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Trade and Expropriation: A Factor Proportions Approach

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Abstract

An extended small open economy model is developed and used to examine the effect of trade on the illicit expropriation of incomes and the provision of legal services. We derive conditions under which trade liberalization will reduce expropriation activities. We also derive sufficient conditions for the gains from trade to be amplified or muted relative to the standard model. The signs of these effects depend on factor intensity rankings and factor abundance ratios. Thus the results show that trade liberalization will be beneficial to countries that export labor intensive goods by reducing the incentives for illicit expropriation and reducing the costs of providing legal services. The model also shows that trade liberalization can increase expropriation, particularly for countries that import labor intensive goods and have labor intensive crime problems.

Keywords: Expropriation, Factor Proportions, Gains from Trade, Legal Services.

JEL: F1, K42

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1 Introduction

There is considerable empirical support for the idea that economic prosperity depends on institutions to secure property rights. Examples include Engerman and Sokoloff (1997), Hall and Jones (1999), Rodrik (1999), Acemoglu, Johnson and Robinson (2001), Dollar and Kraay (2003), Rodrik, Subramanian and Trebbi (2004) and Levine (2005).¹ Nevertheless, as stated by Acemoglu, Johnson and Robinson (2005), we remain far from having a useful framework for understanding how economic institutions are determined and why they vary across countries.²

The aim of this paper is to consider how international trade affects the security of property rights and predatory activities (expropriation) and how these affect the gains from trade. It is recognized that international trade can affect the incentives to engage in unproductive activities and also affect the cost of providing institutions to protect property rights.³ We extend this literature by incorporating expropriation of incomes and law enforcement activities into a general equilibrium model. In this model, factor endowments, technology and world prices determine not only factor returns and output levels, but also the level of expropriation and the provision of legal services. The model is used to describe the relationship between trade liberalization, the level of expropriation in the economy and the gains from trade. One interpretation of our results, for example, is that, if crime is a labor intensive activity, trade liberalization can increase crime in developed countries but reduce crime in developing countries.

The outline of the paper is as follows. In Section 2 we briefly review the related literature on trade and predation. In Section 3 we describe a simplified model in which predation occurs but the level of law enforcement supplied is fixed. Preliminary results, presented in Section 4, derive the necessary restrictions on factor proportions and intensities of factor

¹This literature builds upon pioneering studies such as North and Weingast (1989), Engerman (1973).

²Likewise Glaeser, La Porta, Lopez-de Silanes and Shleifer (2004) and Rodrik (2008) have highlighted the complexity of defining institutions and understanding interactions between institutional reform and economic prosperity.

³For example see Holmes and Schmitz Jr (2001) regarding unproductive activities and Clarida and Findlay (2003) regarding trade and institutions.

use in expropriation that must hold for falling trade costs to reduce predation. Section 5 introduces the full model with endogenous law enforcement services and presents the main comparative static results. The gains from trade propositions are presented in Section 6 and Section 7 concludes.

2 Background

Models of incomplete property rights have been used extensively in the economics of crime literature that followed Becker (1968), and in the conflict literature following early studies by Boulding (1988) and Hirshleifer (1988).⁴ As noted by Skaperdas and Syropoulos (2001), however, there are few formal models that attempt to explain the interaction between international trade and property rights. To this end Skaperdas and Syropoulos (2001) incorporate endogenous conflict into a Ricardian trade model model to see how the gains from trade are affected by the need for investment military institutions (guns). Likewise Anderson and Marcouiller (2005) and Anderson and Bandiera (2006) use Ricardian models, with the addition of potential piracy, to demonstrate how institutions may promote trade.⁵

We extend this literature by considering how international trade affects the protection of private property in a small open economy. Thus, as opposed to international conflict over common resources or piracy, we consider what Acemoglu (2006) describes as "simple violations of property rights". Examples include the illicit removal of land tenure, expropriation of assets, a failure to pay wages and various forms of coercion. In what follows we refer to these all such violations simply as "expropriation". We also extend the literature by incorporating expropriation into a factor proportions framework. The generalization to more than one factor is important since, empirically, expropriation is

⁴Recent examples of the crime and economics literature include Burdett, Lagos and Wright (2004) and Imrohoroglu, Merlo and Rupert (2000). Notable examples of the conflict literature include Hirshleifer (2001), Grossman and Kim (1995) and Collier and Hoeffler (2004).

⁵For example they find there is an important "safety in numbers" effect and relate this to historical trade patterns and the usefulness of convoys.

related to differences in relative incomes.⁶

Investigating the causes of expropriation is an important economic issue since expropriation imposes significant economic costs. For instance Kaufmann, Kraay and Zoido-Lobato (1999) note the economic costs of governance indicators (including corruption and perceptions of crime) on income levels.⁷ Likewise the ILO (2005) stress the wide prevalence of coercion and forms of servitude, and Collier and Gunning (1999) highlight the economic costs of armed civil conflict.⁸ In addition to these direct costs of expropriation, the cost of maintaining adequate legal services is a significant economic constraint in newly developing economies such as India and China.⁹

The role of international trade in impeding or facilitating expropriation is, however, the subject of an enduring debate.¹⁰ The potential costs of trade liberalization, in terms of inequality and crime, have been emphasized by Stiglitz (2002) and Wade (2004). Likewise rising social conflict has been attributed to trade liberalization episodes in several countries. For example Keen (2005) discusses the case of Sierra Leone, Deraniyagala (2005) discusses Nepal, and Brysk and Wise (1997) discuss some examples of rising social conflict in Latin America countries.

In contrast Collier and Gunning (1999) and Collier and Hoeffler (2002) note the beneficial effects of openness on crime and civil conflict in African countries. Other relevant evidence includes the escalation of crime that occurred in Yugoslavia in 1992 following trade sanctions, and the rise in crime in Columbia following negative terms-of-trade shocks.¹¹

⁶See for example Soares (2004). The factor proportions approach also helps us relate our results to the extensive literature on trade and wages. As noted by Krugman (2008) the factor proportions setting remains the most useful model for thinking about trade and factor incomes issues.

⁷Bourguignon (1999) shows that crime is especially high in some developing economies. Kaufmann and Kraay (2002) report that more than 70 percent of firms and public officials stated that organized crime was “highly influential” on state affairs in Peru. Batra, Kaufmann and Stone (2003) report that firms in developing East Asia view street crime and corruption as the two leading constraints on business.

⁸For example the ILO (2005) estimate that there are approximately 12.3 million people who are victims of forced labor.

⁹This point is made by Basu (2004) with respect to India and by Keefer (2007) with respect to China.

¹⁰Linking openness and expropriation dates back at least to *The Wealth of Nations*. See in particular Bk 1, Ch. 9 Par. 15 of Smith (1998). Dollar and Kraay (2002) emphasize the positive empirical link between growth and poverty and Winters, McCulloch and McKay (2004) examines the evidence regarding trade liberalization and poverty.

¹¹For a discussion of the effects of UN trade sanctions in Yugoslavia see Brooks (2002) and Andreas

Thus case studies suggest that the effects of liberalization differ across countries. Evidence from the cross-country literature on openness and different forms of expropriation, such as corruption and civil conflicts, is also ambiguous.¹²

In the absence of a clear empirical relationship between expropriation and international trade it is useful to explore potential theoretical links. In particular trade can affect factor incomes which in turns affects the opportunity costs of crime. It may have an impact on the costs of providing of legal institutions. These arguments suggest that effect of trade liberalization on expropriation will differ across countries depending on a country's factor endowments and the factors used in expropriation. The following model makes these links explicit.

3 The Model

Consider a small open economy comprising of a unit measure of identical individuals. The representative individual is endowed with \bar{L}_u units of unskilled labor and \bar{L}_s units of skilled labor, the returns (per unit) to which are denoted by w_u and w_s respectively. There are two tradable goods, an exportable and an importable denoted by x and m respectively. Let p_x and p_m respectively denote the world price of the exportable and importable. Treating exportable good x as the *numéraire* we normalize $p_x = 1$. Choosing units appropriately for the importable good m we also set $p_m = 1$. We assume that the import-competing sector is tariff protected and let p (> 1) denote the tariff-inclusive price of the importable good faced by domestic consumers.

The representative consumer i maximizes $U(x_c^i, m_c^i)$, a homothetic utility function in x and m , subject to the budget constraint $x_c^i + pm_c^i = y_d^i$, where x_c^i , m_c^i , and y_d^i respectively denote the consumption of x , consumption of m and the income available to i

(2005). Dube and Vargasz (2007) provide evidence that crime was linked to terms of trade shocks in Columbia.

¹²For example see Knack and Azfar (2003) on openness and corruption, Bussmann, Schneider and Wiesehomeier (2005) on trade liberalization and civil conflict and Hafner-Burton (2005) on the effects of trade on human rights.

for consumption of x and m . Corresponding to this utility maximization problem let $V(p, y_d^i) \equiv V^i$ denote the indirect utility function. Homotheticity implies that the indirect utility function is separable in y_d^i and p . More specifically,

$$V^i = v(p) y_d^i, \quad (1)$$

where $v(p)$ is decreasing in p .

Both x and m are produced under constant returns to scale and perfect competition using skilled and unskilled labor. Perfect competition in both these sectors imply that unit cost equals price:

$$c_x(w_u, w_s) = 1, \quad (2)$$

$$c_m(w_u, w_s) = p, \quad (3)$$

where $c_x(w_u, w_s)$ and $c_m(w_u, w_s)$ denote the unit cost functions for x and m respectively.

Definition 1: For any given pair of factor returns (w_u, w_s) , x is unskilled (skilled) labor intensive if

$$\frac{a_{ux}}{a_{sx}} > (<) \frac{a_{um}}{a_{sm}}, \quad (4)$$

where $a_{ug} \equiv \frac{\partial c_g}{\partial w_u}$ and $a_{sg} \equiv \frac{\partial c_g}{\partial w_s}$ respectively denote the unskilled and skilled labor requirements to produce one unit of good $g \in \{x, m\}$.

In what follows we consider how the comparative static results vary depending on whether the export good, x , is intensive in unskilled labor or skilled labor.¹³ For convenience we shall refer to a the economy as a “developing economy” if the export good, x , is intensive in unskilled labor, $\frac{a_{ux}}{a_{sx}} > \frac{a_{um}}{a_{sm}}$, and a “developed economy” if x is a skilled labor intensive good, $\frac{a_{ux}}{a_{sx}} < \frac{a_{um}}{a_{sm}}$.

¹³An alternative approach would be to consider the two country Heckscher-Ohlin model, where each country has different endowment ratios, and examine the implications of trade liberalization for each country. We think however the small country case is simpler and more transparent. Arguably it is also more relevant. Nevertheless we note that in our model the terms-of-trade are given by exogenous world prices.

Our departure from the standard Heckscher-Ohlin framework lies in labor usage. Not all labor units are engaged in productive activities. With imperfect law enforcement individuals face an effective choice between employing labor in producing goods or services and expropriating income from other agents. Suppose individual i uses N_u^i units of unskilled labor and N_s^i units of skilled labor in expropriation. Accordingly, $L_u^i \equiv \bar{L}_u^i - N_u^i$ units of unskilled labor and $L_s^i \equiv \bar{L}_s^i - N_s^i$ units of skilled labor are employed in productive activities. Then, absent expropriation, income from productive activities for i is

$$\omega^i \equiv w_u L_u^i + w_s L_s^i.$$

A fraction $\gamma \in (0, 1)$ of this income is subject to potential expropriation and hence the actual income from productive activities may be less than ω^i . Nevertheless ω^i may also be realized if the act of expropriation is verified by a court. In this case the expropriated amount is returned back to the owner. Though such rights (i.e., rights to consumption of one's own income in this case) are provided by law, detection and verification are imperfect and costly.

Let z denote the level of legal services in the economy, which is competitively produced under constant returns to scale using skilled and unskilled labor. This implies

$$p_z = c_z(w_u, w_s), \tag{5}$$

where $c_z(w_u, w_s)$ and p_z respectively denote the unit cost function and the price of z . Unlike x and m , z is assumed to be non-traded. Naturally, the higher the level of z , the higher the probability that the claim of expropriation is successfully verified in the court. Let $\alpha(z)$ denote that probability, where $\alpha(\cdot)$ satisfies the following properties:

Assumption 1: (i) $\alpha(0) = 0$, (ii) $\alpha'(z) > 0$, $\alpha''(z) < 0$ for all $z < \bar{z}$, (iii) $\alpha(z) < 1$ for all finite z , and (iv) $\ln(1 - \alpha(z))$ is strictly concave in z .

Assumptions 1(i) and 1(ii) are standard. Assumption 1(iii) says that there is always

a strictly positive probability that verification of expropriation claims is unsuccessful. To understand Assumption 1(iv), note that, for a given z , the probability of failure to verify/detect expropriation is $1 - \alpha(z)$. Conditional on failure, the probability that an additional unit of z will be successful in detection/verification is $\frac{\alpha'(z)}{1-\alpha(z)}$. The log-concavity of $1 - \alpha(z)$ implies that the conditional probability is increasing in z . That is, $\frac{\alpha'(z)}{1-\alpha(z)}$ increases as z increases.¹⁴

3.1 Expropriation Technology

We assume that, in their attempt to expropriate income, each individual can target only one individual and similarly she can be targeted only by one individual.¹⁵ Without loss of generality, assume that individual i attempts to extract income from k and individual j attempts to do the same from individual i .

The probability of successfully expropriating another individual's market income depends on the resources committed to expropriation. The production function for expropriation is given by $e(N_u^i, N_s^i) \equiv e^i$, where

Assumption 2: (i) $e(0, 0) = 0$, (ii) e^i is homogenous of degree one, (iii) $\frac{\partial e(\dots)}{\partial N_f^i} > 0$, $\frac{\partial^2 e(\dots)}{\partial N_f^i{}^2} < 0$; $f \in \{u, s\}$.

The unit cost function associated with this expropriation technology, which captures the minimum income that an agent i has to forego to produce $e^i = 1$, is given by

$$c_e^i(w_u, w_s) = \min \{w_u N_u^i + w_s N_s^i \mid e^i = 1\}. \quad (6)$$

Let $a_{ue}^i \equiv \partial c_e^i(w_u, w_s) / \partial w_u$ and $a_{se}^i \equiv \partial c_e^i(w_u, w_s) / \partial w_s$ respectively denote the unskilled

¹⁴The term $\frac{\alpha'(z)}{1-\alpha(z)}$ is often referred to as the hazard rate. In the contract literature, the hazard rate is usually assumed to be monotone in the underlying variable. See for example, Bolton and Dewatripont (2005).

¹⁵The overlaps - that the same person is are targeted by the same individual - are ruled out by assumption. Allowing for overlaps simply reduce the effectiveness of expropriation which has no important consequence in our model.

and skilled labor required to produce one unit of e^i . The level of e^i determines the probability of i 's success in expropriation. More specifically, an agent i succeeds in expropriation with probability $\phi(e^i)$ where $\phi(\cdot)$ satisfies the following properties:

Assumption 3: (i) $\phi(0) = 0$, (ii) $\phi'(e^i) > 0, \phi''(e^i) < 0$, and (iii) $\phi(e^i(\bar{L}_u, \bar{L}_s)) < 1$.

Assumptions 3(i) and 3(ii) are standard. Assumption 3(iii) says that there is strictly positive probability of failure even if all resources are devoted to expropriation.

3.2 Income

An individual i 's income comes from two sources: productive activities and expropriation. Consider first the income from expropriation. If i succeeds in targeting k and is not detected/convicted by legal authorities then she earns $\gamma\omega^k = \gamma(w_u L_u^k + w_s L_s^k)$.¹⁶ The probabilities of (a) i 's success in targeting k and (b) failure of detection/verification by courts are given by $\phi(e^i)$ and $1 - \alpha(z)$ respectively. Since these two events, given by (a) and (b), are independent the probability that i successfully expropriates $\gamma\omega^k$ from k is $\phi(e^i)(1 - \alpha(z))$. In all other cases i 's income from expropriation is zero. To summarize, an individual i 's income from expropriation is

$$\begin{aligned} \gamma\omega^k, & \quad \text{with probability } \phi(e^i)(1 - \alpha(z)); \\ 0, & \quad \text{with probability } 1 - \phi(e^i)(1 - \alpha(z)). \end{aligned}$$

Now consider i 's income from productive activities. Given that a fraction $\gamma\omega^i$ can be successfully expropriated by j with probability $\phi(e^j)(1 - \alpha(z))$, i 's income from productive

¹⁶Alternatively, one could assume that expected income from targeting a random agent is equal to the average income per capita $\gamma w_u(\bar{L}_u^e - N_u^e) + w_s(\bar{L}_s^e - N_s^e)$, where $\bar{L}_u^e, \bar{L}_s^e, N_u^e, N_s^e$ are the average levels of labor and expropriation. Under symmetry this just reduces to the income of the representative agent $\gamma(w_u L_u + w_s L_s)$.

activities is

$$\begin{aligned} (1 - \gamma)\omega^i, & \quad \text{with probability } \phi(e^j)(1 - \alpha(z)); \\ \omega^i, & \quad \text{with probability } 1 - \phi(e^j)(1 - \alpha(z)). \end{aligned}$$

Taking these different types of incomes and probabilities into account, individual i 's expected overall income turns out to be

$$\omega^i(1 - \gamma\phi(e^j)(1 - \alpha(z))) + \gamma\omega^k\phi(e^i)(1 - \alpha(z)),$$

part of which is used to meet the cost of legal provision. Assuming that the legal expenditures, $p_z z$, are funded by a uniform per-head tax, individual i 's expected income available for consumption of tradables is

$$\bar{y}_d^i \equiv \omega^i(1 - \gamma\phi(e^j)(1 - \alpha(z))) + \gamma\omega^k\phi(e^i)(1 - \alpha(z)) - p_z z. \quad (7)$$

3.3 Utility maximization

Recall from (1) that indirect utility is linear in income. Then, the expected indirect utility for given levels of appropriation and demand for legal services is

$$\bar{V}_i \equiv v(p)\bar{y}_d^i, \quad (8)$$

where \bar{y}_d^i is given by (7).

To analyze the direct effect of a change in trade costs on expropriation activities, we treat z as exogenous until section 4. For given z and p (which in turn fixes w_u and w_s), each individual i chooses e^i to maximize (8) taking e^j as given for all $j \neq i$.

Noting that

$$\begin{aligned}
\omega^i &= w_u(\bar{L}_u^i - N_u^i) + w_s(\bar{L}_s^i - N_s^i) \\
&= w_u\bar{L}_u^i + w_s\bar{L}_s^i - (w_uN_u^i + w_sN_s^i) \\
&= w_u\bar{L}_u^i + w_s\bar{L}_s^i - c_e^i(w_u, w_s) e^i,
\end{aligned}$$

the first order condition of the maximization problem (i.e., $\frac{\partial \bar{V}_i}{\partial e^i} = 0$) gives

$$c_e^i(w_u, w_s) [1 - \gamma\phi(e^j) (1 - \alpha(z))] = \phi'(e^i) (1 - \alpha(z)) \gamma\omega^k. \quad (9)$$

The left-hand side of (9) captures the expected income foregone from devoting labor to produce an additional unit of expropriation. The right-hand side of (9) captures the incremental benefits, that is, the expected income from an additional unit of expropriation. In equilibrium these two must be equal. In what follows we focus on symmetric equilibrium where $e^i = e$, $\omega^i = \omega$ for all i . Exploiting symmetry and rearranging (9) we get:

$$1 = \gamma(1 - \alpha(z)) (\phi(e) + \phi'(e)(r - e)) \quad (10)$$

where

$$r \equiv \frac{w_u\bar{L}_u + w_s\bar{L}_s}{c_e^i(w_u, w_s)} \quad (11)$$

is the ratio of maximum potential income to the opportunity unit cost of expropriation. Thus, r can be interpreted as the maximum level of expropriation. For the remainder of the analysis we assume that $r - e = \frac{w_s\bar{L}_s + w_u\bar{L}_u - (w_sN_s + w_uN_u)}{w_s a_{se} + w_u a_{ue}} > 0$ which holds as long as all labor is not employed in expropriation.

3.4 Equilibrium

An equilibrium of this small open economy for given z and p comprises of (a) a pair of factor prices $\{w_u, w_s\}$, (b) a vector of unit labor allocations $\{a_{ux}, a_{sx}, a_{um}, a_{sm}, a_{ue}, a_{se}\}$,

(c) a pair of output levels $\{x, m\}$, and (d) a scalar e such that:¹⁷

- w_u and w_s satisfy the pricing equations (2) and (3),
- e satisfies (10),
- factor market clears:

$$a_{um} m + a_{ux} x + a_{uz} z + a_{ue} e = \bar{L}_u,$$

$$a_{sm} m + a_{sx} x + a_{sz} z + a_{se} e = \bar{L}_s,$$

- and, trade is balanced.

4 Trade Liberalization and Expropriation

Trade liberalization in our framework is equivalent to a reduction in domestic price of the importables, p .¹⁸ To determine the effect of a reduction in p on the level of expropriation, e , first we examine the effect on factor prices. Applying the standard Stolper-Samuelson theorem gives the following result.

Lemma 1: For an economy that exports the unskilled labor intensive good a reduction in p reduces skilled wages and increases unskilled wages. The effects on wages are reversed for an economy that exports the skilled labor intensive good.

Proof: Differentiating (2) and (3) and simplifying further gives

$$\theta_{ux} \hat{w}_u + \theta_{sx} \hat{w}_s = 0,$$

$$\theta_{um} \hat{w}_u + \theta_{sm} \hat{w}_s = \hat{p},$$

¹⁷We omit consumption values, x_c and m_c , from the definition of equilibrium since these are already taken into account in the indirect utility function.

¹⁸Similarly, an increase in protection or trade sanctions can be viewed as an increase in the price of importables faced by the domestic consumers.

where, for any variable b , $\hat{b} \equiv d \ln b \equiv \frac{db}{b}$, and $\theta_{ij} = \frac{w_i a_{ij}}{w_u a_{uj} + w_s a_{sj}}$ ($i \in \{u, s\}, j \in \{x, m\}$) denote the cost share of factor i in production of one unit of j . Solving these equations yields:

$$\hat{w}_u = \frac{\theta_{sx}}{\theta_{sx} - \theta_{sm}} \hat{p}, \quad (12)$$

$$\hat{w}_s = \frac{-\theta_{ux}}{\theta_{sx} - \theta_{sm}} \hat{p}, \quad (13)$$

Multiplying both sides of (4) by $\frac{w_u}{w_s}$ and subsequently adding 1 to each side and rearranging gives $\theta_{sx} - \theta_{sm} < 0$ for the developing economy and $\theta_{sx} - \theta_{sm} > 0$ for the developed economy. Then, since $\hat{p} < 0$ we have $\hat{w}_u > 0$ and $\hat{w}_s < 0$ for the developing and the opposite signs ($\hat{w}_u < 0$ and $\hat{w}_s > 0$) for the developed economy. *QED*

It will also be useful to recall the implication of Lemma 1 in terms of the skill premium, w_s/w_u . Thus the Stolper-Samuelson theorem implies that the skill premium falls in a developing economy, i.e. one that exports the unskilled labor intensive good, $\hat{w}_s - \hat{w}_u < 0$ if $\theta_{sx} - \theta_{sm} < 0$ and rises in a developed economy, $\hat{w}_s - \hat{w}_u < 0$ if $\theta_{sx} - \theta_{sm} < 0$.

To evaluate the implications of changes in factor prices on the level of expropriation, e , we also need to evaluate the effect of commodity price changes on r , i.e., the ratio of maximum income to unit cost of expropriation (see equation 11).

Lemma 2: If expropriation activities are relatively intensive in unskilled labor (skilled labor) such that $\frac{a_{ue}}{a_{se}} > (<) \frac{\bar{L}_u}{\bar{L}_s}$, then the effect of trade liberalization on r has the same sign (opposite sign) as the skill premium $\hat{w}_s - \hat{w}_u$.

Proof: Note that $r \equiv \frac{w_u \bar{L}_u + w_s \bar{L}_s}{c_e}$ and $c_e \equiv w_u a_{ue} + w_s a_{se}$ is the opportunity cost per unit of expropriation. We have that

$$\hat{r} (\equiv d \ln r) = (\hat{w}_s - \hat{w}_u)(\theta_{ue} - \lambda_u) \quad (14)$$

where $\lambda_u \equiv \frac{w_u \bar{L}_u}{w_u \bar{L}_u + w_s \bar{L}_s}$ denotes the unskilled labor income share in each individual's potential income and $\theta_{ue} \equiv \frac{w_u a_{ue}}{w_u a_{ue} + w_s a_{se}}$ denotes the share of unskilled labor income in

total income foregone by an individual to produce one unit of expropriation.¹⁹ From these definitions we have $\frac{a_{ue}}{a_{se}} > (<) \frac{\bar{L}_u}{\bar{L}_s} \Rightarrow \theta_{ue} - \lambda_u > (<) 0$. Thus if $\frac{a_{ue}}{a_{se}} > \frac{\bar{L}_u}{\bar{L}_s}$ we have $\text{sgn } \hat{r} = \text{sgn } (\hat{w}_s - \hat{w}_u)$. If however $\frac{a_{ue}}{a_{se}} < \frac{\bar{L}_u}{\bar{L}_s}$ we have $\text{sgn } \hat{r} = -\text{sgn } (\hat{w}_s - \hat{w}_u)$ *QED*.

We are now ready to examine the effect of trade liberalization on the equilibrium level of expropriation activities.

Proposition 1: Consider a small open economy with an imperfect legal system and a given level of legal service provision. If expropriation activities are relatively intensive in unskilled labor, such that $\frac{a_{ue}}{a_{se}} > \frac{\bar{L}_u}{\bar{L}_s}$, then the effect of trade liberalization on expropriation has the same sign as its effect on the skill premium. If expropriation activities are relatively intensive in skilled labor, however, expropriation has the opposite sign to the skill premium.

Proof: Differentiating (10) with respect to r and applying the implicit function theorem gives

$$\frac{\partial e}{\partial r} = \frac{-\phi'(e)}{\phi''(e)(r-e)} > 0 \quad (15)$$

since $\phi'(e) > 0$, $\phi''(e) < 0$, and $r - e > 0$. Since $\frac{de}{dp} \equiv \frac{\partial e}{\partial r} \frac{dr}{dp}$, it follows that the sign of the effect of trade liberalization on expropriation activities, $\frac{de}{dp}$, depends only on the sign of $\frac{dr}{dp}$. As shown in Lemma 2, $\frac{dr}{dp}$ has the same sign as the skill premium if expropriation activities are relatively intensive in unskilled labor, and has the opposite sign to the skill premium if expropriation activities are relatively intensive in skilled labor. *QED*

The intuition for Proposition 1 is simple. Trade liberalization increases the returns to factor used intensively in the exportable sector. If exports are intensive in unskilled labor (the developing economy case) trade liberalization increases unskilled wages and reduce skilled labor wages. If expropriation activities are relatively intensive in unskilled labor a rise in unskilled wages increases the opportunity cost of engaging in expropriation, c^e and reduces the potential for efficient expropriation, r .

¹⁹Since there is a unit measure of identical individuals and we are focusing on symmetric equilibrium, these shares also represent economy wide shares.

Thus Proposition 1 shows that the benefits of trade liberalization may well include reductions in labor intensive crime. Arguably it is natural to think of many illicit activities as labor intensive. Proposition 1 also says, however, that trade liberalization will increase crime in developing countries if crime is skill intensive. Thus a developing economy faced with extensive political corruption may have a different liberalization experience from one that is faced with problems of street crime or civil conflict. Likewise a developed economy faced mainly with problems of low skilled crime may experience increases in crime as a consequence of falling trade costs or trade liberalization.²⁰

5 Endogenous Legal Services

The level of legal services is exogenously given in the model described above. While this might be appropriate for a short run analysis, in the long run, presumably, the demand and supply of these services respond to change to prices and incomes as well. Changes in the demand and costs affects the equilibrium level of legal provision which in turn affects the level of expropriation. Below, Lemma 3 records a comparative statics result for future reference and later in this section, Propositions 2 and 3 examine the effect of trade liberalization on legal services as well as expropriation.

Lemma 3: For any given pair of factor prices (w_u, w_s) , an exogenous increase in the level of legal services reduces expropriation.

Proof: Differentiating (10), noting that r is constant, and applying the implicit function theorem we have

$$\frac{\partial e}{\partial z} = \frac{\alpha'(z)}{(1 - \alpha(z))^2} \frac{1}{\phi''(e)(r - e)} < 0. \quad (16)$$

The sign follows from noting that $\phi''(e) > 0$, $\alpha'(z) > 0$ and $r - e > 0$. *QED*

We consider the following sequence of events. First, the government chooses the level of

²⁰Note also that if the factors were land and labor, it would be very natural to think of crime as labor intensive. Proposition 1 indicates that a positive terms of trade shock to an agricultural exporting economy might then lead to an increase in crime as land rents rise relative to wages.

z to maximize the sum of individual expected utilities, $\int_{[0,1]} v(p)\bar{y}_d^i di$, where y_d^i is given by (7). Then each individual i chooses e^i to maximize $v(p)\bar{y}_d^i$ taking e^j as given for all $j \neq i$.

Consider the choice of e^i first. The first order condition with respect to e^i , $\frac{\partial \bar{V}_i}{\partial e^i} = 0$, is given by (9). Imposing symmetry (i.e., $e^i = e$), (9) reduces to (10). Then, applying Implicit Function Theorem we have that

$$e = e(r, z)$$

where $e(r, z)$ is the value of e that solves $\gamma(1 - \alpha(z)) (\phi(e) + \phi'(e)(r - e)) = 1$.

The government chooses z to maximize

$$\int_{[0,1]} v(p)\bar{y}_d^i di \equiv v(p)[w_u \bar{L}_u + w_s \bar{L}_s - c_e e(r, z) - p_z z].$$

Since p is exogenously given and w_u and w_s by p , effectively, the government solves the following:

$$\min_z S(z) \equiv [c_e e(r, z) + p_z z]$$

where $S(z)$ satisfies the following assumption.

Assumption 4: $S(z)$ is strictly concave in z (i.e., $S''(z) < 0$).

From the first order condition of this minimization problem we have that

$$-\frac{\partial e(r, z)}{\partial z} = \frac{p_z}{c_e}, \tag{17}$$

which implicitly determines the optimal level of legal services. An increase in the level of legal services lowers expropriation (Lemma 3) which in turn raises overall income in the economy. The increase in overall income due to an additional unit of z is $-c_e \frac{\partial e(r, z)}{\partial z}$ while the cost is $c_z(w_u, w_s) = p_z$. Equation (17) captures the fact that at optimal z , these two must be equal.

Lemma 4: For a developing (developed) economy trade liberalization leads to a reduction (an increase) in $\frac{p_z}{c_e}$ if and only if $\frac{a_{uz}}{a_{sz}} < \frac{a_{ue}}{a_{se}}$.

Proof: Log differentiating $c_e = w_u a_{ue} + w_s a_{se}$ and $p_z = w_u a_{uz} + w_s a_{sz}$ and subsequently using (12) and (13) we get

$$\hat{c}_e = \frac{\theta_{ue} - \theta_{ux}}{\theta_{sx} - \theta_{sm}} \hat{p}, \quad (18)$$

$$\hat{p}_z = \frac{\theta_{uz} - \theta_{ux}}{\theta_{sx} - \theta_{sm}} \hat{p}, \quad (19)$$

and

$$\hat{p}_z - \hat{c}_e = \frac{\theta_{uz} - \theta_{ue}}{\theta_{sx} - \theta_{sm}} \hat{p}. \quad (20)$$

Recall that $\hat{p} < 0$. For the developing economy $\theta_{sx} - \theta_{sm} < 0$ and the result follows from noting that $\frac{a_{uz}}{a_{sz}} < \frac{a_{ue}}{a_{se}} \Rightarrow \theta_{uz} - \theta_{ue} < 0$. For the developed economy $\theta_{sx} - \theta_{sm} > 0$ and this reverses the sign of (20) *QED*.

How does trade liberalization affect the level of legal services? To answer this consider equation (17) which implicitly determines the optimal level of legal services. If legal services are relatively skilled-labor intensive compared to expropriation activities, the right-hand side of (17) decreases with trade liberalization. Loosely speaking, legal services become cheaper with trade liberalization. If r were unaffected by trade liberalization then this effect alone would lead to higher level of legal services in a developing economy. However, except for the special case where $\frac{a_{ue}}{a_{se}} = \frac{\bar{L}_u}{\bar{L}_s}$, trade liberalization affects r . The left-hand side of (17), $\frac{\partial e(r,z)}{\partial z}$, can increase or decrease with r (see below) which in turn suggests that level of legal services might increase or decrease with trade liberalization.

Thus, despite the fact that Lemma 4 unambiguously signs the effect of trade liberalization on the right hand side of (17), the effect of trade on legal service provision is ambiguous. Moreover since the amount of expropriation depends on the level of legal services it is natural to expect that the effect of trade liberalization on expropriation, with endogenous

legal services, will also be ambiguous. Surprisingly, we find that this is not the case.

Proposition 2: Suppose Assumptions 1-4 hold. Then if expropriation is intensive in unskilled labor such that $\frac{a_{ue}}{a_{se}} > \max\{\frac{\bar{L}_u}{L_s}, \frac{a_{uz}}{a_{sz}}\}$, the effect of trade liberalization on expropriation has the same sign as the skill premium. If expropriation is intensive in skilled labor such that $\frac{a_{ue}}{a_{se}} < \min\{\frac{\bar{L}_u}{L_s}, \frac{a_{uz}}{a_{sz}}\}$, then the effect of trade liberalization on expropriation has the opposite sign to the skill premium. In both cases the effect of trade liberalization on the level of legal services is ambiguous.

Proof: Differentiating (17) with respect to p yields

$$\frac{\partial^2 e(r, z)}{\partial z^2} \frac{dz}{dp} + \frac{\partial^2 e(r, z)}{\partial z \partial r} \frac{dr}{dp} = -\frac{d(\frac{pz}{c_e})}{dp},$$

rearranging which gives

$$\frac{dz}{dp} = \frac{-\frac{d(\frac{pz}{c_e})}{dp} - \frac{\partial^2 e(r, z)}{\partial z \partial r} \frac{dr}{dp}}{\frac{\partial^2 e(r, z)}{\partial z^2}}. \quad (21)$$

By Lemmas 2 and 4 respectively we can sign $\frac{dr}{dp}$ and $\frac{d(\frac{pz}{c_e})}{dp}$. Furthermore $S''(z) < 0 \Rightarrow \frac{\partial^2 e(r, z)}{\partial z^2} > 0$. Nonetheless, the sign of

$$\frac{\partial^2 e(r, z)}{\partial z \partial r} = -\frac{\alpha'(z)}{(1 - \alpha(z))^2} \frac{\phi''(\cdot) - \frac{\partial e}{\partial r}(\phi''(\cdot) - \phi'''(\cdot)(r - e))}{(\phi''(e)(r - e))^2}, \quad (22)$$

is ambiguous since $\phi'''(\cdot)$ could be positive or negative. This in turn implies that the sign of $\frac{dz}{dp}$ is ambiguous as well.

Now consider the effect of trade liberalization on expropriation, $\frac{de}{dp}$. We have

$$\frac{de}{dp} = \frac{\partial e(r, z)}{\partial r} \frac{dr}{dp} + \frac{\partial e(r, z)}{\partial z} \frac{dz}{dp} \quad (23)$$

Substituting the expression for $\frac{dz}{dp}$ from (21) in (23) and rearranging gives

$$\frac{de}{dp} = \frac{1}{\frac{\partial^2 e(r, z)}{\partial z^2}} \left[\Theta \frac{dr}{dp} + \left(-\frac{\partial e(r, z)}{\partial z} \right) \frac{d(\frac{pz}{c_e})}{dp} \right]. \quad (24)$$

where $\Theta \equiv \frac{\partial e(r,z)}{\partial r} \frac{\partial^2 e(r,z)}{\partial z^2} - \frac{\partial e(r,z)}{\partial z} \frac{\partial^2 e(r,z)}{\partial r \partial z}$. The effect of trade liberalization on expropriation is given by the sign of the right-hand side of (24). Note, we have already shown that $\frac{\partial^2 e(r,z)}{\partial z^2} > 0$. Moreover from Lemma 3 we have $-\frac{\partial e(r,z)}{\partial z} > 0$. The sign of the term Θ depends on the extent to which the probability of success in court $\alpha(z)$ increases as z increases. In Appendix we prove that log-concavity of $1 - \alpha(z)$ implies that $\Theta > 0$. Given this, the sign of right-hand side of (24) depends on $\frac{d(\frac{p_z}{c_e})}{dp}$ and $\frac{dr}{dp}$. Again by Lemma 2 and Lemma 4 we know that these terms are both positive for developing economy and both negative for a developed economy if and only if $\frac{a_{ue}}{a_{se}} > \frac{\bar{L}_u}{L_s}$ and $\frac{a_{ue}}{a_{se}} > \frac{a_{uz}}{a_{sz}}$. Together these imply that if $\frac{a_{ue}}{a_{se}} > \max\{\frac{\bar{L}_u}{L_s}, \frac{a_{uz}}{a_{sz}}\}$ then $\frac{de}{dp} > (<) 0$ for a developing (developed) economy. Likewise it follows that if $\frac{a_{ue}}{a_{se}} < \min\{\frac{\bar{L}_u}{L_s}, \frac{a_{uz}}{a_{sz}}\}$ then $\frac{de}{dp} < (>) 0$ for a developing (developed) economy. *QED*

Thus, even when the effect of trade on legal services is ambiguous, expropriation unambiguously declines. Intuitively the ambiguity of the change in legal services arises because of shifts in the government demand for these services. From (17), $-c_e \frac{\partial e(r,z)}{\partial z}$ is the social value of the marginal product of z which may be interpreted as the demand schedule. The supply schedule is perfectly elastic at price $p_z = c_z$. A fall in p_z leads to a shift along this demand curve. However a simultaneous fall in r also shifts the demand curve toward the origin leaving the sign of z ambiguous.

As shown by Proposition 2 however, this ambiguity is irrelevant for determining the effect of trade liberalization of expropriation. In fact Proposition 2 shows that with endogenous law enforcement the results of Proposition 1 are maintained with just one additional condition, given by Lemma 4. The additional condition, moreover, does not necessarily imply any restriction on the range of factor intensities rankings over which the results hold.

Thus the model points to some potential consequences of rising skill premiums associated with trade liberalization and falling trade costs. It suggests that falling trade costs will increase crime in countries with skilled labour intensive exports, such as the U.S.A., if crime is intensive unskilled labor. Empirically this suggests globalization might increase

crime in the U.S.A.. Though crime rates have been falling in the U.S.A., Imrohorglu, Merlo and Rupert (2004) find that crime rates would have fallen faster had it not been for rising inequality. Moreover some of this increase in inequality can be attributed to international factors.²¹ Perhaps more importantly however the model suggests that the positive effect of trade on unskilled wages may help reduce both the incentives for expropriation and the costs of legal services in economies that export labor intensive goods.

5.1 Log-concavity of $1 - \alpha(z)$

The finding, in Proposition 2, that trade liberalization lowers expropriation relies on the assumption that $1 - \alpha(z)$ is log-concave. The assumption eliminates the possibility that increments in spending on z reduce the conditional probability of conviction. This assumption, which is weaker than standard assumption of concavity, is quite plausible and used extensively in the contract literature. Without log-concavity we can obtain the same result, that is, trade liberalization lowers expropriation if the ratio of aggregate income lost (due to expropriation) to aggregate income earned (*i.e.*, $\frac{e}{r-e} \equiv \frac{w_u N_u + w_s N_s}{w_u L_u + w_s L_s}$) is small.²²

5.2 Private Provision

So far we have assumed that the legal services which detect and verify expropriation claims are publicly provided. What happens if, instead, we assume that each individual i has to purchase z^i units of legal services privately once their income is expropriated? Except for the nature of the provision of the legal services itself (private versus public) there are two differences. First, an individual i does not purchase and hence does not

²¹According to Rodrik (1997), trade accounts for a small but significant fraction (10-20 percent) of the observed rising inequality in the U.S.A. and Pablo, Lederman and Loayza (2002) and Soares (2004) show that inequality is positively related to crime. In a similar vein Borjas, Grogger and Hanson (2006) find a significant correlation between immigration, which also increases the skill premium, black wages, black employment rates, and black incarceration rates in the U.S.A..

²²Details are available upon request.

pay for the legal services unless she is targeted successfully by individual j . Second, is the timing of decisions. In case of private provision, each individual choosing e^i and z^i simultaneously to maximize (8) taking (e^j, z^j) as given for all $j \neq i$, seems more natural than the two stage game in section 4, where z is chosen prior to e^i . Incorporating these differences in the model, we find that, as in the private provision case, trade liberalization lowers expropriation if expropriation activities are relatively intensive in unskilled labor. See Appendix B for details.

Note that, in some of the poorest regions in the world (e.g. sub-Saharan Africa) there is an acute lack of social capital so that there is neither government provision nor a private market for legal services. In such situations, according to Collier and Gunning (1999), communities have turned to traditional types of social organization. Modifying our framework suitably, our analysis can be applied for those situations as well. Substituting p_z by $c_z(w_u, w_s)$ and interpreting z as self-provided defense services the entire analysis in Appendix B goes through. Thus presence of a competitive market is not crucial and we can also interpret the private provision case as a model where security services are produced by the household.

6 Gains from Trade

Compared to the standard Heckscher-Ohlin framework ours has two new activities: expropriation and legal services. Reallocation of resources between these activities and the tradables sector can generate additional gains or losses beyond the standard gains. The precise magnitude, in general, depends on factor intensity rankings as well as the size of legal sector and extent of expropriation. However to determine that there are indeed additional gains and not additional losses (and vice versa), we find that under certain circumstances, the factor-intensity ranking of sectors alone is sufficient.

Let V denote the aggregate expected indirect utility. Then,

$$V \equiv \int_{i \in [0,1]} v(p) \bar{y}_d^i di \equiv v(p) [w_u \bar{L}_u + w_s \bar{L}_s - (w_u a_{ue} + w_s a_{se}) e(r, z) - p_z z] \quad (25)$$

where z solves (17). To capture the additional gains from trade, first we need to consider a standard Heckscher-Ohlin economy with no expropriation or legal services. Set $e = z = 0$ in (25). Then, taking logarithms and subsequently differentiating (25) gives

$$\frac{\hat{V}}{\hat{p}} = \frac{pv'(p)}{v(p)} + \frac{\lambda_u - \theta_{ux}}{\theta_{sx} - \theta_{sm}}. \quad (26)$$

In the presence of expropriation and endogenous legal provision, we have that

$$\frac{\hat{V}}{\hat{p}} = \frac{pv'(p)}{v(p)} + \frac{\lambda_u - \theta_{ux}}{\theta_{sx} - \theta_{sm}} - \frac{\eta c_e e(r, z) (\theta_{ue} - \lambda_u) + p_z z (\lambda_u - \theta_{uz})}{(\theta_{sm} - \theta_{sx}) [w_u \bar{L}_u + w_s \bar{L}_s - (w_u a_{ue} + w_s a_{se}) e(r, z) - p_z z]}. \quad (27)$$

where $\eta = \frac{r}{r-e} \frac{1}{(-\frac{e\phi''(e)}{\phi'(e)})} - 1$.²³

The underlying product and factor prices are same in the standard Heckscher-Ohlin economy and the economy with expropriation and legal services. This in turn implies that the factor shares in the unit cost functions of the tradable goods (i.e., θ_{ij} , where $i = u, s$ and $j = x, m$) are same in the two economies as well. Then, comparing (26) and (27), it follows that the magnitude of additional gains from trade is

$$\frac{\eta c_e e(r, z) (\theta_{ue} - \lambda_u) + p_z z (\lambda_u - \theta_{uz})}{(\theta_{sm} - \theta_{sx}) [w_u \bar{L}_u + w_s \bar{L}_s - (w_u a_{ue} + w_s a_{se}) e(r, z) - p_z z]}, \quad (28)$$

which we denote by Δ hereafter. Recall from Definition 1 that $\theta_{sm} - \theta_{sx} > 0$ for a developing economy and $\theta_{sm} - \theta_{sx} < 0$ for a developed economy. Hence for a developing economy the denominator of (28) is strictly positive for any economy with strictly positive consumption of x or m and strictly negative for the developed economy. To sign (28) it remains only to sign the numerator. Note that, if $\frac{a_{ue}}{a_{se}} = \frac{\bar{L}_u}{\bar{L}_s} = \frac{a_{uz}}{a_{sz}}$ then $\theta_{ue} = \lambda_u = \theta_{uz}$, and there are no additional gains or losses (i.e., $\Delta = 0$). The economy with expropriation

²³See Appendix A for the derivation of (27).

and legal services in this case is effectively a scaled-down version of the standard small open Heckscher-Ohlin economy where the scale is invariant to the factor prices.

Proposition 3: Suppose that $\eta > 0$. If $\frac{a_{uz}}{a_{sz}} < \frac{\bar{L}_u}{L_s} < \frac{a_{ue}}{a_{se}}$ then, in presence of expropriation and legal services, there are additional gains from trade liberalization for the developing economy and additional losses for the developed economy. If the ranking is reversed, that is, if $\frac{a_{uz}}{a_{sz}} > \frac{\bar{L}_u}{L_s} > \frac{a_{ue}}{a_{se}}$, then there are additional losses from trade liberalization for the developing economy and additional gains for the developed economy.

Proof: Note that $\frac{a_{uz}}{a_{sz}} < \frac{\bar{L}_u}{L_s} < \frac{a_{ue}}{a_{se}} \Leftrightarrow \frac{w_u a_{uz}}{w_u a_{uz} + w_s a_{sz}} < \frac{w_u \bar{L}_u}{w_u \bar{L}_u + w_s L_s} < \frac{w_u a_{ue}}{w_u a_{ue} + w_s a_{se}} \Leftrightarrow \theta_{uz} < \lambda_u < \theta_{ue}$. Then, from (28) it immediately follows that $\Delta > 0$ for the developing economy where $\theta_{sm} - \theta_{sx} > 0$, and $\Delta < 0$ for a developed economy. Similarly $\frac{a_{uz}}{a_{sz}} > \frac{\bar{L}_u}{L_s} > \frac{a_{ue}}{a_{se}} \Leftrightarrow \theta_{uz} > \lambda_u > \theta_{ue}$ which in turn implies that $\Delta < (>)0$ for a developing (developed) economy. *QED*

Proposition 4 implies that if $\frac{\bar{L}_u}{L_s} \in [\min\{\frac{a_{uz}}{a_{sz}}, \frac{a_{ue}}{a_{se}}\}, \max\{\frac{a_{uz}}{a_{sz}}, \frac{a_{ue}}{a_{se}}\}]$, factor-intensity rankings alone can determine whether there are additional gains or losses from trade liberalization. In other cases size of the legal sector and scale of expropriation activities are necessary to sign Δ .

How restrictive is the requirement that $\eta > 0$? We find that a sufficient condition for $\eta > 0$ to hold is that $e\phi''(e) + \phi'(e) > 0$. Under the standard specification $\phi(e) = ke^\sigma$ where $k > 0, \sigma < 1$, this condition is satisfied for all $e > 0$. Also in general this condition is satisfied if e is less than a certain threshold.²⁴

It is worth noting that, even if trade liberalization lowers expropriation, this does not necessarily imply there are additional gains. A reduction in expropriation releases resources for production of tradables which creates additional gains. These gains, however, could be more than offset if the legal sector expands as well with trade liberalization and

²⁴Note, except for the fact that it is bounded above by unity, the properties of $\phi(e)$ are similar to the ones of an utility function. Interpreting $\phi(e)$ as the utility function in e and $\phi'(e)$ as the price, the condition $e\phi''(e) + \phi'(e) > 0$ means that the marginal revenue is positive. For an arbitrary demand function marginal revenue is not positive for all output levels. However the output levels where marginal revenue is negative are not interesting as they never arise in a profit-maximizing equilibrium as long as marginal cost is positive.

absorbs more than the resources released in the economy because of lower expropriation. Observe that if $\frac{a_{ue}}{a_{se}} > \frac{a_{uz}}{a_{sz}} > \frac{\bar{L}_u}{L_s}$, expropriation declines with trade liberalization (Proposition 2). However this ordering does not necessarily generate additional gains from trade (see Proposition 4). In fact if $p_z z$ is large, $\Delta < 0$.

7 Conclusion

We have considered a Heckscher-Ohlin type model of a small open economy in which there is an imperfect level of protection of property rights. This imperfection means that a positive level of expropriation will exist in equilibrium. We use the model to determine under what conditions trade liberalization, or falling trade costs, will increase or decrease expropriation through changing the incentives to engage in expropriation and changing the costs of legal services. The overall impact is shown to depend upon a chain of factor intensity rankings. Depending on these rankings we show that the gains from trade may be amplified or muted due to changing levels of expropriation.

The results show therefore that trade liberalization will have a different impact on expropriation in different countries, depending on their trade patterns. Assuming, for example, that crime is essentially a labour intensive activity, the results show that trade liberalization can increase crime in an economy with skilled labor intensive exports, such as the U.S.A.. Since crime levels tend to be most severe in developing countries, however, an important result from the model is the possibility that trade liberalization can reduce expropriation and amplify the gains from trade. This is shown to be more likely to occur in countries that export labour intensive goods, as is the case in many developing economies.

Appendix A: Proofs

First, we prove a claim used in the proof of Proposition 2. Then we provide the details of the derivation of (27).

Claim: Suppose $1 - \alpha(z)$ is log-concave. Then $\frac{\partial e(r,z)}{\partial r} \frac{\partial^2 e(r,z)}{\partial z^2} - \frac{\partial e(r,z)}{\partial \tilde{z}} \frac{\partial^2 e(r,z)}{\partial r \partial z} > 0$.

Proof: Rewrite (16) as

$$\frac{\partial e}{\partial z} = h(z)f(r, e(r, z)), \quad (\text{A.1})$$

where $f(r, e(r, z)) \equiv \frac{1}{\phi''(e(r,z))(r-e(r,z))}$ and $h(z) \equiv \frac{\alpha'(z)}{(1-\alpha(z))^2}$. Differentiating (A.1) with respect to r and z respectively gives

$$\begin{aligned} \frac{\partial^2 e}{\partial z^2} &= h'(z)f(r, e(r, z)) + h(z)\frac{\partial f(\cdot)}{\partial e} \frac{\partial e(\cdot)}{\partial z}, \\ \frac{\partial^2 e}{\partial r \partial z} &= h(z)\left(\frac{\partial f(\cdot)}{\partial r} + \frac{\partial f(\cdot)}{\partial e} \frac{\partial e(\cdot)}{\partial r}\right). \end{aligned}$$

Using these expressions we find that

$$\frac{\partial e(r, z)}{\partial r} \frac{\partial^2 e(r, z)}{\partial z^2} - \frac{\partial e(r, z)}{\partial \tilde{z}} \frac{\partial^2 e(r, z)}{\partial r \partial z} = h'(\cdot)f(\cdot)\frac{\partial e(r, z)}{\partial r} - h(\cdot)\frac{\partial e(r, z)}{\partial z} \frac{\partial f(\cdot)}{\partial r} \quad (\text{A.2})$$

Since $h(\cdot) > 0$, $\frac{\partial e(r,z)}{\partial z} < 0$, and $\frac{\partial f(\cdot)}{\partial r} = -\frac{1}{\phi''(\cdot)(r-e)^2} > 0$ we have that $-h(\cdot)\frac{\partial e(r,z)}{\partial z} \frac{\partial f(\cdot)}{\partial r} > 0$.

Also, we have $f(\cdot) > 0$ and $\frac{\partial e(r,z)}{\partial r} > 0$. Thus it suffices to show $h'(z) > 0$.

Noting that $\frac{d \ln(1-\alpha(z))}{dz} = -\frac{\alpha'(z)}{1-\alpha(z)}$, $h(z) \equiv \frac{\alpha'(z)}{(1-\alpha(z))^2}$ can be expressed as

$$h(z) = -\frac{d \ln(1-\alpha(z))}{dz} \frac{1}{1-\alpha(z)}.$$

Differentiating $h(z)$ with respect to z gives

$$h'(z) = -\frac{d^2 \ln(1-\alpha(z))}{dz^2} \frac{1}{1-\alpha(z)} - \frac{d \ln(1-\alpha(z))}{dz} \frac{\alpha'(z)}{(1-\alpha(z))^2}$$

We have that (i) $\frac{d \ln(1-\alpha(z))}{dz} < 0$, and (ii) $\frac{d^2 \ln(1-\alpha(z))}{dz^2} \geq 0$ (since $1 - \alpha(z)$ is log-concave). Together (i) and (ii) imply $h'(z) > 0$.

Derivation of (27): Log-differentiating (25) yields:

$$\hat{V} = \frac{pv'(p)}{v(p)} \hat{p} + \frac{d(w_u \bar{L}_u + w_s \bar{L}_s) - dS(z)}{w_u \bar{L}_u + w_s \bar{L}_s - c_e e(r, z) - p_z z} \quad (\text{A.3})$$

where $S(z) \equiv c_e e(r, z) + p_z z$ and z solves (17).

We have that $d(w_u \bar{L}_u + w_s \bar{L}_s) = (w_u \bar{L}_u + w_s \bar{L}_s)(\lambda_u \hat{w}_u + (1 - \lambda_u) \hat{w}_s)$. Substituting $\hat{w}_u = \frac{\theta_{sx}}{\theta_{sx} - \theta_{sm}} \hat{p}$ and $\hat{w}_s = -\frac{\theta_{ux}}{\theta_{sx} - \theta_{sm}} \hat{p}$ from (12) and (13) respectively we get

$$d(w_u \bar{L}_u + w_s \bar{L}_s) = (w_u \bar{L}_u + w_s \bar{L}_s) \frac{\lambda_u - \theta_{ux}}{\theta_{sx} - \theta_{sm}} \hat{p}.$$

Totally differentiating $S(\cdot)$ gives $dS(\cdot) = (c_e \frac{\partial e(r, z)}{\partial z} + p_z) dz + c_e \frac{\partial e}{\partial r} dr + e(r, z) dc_e + z dp_z$.

By (17), $c_e \frac{\partial e(r, z)}{\partial z} + p_z = 0$. Hence, we have

$$dS(\cdot) = c_e e \frac{r}{e} \frac{\partial e}{\partial r} \hat{r} + c_e e(r, z) \hat{c}_e + p_z z \hat{p}_z.$$

Substituting the expressions for $\frac{\partial e}{\partial r}$, \hat{r} , \hat{c}_e and \hat{p}_z from (15), (14), (18) and (19) respectively in the right-hand side of the equation above and rearranging we get:

$$dS(\cdot) = (c_e e(r, z) + p_z z) \left(\frac{\lambda_u - \theta_{ux}}{\theta_{sx} - \theta_{sm}} \hat{p} \right) + \frac{\eta c_e e(r, z) (\theta_{ue} - \lambda_u) + p_z z (\lambda_u - \theta_{uz})}{\theta_{sm} - \theta_{sx}} \hat{p}$$

where $\eta = \frac{r}{r-e} \frac{1}{(-\frac{e \phi''(e)}{\phi'(e)})} - 1$. Substituting the expressions for $d(w_u \bar{L}_u + w_s \bar{L}_s)$ and $dS(\cdot)$ in (A.3) and rearranging gives (27).

Appendix B: Private Provision of Legal Services

As discussed in section 6.1 the basic model is the same as in section 2 except for the timing of decisions and payment for legal services. The level of e and z are chosen simultaneously in the private provision case, where as in the public provision case each individual chooses e^i after the government has determined the level of z . Also, in the private provision case, since each individual purchases legal services only when she is targeted there is strictly positive probability that an individual does not pay for the legal services. In the public provision case however, each individual, irrespective of the fact whether she is targeted or not, pays for legal services since legal expenditures are met through per-head tax.

Consider the optimization problem faced by an individual i who targets individual k and is targeted by individual $j (\neq k)$. Each individual i chooses (e^i, z^i) to maximize $v(p)\bar{y}_d^i$ where

$$\bar{y}_d^i \equiv \omega^i(1 - \gamma\phi(e^j)(1 - \alpha(z^i))) + \gamma\omega^k\phi(e^i)(1 - \alpha(z^k)) - \phi(e^j)p_z z^i$$

The first-order conditions of this maximization problem (with respect to e^i and z^i respectively) are:

$$\gamma\omega^k\phi'(e^i)(1 - \alpha(z^k)) = (w_u a_{ue} + w_s a_{se})(1 - \gamma\phi(e^j)(1 - \alpha(z^i))) \quad (\text{B.1})$$

$$\gamma\omega^i\phi(e^j)\alpha'(z^i) = p_z\phi(e^j). \quad (\text{B.2})$$

The expressions in the left-hand sides of (B.1) and (B.2) capture the incremental expected benefit from an additional unit of e^i and z^i respectively while the right-hand sides express the expected marginal costs. In symmetric equilibrium with $e^i = e$, $z^i = z$ and $\omega^i = \omega$ for

all $i \in [0, 1]$, equations (B.1) and (B.2), after some rearrangement reduce to the following:

$$\gamma(1 - \alpha(z)) (\phi(e) + \phi'(e)(r - e)) = 1, \quad (\text{B.3})$$

$$\frac{\gamma\omega\alpha'(z)}{p_z} = 1. \quad (\text{B.4})$$

Taking logarithms and subsequently differentiating and rearranging gives the following system:

$$\begin{pmatrix} -\frac{e\phi''(e)(r-e)}{\phi(e)+\phi'(e)(r-e)} & \frac{z\alpha'(z)}{1-\alpha(z)} \\ \frac{e}{r-e} & -\frac{z\alpha''(z)}{\alpha'(z)} \end{pmatrix} \begin{pmatrix} \hat{e} \\ \hat{z} \end{pmatrix} = \begin{pmatrix} \frac{r(\lambda_u - \theta_{ue})\phi'(e)}{\phi(e)+\phi'(e)(r-e)}(\hat{w}_u - \hat{w}_s) \\ (\lambda_u - \theta_{uz} + \frac{e}{r-e}(\lambda_u - \theta_{ue}))(\hat{w}_u - \hat{w}_s) \end{pmatrix}$$

From Lemma 1 we know that $\hat{w}_u - \hat{w}_s > 0$. The term $\frac{e}{r-e}$ is positive. Applying Assumptions 1-3 we can show that all other entries in 2×2 matrix are strictly positive. Nonetheless, the signs of \hat{e} and \hat{z} are ambiguous, and in general will depend on the sectoral factor intensities and the extent of expropriation activities. The proposition below tells us that \hat{e} and \hat{z} can be signed unambiguously when expropriation activities are unskilled labor intensive and legal services are relatively skilled labor intensive.

Proposition: Suppose $\frac{a_{uz}}{a_{sz}} < \frac{\bar{L}_u}{L_s} < \frac{a_{ue}}{a_{se}}$ and $\frac{e}{r-e}$ is small. Then, for a developing economy trade liberalization increases the level of legal services sector and reduces the extent of expropriation. For a developed economy trade liberalization reduces the level of legal services sector and raises the extent of expropriation. The signs are reversed for the case when $\frac{a_{uz}}{a_{sz}} > \frac{\bar{L}_u}{L_s} > \frac{a_{ue}}{a_{se}}$.

Proof: Applying Cramer's Rule and letting $e \rightarrow 0$ we get

$$\hat{e} = \frac{(\lambda_u - \theta_{ue})\epsilon_\alpha - (\lambda_u - \theta_{uz})\frac{z\alpha'(z)}{1-\alpha(z)}}{\epsilon_e\epsilon_\alpha}(\hat{w}_u - \hat{w}_s) < 0,$$

$$\hat{z} = \frac{(\lambda_u - \theta_{uz})(\hat{w}_u - \hat{w}_s)}{\epsilon_\alpha} > 0,$$

where $\epsilon_\alpha \equiv -\frac{z\alpha''(z)}{\alpha'(z)}$, $\epsilon_e \equiv -\frac{e\phi''(e)}{\phi'(e)}$. Applying assumptions 1(ii) and 3(ii) respectively we have that $\epsilon_\alpha > 0$ and $\epsilon_e > 0$. Then, the inequalities in the equations above (determining

the sign of \hat{e} and \hat{z}) follow from noting that (i) $\frac{a_{uz}}{a_{sz}} < \frac{\bar{L}_u}{L_s} < \frac{a_{ue}}{a_{se}} \Rightarrow \theta_{uz} < \lambda_u < \theta_{ue}$, and (ii) Lemma 1 which implies $\hat{w}_u - \hat{w}_s > 0 (< 0)$ for the developing (developed) economy.

Likewise if $\frac{a_{uz}}{a_{sz}} > \frac{\bar{L}_u}{L_s} > \frac{a_{ue}}{a_{se}}$ we have $\theta_{uz} > \lambda_u > \theta_{ue}$ and the signs of \hat{e} and \hat{z} are reversed.

QED

Note further that in order to determine change in e the condition $\frac{\bar{L}_u}{L_s} < (>) \frac{a_{ue}}{a_{se}}$ is sufficient, but not necessary. For example consider the case of a developing economy. Even if expropriation is skilled labor intensive such that $\frac{\bar{L}_u}{L_s} > \frac{a_{ue}}{a_{se}}$ (and accordingly $\lambda_u > \theta_{ue}$), expropriation can decline with trade liberalization if the level of legal services increase. To see this, suppose that $\lambda_u - \theta_{ue} > 0$ but small. Assume that e is small as well. Then $\text{sgn}(\hat{e})$ is determined by $\text{sgn}(\theta_{uz} - \lambda_u)$. This implies $\hat{e} < 0$ as long as $\theta_{uz} < \lambda_u$ or equivalently $\frac{a_{uz}}{a_{sz}} < \frac{\bar{L}_u}{L_s}$.

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