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Abstract: Local content requirement policies typically call for a foreign investor to source a portion of its procurements from local suppliers in the domestic economy. Local content requirement policies have long been studied for various industries, and there is currently a vibrant debate on their design or implementation in extractive industries, such as minerals, oil, or gas, especially in resource-rich low-income countries. Our objective in this paper is to characterise optimal local content requirement policies in the context of extractive industries. If an optimal local content requirement policy serves to monetise the positive externalities from foreign investment, then it is, in essence, a Pigouvian subsidy, which is a first-best policy, but the incremental volume of business which it may induce is a function not only of the size of the positive externalities but also of the response of local suppliers to new business opportunities. We discuss four implications: providing high-powered incentives for investor compliance, harvesting the investor's superior information, managing the host government's administrative burden, and mitigating the risk of infantilising local suppliers.

Keywords: Local content requirement, extractive industries, Pigouvian subsidy, positive externalities

1 Introduction

Extractive industries, such as minerals, oil, or gas, could fuel economic development in resource-rich low-income countries. One popular development strategy is to establish a local content requirement ("LCR") policy calling for a foreign investor to source a portion of its procurements from local suppliers in the domestic economy. LCR policies have long been studied for various industries (Grossman 1981), and there is currently a vibrant debate on their design or implementation in extractive industries, especially in resource-rich low-income countries (Venables 2016; Marcel *et al* 2016; Bastida 2014; Adedeji *et al* 2016; Ovadia 2016; Nwapi 2015; Morris *et al* 2012; Haddow 2014; Sutton 2014; Hanlin and Hanlin 2012; Hunter 2014; Tordo *et al* 2013; Ramdoo 2015; Kaiser 2014; Bloch and Owusu 2012; Kolstad and Kinyondo 2015; Hufbauer *et al* 2013; Adewuyi and Oyejide 2012; Östensson 2014; Winkler 2014; Fessehaie 2012). Although sub-optimal LCR policies in extractive industries, as we discuss further below, likely have adverse economic consequences, the fundamental elements of optimal design or implementation seem to be poorly understood. Indeed Tordo *et al* (2013) claims that much of LCR policy analysis in the oil and gas sector has been qualitative.

Our contribution to the debate is to characterise optimal LCR policies in the context of extractive industries. We have a distinctive approach to the modelling. Foreign investment potentially brings positive externalities to the domestic economy, such as new skills, the leverage of foreign capital, or local linkages. If an optimal LCR policy serves to monetise the positive externalities of foreign investment, then it is, in essence, a Pigouvian subsidy, which is a first-best policy. It follows that the concept of an optimal LCR policy, represented in the modelling as an optimal subsidy, arises from the maximisation of incremental economic welfare consisting of the policy cost, the incremental producer surplus enjoyed by local supply, and the social benefit arising from additional local supply above the natural level prevailing in the absence of an LCR

policy. In other words, depending on the circumstances, there is a natural level of local content due to the innate competitiveness of local suppliers without an LCR policy, and there is an efficient level of local content due to optimal LCR policy.

However, the incremental volume of business which an optimal LCR policy may efficiently induce is a function of both the size of the positive externalities and the response of local suppliers to new business opportunities. The size of the positive externalities depends on the gap between the private values and social opportunity costs of labour or capital. The response of local suppliers to new business opportunities is contingent on their competitiveness. We posit in our model that local supply for an input required by the investor uses labour and capital under a decreasing returns-to-scale Cobb-Douglas technology which facilitates the representation not only of the gap between private values and social opportunity costs of labour and capital, but also of the potentially limited capability of local suppliers to respond to market signals. We demonstrate that the interaction between the size of the positive externalities and the capability of local suppliers has profound effects on optimal LCR policy.

We discuss four implications for LCR policy. One is the high-powered incentives for investor compliance. The investor procures a higher quantity of local supply, and incurs a higher procurement cost, with the LCR policy than without it. In short, typically there is a policy cost. We propose that, although the policy cost is typically borne by the investor, it is ultimately shouldered by the government through a reduction in the royalty paid on the resource, as long as there is compliance. In other words, the investor, enjoying a royalty break if it complies with the LCR policy, is compensated for the policy cost it incurs. However, we further propose that, in the event of non-compliance, the government imposes a penalty equal to the foregone economic benefits comprising not only the incremental producer surplus which would have been enjoyed by local suppliers, but also the social benefit which would have been generated by additional

local supply above the natural level without the LCR policy. Inasmuch as the compliance cost, if the royalty break is properly estimated, is nil, even a small amount of foregone economic benefits is sufficient to cause a positive cost of non-compliance. As a consequence, the cost of compliance is likely lower than that of non-compliance, and the sensible course of action for the investor is to comply.

Another implication for LCR policy is the harvesting of the superior information of the investor. An investor in extractive activities obviously has limited flexibility on its production location decision and thus is generally unable to engage in spatial cost arbitrage pitting production cost in one location against that in another. Thus, pretty much immobile, the investor located on-site is likely motivated to search diligently for cost saving opportunities wherever they could be found. As we discuss above, the royalty break, which is the compensation to the investor for the policy cost, is an estimate of the extra procurement cost incurred under an LCR policy. If the investor, relying on its deep knowledge and expertise, finds local suppliers which, at the appropriate quality, are willing and able to deliver at very low cost, then it may be able to reduce its actual extra procurement cost, and pocket the difference. We argue that the opportunity to secure cost savings until the LCR policy is adjusted over the policy cycle, akin to a process under price cap regulation, provides an incentive for the investor to search for the best-performing local suppliers. This virtuous process, in turn, encourages local suppliers to be as competitive as possible and enhances the prospects for strengthening local linkages.

A third implication for LCR policy is the management of the administrative burden on the host government. We assert that an optimal LCR policy minimises the risk, not uncommon amongst resource-rich low-income countries, of government mismanagement or corruption. Under an optimal LCR policy, the incentives for compliance or non-compliance are not only based on economically sound principles (rather than on

arbitrary edicts), but also verifiable by a third-party, such as a judge, jury, or arbitrator, in the event of a dispute. As a result, the audit of policy benefits or costs is facilitated, and the scope for bureaucratic discretion is restricted, both of which are especially important if governance capacity in the host economy happens to be low. Moreover, the economic benefits of policy are delivered directly through the profit-maximising behaviour of an investor "on the ground" rather than indirectly through a possibly conflicted government bureaucracy "far away."

Finally, a fourth implication for LCR policy is the mitigation of the risk of infantilising local suppliers. Under an LCR policy, the maturation of local suppliers, enjoying protection from international competition, may be slow. We claim that the LCR policy cycle serves as a mechanism for monitoring the magnitude or direction of the performance of local suppliers. If local capability improves over time, the local supply curve is likely to shift out, indicating an increase in competitiveness, and the result is a higher quantity available at any given price. However, if, over the policy cycle, the local supply curve has not shifted out or is slow to shift out, there is an economically sound (rather than arbitrary) basis for changing or terminating the LCR policy. In other words, if the investor, after several LCR policy cycles, repeatedly finds uncompetitive sectors chronically unwilling or unable to respond to new business opportunities, then the government receives a clear market signal to alter or end policy support.

Our approach is to deploy a high level of generality and abstraction in order to isolate the fundamental elements of the incentive problem and to support their application to a wide range of settings. The rest of this paper is structured as follows. Section 2 reviews the principles underlying LCR policies in extractive industries. Section 3 describes the optimisation model and the calibration. Section 4 draws implications for the design or implementation of LCR policy. Section 5 offers a conclusion and identifies areas for further research.

2 Local content requirement policies in extractive industries

It is not immediately obvious that extractive industries could be catalysts for economic development in resource-rich low-income countries. Extractive industries are highly capital intensive, and their spill-overs, such as linkages beyond enclaves, tend to be limited (Kaiser 2014; Boadway and Keen 2010). Their employment impact, especially upstream, is modest and relatively low-skilled (Kaiser 2014; McMillan and Rodrik 2011; Boadway and Keen 2010). In fact, it seems very difficult to rely on extractive industries for economic development. Venables (2016) narrates that, although harnessing extractive industries for development sounds straightforward, it is not easy at all, for various reasons, such as the intense pressure for current spending, the damage to other tradable sectors of an exchange rate appreciation due to resource exports (the so-called "Dutch disease" effect), a disproportionate dependence on a lone volatile source of income, weak governance, or political forces prompted by the potential for resource wealth. Indeed Venables (2016) reports that few developing economies have succeeded in doing so, and that "… economic growth has generally been lower in resource-rich developing countries than in those without resources." McMillan and Rodrik (2011), providing evidence for China, India, other Asian countries, Latin America, and sub-Saharan Africa, shows that the larger the share of natural resources in exports, the smaller the scope for productivity-enhancing structural change. Conducting a scholarly synthesis of a vast literature, Venables (2016) concludes that "… no single answer can be given to the question of why it has proven so difficult to harness natural resource wealth for broader economic development."

Another way of looking at the matter is to identify mechanisms for enhancing the value captured from extractive industries. The fiscal regime obviously plays a crucial role.

Boadway and Keen (2010) expounds on the characteristics of the resource sector. Given the prevalence of foreign ownership and the magnitude of tax receipts, tax revenue is likely to be the core benefit to the host country. There are high sunk costs and long production periods. Hundreds of millions of dollars could be spent over decades. In mining, it is not uncommon for 50 years to elapse between exploration and rehabilitation. Expenses are incurred early in the life of the project, often prior to the generation of cash flow, and then are sunk, with little if any alternative use. While the resource project is in the design stage, the prospective tax base is highly sensitive to the anticipated tax regime, but once sunk costs have been incurred, investors have little choice. As long as they can cover variable costs, producing is more profitable than ceasing operations and the tax base becomes relatively insensitive to tax design.

There are, of course, other mechanisms for increasing value capture, such as harvesting the benefits from local economic linkages across the value chain. Rodríguez-Clare (1996) provides a discussion of the positive externalities arising from backward and forward linkages. A final-good firm increases the demand for inputs and induces a widening variety of specialised inputs. This backward linkage represents a positive externality to other final-good producers. The local production of increasing amounts of specialised inputs allows the competitive production of increasingly complex goods which intensively use specialised inputs. This forward linkage represents a positive externality to other input producers. Moretti (2010) offers a characterisation of local multipliers. The multiplier varies according to the type of job added or the type of industry. In the US, one additional skilled job in the tradable sector generates 2.5 jobs in local goods and services, but the corresponding figure for unskilled jobs is one, and high technology industries have the largest multiplier. Javorcik (2004) finds that positive productivity spill-overs from foreign investment occur through the interaction between foreign affiliates and their local suppliers in upstream sectors, and that spill-overs arise from

projects which have shared domestic and foreign ownership but not from those which are only foreign owned.

There is evidence that local economic linkages can indeed be established across the value chain of extractive industries. Hunter (2014) narrates that, in Norway, consistent and decisive government policy aimed at building local industrial competence and implemented through statutes and licensing conditions succeeded in establishing cross-sectoral linkages. Clark *et al* (2016) provides evidence suggesting that, in Africa, a heavy reliance on extractive activities, which stimulate manufacturing diversification through improvements in infrastructure, rising incomes, or expansions in the demand for locally produced goods, is not an obstacle to diversification. Kaplan (2012) shows that, in the mining equipment and specialist services sector, South Africa is technologically sophisticated and globally competitive. Adewuyi and Oyejide (2012), studying the oil and gas industry in Nigeria, demonstrates that, due to LCR policies and investments in telecommunications and transport, there are many local firms participating in the value chain. Bloch and Owusu (2012) shows that, due to backward linkages, gold mining in Ghana is no longer completely an enclave. An increase in local copper production in Zambia, Lippert (2014) chronicles, appears to have improved living standards in areas around the mines, even for households not directly employed in mining. Mine employee expenditures, Östensson (2014) asserts, are arguably at least as important as production linkages to employment. Strengthening the forward or backward linkages with the resource sector, Morris *et al* (2011) concludes, holds much promise for industrial development in resource-rich low-income economies.

Nevertheless, strengthening local economic linkages is not easy. African countries have been trying to promote linkages with the commodities sector, but in general their efforts to encourage local content have had limited success (Morris *et al* 2011). After a century of gold mining, Ghana's share of resource rents is small and its employment generation

remains low (ACET 2014). In most African countries producing gold, few of the goods and services supporting gold mining are sourced locally, almost all machinery and equipment are imported, and general consumables (e.g. office supplies) or specialised consumables (e.g. diamond dust, glue, industrial alcohol) are imported (Gajigo *et al* 2012). For nearly five decades, ACET (2014) reports, Nigeria, a major oil exporter, has failed to establish a sustainable, competitive, and diversified economy. The situation, ACET (2014) further reports, is similar for copper in Zambia, cobalt in Democratic Republic of Congo, uranium in Namibia or Niger, and bauxite in Guinea. The positive experience of the Norwegian marine engineering sector or globally competitive national resource companies, such as Saudi Aramco or Petronas, is difficult to replicate in lower-income countries (Venables 2016). Thus, although there is considerable scope for enhancing linkages in the mining sectors of developing countries in general and in Africa in particular, linkages in supply chains, labour markets, or wider networks tend to remain limited (Kaiser 2014; Morris *et al* 2011).

Designing or implementing development policy specifically targeting economic linkages is a formidable challenge. Clark *et al* (2016) reviews a large literature on economic development strategies. There is a need both to produce new products with new technologies and to shift resources from traditional activities to new ones. There is also a need for government not only to gather information from the private sector as regards business constraints or opportunities, but also to engage in strategic coordination as regards the design, implementation, or monitoring of policy interventions. And there is a need for targeted industrial policy in order to diversify the manufacturing base. Tordo *et al* (2013) demonstrates that Asian economies have benefitted immensely from non-neutral policies promoting specific industries, and that LCR policies, together with protectionism, fall under a category of interventions aimed at strengthening the productive structure of an economy. One of the economic reasons for using LCR policy,

Tordo *et al* (2013) continues, is to correct market failure, such as learning or production externalities. Mankiw (2009) expounds on externalities, which is a type of market failure, and Pigouvian tax or subsidy policies (named after British economist Arthur Cecil Pigou) for correcting them. A key axiom in the fundamental theory of welfare economics is the absence of externalities. If a transaction imposes a cost or confers a benefit on a party which is not part of the transaction, a failure to account for the negative or positive externality, respectively, could lead to an inefficient outcome. A simple remedy is to establish a tax on the external cost imposed or a subsidy for the external benefit conferred. One reason for the popularity of a Pigouvian tax or subsidy is that, restoring the efficient allocation without heavy government intervention, it is typically the least invasive way to remedy market failure.

Veloso (2006), analysing positive externalities pertaining to learning or technological spill-overs, puts emphasis on the private and social valuations of labour or capital. Economic benefits for the local economy are generated as long as the quantity localised as a result of the LCR policy brings more social value than the additional procurement cost incurred by the investor. The negative surplus due to the investor's extra procurement cost is compared to the positive surplus due to the difference between private and social valuations of labour or capital. In low-income countries, the private value of the input may exceed its social opportunity cost, and the difference is a positive externality. The investor continues to localise the quantity until incremental welfare gains are exhausted. For labour, training or skill acquisition increases the productivity of the worker. The alternative uses of the worker's enhanced capability are limited, and its value in unrelated domestic activities elsewhere in the economy is low. As a result, the wage paid is higher than the worker's social opportunity cost. For capital, the complementarity associated with foreign capital increases the marginal productivity of

domestic technology. As a result, the opportunity cost of capital in alternative but unrelated domestic activities elsewhere in the economy is also low.

In the context of extractive industries, there are many difficulties in the design or implementation of LCR policy. For major resource companies, procurement is typically a specialised function managed from corporate headquarters rather than from their country offices (ACET 2014; Kaiser 2014), although there is evidence of a significant share of procurement decisions made by domestic management in Ghana, Chile, and Mozambique (Kaiser 2014). The extractive industries tend to rely on global supply chains not only to control costs and quality but also to ensure the reliability of supplies (Tordo *et al* 2013). A key determinant of linkage development is skills and firm- and sector-level capabilities (Kaiser 2014; Morris *et al* 2011; Winkler 2014). Local suppliers may have difficulty meeting the high standards or quality requirements of the investor (Levett and Chandler 2012). However, even if the local capability exists, local suppliers, Tordo *et al* (2013) explains, may still not win the business because the contract size may be too large, the contract may require an integrated package, or there may be information asymmetry between local and foreign contractors. Hanlin and Hanlin (2012), studying the purchasing procedures of large mining corporations and specialist construction companies in the East African gold mining industry, shows that the opportunities of local suppliers to provide goods or services are minimal due to the established relationships of lead firms. Marcel *et al* (2016), demonstrating the difficulty of achieving local content development in the extractives sector, shows that emerging producers (in the early stages of petroleum resource development) face particular challenges, such as "uncertainty in regard to their resource base, lack of petroleum sector experience and often limited state administrative capacity." Moreover, although some forms of LCRs, under World Trade Organization ("WTO") agreements, are prohibited, disciplined, or allowed, there has been a proliferation, partly because of the

wide range of interpretations of LCRs (Ramdoo 2015). Under WTO rules, the scope of LCR policy depends on the specific agreements or exceptions which a country has negotiated (Tordo *et al* 2013).

Crucially, there is no "blueprint" for LCR policy inducements as regards compliance or non-compliance (Tordo *et al* 2013). Ovadia (2016), reviewing recent LCR policies in Uganda, Mozambique, Tanzania, Kenya, and Liberia, finds that LCR policies have been weakened in favour of a pro-business agenda and that key issues pertaining to definition and measurement, which have been major concerns in Angola or Nigeria, have been avoided. Ramdoo (2015), EY (2014), Kaiser (2014), PwC (2013), and Tordo *et al* (2013) provide examples of LCR or related policies for the oil and gas sector in Africa and elsewhere. Procurement from abroad requires prior approval. Certain services are provided only by local suppliers, completely excluding foreign contractors, or only by local suppliers or foreign contractors partnering with local suppliers. Preference is given to a local supplier if its foreign ownership is less than a certain percentage. There is a target local participation percentage to be achieved by a particular year. Some LCR percentages are variable, but others are fixed or increase in pre-defined increments over time. A bid with the highest local content percentage is selected if its price is within a certain percentage of the world price. Local workers are given preference over foreign workers. If local workers are not employed because of lack of training, the investor is required to provide training locally.

Furthermore, the implementation of LCR policy, Tordo *et al* (2013) explains, is likely ineffective if the investor perceives that incentives, subsidies, or privileges may be voided, or a discretionary penalty, including nil, is associated with non-compliance. Ramdoo (2015) and PwC (2013) provide several examples from Africa of penalties for non-compliance. A levy of 1% is foisted on every contract awarded in the upstream oil and gas sector of the economy. Any violation of the LCR policy is liable for a fine of 5% of

contract value and may result in the cancellation of the contract. The use of local workers, goods or services, businesses, or financing is to be maximised to the satisfaction of a ranking government official. Compliance with the LCR is a condition for the renewal of licenses and permits in the oil and gas sector. Finally, special privileges granted to local suppliers could be politically difficult to remove even if their sustainability is doubtful (Tordo *et al* 2013). It is recognised that LCR policies cannot continue forever and that local suppliers must eventually be exposed to global competition (ACET 2014). It is unclear, however, if LCR or related policies for the oil and gas sector in general have specific provisions arranging for their orderly end.

In summary, the structure of LCR policy matters immensely. Venables (2016), commenting on LCR policy, shows that "A number of countries have a domestic content requirement policy to strengthen these backward linkages, but such rules have generally not led to transformative growth of new activities … Rigid rules are gamed, and in any case do not come free; part of any cost increase they cause is borne by the host country through reduced tax and revenue receipts." As we discuss above, various LCR policy provisions, individually or in combination, tend to have economic consequences, deliberately or accidentally motivating compliance or non-compliance. It would be ideal, therefore, if they are understood or optimised within a coherent model.

As far as we could see, much of the academic literature on optimal LCR policy seems silent on the specific features of extractive industries, the interaction between positive externalities and local supplier capabilities, or any of the LCR policy implications we discuss above. Lahiri and Ono (2003), using an oligopoly model in which the intermediate input is produced using only labour under a constant returns-to-scale technology and the oligopolistic sector uses labour and the intermediate input under a Leontief production technology (i.e. factors of production are used in fixed or technologically pre-determined proportions), studies the effects of LCR policy on the

competitiveness of foreign firms locating in a host country and exporting their outputs to a third (consuming) country. In our model, the key factors affecting the optimal level of local content in the host country are the size of the positive externalities (contingent on the gap between the private values and social opportunity costs of labour or capital) and the response of local suppliers to new business opportunities (contingent on their competitiveness). Lahiri and Mesa (2006) analyses the impact of exchange rate volatility in the host and parent countries on host country LCR policy for export-oriented foreign investment, given an oligopolistic market in a third country. In our model, the effect of exchange rate volatility is unlikely to alter the key results or main insights, and the analysis is not focused on exchange rate volatility or a third country market. Qiu and Tao (2001) evaluates the implications of LCR policy for market penetration strategies of multinational firms. In our model, the investor's location is taken as a given, and the analysis is not focused on market penetration. Lahiri and Ono (1998), using a partial equilibrium oligopoly model, analyses the location decision of firms across alternative markets as a function, amongst others, of the LCR policy. In the extractive industries, the investor, heavily influenced by the quality of the resource, tends to have limited flexibility on its production location decision. Kwon and Chun (2009), examining the interaction between LCR policy and the technology transfer decision of a multinational firm, finds that the technology transfer decision depends on the technological inferiority of the host country, the scale of technology diffusion, and the training cost of transferring advanced technology, and that raising the LCR could encourage the multinational firm to establish its own intermediate input supplier (i.e. vertical integration). In our model, the analysis is centred on the investor's decision to purchase local goods or services rather than to engage in vertical integration as a response to the local level of technology. In short, our impression is that much of the academic literature on optimal LCR policy does not look fit for our purpose.

Veloso (2006), building on Grossman (1981) and the early literature, brings a unique perspective on LCR policies. A maximisation model of economic welfare is used to estimate base line and optimal levels of local content for the automotive sector. Foreign investment often generates spill-overs through backward links and may create a gap between private and social valuations of resources, and the resulting level of local content may fall below the optimal level. An LCR policy can improve economic welfare if externalities are taken into account in the decisions of private economic agents, but the government subsidises the investor as compensation for the additional procurement costs. Our work, extending Veloso (2006), explores the interaction between positive externalities and local supplier capabilities, its implications for optimal LCR policy, the concept of a royalty break, its implications for compliance rewards and non-compliance penalties, the investor's profit-maximising behaviour encouraging local suppliers to be competitive, and the market signal for amending or halting the LCR policy.

3 Model

We focus on a single tradeable input which the investor, operating over a long production period, needs. The investor, having decided that producing is preferable to not producing, wishes to procure an amount q_D of input from local supply or imports, and takes, as given, the world price of the input. Prices and quantities reflect quality-adjusted cost and the investor, as a consequence, is indifferent between local and imported supply. The assumption on quality-adjusted cost does not hinder the key results or main insights. It is convenient that a Cobb-Douglas functional form depicts a consistent relationship not only between inputs, outputs, and technical efficiency, but also between the returns to scale and the shape of the supply curve. Local supply deploys labour x_1 at the private wage w_1 and capital x_2 at the private cost of capital w_2,

and is subject to a Cobb-Douglas technology $f(x_1, x_2) = x_1^a x_2^b$ with decreasing returns to scale $a + b < 1$, indicating an upward sloping supply curve. Decreasing returns to scale tend to occur at high levels of output, and the firm could become difficult to manage, especially if there is a large order to fill. At the profit-maximising equilibrium, the inverse supply of a perfectly competitive Cobb-Douglas firm is $p_L = S w_1^m w_2^n q_L^u$ in which $S = \left[a^{-\left(\frac{a}{a+b}\right)} \right] \left[b^{-\left(\frac{b}{a+b}\right)} \right]$, $m = \frac{a}{a+b}$, $n = \frac{b}{a+b}$, and $u = \frac{1-a-b}{a+b}$. Import supply at the world price p_W is perfectly elastic. Without policy intervention, if local supply is competitive enough, in equilibrium a part or all of q_D is procured locally and the rest, if any, is imported. The portion q_L^* competitive vis-à-vis imports and procured locally without policy intervention constitutes the natural level of local content, or what Veloso (2006) labels the base line.

Proposition 1: There is a natural level of local content, even without an LCR policy.

Proof: At the world price p_W, supply of a perfectly competitive Cobb-Douglas firm, which is derived as the optimal choice of output given optimal factor demands or as the first derivative of the total cost function with respect to output, is $q_L^* = \left(\frac{p_W}{S w_1^m w_2^n} \right)^{\frac{1}{u}} \leq q_D$. This is the natural level of local content without an LCR policy, and the volume, if any, above it, but only up to q_D, is imported. ∎

By inspection, q_L^* is decreasing in the private wage w_1 or the private capital cost w_2. If either of them increases, the local supply curve shifts upward, resulting in a lower quantity available at a given price and indicating a reduction in competitiveness. But if either of them decreases, the local supply curve shifts downward, resulting in a higher quantity available at a given price and indicating an increase in competitiveness. If the downward shift of the local supply curve results in $q_L^* \geq q_D$, local supply would already be at least as competitive as imported supply and the economic rationale for an LCR

policy becomes moot. If $q_L^* < q_D$, the difference between them is imports, an indication of the limited competitiveness or capability of local supply.

Now, consider a government objective to increase the local content above the natural level q_L^* through an LCR policy. Assume the government has ample scope for LCR policy under WTO rules. The government searches for an optimal level of local content q_{LCR}^* which maximises incremental economic welfare ("IW") within a limit defined not only by the positive externalities arising from the gap between private and social values of wages or capital, but also by the competitiveness or capability of local supply. IW has three components: policy cost ("PC") typically borne by the investor (but ultimately shouldered by the government), incremental producer surplus ("IP") enjoyed by local supply, and social benefit ("SB") arising from additional local supply above q_L^*. PC is a welfare loss, but IP and SB are welfare gains. In equilibrium, given the capability of local supply, q_{LCR}^*, which is the optimal level of local content, reflects a balance between the negative surplus caused by extra procurement costs and the positive surplus arising from the gap between private and social values of wages or capital.

Proposition 2: There is an optimal level of local content.

Proof: By definition, $IW = -PC + IP + SB$. $PC = (p_L^* - p_W)q_{LCR}^*$ in which p_L^* is the price at which inverse supply p_L produces q_{LCR}^*, or $p_L^* = S w_1^m w_2^n q_{LCR}^{*u}$. $IP = \frac{p_L^* q_{LCR}^*}{2} - \frac{p_W q_L^*}{2}$ in which the first term is producer surplus under q_{LCR}^* and the second term is producer surplus under q_L^*. $SB = (q_{LCR}^* - q_L^*)p_W$ shows that additional output above the natural level of local content is valued at p_W. The objective of a social planner, with respect to q_{LCR}^*, is to maximise IW, subject to two constraints: $q_{LCR}^* \leq \acute{q}_L^*$, indicating an upper bound defined by the quantity implied by inverse supply $\acute{p}_L$ at the social values of labour and capital; and $q_{LCR}^* \leq q_D$, indicating an upper bound defined by the investor's input requirement.

We formulate the Lagrangian $L = IW - \lambda_1\left(q^*_{LCR} - \acute{q}^*_L\right) - \lambda_2(q^*_{LCR} - q_D)$. Differentiating with respect to q^*_{LCR}, λ_1, and λ_2 yields Karush-Kuhn-Tucker conditions:

$$\frac{-(u+1)Sw_1^m w_2^n {q^*_{LCR}}^u}{2} + 2p_W - \lambda_1 - \lambda_2 = 0$$

$$\lambda_1\left(q^*_{LCR} - \acute{q}^*_L\right) = 0$$

$$\lambda_2(q^*_{LCR} - q_D) = 0$$

$$q^*_{LCR}, \lambda_1, \lambda_2 \geq 0$$

In equilibrium, $q^*_{LCR} = \left[\frac{2(2p_W - \lambda_1 - \lambda_2)}{(u+1)Sw_1^m w_2^n}\right]^{\frac{1}{u}}$. ∎

Given that the investor procures, at most, only what it needs, the second constraint in the maximisation is obvious, but the first constraint merits further discussion. In principle, an increase in the private wage w_1 or capital cost w_2 shifts the inverse supply p_L upwards to the left. However, social values $\acute{w}_1 < w_1$ and $\acute{w}_2 < w_2$ imply an inverse supply $\acute{p}_L$ which enjoys an imaginary shift out downwards to the right of inverse supply p_L. In other words, for inverse supply $\acute{p}_L$, a higher quantity is available at any given price. The magnitude of the imaginary shift reflects the size of the positive externality caused by the difference between the private and social values of labour or capital. Evaluating inverse supply $\acute{p}_L$ at p_W yields $\acute{q}^*_L$, which has the characteristic $q^*_L < \acute{q}^*_L \lessgtr q_D$, depending on the magnitude of the gap between private and social opportunity costs of labour or capital. Thus, $\acute{q}^*_L$ is an upper bound associated with the positive externality. The larger the gap between private and social values of labour or capital, the further out the downward shift of inverse supply $\acute{p}_L$, and the higher the upper bound $\acute{q}^*_L$ (and potentially the higher q^*_{LCR}).

By inspection, q^*_{LCR} is increasing in p_W, implying that the lower p_W (the stronger the competition from imports), the lower q^*_{LCR}. Intuitively, as an extreme example, if the

imported input is free, the investor has no incentive to buy local. However, for a given p_W, our model determines whether or not the balance between the positive and negative surpluses is adequate to eliminate some or all of imports. In the presence of widespread unemployment or idle capital, it is tempting to establish a very high LCR, up to the point of eliminating all imports, ostensibly to capture the benefits from a substantial gap between private and social values of wages or capital cost. In other words, it is understandable for government to desire the additional economic welfare potentially available as a result of a hefty outward shift in inverse supply $\acute{p}_L$. However, if local suppliers are significantly uncompetitive, it may not be efficient to establish $q^*_{LCR} = q_D$ through an LCR policy, even if the social opportunity costs of labour or capital are extremely low.

Proposition 3: For a given p_W, the lower the competitiveness of local supply vis-à-vis import supply, the smaller is the optimal level of local content.

Proof: We investigate the impact of the competitiveness of local supply on q^*_{LCR} through a calibration. Consider the following parameter values: $a = 0.10$, $b = 0.39$, $w_1 = 1.50$, $w_2 = 0.20$, $p_W = 40$, and $q_D = 60$. The value for w_1 can be viewed as a wage of \$1.50, and the value for w_2 can be viewed as a capital cost of 20%. Given the parameterisations, $q^*_L = 33.92$ (see Figure 1). If, for example, the social value of labour is 50% of its private value, $\acute{w}_1 = 0.75$, and the social value of capital is 75% of its private value, $\acute{w}_2 = 0.15$, then $q^*_{LCR} = 48.42$, which is approximately 80% of q_D (see Figure 2). λ_1 is binding, but the positive externality, or the gap between private and social opportunity costs of labour or capital, is not large enough to eliminate imports. If the social values of labour and capital are merely 20% of their private values, $\acute{w}_1 = 0.30$ and $\acute{w}_2 = 0.04$, then $q^*_{LCR} = 60$ (see Figure 3). λ_2 is binding, all imports are eliminated, and the optimal level of local content could far exceed 60 if not for the constraint $q_D = 60$. However, if the figure for parameter b is reduced to 0.35, resulting in a significant steepening of inverse supply,

even if $\acute{w}_1 = 0.30$ and $\acute{w}_2 = 0.04$, the natural and optimal levels of local content fall dramatically, $q_L^* = 17.85$ and $q_{LCR}^* = 28.87$, which is less than 50% of q_D (see Figure 4). Neither λ_1 nor λ_2 is binding, and the localised quantity at which the positive externality is balanced by the investor's higher procurement cost is not enough to eliminate imports, even if labour or capital have few uses elsewhere in the economy. ∎

Now, apart from the determination of q_{LCR}^*, there is a need to study the incentives encouraging compliance or discouraging non-compliance. In the context of LCR policy, the incentive to comply is a function of the costs of compliance and non-compliance (Tordo *et al* 2013). Compliance costs are the expense of applying LCR policy, and non-compliance costs reflect both the probability of detecting non-compliance and the magnitude of the penalty imposed. First, consider compliance costs. In an optimal subsidy model, PC is the cost to the government and, depending on its budget, the government would need to build political support for the subsidy. Under an LCR policy, in the absence of compensation, PC is the additional procurement cost which the investor typically tolerates in order to provide protection for local suppliers which are unwilling or unable to compete with imports at p_W. Without compensation, compliance cost for the investor is positive. Veloso (2006), invoking an analytical simplification, assumes that the government subsidises the investor as compensation for the extra procurement costs. We suggest that, instead of funding the subsidy from general government accounts, if the royalty paid by the investor is reduced by PC, then the government's fiscal regime for the natural resource ultimately shoulders PC. With compensation, compliance cost for the investor is nil.

Next, consider non-compliance costs. Assume a probability of detection greater than zero. The penalty for non-compliance has to be economically meaningful (rather than punitive or indiscriminate). Here we rely on the economics of contract law. Cooter and Ulen (2014) reviews the concepts of efficient breach and expectations damages. There

are situations in which breach of contract is more efficient than performance. Breach is efficient if the costs of performing on the contract exceed the benefits to the parties. Due to a windfall or an accident, resources required for performance are more valuable elsewhere. Expectations damages restore the position of a breach victim as if the other party had performed. As a result, the breach victim "… is equally well off whether there is performance, on the one hand, or breach and payment of damages, on the other."

In the context of optimal LCR policy, the government, as it were, writes a contract with the investor for the "delivery" of economic welfare. In the event of breach, which is non-compliance on the part of the investor, expectations damages are the efficient form of restitution. Non-compliance prevents local suppliers from serving the investor's additional procurement, curtails the replacement of part or all of imports, thwarts the internalisation of positive externalities, and prevents the enjoyment of economic welfare. We assert that, under an optimal LCR policy, defining the penalty as the foregone economic benefit from non-compliance restores the wellbeing of society as if the investor had performed. Let us now bring together the costs of compliance and non-compliance. If, in the event of compliance, the policy cost is ultimately shouldered by the government through a royalty break and if, in the event of non-compliance, a penalty equal to the foregone economic benefit is imposed, then the investor has high-powered incentives to comply.

Proposition 4: Providing compensation for PC in the event of compliance and imposing a penalty equal to the foregone economic benefit in the event of non-compliance constitute high-powered incentives for the investor to comply with the LCR policy, assuming the probability of detection is greater than zero.

Proof: By definition, PC, a negative surplus, is the investor's extra procurement cost above the cost of procuring q_{LCR}^* at a price exceeding p_W. If the investor receives

compensation for PC, the cost of compliance is nil. The foregone economic benefit consists of positive surpluses IP and SB. If the detection probability exceeds zero, the investor compares a nil compliance cost to a positive non-compliance cost and observes that the former is preferable to the latter. ∎

Discarding the assumption of a detection probability exceeding zero does not completely remove the investor's incentive to comply. Regardless of the detection probability, the compliance cost continues to be nil. If the detection probability is zero, the investor, comparing a nil compliance cost to a nil non-compliance cost, might conclude that they are indistinguishable. However, depending on the ease of finding and transacting with local suppliers at the quality-adjusted cost, the investor, receiving PC over the policy cycle, has the potential to incur an extra procurement cost which is lower than PC. In other words, the investor may still procure up to q^*_{LCR}. Thus, even if it could somehow get away with cheating, the investor may continue to have an incentive to comply.

4 Implications for policy design or implementation

We discuss four implications for LCR policy. First, the high-powered incentives for compliance are consistent with market or policy signals influencing investment decisions. The extra procurement cost incurred by the investor ceases to be a further cost burden if compensation, such as a royalty break, is provided. Cost factors, such as access to raw materials, land, facilities, specialist inputs, fiscal incentives, labour and non-labour, or skills, figure prominently in a list of FDI location decision drivers identified by foreign mining companies (Kaiser 2014). A payment, whether it is called a royalty or a tax, has the same effect from the perspective of the investor or policy design, and a royalty, a charge levied on the extraction of the resource, could affect extraction, exploration, or development decisions (Boadway and Keen 2010). Moreover, the royalty

break, interpreted as a tax incentive, is convenient to implement. For a host country, providing tax incentives is easier than addressing deficiencies in infrastructure or skilled labour, is politically less difficult than disbursing funds, and does not require an expenditure of funds or cash subsidies (OECD 2007).

For its part, the non-compliance penalty consisting of the foregone economic benefits is neither punitive nor uninformed, and certainly is a market-based signal. Evidence of slack in the economy could indicate opportunities to be monetised or a lack of the willingness or ability to win new business. In the event local suppliers are extremely uncompetitive, it may be unwise to aspire for a high LCR even if the social valuations of labour or capital are low, or to impose capriciously harsh penalties for non-compliance even if local supply appears to have excess capacity. Adedeji *et al* (2016), studying the oil industry in Nigeria, finds that the LCR policy statistically has a positive and significant effect on local value creation, but that the effect is lower than expected. Teka (2012), analysing the Angolan oil and gas industry, explains that, despite the realistic and strategic potential, local value-added links are limited to labour or basic services due, amongst others, to a weak local content strategy and low skills. In Ghana, Guinea, Senegal, Mali, and Burkina Faso, notwithstanding the presence of rich deposits of gold, iron ore, bauxite, uranium, copper, and diamonds, there is limited local participation in mining supply chains, despite the current or potential capacity (World Bank 2012). In the Nigerian oil industry, despite the promotion of indigenous ownership and an LCR policy, the capacity of indigenous firms remains underutilised, and the industry remains dominated by foreign firms handling projects which could be done by local firms (Ihua 2010). Moreover, it is vital that the penalty is a reliable estimate of the opportunity cost to society of non-compliance and represents a clear signal which the investor can confidently use in making procurement decisions. After all, resource-rich countries have

to remain attractive to investment, even as they use mining as a catalyst to diversify their economies (Haddow 2014).

Second, harvesting the superior information of the investor encourages local suppliers to be as competitive as possible. The host government is generally less informed about geological or commercial circumstances than the investor (Boadway and Keen 2010). We argue that, in the ordinary course of business, the investor located on-site is highly likely to have a much better understanding of the challenges of local contracting than government bureaucrats located elsewhere. We further argue that the implementation cycle for an optimal LCR policy is essentially a process of price cap regulation. Church and Ware (2000) describes a rudimentary form of price cap regulation. The price is allowed to increase by the difference between the general rate of consumer price inflation and a factor reflecting the cost increase beyond the control of the firm. The cap is periodically reviewed and updated. If the firm is efficient and, before the next review, able to cut cost by more than the factor, then it gets to keep the cost savings.

Under an optimal LCR policy, the compensation for PC, the cost of procuring additional local supply above the natural level, is based on an estimate of the extra procurement cost incurred under q_{LCR}^*. This estimate is prepared and adjusted over the LCR policy cycle. The investor, using its deep knowledge and expertise, has a strong incentive to find efficient local suppliers before the next cycle of adjustment in order to push the actual below the estimated extra procurement cost, and then to pocket the difference. In other words, the investor would be highly motivated to quicken the search for the best-performing local suppliers in order to capture the savings between the actual and the estimated extra procurement cost. As a result, competition amongst local suppliers intensifies, and the prospects for strengthening local linkages improve.

On their part, local suppliers which win new business would have replaced part or all of imports, and positive externalities would have been internalised. As successful local suppliers increase in competitiveness, the local supply curve would have shifted out and a higher quantity is thus available at any given price. Kaiser (2014) demonstrates that, over the last 40 years, Chile, emphasising supplier upgrading programmes, has achieved higher levels of local procurement, with far less government regulation, than Africa. Sutton (2014) describes promising initiatives in which the investor works closely with selected local firms to enhance their competitiveness. Winkler (2014) recommends that policy should encourage supplier development and assistance, enhancing the sophistication of production processes, in order to strengthen absorptive capacities which have been shown to increase linkages with foreign investment.

Third, the administrative burden on the host government is manageable. The quality of governance, Fukuyama (2013) demonstrates, is a function of the interaction between capacity and autonomy. If in the short-run a country cannot significantly upgrade capacity, the degree of autonomy or discretion should be reduced in a low-capacity country but increased in a high-capacity one (Fukuyama 2013). A focus on q^*_{LCR} simplifies compliance reporting, supports the audit of policy benefits or costs, facilitates verification by a third-party, such as a judge, jury, or arbitrator, in the event of a dispute, and restricts the scope for government discretion. The complexity of licensing procedures, which may vary according to economic activity, location, size, or legal status, may hinder small business and supplier development (Kaiser 2014). In the Nigerian oil industry, the conditions of participation in the LCR policy, such as seemingly arbitrary charges or fees, or the provision of bank statements as part of the pre-qualification, could be burdensome (Ihua 2010). By contrast, under an optimal LCR policy, there would hardly be a need for arbitrary edicts, such as bid-selection rules based on some

percentage of the world price, or subjecting the localisation of workers, goods and services, businesses, or financing to the whim of host government officials.

Moreover, under an optimal LCR policy, the investor's action is induced to serve as a policy tool for internalising positive externalities, strengthening the productive structure of an economy, and delivering gains in economic welfare. It is widely known that, in a number of resource-rich low-income countries, there is a high risk of government mismanagement or corruption. Nwapi (2015), evaluating the LCR policy affecting the oil and gas industry in Nigeria, finds that the risk of corruption arises from conflict of interest, discretionary power, lack of transparency in contracting, and the potential for "facilitation payments." Now, regardless of the fiscal regime design, if the institutional and administrative capacity of the government is under-developed, it is likely that fewer revenues are collected or fewer benefits captured (ACET 2014). In Ghana, Guinea, Senegal, Mali, and Burkina Faso, policy provisions reflecting a preference for local suppliers which can match the cost and technical features of imports have usually been insufficiently developed, disseminated, monitored, or enforced (World Bank 2012). By contrast, Levi-Faur (2012) provides a conceptualisation of governance in which the market itself is mobilised as a regulatory mechanism. We assert that, under an optimal LCR policy, the economic benefits of policy are delivered directly through the investor which has a profit motive to search for local suppliers and encourage them to be competitive. Proceeds from extractive industry activities can be used to fund directly the construction of roads, schools, or medical facilities in the host country (ACET 2014). A low capacity for governance, therefore, is unlikely to pose a barrier to optimal LCR policy design or implementation.

And fourth, the risk of infantilising local suppliers is likely mitigated. Until local suppliers are fully exposed to international competition, they receive a price above the world price and may inadvertently remain weak. For early-stage local content projects

serving the oil industry in Angola, low cost or quick delivery is not always the most compelling reasons, and mandates, risk insurance, or a social license to operate are used (Levett and Chandler 2012). Under an optimal LCR policy, as we discuss above, there is a natural process for monitoring the magnitude or direction of the performance of local suppliers. If the local supply curve has not shifted out or is slow to shift out, the lack of competitiveness could be chronic, an indication that local suppliers, despite the new business opportunities available to them, may be unwilling or unable to assist in the process of internalising the positive externalities. On the evidence of a performance-based market signal, therefore, policy support may have to be adjusted or cut. Indeed Marcel *et al* (2016) suggests that "A sequenced approach to the development of local content may help to keep policy in line with evolving geological and market circumstances as well as changing domestic capabilities."

Although there are many other factors adversely affecting the competitiveness of local supply, the lack of education and training or access to finance is likely to have a direct, negative impact on the gap between private values and social opportunity costs of labour or capital. Investors are keen to increase the localisation of management and technical staff, but the main obstacle is perceived to be the lack of available local skills (Kaiser 2014). In Angola, although the critical human capital problem in the oil sector is higher technical level personnel, especially the metallurgical sector, training programmes focus on mid-level technical training, the output of oil and gas industry training institutes and programmes is very low, and, despite the growth in the number of universities, they provide training mostly in the social sciences and offer limited training in engineering (much less, petroleum engineering) (Teka 2012). In the Nigerian oil industry, locally trained experts and skilled manpower are inadequate due to falling standards of universities and other tertiary institutions, and Nigerian tertiary institutions tend to be

under-funded or ill-equipped to produce the quality of graduates needed for the oil and gas business (Ihua 2010).

In Sub-Saharan Africa, the high costs of capital and difficulties in accessing finance, in addition to the lack of access to business premises and unreliable supply of utilities, are some of the key challenges which make it difficult for local suppliers to establish businesses and compete effectively (Kaiser 2014). In Angola, access to capital is a major constraint to the growth of local small- and medium-scale enterprises serving the oil industry (Levett and Chandler 2012). In Nigeria, there is a need for banks to expand their services, such as insurance, with emphasis on the oil and gas business; enhance their ability in loan syndication for projects requiring huge capital outlay; and fight an inclination for offering loans to foreign rather than local firms serving the oil and gas industry (Ihua 2010). In Ghana, small- and medium-scale suppliers and service companies serving the mining industry have difficulty in accessing finance and face high interest rates (Bloch and Owusu 2012).

5 Conclusion

An optimal LCR policy serving to monetise the positive externalities from foreign investment is essentially a first-best Pigouvian subsidy. It could induce an incremental volume of new business, depending on the gap between the private values and social opportunity costs of labour or capital, as well as on the competitiveness of local suppliers. We investigate the policy implications related to the high-powered incentives for investor compliance, the harvesting of the superior information of the investor, the management of the administrative burden on the host government, and the mitigation of the risk of infantilising local suppliers. It would be interesting to study situations in which an investor elects not to comply despite evidence of competitive local suppliers, or

local suppliers proven to be severely uncompetitive continue to receive policy protection from international prices. Either situation could bring much insight not only on the size of the positive externalities in the economy, but also on the willingness or ability of local suppliers to respond to new business opportunities.

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References

ACET (2014) "2014 African transformation report: growth with depth." Available at http://africantransformation.org/wp-content/uploads/2014/02/2014-african-transformation-report.pdf.

Adedeji A, Sidique S, Rahman A, Law S (2016) "The role of local content policy in local value creation in Nigeria's oil industry: A structural equation modeling (SEM) approach" Resources Policy 49: 61-73.

Adewuyi A, Oyejide T (2012) "Determinants of backward linkages of oil and gas industry in the Nigerian economy" Resources Policy 37: 452-460.

Bastida A (2014) "From extractive to transformative industries: paths for linkages and diversification for resource-driven development" Mineral Economics 27(2-3): 73-87.

Bloch R, Owusu G (2012) "Linkages in Ghana's gold mining industry: challenging the enclave thesis" Resources Policy 37: 434-442.

Boadway R, Keen M (2010) "Theoretical perspectives on resource tax design" in Daniel P, Keen M, McPherson C (eds.) *The taxation of petroleum and minerals (principles, problems and practice)*. Routledge, Oxon and New York.

Church J, Ware R (2000) *Industrial organization: a strategic approach*. Irwin McGraw-Hill.

Cooter R, Ulen T (2014) *Law and economics*. Sixth Edition. Pearson.

Clark D, Lima L, Sawyer W (2016) "Stages of diversification in Africa" Economics Letters 144 68-70.

Fessehaie J (2012) "What determines the breadth and depth of Zambia's backward linkages to copper mining? The role of public policy and value chain dynamics" Resources Policy 37: 443-451.

Fukuyama F (2013) "What is governance?" Governance 26(3): 347–368.

EY (2014) *Global oil and gas tax guide 2014*. Available at http://www.ey.com/oilandgas.

Gajigo O, Mutambatsere E, Ndiaye G (2012) "Gold mining in Africa: maximizing economic returns for countries" African Development Bank, Working Paper Series No. 147, March.

Grossman G (1981) "The theory of domestic content protection and content preference" Quarterly Journal of Economics 96(4) November: 583-603.

Haddow K (2014) "How best can mining be a catalyst for diversifying economies?" Mineral Economics 27(2-3): 149-151.

Hanlin R, Hanlin C (2012) "The view from below: 'lock-in' and local procurement in the African gold mining sector" Resources Policy 37: 468-474.

Hufbauer G, Schott J, Cimino C, Vieiro M, Wada E (2013) "Local content requirements: report on a global problem" Peterson Institute for International Economics.

Hunter T (2014) "Law and policy frameworks for local content in the development of petroleum resources: Norwegian and Australian perspectives on cross-sectoral linkages and economic diversification" Mineral Economics 27(2-3): 115-126.

Ihua U (2010) "Local content policy and SMEs sector promotion: the Nigerian oil industry experience" International Journal of Business and Management 5(5) May.

Javorcik B (2004) "Does foreign direct investment increase the productivity of domestic firms? In search of spillovers through backward linkages" American Economic Review 94(3): 605–27.

Kaiser Associates Economic Development Partners (2014) "Sector case study: mining" in Farole T, Winkler D (eds.) *Making foreign direct investment work for Sub-Saharan Africa: local spillovers and competitiveness in global value chains*. Washington, DC.

Kaplan D (2012) "South African mining equipment and specialist services: technological capacity, export performance and policy" Resources Policy 37: 425-433.

Kolstad I, Kinyondo A (2015) "Alternatives to local content" WIDER Working Paper 2015/106.

Kwon C, Chun B (2009) "Local content requirement under vertical technology diffusion" Review of Development Economics 13(1): 111–124.

Lahiria S, Mesa F (2006) "Local content requirement on foreign direct investment under exchange rate volatility" International Review of Economics and Finance 15: 346–363.

Lahiri S, Ono Y (1998) "Foreign direct investment, local content requirement, and profit taxation" Economic Journal 108: 444-457.

Lahiri S, Ono Y (2003) "Export-oriented foreign direct investment and local content requirement" Pacific Economic Review 8(1): 1-14.

Levett M, Chandler A (2012) "Maximizing development of local content across industry sectors in emerging markets (how private-sector self-interest can help US development policy)" (with Thomas Patterson and Conor M. Savoy) Center for Strategic and International Studies, May.

Levi-Faur D (2012) "From "Big Government" to "Big Governance?"" in Levi-Faur D (ed) *The Oxford handbook of governance*. Oxford University Press.

Lippert A (2014) "Spill-overs of a resource boom: evidence from Zambian copper mines" Oxford Centre for the Analysis of Resource Rich Economies, OxCarre Research Paper 131.

Mankiw N (2009) "Smart taxes: an open invitation to join the Pigou club" Eastern Economic Journal 35: 14-23.

Marcel V, Tissot R, Paul A, Omonbude E (2016) "A local content decision tree for emerging producers" The Royal Institute of International Affairs.

McMillan M, Rodrik D (2011) "Globalization, structural change and productivity growth" in Bacchetta M, Jansen M (eds.) *Making globalization socially sustainable*. International Labour Organization and World Trade Organization.

Moretti E (2010) "Local multipliers" American Economic Review: Papers & Proceedings 100 May 1-7.

Morris M, Kaplinsky R, Kaplan D (2011) "Commodities and linkages: industrialisation in Sub Saharan Africa" University of Cape Town and Open University, Making the Most of Commodities Programme Discussion Paper No. 13.

Morris M, Kaplinsky R, Kaplan D (2012) ""One thing leads to another" — Commodities, linkages and industrial development" Resources Policy 37: 408-416.

Nwapi C (2015) "Corruption vulnerabilities in local content policies in the extractive sector: An examination of the Nigerian Oil and Gas Industry Content Development Act, 2010" Resources Policy 46: 92-96.

OECD (2007) *Tax incentives for investment – a global perspective: experiences in MENA and non-MENA countries*.

Östensson O (2014) "The employment effect of mine employees' local expenditure" Mineral Economics 27(2-3): 135-142.

Ovadia J (2016) "Local content policies and petro-development in Sub-Saharan Africa: a comparative analysis" Resources Policy 49: 20-30.

PwC (2013) *Oil and gas tax guide for Africa 2013*. Available at http://www.pwc.com/africaOGguide.

Qiu L, Tao Z (2001) "Export, foreign direct investment, and local content requirement" Journal of Development Economics 66: 101-25.

Ramdoo I (2015) "Unpacking local content requirements in the extractive sector: what implications for the global trade and investment frameworks?" E15Initiative. Geneva: International Centre for Trade and Sustainable Development and World Economic Forum. Available at http://www.e15initiative.org/.

Rodríguez-Clare A (1996) "Multinationals, linkages, and economic development" American Economic Review 86(4) September: 852-73.

Sutton J (2014) "Gains from the natural gas: local content and Tanzania's industrial development." The Seventh Gilman Rutihinda Memorial Lecture, Delivered at the Bank of Tanzania, June 10, 2014. International Growth Centre, London School of Economics, http://www.theigc.org/wp-content/uploads/2014/08/Sutton-2014-Gilman-Rutihinda-Memorial-Lecture-Speech.pdf.

Teka Z (2012) "Linkages to manufacturing in the resource sector: the case of the Angolan oil and gas industry" Resources Policy 37: 461-467.

Tordo S, Warner M, Manzano O, Anouti Y (2013) "Local content policies in the oil and gas sector" World Bank Study 78994, Washington, DC: World Bank. Available at http://www.localcontentsolutions.com/pdf/lc_policies.pdf.

Veloso F (2006) "Understanding local content decisions: economic analysis and an application to the automotive industry" Journal of Regional Science 46(4): 747-772.

Venables A (2016) "Using natural resources for development: why has it proven so difficult?" Journal of Economic Perspectives 30(1) Winter: 161-184.

Winkler D (2014) "Determining the nature and extent of spillovers: empirical assessment" in Farole T, Winkler D (eds.) *Making foreign direct investment work for Sub-Saharan Africa: local spillovers and competitiveness in global value chains*. The World Bank. Washington, DC.

World Bank (2012) "Increasing local procurement by the mining industry in West Africa" Sustainable Energy—Oil, Gas, and Mining Department, January.
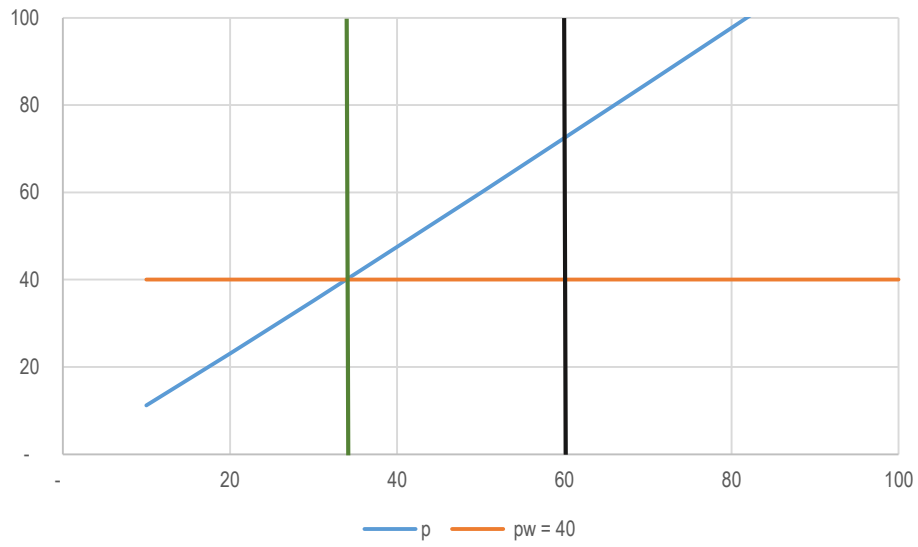
Figure 1 Natural level of local content

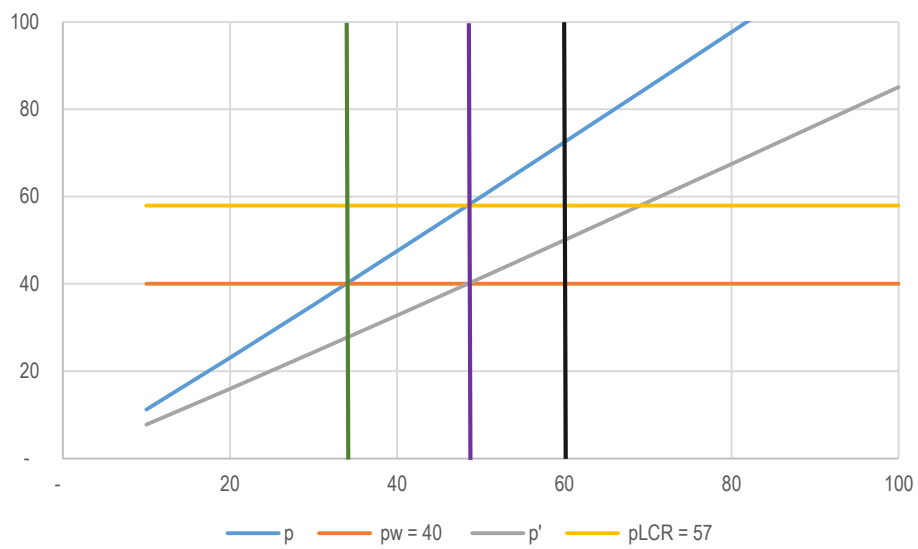Figure 2 Natural and optimal levels of local content

Figure 3 Natural and optimal levels of local content, low shadow values
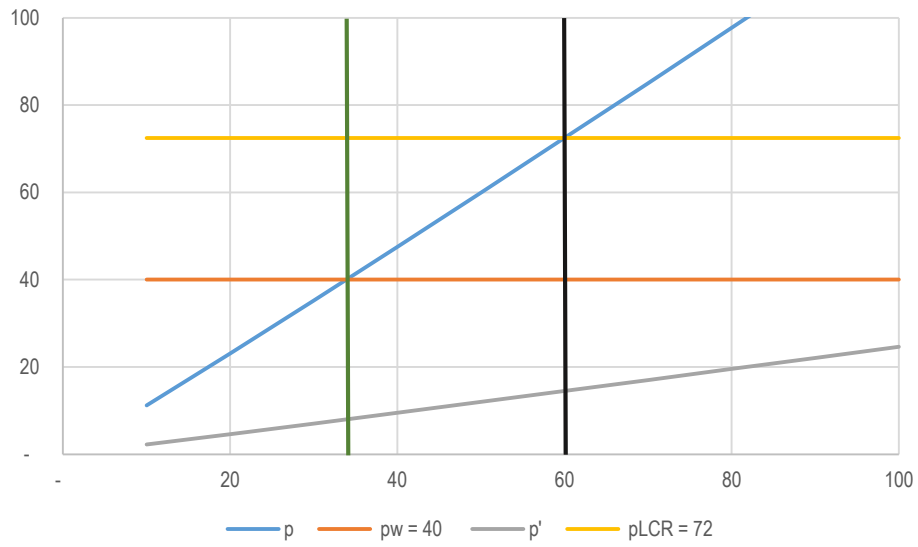

Figure 4 Natural and optimal levels of local content, uncompetitive local supply