($0 < \delta < 1$) increases cost of production, lowers profitability of the project and thus decreases tax revenues and equity share. However, when δ is small, the positive effect of LC policy on the profits earned by local supplier's is offsetting the negative effect of the policy on tax revenue and equity share. On the other hand, once HG impose a LC policy that is higher than the optimal (i.e. too high), the negative effect it

[3] s represents the number of input employed in the production function, but it does not specify the units of that input.



(a) W_{HG} as a function of δ



(b) t as a function of δ

Figure 2: Optimal LC policy (δ^*) and equilibrium tax rate (t^*) as functions of oil price

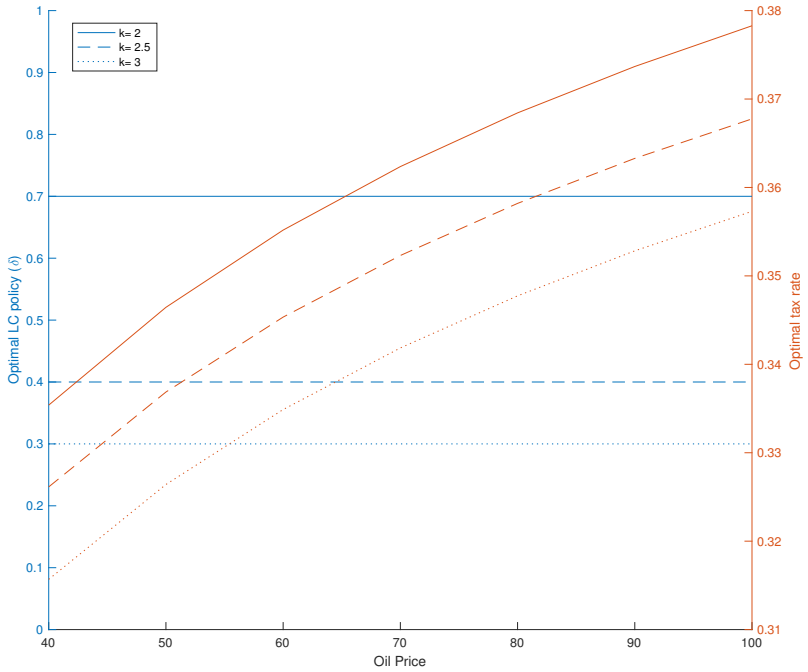


Figure 3: Welfare at HG and tax rate as functions of LC policy for different quality levels of domestic inputs

creates on tax revenues and equity shares becomes more dominant than the positive effect generated through local suppliers. Besides, LC requirement is higher for the HGs that can supply technologically superior inputs. The intuition behind this finding simply is that the lower is the quality of the inputs manufactured domestically, the more it will increase cost of production for a given level of LC policy. If HG could improve its technology and manufacture inputs that will cost $k = k^f$, MNC would procure all the inputs locally without any policy imposed by HG. Lastly, the negative relationship depicted betwen tax rate and LC policy in Figure 2(b) is in line with our previous finding provided by Equation 11. Figure 2(b) also reveals the fact that HGs with better inputs can bargain higher income tax rate to be imposed on profits earned by MNCs. Similarly, the MNC will be willing to pay higher tax rate in a market where better inputs are supplied, since the increase in tax liability is offset by the decrease in cost of production (or the increase in profitability).

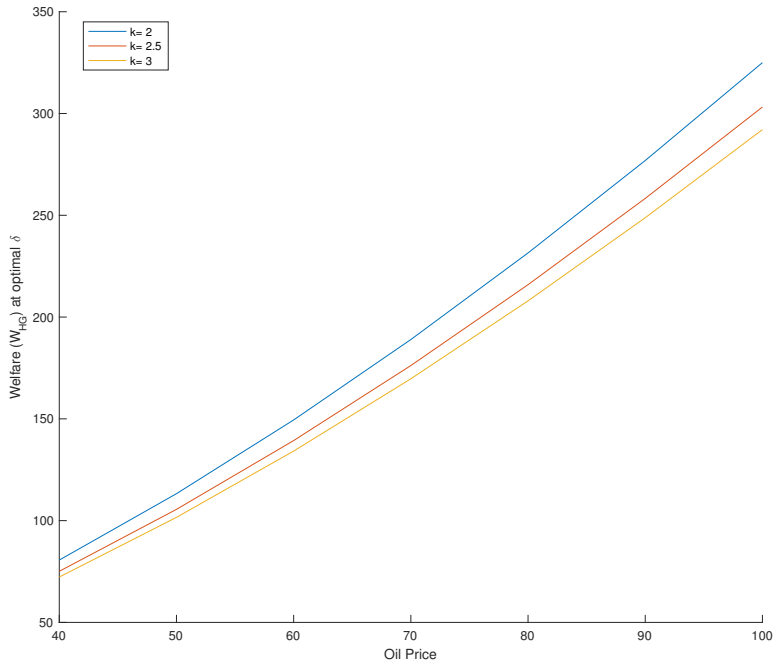


Figure 4: Welfare at optimal LC policy (δ) as a function of oil price

2.5. Policy responses

In previous section, we calibrated the model and solved for the equilibrium for a fixed level of oil price. However, due to the volatile nature of oil prices, perceived long-run level of oil price formed by the expectations of HG and MNC may shift. As a result, both parties may reconsider their position, i.e. outside options and bargaining power, and act accordingly. Additionally, HG will have to decide how to adjust LC policy and/or tax rate that are subject to a trade-off as a response to higher oil price. To that goal, we will analyze the effect of oil prices on the optimal level of LC policy and tax rate within the model. More precisely, we will vary oil price between \$40 and \$100 and solve for the equilibrium computationally using the calibrated models given in the previous section.

As it is shown on Figure 3, our model predicts that optimal LC policy is invariant to the oil price, instead HG chooses to reap the benefits of higher oil price through higher tax rate

without having to lower its LC requirement. This adjustment lets the HG to enjoy higher welfare as oil price goes up (Figure 4). Besides, since the gap between the curves in Figure 4 wides as oil price increases, we can conclude that the more efficient are the inputs supplied by local suppliers, the higher is the incremental welfare benefit.

3. Conclusion

In this paper, we have analyzed the two policies that the HGs of resource-rich countries pursue in order to increase domestic welfare. It is true that tax revenue is the central benefit to host country. However, it is useful to remind that the objectives of the HG is not just maximizing resource revenue, but also the use of it consistent with the development needs and generate spillover benefits by promoting local contents.

To understand the interaction between two policies that the HG faces, we have developed a simple model on profit sharing from natural resources. In this model, initially the profit-maximizing MNC optimally chooses the level of inputs (e.g. drilling machine) needed for extraction of those resources. However, there is a strong requirement by HG that some fraction of input procured by MNC must come from local supplies. Upon extraction is complete, the two players share the pre-tax profit according to the rules set by PSA. Then both players negotiate on the income-tax rate to be imposed on MNC's profit within a Nash bargaining framework. Since HG cannot simultaneously contribute to development of LC policy and tax revenue, it has to choose the optimal fraction of local supplies needed for maximum welfare. We find that there exists an optimal LC requirement and it is higher for those countries with technologicaly superior inputs supplied locally. Additionally, there is a trade-off between LC policy and tax rate. A related finding of policy relevance is that a higher world oil price is predicted to lead to higher tax rate but have no impact on optimal LC policy.

There are a number of directions in which this paper can be extended. In the analysis

for convenience purpose we have assumed that equity share from the project is exogenously determined and we skipped other tax instruments such as royalty. However, in the future we hope to explore the effects of these instruments endogenously. It is important to recognize that the form and instruments of the tax regime will affect the incentives for the MNCs in developing and extracting the resource base. The choice of fiscal instruments and ownership vehicles affect the pace of extractions, the amount of the resource recovered, and the management of the field. Moreover, local content regulations are a prime area for corruption in natural resource deals.

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