The Trade Corruption Trap: N-S Trade with Weak Institutions*†

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Abstract

Trade corruption traps are associated with trade between poor countries with weak institutions (South) and rich countries with strong institutions (North). Predators (extortionists) on trade at South's border earn their opportunity cost in production. Equilibrium extortion in the trap is invariant to productivity growth – one jaw. Endogenous enforcement stuck in a bad equilibrium for South is the other trap jaw. Due to terms of trade effects of enforcement on labor supply, North prefers Mafia enforcement to anarchy to welfarist South enforcement. Equilibrium corruption falls with closeness to North, globalization and size – drivers of escape from the trap.

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The presence and durability of corruption (more narrowly extortion) across a wide range of countries is well documented in surveys.[1] A trade corruption trap may explain this pattern. The corruption trap model in this paper is based on equilibrium predation on trade, partly or wholly controlled by endogenous institutions. South predators (extortionists or thieves) earn their opportunity cost in productive labor. One jaw of the trap is that equilibrium corruption is invariant to productivity growth. This is because rises in labor productivity are paired with rises in the amount of trade to extort. The other trap jaw is North's malign (to South) influence on endogenous institutions. When enforcement is effective enough to dominate anarchy, North partners prefer enforcement institutions that serve their interests while trapping South in bad equilibria. Comparative statics give predictions about the range of equilibrium corruption levels across countries.

Two way causality between trade and institutions has a long history in economic thought. On one hand, classical political economy told a happy story about trade and institutions: mutual gains from trade were assured (Ricardo, 1817), and trade would stimulate better institutions (Smith, 1776).[2] On the other hand, Smith condemned the British East India Company for its notorious effects on India. The contribution of this paper is a tightly specified general equilibrium trade model that generates predictions about equilibrium institutions and trade. There is something in the analysis for both hands, but less for the happy hand of liberal optimism.

Enforcement institutions coordinate collective action to restrain predation on trade and/or to interact with other institutions.[3] Weakness of institutions – limits or inability – is endogenous to economic equilibrium. Institutions must pay for enforcement out of their gain from improved security, possibly exploiting their power to extract a surplus over the cost of

[1] See for example the World Economic Forum and Transparency International data.

[2] *Wealth of Nations* Book III, Chapter IV, crediting Hume: "...commerce and manufactures gradually introduced order and good government, and with them the liberty and security of individuals, among the inhabitants of the country, who had before lived in almost a continual state of war with their neighbours, and of servile dependency on their superiors. This, though it has been the least observed, is by far the most important of all their effects."

[3] Institutions are interpreted here as constraints on the actions of agents, following Douglass North.

enforcement. In one range of parameters, enforcement costs more than it gains in predation reduction, hence free entry predation (anarchy) or autarky prevails. In other parameter ranges, enforcement is beneficial to the institution deploying it but may be costly to other parties. Multiple institutions are rivals in grabbing rents generated from enforcement.

North institutions coordinate atomistic North traders. South loses from North or Mafia enforcement. (Gains from trade for South relative to autarky are nevertheless assured by the participation constraint.) North gains from Mafia enforcement because it improves North's terms of trade relative to anarchy. Worse than anarchy for North, welfarist South enforcement harms North's terms of trade. North tribute paid for secure trade is lower with the Mafia than with welfarist South. Direct North enforcement may dominate all options. Historical examples illustrate the model's chief implication that North gains from selecting trade enforcement institutions unfavorable to South. The current use of private security forces to protect the trade of rich world firms with institutionally weak countries suggests contemporary relevance of the model.

Predators in the model prey on goods in exchange, possibly opposed by enforcement institutions of North and/or South. Predators, productive workers and enforcers all are drawn from a common labor pool. The model is otherwise fully classical, with perfect competition and mobile labor. (The model builds on Anderson and Marcouiller (2005) by introducing institutions of enforcement. It differs in some other details as well, noted below.) A labor market channel modifies the standard terms of trade mechanism that divides the gains from trade in secure trade models. For example, enforcement by North reduces North labor supply and raises South (directly productive) labor supply as predators exit into production. Both forces raise South's relative size and thus lower South's terms of trade. In contrast, without endogenous predation, exogenous improvement in security improves the terms of trade for both South and North.

Weak enforcement is modeled as a patrol technology that deflects a portion of predation. South may not be willing or able to prevent patrols by North on South's border (e.g. act-

ing on goods crossing South's border, inward or outward, or goods stored in warehouses). Enforcement in this form normally implies opposed interests in the model: North terms of trade improve from its enforcement while South loses, and conversely.

Permanence of institutional authority in South may enable strong enforcement – control of predator entry by deterrence. Deterrence is enabled by credible institutional commitment to pursue and punish unauthorized predators. The commitment requires a fixed enforcement level. For a large enough market size relative to the required fixed force size, strong enforcement can be worth its cost. A Mafia cares only about its members, so the market size enabling Mafia control of predation is smaller than the market size enabling strong enforcement by a welfarist South state. This assumes that Mafia and South have the same enforcement technology. (Plausibly, a welfarist South state may be ethically or informationally constrained in enforcement relative to a Mafia.) North gains from Mafia enforcement relative to no enforcement while welfarist South loses. This is because the Mafia's optimal predation level implies that South's labor force rises relative to anarchy, hence North's terms of trade improve. Thus North has an incentive to encourage Mafia enforcement and to oppose welfarist South enforcement.

Tribute agreements with North are possible with strong enforcement South institutions. Tribute is modeled as a bargained payment for elimination of predation. North selects as partner a corrupt institution (a Mafia) over a welfarist institution because the bargained tribute is less with the Mafia. A South state capable of damaging the Mafia may use its threat to bargain a division of surplus with the Mafia – a semi-corrupt state.[4]

Comparative statics of the model reveal that equilibrium predation is lower for relatively larger South economies and higher for relatively more remote economies. More surprising, equilibrium predation is invariant to relative productivity improvement. This property is

[4]South is assumed too weak to prevent the North state or para-state actor from dealing with the Mafia. A sufficiently strong South is a North-type government with no South Mafia to offer an outside option for North. North's trade institution may be constrained by law or norms from such behavior, but historical examples of North springing the corruption trap include the British East India Company. The analysis exemplifies Weber's (2015) emphasis on a monopoly of legitimate violence as the essential property of a state.

consistent with relatively high insecurity across countries with differing income per capita, and with its invariance to changes in country incomes over time.[5] Moreover, South optimal weak enforcement, if it occurs, is invariant to productivity growth.

Optimism about the effect of growth on institutions was based on the intuition that growth raises the return to productive work that is the opportunity cost of predation. Moreover, higher incomes make enforcement more affordable. The intuition fails because growth also increases the return to predation because more trade is available to prey upon. In contrast optimistic implications come from improvements in trade technology – predation falls and terms of trade of both North and South improve. Also, improvements in enforcement technology improve security, improve South welfare, and may improve North welfare.

While the Ricardian model and the details of predation are special, the main lessons drawn from it are likely to hold in a wide range of reasonable models of endogenous predation (a claim examined further below). The model should be interpreted as applying to economies of any size, based on the recent theoretical and empirical success of the gravity model in which no country is 'small'. The long standing convention of treating relatively small economies as having no terms of trade power is a convenient simplification in many settings, but with endogenous predation the terms of trade are an essential ingredient.

The model resembles the Resource Curse literature (e.g. Frankel, 2010) in that an exogenously generated gain may lead to a social loss by stimulating predatory behavior. But the mechanisms here are different: the gains and losses come through the terms of trade and there is no actual conflict that consumes resources. The results of the model point to economic determinants of conflict between states and within states, and to intervention by more powerful states in the civil conflict of weaker states. Thus it relates to a wider literature on economic determinants of conflict (Garfinkel and Skaperdas, 2007). The potential loss

[5]Assiotis (2012) reports invariance of corruption to income per capita in a panel regression with country fixed effects and time effects using several corruption indexes and real income per capita from the Penn World Tables for 135 countries, 1984-2009. Corruption measures prominently reflect extortion, and extortion at borders reduces trade (Anderson and Marcouiller, 2002). The theory in this paper provides a rationale for Assiotis' finding.

in the paper resembles the well-examined analyses of loss from trade due to labor market failures or economies of scale, but here the potential losses from trade are inherent to the trade activity itself. With institutions endogenous to trade, the paper is part of a literature suggesting that globalization may improve or worsen institutions (Nunn and Trefler, 2014).

Further afield, the model suggests a new perspective for the theory of international trade relations as it applies to North-South trade. The standard theory (Bagwell and Staiger, 2004) treats trade relations between states of equivalent competency in control of their borders. International institutions such as the WTO are understood as constraining trade policies to minimize negative terms of trade externalities on partners. Endogenous predation is a security externality and enforcement policies have terms of trade externalities. Future work may consider the implications for international institutional design of North-South relations. It may be that alternative mechanisms would do better for North-South trade relations.

Section 1 motivates the model with a review of Britain's 17th century trade with India. Section 2 is a nontechnical outline of the theory. Section 3 begins analysis with frictionless secure trade in a Ricardian production model of trade between North and South. South is poorer due to less efficient technology. Cobb-Douglas preferences over the two traded goods are identical. Section 4 introduces potential predation on trade. Predation is competitive – there is free entry/exit of predators. Existence conditions for insecure equilibrium are derived and comparative statics of growth and globalization are presented. Section 5 introduces enforcement institutions. Weak enforcement in the form of patrols is analyzed in Section 5.1. North and South states have opposing interests in enforcement. In Section 5.2, strong enforcement enables control of the supply of predators. Section 5.2.1 analyzes the case where the Mafia bargains for tribute with North, where the Mafia's outside option is its rent earned by optimal selection of the level of predation. Section 5.2.2 analyzes the case where a strong welfarist South enforcer bargains for tribute with North in return for the elimination of predation. For North, bargaining with the Mafia always dominates bargaining with the welfarist South institution. Section 6 concludes. Appendix Section 7 shows that the analysis

is qualitatively the same when predation is on South's export.

1 Historical Motivation

Predation (extortion or outright theft) is a prominent feature of North-South trade (e.g., Anderson and Marcouiller, 2002) now and was even more prominent in the 17th to 19th centuries. Chaudhuri (1978) gives a richly detailed description of British East India Company agents (factors) actions to deal with local predation and local rulers in Mughal India, based on his monumental study of the trove of East India Company documents. The brief review here motivates and illustrates the model's use. See also Andrade (2004) for a description of Dutch East India Company activities competing and colluding with pirates against the weak and distant late Ming dynasty power in coastal China

The East India Companies are plausibly taken as institutions of the North state. "During the greater part of its history as an active commercial enterprise, the East India Company was a state within a state." (Chaudhuri, p. 20.) Trade was carried on in a number of coastal towns, each approximating the North-South interaction of the model. North controlled the sea with its powerful ships but its power on land was relatively weak. In harbor, unloading and loading was vulnerable. More importantly, warehousing necessitated by nature of the India trade was vulnerable to predation throughout the year. (i) Trade between India and England was concentrated in time: Company ships arrived with English goods and bullion (primarily the latter, some 70% to 90% of the value of exports) in the season of prevailing west winds and left with Indian goods in the season of prevailing east winds. (ii) The arriving bullion was stored for payment over the next year for Indian goods that accumulated until next year's ships arrived. (iii) Local officials and rulers made uncertain demands for bribes and returned uncertain enforcement against local predators.

Some settlements (factories in contemporary terminology) in towns were unfortified but the main ones (and an increasing portion over time in reaction to predation problems) were

fortified. The big exception was Surat, the most important town in this period, where the Mughal Emperor was strong. Here the Company did not fortify or enforce, but paid tribute, effectively for enforcement by the Mughals. (Surat trade thus resembled contemporary practices in European trade.) Over time the importance of Surat declined as the Company shifted trade to outlying towns.

Chaudhuri argues persuasively that the form of Company activity in India evolved in the period 1657-1709 to maximize profits given experience with the Indian conditions. Valuable trade concentrated in space and exposed over time combined with the uncertain losses to predation and extortion induced a shift to defended warehouses despite the expense of garrisons. The cost of garrisons and maintenance of fortifications vs. its benefit in protecting trade is constantly weighed in the internal Company documents surveyed by Chaudhuri. Tribute payments to local rulers were common: "... all local governors and officials demanded separate presents as a condition of unhindered trade. ... The companies generally paid the price because it was simpler and less expensive than sending embassies to the imperial court." (Chaudhuri, p. 123.)

After the death of Aurangzeb (1707), the last strong Mughal emperor, the Indian side is associated with more turnover of more corrupt local rulers, rebellions and conflicts. The Company side is associated with worsening conflict of interest between headquarters and distant agents, increasing intervention by local Company agents in internal Indian trade and politics, culminating in an extension of control that ultimately was taken over by the British government. (The analysis below abstracts from the agency problems that are a focus of Chaudhuri *inter alia*.)

Chaudhuri constructs terms of trade data for the Company's activities in India that illustrate the operation of the economic model of succeeding sections. The model predicts that both enforcement by North and tribute payments by North improve its terms of trade as South's expense.[6] The crucial period 1657 (with the Company receiving a new charter

[6]The quality of the data appears to be very high because it is based on voluminous Company records of annual payments for its imports and the corresponding volumes. Given the detailed nature of the goods, the

from the government and beginning its expansion) to 1709 sees a substantial improvement in the Company's terms of trade and a substantial fall in India's terms of trade in most years relative to the base. The Company's main export (bullion, principally silver) had a nearly constant price (and was available to India from other sources). India's terms of trade is the ratio of the import price index to the price of silver.[7] The years 1664-98 show a significant fall in European import price indices (a Laspeyres index of the Company's import prices). The resulting India terms of trade index has an average deterioration of more than 13% relative to base, in some years much larger, ranging to 100%. Security improved, on average at least, so on both counts the European terms of trade improved.

A decline in India's terms of trade seems well established in the data. The increase in protection of its trade by the Company seem likely to have pushed predators out into productive labor, as in the model. Other indirect evidence in Chaudhuri on this force tending to worsen Indian terms of trade indicates that some regional officials pushed for the Mughal Emperor to end the Company trading privileges, presumably reflecting their perception of the regional disadvantage of the trade. Shuja-ud-Din Muhammad Khan, Nawab of Bengal "... advised the Emperor in Delhi against the renewal of the Company's privileges ... " (Chaudhuri, ch. 6). The Emperor's disinclination to do so reflected financial advantages to the Court from the relationship, not inability: "... the military defenses of the Company's settlements before 1757 could never have provided adequate protection from a determined enemy in India." (Chaudhuri, ch. 6). Welfare for India falls over time based on its negative terms of trade movement.

Welfare change for Britain remains ambiguous. Sections 2-4 analyze a competitive trade framework for North that abstracts from the complexities of costly trade and middleman monopoly power described in this section. Thus there is no monopoly power and no changes

problems of equating prices with unit values are attenuated.

[7]The Company's other exports (primarily woolens in this period) were probably cross-subsidized. The government constantly pressured the Company to export goods in exchange for its privileged position, partly due to the doctrine of bullionism. So it is more appropriate to construct a terms of trade using silver as the Company's export, differing from Chaudhuri's treatment in this.

in trade costs or payments for trade services. In the competitive setting, an improvement in security and a deterioration of India's terms of trade would necessarily mean a welfare gain for Britain before accounting for the cost of enforcement, based on Britain's terms of trade defined as the inverse of India's terms of trade.

A proper welfare accounting for Britain consolidates consumer welfare with Company profits. Was the Company profitable? Profits could come from markup on the import price to the European sale price of its imports. For each good this is the product of India's export price, the trade cost factor, and the monopoly markup factor of the Company. Chaudhuri reports the total markups for the years 1664-1709. Markups are huge in some years and highly variable. The trade cost factor includes the cost of insecurity, presumably falling. Efficiencies in trade presumably also were inducing a fall in trade costs. But the cost of fortifying settlements and other protection costs presumably rose, the enforcement effort in the model below. The Company seems to have been profitable for some years in the relevant period, and lost money due to conflict in other years. Moreover, some enforcement costs using naval power were borne by the government. Profitability obtained at least occasionally but overall profitability remains an open question, *a fortiori* for British welfare improvement.

2 Theory Outline

Economic simplicity is imposed by a 2 good 2 country Ricardian trade model with identical Cobb-Douglas preferences. Internal production and exchange is assumed secure.[8] International trade brings interaction with foreigners who are potential prey, hence predation on trade can arise.

Labor may choose to prey on trade on South's border and in equilibrium the predators come exclusively from poorer South. (North is assumed to have an absolute advantage in

[8]Social norms operate in the background to restrain predation within countries, extended here to elimination. Absent norms, predation on production at local levels interacts with local enforcers who enrich themselves partially at the expense of those protected. See Grossman (2002) for example. The present paper has similar characteristics, but it differs in having multiple potential enforcers competing over the surplus.

both goods, hence it has a higher wage in equilibrium.) Predation is commonly extortion but in the model this is equivalent to theft. Departing from Anderson-Marcouiller (2005), costly enforcement is possible and its effects are the focus of the model.[9]

To fix ideas, think of predation in South's port.[10] North's exports may be exposed to extortion or pilferage as they are unloaded from ships or on the way into or out of the warehouse. On the landward side, South's exports may be exposed to extortion on the approach to or exit from the warehouse to be loaded on ships. Specialization in predation depending on the characteristics of the goods is likely, so the polar cases are analyzed.[11] The text focuses on predation on North's export. The qualitatively similar case of predation on South's export is analyzed in the Appendix.

Two parameters govern the interaction of predators, prey and enforcers. One parameter is the relative effectiveness of predators hunting evasive prey. The other parameter is the relative efficacy of enforcers against predators. The technologies of the two economies, the relative effectiveness of predatory and productive labor and the technologies of enforcement describe the environment for the agents. Competitive behavior of agents governs the outcomes in goods and labor markets. Institutional 'agents' provide enforcement. Institutions are unitary actors, avoiding the complications of agency problems for simplicity.

South's labor market clears with the population employed as workers, predators or enforcers. Equal returns are earned in all activities, generating the key equilibrium indifference condition that governs the amount of predation. The equilibrium terms of trade are determined jointly with the equilibrium extortion rate. Depending on the parameters, the model may generate secure trade with no enforcement, insecure trade with no enforcement, and

[9]Further differences from Anderson-Marcouiller (2005) in the present paper are that (i) predators are integrated into South's domestic market for exchange of goods, (ii) predation falls on one of the two goods, and (iii) risk to agents is diversified.

[10]Abstract from piracy on the sea, as it is apparently absent from the motivating example of British East India Company trade with India.

[11]Asymmetric predation results when some goods are more easily stolen or more attractive to steal. For example, high value to weight or volume ratios makes goods more attractive to predators, all else equal. Perishability and other handling characteristics also affect the relative attractiveness of shipments to predators. While there are some interesting differences, the analysis confirms a deeper similarity.

insecure trade with enforcement provided by an active institution. Necessary and sufficient existence conditions for insecure equilibrium are derived.

Enforcement institutions emerge endogenously. Anarchy is one extreme, enforcement does not pay for any institutional agent. Next is weak enforcement in the form of patrols on South's border by North or South institutions that coordinate to overcome the free rider problem. Weak enforcement arises if the enforcer's terms of trade gain more than pays for the enforcers hired from the labor market. North's enforcers cost more but may be more effective than South's enforcers.

Improved security shrinks the insecurity wedge between relative prices of North and South, potentially allowing for both to benefit. This intuition is valid for exogenous insecurity. In contrast, with endogenous insecurity the analysis shows that the enforcer gains and the other party loses ordinarily. Thus North loses from South weak enforcement, and South loses from North's enforcement. These results arise because of the labor market effects of enforcement. The Ricardian Cobb-Douglas model implies that a country's terms of trade are inversely related to its relative size. North enforcement reduces its labor force and increases South's labor force (by driving predators into production). South enforcement, to be beneficial, must reduce its labor force on balance to reap a terms of trade gain. The implication is that North's institutional preferences tend to trap South in a bad equilibrium – North's side of the weak trade corruption trap.

Strong enforcement may be possible by South institutions with permanent authority that can deter predation.[12] Strong enforcement requires a fixed cost paid by either a Mafia or a welfarist South state. Mafia provision of enforcement selects its profit maximizing level of permitted predation, necessarily one which increases the South labor force. North benefits due to a terms of trade improvement.

A North institution that coordinates its traders' interests can bargain for secure trade in

[12]The permanence and its deterrent effect is outside the static model. North has no such institution capable of operating on South's territory, by plausible assumption. This assumption abstracts from full colonial takeover or the transition, where such power is feasible.

exchange for tribute. North prefers tribute payment to the Mafia over tribute to strong welfarist South. Collecting results, North prefers anarchy to weak enforcement by South, prefers Mafia enforcement to anarchy and prefers tribute to Mafia over all other arrangements. The ranking is due to the terms of trade effect of South enforcement and the difference in behavior of Mafia and welfarist South. This is the North side of the corruption trap.

The durability of South's side of the trade corruption trap is built on three unpleasant equilibrium comparative static results. First, predation and hence the insecurity of trade is invariant to productivity in South or North. Second, South's incentive to enforce is invariant to productivity. Third, trade taxation to pay for enforcement may worsen welfare despite improving South's terms of trade because predation acts like costly collection.[13] Independently of North's preferences, South may thus remain in an extortionate equilibrium.

Happier comparative statics for South follow from globalization shocks, falls in international trade costs modeled as iceberg costs. These improve the terms of trade of both North and South. The security of trade rises with globalization if predation is competitive, but falls if predation is under Mafia control. (Finally, a rise in North's labor supply relative to South's increases predation, improves South's terms of trade and worsens North's terms of trade.)

3 The Cobb-Douglas Ricardian Trade Model Review

The simplest model of secure trade sets the stage for the complications of endogenous predation and enforcement institutions in the remainder of the paper. Two countries interact in frictionless trade equilibrium exchanging two goods. A Cobb-Douglas utility function is common to both countries. Ricardian technologies differ between countries. North has a comparative advantage in good 1 and South has a comparative advantage in good 2. Effective country sizes are close enough so that both are completely specialized, enabling terms

[13]North export taxation faces the same problem, but North plausibly has other less costly fiscal policies to raise the revenue.

of trade variability from predation. North is the higher wage country due to its absolute advantage in both goods, so any predators come from South.

North utility is a function $x_1^{\gamma}x_2^{1-\gamma}$ of consumption bundle (x_1, x_2) for $\gamma \in (0,1)$. South utility is similarly $x_1^{*\gamma}x_2^{*1-\gamma}$, where $*$ denotes South variables. The Ricardian technology in North is $a_1y_1 + a_2y_2 \leq L$, where L is the supply of labor, y_1 and y_2 are the production levels of goods 1 and 2, and a_1, a_2 are the unit labor requirements. South technology is similarly $a_1^*y_1^* + a_2^*y_2^* \leq L^*$. Assume $a_1/a_2 < a_1^*/a_2^*$ and $0 < a_i < a_i^*$, $\forall i$. With this setup, North specializes in good 1, South in good 2. With economies not too dissimilar in size, both are completely specialized so North produces $y_1 = L/a_1$, South produces $y_2^* = L^*/a_2^*$.

Let p denote the equilibrium price of good 1 in terms of good 2. North income in terms of good 2 is $wL = pL/a_1$ and South income in terms of good 2 is $w^*L^* = L^*/a_2^*$, where w, w^* are wages. Cobb-Douglas demand implies that $x_1 = \gamma pL/a_1p = \gamma L/a_1$. North exports are thus $y_1 - x_1 = (1-\gamma)L/a_1$. South produces $y_2^* = L^*/a_2^*$ and consumes $x_2^* = (1-\gamma)L^*/a_2^*$, so it exports $y_2^* - x_2^* = \gamma L^*/a_2^*$. The equilibrium terms of trade for North (with frictionless balanced trade) are given by

$$p = \frac{\gamma}{1-\gamma}\frac{L^*/a_2^*}{L/a_1}. \tag{1}$$

South is the low wage economy, the equilibrium $w/w^* > a_2^*/a_2 > 1$.

The comparative statics of the terms of trade follow from differentiating (1). The larger is the South labor supply L^* relative to the North labor supply L, the better are North's terms of trade p and the worse are South's terms of trade $1/p$. Improvements in South technology relative to North technology (a fall in unit labor requirement a_2^* relative to a_1) have the same effect.

The entire potential labor forces N and N^* are in the productive labor force, $L = N$ and $L^* = N^*$. Up to an irrelevant positive constant, indirect trade utility in secure trade equilibrium is given by $v(p, N) = p^{1-\gamma}N/a_1$ for North and $v^*(p, N^*) = p^{-\gamma}N^*/a_2^*$. (It is straightforward to confirm that there are mutual gains from trade.)

4 Trade with Predation

Now and henceforth potentially productive workers may choose predation over production, provided predation (extortion or theft) pays well enough. A model of the interaction of prey (traders), predators and enforcers is introduced first. Section 4.1 embeds this setup in the trade model and analyzes equilibrium predation and terms of trade. Section 4.2 presents the comparative statics of insecure equilibrium. The main object is to characterize the forces that tend to perpetuate insecurity – the South side of the trade corruption trap. Section 4.2 also derives implications for the variation of insecurity across South countries.

In equilibrium the predators (if any) come exclusively from South due to its lower wage. Denote predators as raiders R^*. To counter the predators, governments in North and South may employ enforcers E, E^*. Enforcers are drawn from national active populations N, N^*, hence the productive labor force is equal to $L = N - E$ in North and $L^* = N^* - E^* - R^*$ in South. Until Section 5.1, the enforcement efforts E, E^* are exogenous and may be equal to zero.

Equilibrium predation R^* equalizes the return to South labor in production/trade and predation. Because R^* is endogenous, so is South's productive labor $L^* = N^* - E^* - R^*$. Because predators are fully integrated in South's economy, predation earnings are part of South income, generated by workforce $N^* - E^*$.

The probability of successful shipment is a compound of the probability that enforcement defeats successful matches of predator to prey and the probability that wary prey fall to predators. Wary shippers and predators interact in evasion/pursuit with a logistic success rate $\pi^0 = 1/[1 + \theta R^*/(L + L^*)]$ that decreases with the ratio of predators to prey (Anderson and Marcouiller, 2005) and the relative effectiveness of predators in finding prey, θ.[14] $\theta > 1$ is

[14] L is proportional to volume of North exports, L^* is proportional to volume of South exports. Including both North and South exports in the specification is a modeling convenience without consequence for the qualitative properties of the model. It can formally be rationalized by thinking of specialized predators who on approach cannot distinguish valuable from useless prey. Thus the useless prey serve as decoys that dilute the intensity of predation on the valuable prey. The convenience comes in that the same π^0 specification is used to analyze the range of predation cases from specialized predation on North and on South exports.

In the analysis below with specialized predation, $\partial \ln R^*/\partial \ln p > 1$ whether the useless prey labor enters

sufficient for predation to be increasing in p, as shown below. It is also a sufficient condition for North's terms of trade πp to be increasing in p.

The probability of successful shipment is given by

$$\pi = \mathcal{E} + (1 - \mathcal{E}) \frac{1}{1 + \theta \frac{R^*}{L+L^*}}. \tag{2}$$

$\mathcal{E}$ is the enforcement probability, modeled as the proportion of shipments that can be saved from predation: enforcers defeat a fraction $\mathcal{E}$ of successful predators with full protection of shipments. $1 - \mathcal{E}$ is the probability that enforcement fails to protect shipments, but the shipments nevertheless escape loss with probability $1/[1 + \theta R^*/(L + L^*)]$.

Enforcement probability $\mathcal{E}$ is a function of enforcement labor by North and South:

$$\mathcal{E}(E, E^*) = \frac{\epsilon(bE + b^*E^*)}{1 + \epsilon(bE + b^*E^*)}. \tag{3}$$

Parameters b and b^* are the productivities of North and South in enforcement.[15] The numbers of predators and prey are suppressed as an argument in (3), rationalized as thinking of density of patrols on the limited area of approach to the port town where trade occurs.

4.1 Trade and Predation with Anarchy

Equilibrium predation on North exports by South predators with anarchy means there is no coordination against predation. (The analysis of predation on South's export yields essentially similar results, as shown in the Appendix.) The predators extort $(1-\pi)(y_1-x_1)$ of North exports. They can sell the goods in a gray market that is assumed perfectly integrated with the legitimate domestic market in South. The domestic market price is p. North sellers receive expected price πp. The income of predators is $p(1 - \pi)(y_1 - x_1) = (p - \pi p)(y_1 - x_1)$.

the π^0 function or not. Then the reduced form $\Pi(p)$ function analyzed below has the same qualitative properties whether the useless prey enters or not.

[15] In contrast to North's absolute advantage in production, South may be more productive than North in enforcement on South's border.

The left hand side of the equation gives the value of goods extracted by predators. The right hand side has the form of revenue extracted by a 'tax' $p - \pi p$ times the quantity imported $y_1 - x_1$.

The integration of predators into the South economy implies that their income is spent in the South economy. It is as if 'tariff revenue' collection was costly enough to yield zero net revenue for the rest of the economy. The predators sell their goods in the integrated domestic market at price p in terms of good 2, with a rent per unit (specific tax equivalent) of $p - \pi p$ per unit, effectively like a tariff in that amount. Two key differences between predation and the tariff are: (i) the predators 'ad valorem tax' rate $(1 - \pi)/\pi$ is endogenous in contrast to an exogenous tariff, and (ii) more predation means less South output, improving South's terms of trade, all else equal.

All agents are risk neutral (or equivalently are able to diversify risk) for simplicity. Thus the equilibrium allocation of South labor between predation and production/trade equates the wage in production/trade $1/a_2^*$ with the per predator income from predation:

$$p(1 - \pi)(1 - \gamma)L/a_1 R^* = 1/a_2^*. \tag{4}$$

Equilibrium is solved by first reducing the model to an equation $\pi = \Pi(p, \cdot)$ to combine with a terms of trade equation for insecure trade. $\Pi(p, \cdot)$ is derived as follows. R^* and π are jointly determined as functions of p by equations (2) and (4). Use equation (2) to form an expression for $1 - \pi$ and substitute into (4). Use labor market clearance in South $N^* - E^* - R^* = L^*$ and in North $N - E = L$ to substitute for South and North labor. Finally, arrange the result the result for the supply of predators as a function of South price p:

$$R^* = p(1 - \mathcal{E})(1 - \gamma)\frac{\theta}{\theta - 1}\frac{a_2^*}{a_1}(N - E) - \frac{N - E + N^* - E^*}{\theta - 1}. \tag{5}$$

$\mathcal{E}(E, E^*)$ is given by equation (3).

Substitute the right hand side of (5) for R^* in (2) to yield an implicit relationship between

π and p. After simplification this is

$$\Pi(p, E, E^*) = \mathcal{E} + [1 - \mathcal{E}] \left(\frac{N - E + (N^* - E^*) - R^*(p, E, E^*)}{N - E + (N^* - E^*) + (\theta - 1)R^*(p, E, E^*)} \right). \tag{6}$$

The elasticity of R^* with respect to p has an important role in determining $\partial \ln \Pi / \partial \ln p$. In general there is positive feedback as increases in R^* increase the predators' success rate $1 - \pi$:

$$\frac{\partial \ln R^*}{\partial \ln p} = \frac{1}{1 - p(1-\gamma)(N-E)(a_2^*/a_1)\left[(1-\mathcal{E})\frac{\theta}{N-E+N^*-E^*+(\theta-1)R^*}\left(1 - \frac{(\theta-1)R^*}{N-E+N^*-E^*+(\theta-1)R^*}\right)\right]} > 1.$$

Next, log-differentiate (6) with respect to p to yield

$$\frac{\partial \ln \Pi}{\partial \ln p} = -\frac{\partial \ln R^*}{\partial \ln p}\left[\frac{R^*}{N - E + N^* - E^* - R^*} + \frac{(\theta - 1)R^*}{N - E^{+} N^* - E^* + (\theta - 1)R^*}\right] \frac{(1 - \mathcal{E})\pi^0}{(1 - \mathcal{E})\pi^0 + \mathcal{E}},$$

where $\pi^0 = (N - E + N^* - E^* - R^*)/[N - E + N^* - E^* + (\theta - 1)R^*]$ (the shippers' success rate independent of enforcement). For R^* sufficiently small, $\partial \ln \Pi / \partial \ln p \in (-1, 0)$, the 'normal' case. For large R^*, $\partial \ln \Pi / \partial \ln p < -1$ is possible. This 'perverse' case implies that predation's response to a rise in the buyers' price is so large that sellers lose from it.

The expected price received by North for its exports in insecure equilibrium is given by

$$\pi p / \widetilde{T} = \frac{\gamma}{1 - \gamma} \frac{a_1}{a_2^*} \frac{N^* - E^* - R^*}{N - E} \tag{7}$$

where the right hand side is equivalent to (1), but now the South labor supply is endogenous in p via R^* given by (5). On the left hand side, $\widetilde{T} \geq 1$ is an exogenous trade friction (discussed further below) that reduces the amount received by North from South's buyers price p.

The equilibrium relative price paid by South for North's export p as a function of π solves

(7) for p:

$$p = P(\pi, E, E^*) = \frac{c}{\pi + (1-\mathcal{E})\gamma\theta/(\theta-1)} \tag{8}$$

where

$$c = \widetilde{T}\frac{\gamma}{1-\gamma}\frac{a_1}{a_2^*(N-E)}\left(\frac{N-E+N^*-E^*}{\theta-1}+N^*\right).$$

Log-differentiating (8) yields

$$\frac{\partial \ln P}{\partial \ln \pi} = -\frac{\pi}{\pi + (1-\mathcal{E})\gamma\theta/(\theta-1)} \in (-1, 0]$$

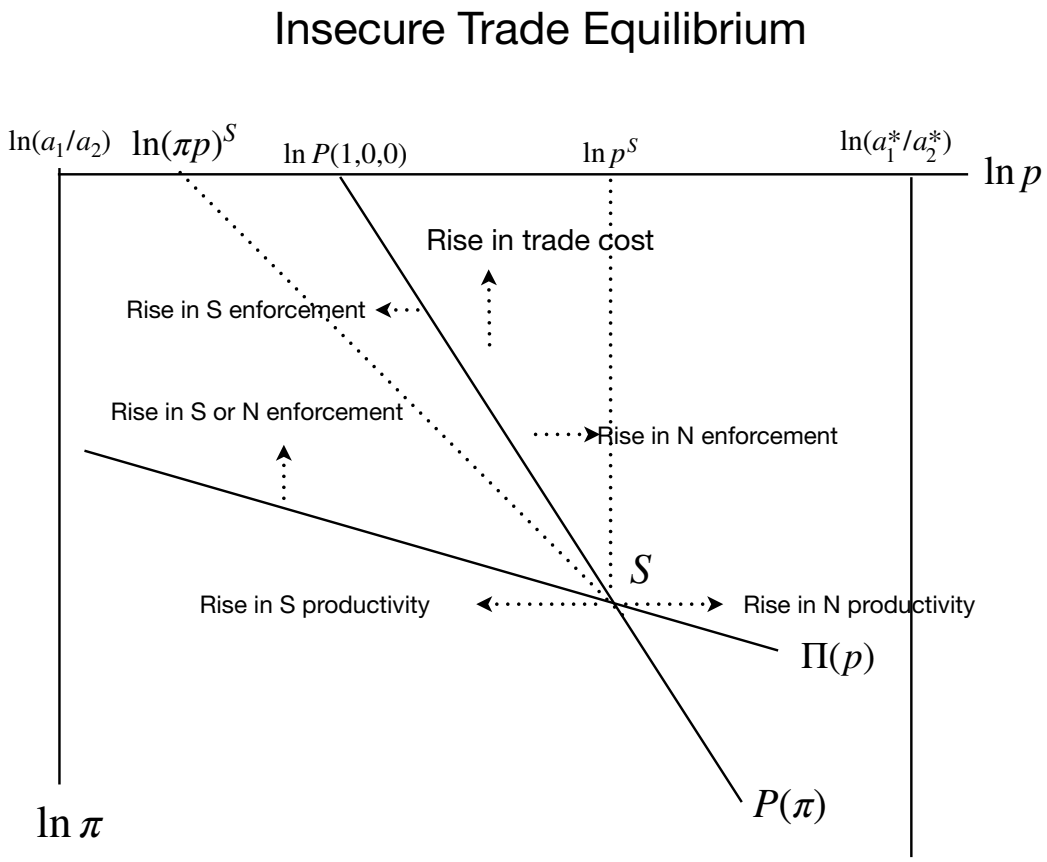
given $\theta > 1$.

The analysis of insecure equilibrium is illustrated in Figure 1 below in $(\ln p, \ln \pi)$ space. The $P(\pi)$ and $\Pi(p)$ schedules are drawn as log-linear for simplicity, with slopes on either side of -1 in the relevant range. Stability and uniqueness is guaranteed in this case.

The diagram is helpful in understanding the characteristics of equilibrium. The assumption in the diagram is $[\ln(p^S),\ \ln(\pi p^S)] \in [\ln(a_1/a_2),\ \ln(a_1^*/a_2^*)]$. This condition assures mutual gains from trade relative to autarky (in South's case aggregating predators and state). Generally, if θ is too large, $\Pi(p)$ passes below $P(\pi)$ everywhere, no trade is possible and the two economies are in autarky equilibrium. If θ is too small, $\Pi(p)$ passes everywhere above $P(\pi)$ in the relevant range and trade is secure. The last alternative possibility is that $\Pi(p)$ intersects $P(\pi)$ twice in the relevant range, the first time as in Figure 1 and the second time in an unstable equilibrium below and to the right where $\Pi(p)$ is steeper than $P(\pi)$.

Stepping back from the details of the Ricardian model and how endogenous predation is specified, plausible models of insecure trade imply Figure 1. Intuitively, the extortion rate rises with price as predators are drawn to more valuable goods and ordinarily not so much as to create a perverse effect of buyers' price increase on sellers: $\partial \ln \Pi / \partial \ln p \in (-1, 0)$. Also intuitively, the sellers' price rises with the security of trade and $\partial \ln P / \partial \ln \pi \in (-1, 0)$. Predation and enforcement draw resources from production, so the effect of enforcement on equilibrium is plausibly implied by the diagram, further implying the trade corruption trap

Figure 1:



of this paper. Introducing risk averstion, the net effect on the wedge between buyers' and sellers' price is ambiguous, because risk aversion reduces predation while it raises the risk premium required for any level of predation.

Endogenous insecurity in this paper contrasts sharply in implications with exogenous insecurity $\pi = 1 - \beta$. Effectively $1 - \beta$ is a component of exogenous friction $\widetilde{T}$. If $1 - \beta$ requires no diversion R^* from production, then $P(\pi)$ has slope -1 while $\Pi(p)$ on Figure 1 is horizontal. If alternatively predators R^* are required to obtain β % of the value of North exports, $P(\pi)$ is more steeply sloped while $\Pi(p)$ remains horizontal. If enforcement can reduce β without diverting labor, it shifts $\Pi(p)$ upward, and there is no shift in $P(\pi)$. South gains a terms of trade improvement while North is indifferent. In either case enforcement weakly improves terms of trade of both North and South, no incentive pushes North to prefer

worse equilibria for South. There is no "trap" in the sense of a mechanism inside the model that causes a level of corruption.

Necessary and sufficient conditions for insecure equilibrium validate the relevance of the model. Two requirements for insecure equilibrium must be met: North participation $\pi p \geq a_1/a_2$ and predation $\Pi(p) \leq 1$. The participation condition for South $p \leq a_1^*/a_2^*$ is automatically met given North's participation in insecure equilibrium, as argued below.

Proposition 1 *A unique stable insecure equilibrium exists if and only if*

$$\frac{1+(N^*-E^*)/(N-E)}{1-\gamma}\frac{a_2}{a_2^*} \geq \theta(1-\mathcal{E})\widetilde{T}. \tag{9}$$

$$(1-\mathcal{E}\theta)\frac{a_1^*/a_2^*}{a_1/a_2} \geq \frac{1+(N-E)/(N^*-E^*)}{1-\gamma}\frac{a_2}{a_2^*} - (\theta-1)\widetilde{T}. \tag{10}$$

Inequality (9) assures that a value of p can be found in an interval that satisfies both North participation and $\pi < 1$. South participation is assured by inequality (10).[16] Note that $\mathcal{E} < 1/\theta$ is necessary for inequality condition (10) – enforcement cannot be too large for an insecure equilibrium to arise.

Proof of Proposition 1: $\pi < 1$ *requires* $R^* > 0$. *From (5) this implies*

$$p > \frac{a_1}{a_2^*}\frac{1+(N^*-E^*)/(N-E)}{\theta(1-\mathcal{E})(1-\gamma)}.$$

North participation with $R^* > 0$ *requires* $\pi p \geq \widetilde{T}a_1/a_2$. *Use (5) in (7) and rearrange terms to yield*

$$\frac{a_1}{a_2}\left[\frac{a_2}{a_2^*}\frac{1+(N^*-E^*)/(N-E)}{1-\gamma} - (\theta-1)\widetilde{T}\right]\frac{1}{1-\theta\mathcal{E}} \geq p.$$

Combine the two preceding requirements that bound p *and simplify to yield inequality (9).*

South participation is assured if a_1^*/a_2^* *is greater than the upper bound on price leading*

[16] Taking the Ricardian model literally, when South is faced with insecure trade leading to $p > a_1^*/a_2^*$, individual agents can achieve autarky utility at the lower price, with no internal trade or international trade. Outside the model and less literally, it may be impossible to move from a welfare-losing trade equilibrium to a well functioning autarky equilibrium without a coordinating government and in the face of resistance from North.

to (9). Rearranging terms, this implies (10). ‖

Proposition 1 suggests explanations of the cross country variation in reported corruption from contemporary survey data. On the left hand side of inequality (9), increases in South relative size $(N^*E^*)/(N-E)$ and in preference for North goods γ raise equilibrium p which attracts North participation. $a_2/a_2^* > 1$ is the absolute disadvantage of South labor in its comparative advantage good. If this is low enough to violate inequality (9) it means North's gain from specialized trade is so low that it prefers autarky to trade with predation. The right hand side of inequality (9) collects terms representing frictions: exogenous $\widetilde{T}$ and parameters raising endogenous insecurity, θ times $1-\mathcal{E}$. As these are too large, $\Pi(p)$ shifts down too far in Figure 1 for North participation. If (9) holds with equality, South participation condition (10) holds automatically since the right hand side is equal to 1 and the left hand side is greater than 1 by the assignment of comparative advantage in good 1 to North. Otherwise inequality (10) implies that comparative disadvantage of South in good 1 must be sufficiently large to overcome the effect of endogenous and exogenous frictions.

4.2 Changes in Productivity, Tariffs, Size and Globalization

Changes in productivity and tariffs are part of South's jaw of the corruption trap. Productivity growth does not draw workers away from predation, while insecurity raises the fiscal cost of paying for enforcement with tariffs. Globalization in contrast improves security. Smaller South countries relative to North will have less secure trade and better terms of trade.

The analysis requires decomposing the $\widetilde{T}$ trade friction introduced in (7). $\widetilde{T}$ comprises iceberg melting trade frictions and South's import tax. Let τ, τ^* denote the iceberg melting factors for North and South exports respectively and let t^* denote South's ad valorem tariff factor. The setup implies that $\widetilde{T} = \tau\tau^* t^*$. $\widetilde{T}$ combines with the wedge due to insecurity to drive relative prices in North and South apart.

Let p_1, p_2 denote prices in South. South's wage rate is the numéraire and North's wage is w. Arbitrage in the completely specialized insecure equilibrium implies that North's prices

are $wa_1 = \pi p_1/\tau t^*$ for good 1 and $a_2^*\tau^*$ for good 2. Then North's terms of trade are given by

$$\frac{\pi}{\tau\tau^* t^*}p$$

where $p = p_1/p_2$ is the relative price of good 1 in South. South's terms of trade are the inverse of p/t^*, the c.i.f. relative price of imports. πp is determined in equilibrium by the forces in equation (7):

$$\pi p = \tau\tau^* t^* \frac{a_1}{a_2^*}\frac{\gamma}{1-\gamma}\frac{L^*}{L}. \tag{11}$$

Proposition 2

(a) Insecurity is invariant to productivity.

(b) Optimal South tariffs are zero when trade is sufficiently insecure, and efficient South tariffs are generally reduced by insecurity.

Proof of 2(a) *Predation invariance with respect to technological progress a_1/a_2^* arises because (after multiplying both sides of (4) by a_1) both (4) and (7) imply that p is linear homogeneous in a_1/a_2^* given π. Then predation R^* is invariant and hence by equation (2) π does not change.* ‖

The intuition for invariance is that on the one hand a fall in a_1 lowers p by the same proportion, making theft less attractive. On the other hand the fall in a_1 raises supply of good 1 in the same proportion, so there is more to steal. The opposing forces exactly balance. The Cobb-Douglas Ricardian case here conveniently illustrates a general property: there is no presumption that technological progress will improve security.[17]

[17]Analysis with more general structure first replaces Cobb-Douglas preferences with homothetic preferences. Then North's export share for good 1 equal to $1-\gamma$ in both equations is replaced by $1-\gamma(\pi p)$, while South's expenditure share on good 1 γ in (7) is replaced by $\gamma(p)$. The Cobb-Douglas preferences case with elasticity of substitution equal to 1 gives constant shares, hence Cobb-Douglas divides the cases where γ is decreasing in relative price ($\gamma' < 0$, elasticity greater than 1) from those where it is increasing in relative price (elasticity less than one). Cobb-Douglas thus takes an agnostic position on the effect of endogenous expenditure share γ with respect to relative price. Similar arguments follow about the effect of allowing general substitution in supply.

Let $g(\pi p, L, K, a)$ denote the neoclassical GDP function for North, where K is a vector of endowments other than labor and a is a technology parameter. South's GDP function is $g^*(p, L^*, K^*, a^*)$. By Hotelling's Lemma, North's supply of good 1 is $g_{\pi p}$. With Cobb-Douglas preferences, North's exports equal $g_{\pi p} - \gamma g/\pi p$. South's supply of good 2 is, after using the degree one homogeneity in prices of the GDP function, given by

An accounting for South's tariff revenue is needed in the proof of 2(b). For simplicity no revenue is generated by the iceberg costs. South's external budget constraint is given by

$$p^{\gamma}v^{*} = \frac{N^{*} - E^{*}}{a_2^{*}} + \frac{t^{*} - 1}{t^{*}} p\gamma\pi p^{\gamma-1}v^{*} = \frac{N^{*} - E^{*}}{a_2^{*}} + \frac{t^{*} - 1}{t^{*}} \gamma\pi p^{\gamma}v^{*}$$

where the left hand side is South's expenditure function, and the second term on the right hand side is tariff revenue collected on that portion π of imports that escape predation. Imports are derived from South's expenditure function using Shephard's Lemma.

Proof of 2(b) *Differentiate the budget constraint with respect to t^{*} and simplify. This yields*

$$\left(1 - \frac{t^{*} - 1}{t^{*}}\gamma\pi\right) \frac{d\ln v^{*}}{d\ln t^{*}} = \gamma\left[-\frac{d\ln p}{d\ln t^{*}} + \frac{\pi}{t^{*}}\right] + \pi\gamma\frac{t^{*} - 1}{t^{*}}\left[\frac{d\ln \pi}{d\ln t^{*}} + \gamma\frac{d\ln p}{d\ln t^{*}}\right].$$

The bracket term on the left hand side is positive. For initial zero tariffs $t^{*} = 1$, the second term on the right hand side is equal to zero and $d\ln v^{*}/d\ln t^{*} < 0$ if and only if $d\ln p/d\ln t^{*} > \pi$. For discrete tariffs, $t^{*} > 1$ and π decreases, hence negativity of the first term on the right is more likely. Discrete tariffs activate the second bracket term on the right hand side, which is negative because $d\ln \pi p/d\ln t^{*} < 0$ by the proof of 2(b). Thus discrete tariffs make $d\ln v^{*}/d\ln t^{*} < 0$ more likely. ‖

Intuitively, the benefit of exploiting South's terms of trade power can be offset by the inefficiency of insecure trade. South's terms of trade is t^{*}/p. Secure trade $\Rightarrow d\ln p/d\ln t^{*} \in (0, 1)$, so it always pays to levy at least a small tariff. With insecure trade $1 - \pi$ % of the

$g^{*} - g_p^{*}p$. Then South's export of good 2 is $g^{*} - g_p^{*}p - (1 - \gamma)g^{*}$. The terms of trade equation (7) becomes

$$\pi p = \frac{\gamma - s^{*}(p)}{s(\pi p) - \gamma}\frac{g^{*}}{g}$$

where $s(\pi p)$ and $s^{*}(p)$ are good 1's share of GDP in North and South respectively. The equilibrium predation equation (4) becomes

$$p(1 - \pi)[s(\pi p) - \gamma]g/\pi p R^{*} = g_{L^{*}}^{*}.$$

The Ricardian case implies $g_{\pi p}\pi p/g = 1$, $g_p^{*}p/g = 0$, and $g_{L^{*}}^{*} = 1/a_2^{*}$. In the general neoclassical case s, s^{*} and $g_{L^{*}}^{*}$ are increasing functions of p, with no presumption about their net effect at constant π on the new versions of (5) and (7). Ricardian technology thus imposes an agnostic position.

tariff is lost, as if due to collection costs. Insecurity thus can create a welfare loss from initial tariffs, despite South's monopsony power. Thus insecurity and the security reducing effect of tariffs combine with marginal deadweight loss to reduce or offset the benefit of the usual terms of trade improvement effect of tariffs for a large country.

Comparative statics of country size and globalization help account for other influences on equilibrium levels of corruption and the terms of trade. In secure trade North's terms of trade p is proportional to relative economy size $(L^*/L)a_1/a_2^*$, so the terms of trade effects of productivity growth and population size are identical. Globalization improves both countries terms of trade and trade is always secure. With insecure trade, p remains proportional to a_1/a_2^*, and π is invariant to a_1/a_2^*. In contrast, insecurity causes different comparative statics with respect to relative population size and globalization.

Proposition 3 *(a) A rise in $N - E$ relative to $N^* - E^*$ increases insecurity, improves South's terms of trade and worsens North's terms of trade, and*

(b) Globalization improves security and improves the terms of trade of North and South, given $\partial \ln \Pi / \partial \ln p \in (-1, 0)$.

Proof of 3 (a) *Log-differentiate (5) with respect N to yield $\partial \ln R^*/\partial \ln N > 1$. Log-differentiation with respect to N^* yields $\partial \ln R^*/\partial \ln N^* < 0$. Applying these results to log-differentiation of (6 implies that $\Pi(p)$ shifts up (down) as $N^* - E^*$ is larger ($N - E$ is smaller). Applying the results to (11), the constant πp line and thus $P(\pi)$ at constant π shifts right (left) as $N^* - E^*$ is larger ($N - E$ is smaller).* $\|$

Intuitively, consider a fall in N^* in a cross section of South countries trading with North. A rise in $(N-E)/(N^*-E^*)$ is associated with smaller South. $\Pi(p)$ shifts down, the constant πp line and hence $P(\pi)$ shift left, hence security π falls, South terms of trade improve and North terms of trade deteriorate. South's terms of trade improve at less than the relative change in $(N-E)/(N^*-E^*)$, which is the result with secure trade based on log-differentiating (1). Part of the potential gain is lost to increasing inefficiency due to rising predation.

Proof of 3(b)

Defining globalization as a fall in $\tau\tau^*$, (11) implies that equilibrium security π rises. Log-differentiate (11) totally with respect to $\tau\tau^*$ and rearrange to yield:

$$\left(1+\frac{\partial \ln \Pi}{\partial \ln p}\right)\frac{d\ln p}{d\ln \tau\tau^*}+\frac{R^*}{N^*-E^*-R^*}\frac{\partial \ln R^*}{\partial \ln p}\frac{d\ln p}{d\ln \tau\tau^*}=1.$$

Given $\partial \ln \Pi/\partial \ln p \in (-1,0)$ and $\partial \ln R^*/\partial \ln p > 1$, $d\ln p/d\ln \tau\tau^* > 0$. Thus South's terms of trade $1/p$ improve with a fall in $\tau\tau^*$, while security $\pi = \Pi(p)$ rises due to the fall in p. North's terms of trade $\pi p/\tau\tau^*$ also rise with a fall in $\tau\tau^*$. Totally differentiate $\ln(\pi p/\tau\tau^*)$ with respect to $\tau\tau^*$ using (11):

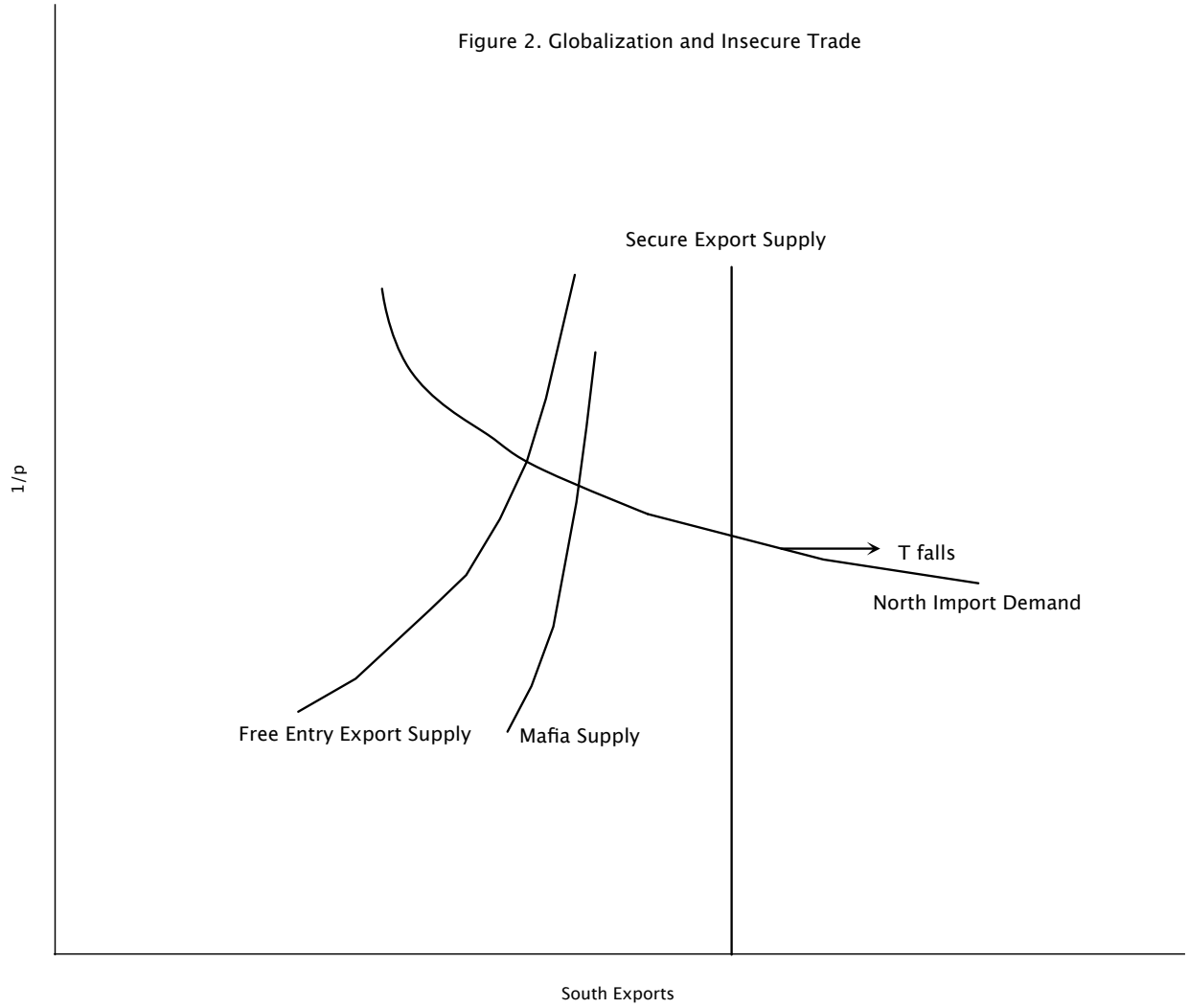
$$\frac{d\ln(\pi p/\tau\tau^*)}{d\ln \tau\tau^*}=-\frac{R^*}{N^*-E^*-R^*}\frac{d\ln R^*}{d\ln p}\frac{d\ln p}{d\ln \tau\tau^*}<0.$$

since $d\ln R^*/d\ln p$ and $d\ln p/d\ln \tau\tau^* > 0$.‖

Secure trade [(11) with $\pi = 1$] implies that p falls 1:1 with $\tau\tau^*$ so South secures all the gain from globalization (due to its completely inelastic supply schedule $\gamma L^*/a_2^*$ in the Ricardian Cobb-Douglas model). Endogenous predation makes South's export supply schedule more elastic. Both North and South's terms of trade improve with globalization and security improves. Figure 2 illustrates, with $\widetilde{T} = T \equiv \tau\tau^* t^*$ to simplify notation.

A cross section implication of Proposition 3 (a) is surprising: *smaller South countries have less secure trade, all else equal.* This is a consequence of $\partial \ln R^*/\partial \ln N^* < 0$, which in turn results from the specification of predator/prey interaction (2). A rise in N^*, all else equal, reduces the success rate of predators $1-\pi$ and thus the returns to predation at constant price p. This effect is also present in a rise in N but more than offset by the direct effect of a N on the volume of trade in (5). The cross section implications of Proposition 3 (b) are less surprising: *South countries more economically remote from North have less secure trade.*

Figure 2:



5 Enforcement

Enforcement requires institutions to overcome the free rider problem. South's environment hampers its enforcement even if North is passive. North's self-interested incentives are opposed to welfarist South enforcement, the other jaw of the corruption trap.

Weak enforcement is in the form of patrols, done by North or South. Strong enforcement results in deterrence by a South Mafia or welfarist state. Deterrence requires commitment to pay a fixed cost (in every period, with credibility outside the model). The fixed cost implies that only South markets of size above a cutoff value will have strong enforcement.

Section 5.1 begins with analysis of weak enforcement. North prefers anarchy to South enforcement and may prefer its own enforcement to anarchy. Strong enforcement is analyzed in Section 5.2. North prefers Mafia enforcement to anarchy. Tribute equilibrium for secure trade is is possible .rovided North has an institution to coordinate the interest of its atomistic traders. Section 5.2.1 analyzes Mafia enforcement, first as a monopoly enforcer and then in a bargained tribute equilibrium with North's institution. Section 5.2.2 analyzes North's bargain with the welfarist South state, and section 5.2.3 shows that the Mafia bargain is cheaper for North. Section 5.2.4 considers South's incentive to suppress the Mafia and North's incentive to intervene.

For clarity the implications of trade for institutions are collected in the table below.

Trade and Institutional Outcomes

Market Size	Institution	North Passive	North Active
small	anarchy		
medium	weak enforcement	South enforces; North likely loses	North enforces; South loses
large	Mafia enforces	North gains, South loses	North tribute to Mafia, South loses
larger	South vs. Mafia	South vs. Mafia	North tribute to Mafia preferred

5.1 Comparative Statics of Weak Enforcement

South enforcement normally harms North. If North has an institution to coordinate the traders' interests, North opposes South enforcement. North enforcement always harms South. Asymmetric power (outside the model) tends to lock in North's optimal level of enforcement.[18]

A necessary condition for enforcement to be undertaken is that it improves the enforcer's terms of trade with effect large enough relative to the cost of enforcement. To simplify notation, assume no exogenous trade frictions: $\widetilde{T} = 1$. Payoffs for North and South are $v = (\pi p)^{1-\gamma}(N - E)/a_1$ and $v^* = p^{-\gamma}(N^* - E^*)/a_2^*$ respectively. Assume initially that lump sum taxation is available for simplicity. The first order condition for South is $d\ln v^*/d\ln E^* = -\gamma d\ln p/d\ln E^* - E^*/(N^* - E^*) = 0$. $d\ln v^*/d\ln E^*$ is positive at $E^* = 0$, hence it always pays South to enforce at least a little with lump sum taxation. Introducing a small fixed cost of enforcement suffices to eliminate enforcement for market sizes below a cutoff value. (Formally, $E^* = \max[E^*, \bar{E}]$ where $\bar{E} > 0$ indicates the minimum size force needed for effective patrols – for example $\bar{E}$ represents management.) North enforcement choice is similar.[19]

The South jaw of the corruption trap is strengthened by another comparative static result: productivity growth in South does not raise its incentive to enforce. Thus even if North is passive, productivity growth does not increase security either directly [Proposition 2 (a)] or indirectly [Proposition 4 (a)] below. In contrast, South productivity growth in enforcement improves security [Proposition 4 (b)].

The arrows in Figure 1 illustrate the effects of changes in enforcement efforts E and E^* on p and π. The $P(\pi)$ schedule shifts left as E^* rises due to the terms of trade effect of reduced labor supply in South ($L^* = N^* - E^* - R^*$). Reduced labor supply is a necessary

[18]Nash equilibrium in enforcement has interesting properties, but seems irrelevant in context.

[19]Trade taxation to pay enforcers provides an additional terms of trade gain for the enforcer but Proposition 2 (b) implies this may be more than offset by predation's effect on revenue. North plausibly has less costly means of raising revenue than South, but for either, the terms of trade effects of enforcement may not be large enough to exceed the cost of enforcement.

condition for efficient South enforcement because it reaps a terms of trade benefit. (If raising E^* reduced R^* by more, raising L^*, it induces a terms of trade deterioration that adds to cost of raising E^*.) $P(\pi)$ shifts right as E increases because the direct effect on North labor $N - E$ is amplified by the induced rise in South labor $N^* - E^* - R^*$.[20],[21]

$\Pi(p)$ rises with enforcement by either North or South. Enforcement acts directly via $\mathcal{E}$ from (3) to reduce R^* in (5). But indirectly, enforcement affects R^* given p in (5) because enforcement changes productive labor. North enforcement lowers $N-E$, reducing the amount available to predators, hence R^* falls and Π rises at given p: $\Pi_E > 0$. South enforcement E^* in contrast directly raises R^* in (5). South enforcement would never be used unless its net effect reduces predation, reflected in the arrows in Figure 1, meaning $\Pi_{E^*} > 0$.

Figure 1 shows that North enforcement must harm South's terms of trade. South's enforcement harms North when $\partial \ln \Pi / \partial \ln p > -1$ as in Figure 1. In this 'normal' case the equilibrium fall in p means πp falls in the new equilibrium generated by the intersection of $P(\pi)$ and $\Pi(p)$. In contrast, when $\partial \ln \Pi / \partial \ln p < -1$, North's terms of trade πp improve with South enforcement. It is possible that such an equilibrium is stable, requiring that $\Pi(p)$ be less steeply sloped than $P(\pi)$. $\partial \ln \Pi / \partial \ln p$ is decreasing in R^*, so North improvement requires a narrow range of parameter values such that R^* is large enough so that the elasticity is less than -1 but not so large that equilibrium is unstable. In this sense, North terms of trade improvement is unlikely.

The analysis of costly enforcement here differs substantially from simple intuition about

[20]Formally, the effect of North enforcement on P is given by differentiating (8) with respect to E:

$$P_E = \frac{p\gamma\theta/(\theta-1)}{\pi + (1-\mathcal{E})\gamma\theta/(\theta-1)} > 0.$$

[21]An alternative and realistic possibility is that North employs South enforcers. Assume that the South enforcers have access to North's enforcement technology with heightened effectiveness $A > 1$ relative to employment by South. In this case North only benefits if South labor force rises due to a fall in R^* that exceeds the rise in E^*. Nevertheless, $\partial(L^*/L)/\partial E > \partial(L^*/L)/\partial E^*$. North welfare when employing South enforcers is $v = (\pi p)^{-\gamma}(\pi p N/a_1 - E^*/a_2^*)$. On the one hand, South labor is cheaper than North labor (and North's improved terms of trade make it still cheaper). On the other hand, the effect of enforcement on North's terms of trade via raising L^*/L is greater when North enforcers are employed. Foreign mercenaries are used when the absolute disadvantage of South labor is sufficiently strong.

predation on trade. Predation is like a tax on trade with the revenue going to the predators, analogous to trade tax collection cost equal to the revenue collected. Net revenue is equal to zero just as it is with zero tariffs, but zero tariffs have the advantage of increasing productive labor (and the disadvantage of worsening terms of trade). Analogous to choosing zero tariffs and zero tax collectors, suppose in the predation model that enforcement is free. Then raising $\mathcal{E}$ does not remove labor from productive activity. Then $P_E = P_{E^*} = 0$ with enforcement, South gains productive labor and the model shows that both South and North have their terms of trade improve from enforcement.

The free enforcement example reveals that it is the combination of costly enforcement and predation that makes trade relations more conflicted than in standard trade policy analysis. (In contrast, the appendix shows that with predation on South exports, the application of costless enforcement still makes trade relations conflicted. Combining the two cases, the implication is that conflicted relations are due to the combination of enforcement and predation.)

Now consider the comparative statics of South optimal enforcement. Casual intuition suggests that growth (a fall in a_2^*) should raise optimal enforcement E^* because there is more income to pay for it. In contrast the model implies that the corruption trap binds (but improvement in enforcement technology may provide escape.[22] Assuming positive enforcement,[23] the model implies sharp comparative statics with respect to productivity changes. South productivity in production rises with $1/a_2^*$ and in enforcement with b^* in (3).

Proposition 4 *(a) South productivity growth in production does not raise its incentive to enforce, and (b) South productivity growth in enforcement improves security and South welfare.*

Proof of 4 (a): *Change in* a_2^* *affects* $d\ln v^*/d\ln E^*$ *only via*

$$d\ln p/d\ln E^* = \frac{\partial \ln P}{\partial \ln E^*} + \frac{\partial \ln P}{\partial \ln \pi}\frac{\partial \ln \Pi}{\partial \ln E^*}.$$

[22] I am in debt to Alfredo Burando for suggesting the latter escape route.

[23] The second order condition for an interior maximum is satisfied, by the proof of Proposition 4(a) below.

From (2) and (3), $\partial \ln \Pi / \partial \ln E^* = (1-\mathcal{E})(1-\pi^0)$. π^0 *is independent of* a_2^* *by the proof of Proposition 2(a). From the structure of (8) the elasticities of* P *with respect to* π *and* E^* *are independent of* a_2^*. *Thus* $d \ln p / d \ln E^*$ *is independent of* a_2^*. $\|$

Proof of 4 (b): $d \ln p / d \ln E^*$ *is affected by change in* b^* *because it affects* $\partial \ln \Pi / \partial \ln E^* = (1-\mathcal{E})(1-\pi^0)$. *Log-differentiation gives*

$$\partial^2 \ln \Pi / \partial \ln E^* \partial \ln b^* = -\frac{1}{1+\epsilon b^* E^*} \in (-1, 0).$$

Thus E^* *falls but* $b^* E^*$ *rises* $\Rightarrow \pi$ *rises.* p *falls, hence* v^* *rises.* $\|$

North welfare may rise or fall when South weak enforcement technology improves, given positive South initial enforcement. North terms of trade πp benefit from the improvement insecurity π but lose from the fall in destination price p.

5.2 Strong Enforcement

Strong South institutions may arise that deter predation directly. Deterrence works through the threat of pursuit and punishment. Credibility of the threat is provided by a technology that requires a fixed force of F^* units of labor. This is a reduced form of a sequence of static equilibria that presupposes durability of the institution, both outside the static model.

Two polar cases span the interesting range of institutions – a kleptocratic South institution (a Mafia) and a welfarist South state. F^* is common to both the Mafia and the welfarist South state (a lower fixed cost for the Mafia is plausible but only increases the advantage it has in the analysis below in Section 5.2.1).

The Mafia analysis in Section 5.2.1 begins with equilibrium when the Mafia sets its profit-maximizing level of predation and North is passive.[24] Next, if North's traders are coordinated in an institution, the institution can obtain secure trade in return for tribute

[24]This assumes that given Mafia enforcement, North's own weak enforcement does not pay. The alternative requires modeling the Nash equilibrium of North and Mafia enforcement to generate the outside options for the Nash bargaining. This is an unnecessary complication for present purposes.

bargained with the Mafia. The outside options in Nash bargaining are the Mafia profits and North welfare in the profit-maximizing equilibrium.

Section 5.2.2 analyzes welfarist South's bargain with North's institution over providing secure trade in exchange for tribute. The outside options for both parties are their payoffs in the Mafia profit-maximizing equilibrium. This is the natural reference point because Mafias can organize at lower market size than South, with the added virtue of facilitating comparison of Mafia and South as bargaining partners for North. The key result in Section 5.2.3 is that North pays less for Mafia security, implying that it prefers the Mafia to a welfarist South unless constrained by norms or law.

5.2.1 Mafia Tribute

A Mafia controls the entry/exit of predators. The Mafia cares only for the ruler's income (the value of extortion minus the wage bill for F^* gang members). The profit-maximizing Mafia equilibrium profit is characterized, followed by the Mafia-North bargained tribute.

Assume the Mafia is a price taker, but understands the predator/prey determination of the probability of success (2). To deter entry by more predators than its chosen R^*, the Mafia enlists a fixed size force F^* assumed to be paid at the market rate $1/a_2^*$. Mafia profit is the difference between the wage bill $(F^* + R^*)/a_2^*$ and the expected revenue from extortion/theft. Mafias organize only for insecure markets exceeding a critical size large enough to allow a non-negative profit. North trades only if Mafia dominated South offers terms of trade $\pi^M p^M \geq a_1/a_2$, as in the competitive entry case.

The labor market indifference equilibrium condition (4) is replaced by the Mafia first order condition:[25]

$$p(1-\pi)(1-\gamma)\frac{\pi-\mathcal{E}}{1-\mathcal{E}}\frac{L}{a_1 R^*} = 1/a_2^*. \tag{12}$$

(12) is obtained using (2) in the predator success rate $1-\pi$ and substituting $N^* - R^*$ for L^*, then differentiating the resulting expression for $1-\pi$ with respect to R^* and simplifying.

[25]The second order condition is satisfied, so the first order condition is sufficient.

Profit $\mathcal{M}$ is equal to Mafia total revenue minus total cost, wages $1/a_2^*$ paid to $R^* + F^*$. Substitute the profit maximizing level of R^* solved from (12) into the Mafia profit to yield $\mathcal{M}(p,\pi) = p\pi(1-\pi)(1-\gamma)L/a_1 - F^*/a_2^* \geq 0$. Use the trade balance condition to substitute the value of South exports L^*/a_2^* for $\pi p(1-\gamma)L/a_1$ to obtain the Mafia participation (non-negative profit) condition:

$$(1-\pi^M)\gamma L^* \geq F^* \Rightarrow (1-\pi^M)\gamma \geq \frac{F^*}{N^* - R^* - F^*}.$$

The Mafia participation condition can alternatively be expressed as

$$\frac{p}{a_1/a_2} \geq \frac{1}{\pi^M(1-\pi^M)} \frac{F^*/N}{1-\gamma} \frac{a_2}{a_2^*}. \tag{13}$$

The smallest feasible value of $p/(a_1/a_2)$ for Mafia participation is given when (13) holds with equality.

North participation requires $\Pi^M(p)p \geq a_1/a_2$. Given that the North participation condition of Proposition 1 for free entry predation is met, North participation is guaranteed for Mafia predation. Mafia control reduces R^*, p rises and Π falls in equilibrium. Since $0 > \partial \ln \Pi^M / \partial \ln p > \partial \ln \Pi / \partial \ln p > -1$, $p\pi$ rises as the Mafia restricts predation. It is logically possible that the inception of Mafia control could induce trade where autarky prevailed before.

In the analog to Figure 1 the $\Pi(p, E, E^*)$ function shifts up and has less negative slope (lower absolute value of elasticity) than in the free entry predation case. Use (2) in (12) with $\mathcal{E} = 0$ (inessentially) and solve for R^*. In the free entry predation case, $\partial \ln R^* / \partial \ln p = 1$ whereas $\partial \ln R^{*M} / \partial \ln p \in (0,1)$. For this reason $0 > \partial \ln \Pi^M / \partial \ln p > \partial \ln \Pi / \partial \ln p > -1$ where $\partial \Pi / \partial \ln p$ refers to the free entry case. $P(\pi, E, E^*)$ is more steeply sloped and shifts to the right ($F^* + R^*$ falls if the Mafia is to break even or better).

The comparative statics of Mafia control of predation are similar to those of free entry predation. Predation remains invariant to productivity for the same reasons as with free

entry predation. This predictions is consistent with Mafia controlled predation across a range of incomes per capita. Differences in other comparative statics between Mafia control and free entry predation lie in subtleties, not the signs of partial correlations.[26]

Next, consider North's collective action institution paying tribute to the Mafia in return for secure trade. Payment $\mathcal{T}^M$ to the Mafia guarantees secure trade ($R^* = 0 \Rightarrow \pi = 1$) to North. Mafia surplus from the deal is $\mathcal{T}^M - \mathcal{M}^0$ where the Mafia's initial profit $= \mathcal{M}^0 = p^M\pi^M(1-\pi^M)(1-\gamma)L/a_1 - F^*/a_2^*$. To put the valuation of the surplus on real income terms for comparability with the treatment of South's welfarist state in Section 5.2.2, multiply by the surplus by $\tilde{p}(F^*)^{-\gamma}$. North's gain is $\tilde{p}(F^*)^{1-\gamma}(N - \mathcal{T}^M)/a_1 - (\pi^M p^M)^{1-\gamma}N/a_1$.

The secure equilibrium price is

$$\tilde{p}(F^*) = \frac{\gamma}{1-\gamma}\frac{(N^* - F^*)/a_2^*}{N/a_1}, \tag{14}$$

independent of the transfer since identical Cobb-Douglas preferences imply the special case where the terms of trade are independent of transfers.[27]

The Nash bargaining solution for the tribute payment solves

$$\max_{\mathcal{T}}[\mathcal{T}\tilde{p}(F^*)^{-\gamma} - \mathcal{M}^0(p^M)^{-\gamma}]^{\omega}[\tilde{p}(F^*)^{1-\gamma}N/a_1 - \tilde{p}(F^*)^{-\gamma}\mathcal{T} - (\pi^M p^M)^{1-\gamma}N/a_1]^{1-\omega}$$

[26]Terms of trade effects of globalization are similar to those with free entry predation: security rises, and both North and South gain from a fall in $\tau\tau^*$. Qualitative details differ. Totally differentiate (11) with respect to $\tau\tau^*$ using Π^M and $\partial \ln R^{*M}/\partial \ln p \in (0,1)$. Evidently $d\ln p/d\ln \tau\tau^* > 0$ as with free entry predation – South gains from a fall in $\tau\tau^*$. North's terms of trade also improve, since

$$\frac{d\ln(\pi p/\tau\tau^*)}{d\ln \tau\tau^*} = -1 + \frac{1 + \partial \ln \Pi^M/\partial p}{1 + \partial \ln \Pi^M/\partial p + (\partial \ln \rho^M/\partial \ln p)\rho^M/(1-\rho^M)} < 0.$$

The security-improving effect of globalization also remains with Mafia controlled predation: globalization raises the security of trade similarly to its effect on free entry predation:

$$\frac{d\ln \pi}{d\ln \tau\tau^*} = \frac{\partial \ln \Pi^M}{\partial \ln p}\frac{d\ln p}{d\ln \tau\tau^*} < 0.$$

Finally, relative size affects South's terms of trade similarly under Mafia control and free entry predation.

[27]The point is well-known but worth reviewing. North's exports in terms of good 2 are $pL/a_1 - \gamma(pL/a_1 - \mathcal{T}^*) = p(1-\gamma)pL/a_1 + \gamma\mathcal{T}^*$. South's export of good 2 is $\gamma(N^* - F^*)/a_2^* + \gamma\mathcal{T}^*$. The trade balance equation solution for p yields (14).

where $\omega \in (0,1)$ is the bargaining parameter. (Note that transferable utility obtains in the Mafia tribute case as well as the South tribute case, so bargaining over p is irrelevant.) The first order condition[28] yields:

$$v(\mathcal{T}^M) - v^M(\pi^M p^M) = \frac{1-\omega}{\omega}[\mathcal{T}^M \tilde{p}(F^*)^{-\gamma} - \mathcal{M}^0(p^M)^{-\gamma}],$$

where $v^M(\pi^M p^M)$ denotes the utility earned by North in the Mafia controlled predatory equilibrium. The preceding equation uses $\mathcal{M}_{\mathcal{T}^*} = \tilde{p}^{-\gamma}$ and $v_{\mathcal{T}^*} = \tilde{p}^{-\gamma}$ and divides through by $\tilde{p}^{-\gamma}$ to simplify. Bargaining over the terms of trade is redundant because the common Cobb-Douglas preferences and a common relative price imply transferable utility. The participation constraints (positive surplus from an agreement) for North and Mafia hold if North's terms of trade improvement from secure trade is sufficiently valuable. Manipulating the participation constraints yields:

Proposition 5 *Mafia tribute agreement occurs only if*

$$\left(\frac{\tilde{p}}{p^M}\right)^{\gamma}[\tilde{p} - \tilde{p}^{\gamma}(\pi^M p^M)^{1-\gamma}]\frac{N}{a_1} > \mathcal{M}^0. \tag{15}$$

Proof *Mafia participation requires* $\mathcal{T}^M > \mathcal{M}^0(p^M/\tilde{p})^{-\gamma}$. *North participation requires*

$$\mathcal{T}^M < \frac{\tilde{p}^{1-\gamma} - (\pi^M p^M)^{1-\gamma}}{\tilde{p}^{-\gamma}} = [\tilde{p} - (\pi^M p^M)^{1-\gamma}\tilde{p}^{\gamma}]N/a_1.$$

The two conditions together are satisfied by (15). ‖

$\tilde{p} > p^M$ (secure trade raises South's labor supply and thus harms South's terms of trade) so the left hand side of inequality (15) is positive. For tribute to be possible, North's terms of trade improvement must be valuable enough to compensate the Mafia for its terms of trade deterioration.

[28]The second order condition for a maximum holds at an interior solution.

5.2.2 Welfarist South State

The welfarist South state's payoff if it eliminates predation in return for tribute is $v^*(F^*, \mathcal{T}^*) = \tilde{p}(F^*)^{-\gamma}[(N^* - F^*)/a_2^* + \mathcal{T}^*]$ where $\tilde{p}$ is the secure equilibrium price given by (14) and $\mathcal{T}^*$ is the tribute in terms of good 2 paid to South by North. North gets payoff $v(\mathcal{T}^*) = \tilde{p}^{1-\gamma}N/a_1 - p(\mathcal{T}^*)^{-\gamma}\mathcal{T}^*$. The outside options of South and North are their payoffs in the Mafia-limited predation case with North terms of trade $\pi^M p^M$ and South terms of trade $1/p^M$ and labor supply $N^* - F^* - R^{*M}$.

Efficient bargaining implies finding $\mathcal{T}^*$ that maximizes joint welfare:

$$\max_{\mathcal{T}^*}[v^*(\tilde{p}, \mathcal{T}^*) - v^*(p^M)]^{\omega}[v(\tilde{p}, \mathcal{T}^*) - v(\pi^M p^M)]^{1-\omega}.$$

The first order condition implies that $\mathcal{T}^S$ satisfies

$$v(\tilde{p}, \mathcal{T}^S) - v(\pi^M p^M) = \frac{1-\omega}{\omega}[v^*(\tilde{p}, \mathcal{T}^S) - v^*(p^M)].$$

The preceding equation uses $v^*_{\mathcal{T}^*} = \tilde{p}^{-\gamma}$ and $v_{\mathcal{T}^*} = \tilde{p}^{-\gamma}$ and divides through by $\tilde{p}^{-\gamma}$ to simplify. Using the trade indirect utility functions for North and South, the first order condition implies

$$\left[\tilde{p}^{1-\gamma} - (\pi^M p^M)^{1-\gamma}\right]\frac{N}{a_1} - \frac{1-\omega}{\omega}\left(\left[\tilde{p}^{-\gamma} - (\pi^M p^M)^{-\gamma}\right]\frac{N^*}{a_2^*} - \tilde{p}^{-\gamma}F^*/a_2^*\right) = \tilde{p}^{-\gamma}\mathcal{T}^S/\omega. \quad (16)$$

Participation by both North and South is similar to the joint participation condition for North and Mafia, so details are suppressed. Assuming participation constraints are met, which partner does North prefer?

5.2.3 North Preference for Mafia

Start from the initial equilibrium in which the Mafia controls the amount of predation. North can bargain with either Mafia or welfarist South to eliminate predation in return for tribute. Assume equal capabilities of strong enforcement and equal credibility. Which partner does North prefer, assuming no altruism?

Proposition 6 *North prefers the Mafia tribute equilibrium to the welfarist South tribute equilibrium.*

Proof of Proposition 6

North's transfer to the Mafia is solved from the Nash bargaining first order condition to yield

$$\left[\tilde{p}(F^*)^{1-\gamma} - (p^M)^{1-\gamma}\right]\frac{N}{a_1} - \frac{1-\omega}{\omega}\mathcal{M}^0(p^M)^{-\gamma} = \mathcal{T}^M\tilde{p}(F^*)^{-\gamma}/\omega. \tag{17}$$

Subtract equation (17) from (16) and divide the result through by $\tilde{p}^{-\gamma}/\omega$. The result after simplification is

$$\mathcal{T}^S - \mathcal{T}^M = (1-\omega)\left[(p^M/\tilde{p})^{-\gamma} - 1\right](N^*/a_2^* - \mathcal{M}^0) + (1-\omega)F^*/a_2^* > 0.$$

The left hand side is positive because $\tilde{p} > p^M$ and Mafia profit is less than potential national output. ‖

Intuitively, the Mafia is always cheaper for North because South's outside option requires North to pay more than F^*/a_2^* while the Mafia's outside option requires less than the F^*/a_2^* paid in its outside option. The terms of trade deterioration hurts both South and Mafia, but the Mafia's base is much smaller.

The conclusion that North prefers the Mafia to welfarist South is not dependent on the assumption that the initial condition is Mafia limited predation. To see this, start from the initial condition of free entry predation. In this case the Mafia is *a fortiori* cheaper than welfarist South because its outside option is zero. Thus it need not be compensated at all for the South terms of trade loss due to the rise in South's labor force as predation is eliminated.

5.2.4 North, Mafia and South

Finally, consider the South state's possible reactions to the Mafia, and North's incentives to intervene.

Comparing the Mafia profit-maximizing equilibrium to competitive predation, North's terms of trade improve and South's terms of trade deteriorate. The Mafia now earns a profit $\mathcal{M}$ but this profit does not suffice to cover the combined (profit-inclusive) welfare loss for South. A capable welfarist South state has an incentive to attack the profit-maximizing Mafia. North, in contrast, has an incentive to protect the Mafia from attack. Avoidance of loss from conflict could lead to a a bargained division of the profit between welfarist South state and the Mafia, effectively a semi-corrupt state institution.

In a Mafia tribute equilibrium, the Mafia can act as an agent for the South state, splitting the bargained tribute from North – again effectively a semi-corrupt South state. The South state collects partial compensation $\mathcal{T}^{MS}$. The new feature is that the effect of the tribute paid to South on the tribute paid by North is $d\mathcal{T}^M/d\mathcal{T}^{MS} \geq 1$.[29] This result implies that the Mafia prefers the semi-corrupt state. The Mafia's ex ante bribe to the state reduces the value of its outside option and thus ends up extracting weakly more surplus from North.

North prefers the cheaper alternative (17) to the semi-corrupt bargain. It may intervene to destroy the South state's threat power over the Mafia if the cost of doing so is less than its gain from lowering tribute $\mathcal{T}^M$ below its level in the semi-corrupt tribute equilibrium.

Endogenizing the various threats and their cost requires modeling conflict and the effect that gains from trade have on success rates in conflict. This is a worthwhile extension of the model, but unnecessary for present purposes.

[29] South's threat likely extracts $\mathcal{T}^{MS}$ regardless of the bargain with North. The Mafia payoff in bargaining with North in (17) in this case becomes $(\mathcal{T}^M - \mathcal{T}^{MS})p^{-\gamma} - (\mathcal{M}^0 - \mathcal{T}^{MS})(p^M)^{-\gamma}$. Apply the Mafia net payoff to the right hand side of (17) and differentiate to yield (after simplification) $d\mathcal{T}^M/d\mathcal{T}^{MS} = 1 + (1-\omega)(p^M/\tilde{p})^{-\gamma} > 1$. In the case where the Mafia does not pay $\mathcal{T}^{MS}$ if there is no bargain with North, $d\mathcal{T}^M/d\mathcal{T}^{MS} = 1$.

6 Conclusion

A Ricardian model of trade subject to predation yields new qualifications to the gains from trade proposition. Poor countries (South) with weak institutions can be caught in a corruption trap that reduces their gains. The terms of trade divide the global gains from trade as in the standard Ricardian model, but terms of trade effects are amplified by an endogenous size effect as predators and enforcers move into or out of the labor force while rents from enforcement add a source of gain or loss. The enforcement interests of North and South are normally opposed. North has an incentive to resist South's efforts to improve its situation with enforcement, to provide enforcement itself, and to deal with Mafia enforcers directly against the interest of a welfarist South government. While the model is very simple, its lessons seem likely to obtain in more complex economic and political settings.

Standard trade agreements theory implicitly assumes a world of capable states. Asymmetric capability as in the model of this paper suggests a starting point for thinking about alternative design for North-South relationships. The US Foreign Corrupt Practices Act and similar laws in other rich countries may limit the institutional problems for South caused by trade with North. Universal constraint on North para-state actors is likely to limit negative externalities between them in trade with South. Perhaps limits to use of mercenary armies by North para-state actors are justified. Perhaps amendment to WTO obligations or regional trade agreements might limit potential harm to South.

Future application and development of the model looks promising in two directions. First, the comparative statics of the model suggest an approach to empirical work on the cross section variation of security of international trade. The type of institution observed can potentially be related to comparative advantage, geography and South labor market conditions. Second, extensions of the theoretical model could develop the implications for potential conflict and political economy involving North institutions and rival predatory and welfarist South institutions. The extension calls for a dynamic setting where (i) the durability of rival South powers is endogenous, and (ii) North's institutions include a (somewhat)

altruistic state and a large firm interacting with North and South states. Outcomes may be related to the deep economic parameters of the model.

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7 Appendix 1: Predation on South Exports Case

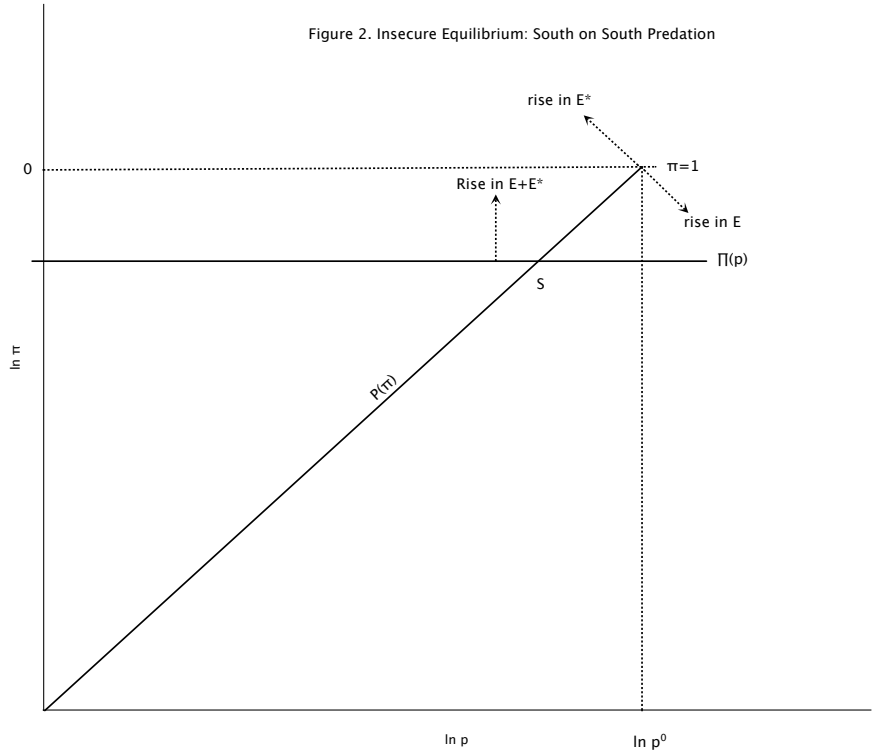
If the predation by South raiders is on South goods coming into the market, the equilibrium terms of trade for North are determined by

$$(1-\gamma)pL/a_1 = \gamma\pi L^*/a_2^* \Rightarrow \frac{p}{\pi} = \frac{\gamma}{1-\gamma}\frac{L^*/a_2^*}{L/a_1}. \tag{18}$$

The South labor market indifference condition in terms of South's product is market wage equal to per predator return to predation $\Rightarrow 1/a_2^* = (1-\pi)(1-\gamma)L^*/R^*$. This implies that predation on South goods, if it exists, is inelastic to the terms of trade. $1-\pi = (1-\mathcal{E})(N-E+N^*-E^*-R^*)/(N-E+N^*-E^*+\theta R^*)$, and substituting this expression into the indifference condition yields a quadratic equation in R^* as a function of the exogenous N, N^*, E, E^* and the parameters ϵ and θ. Thus $\Pi(p)$ is invariant to p.[30] The resulting insecure equilibrium, if it exists, is shown in Figure 2. $P(\pi)$ is given by $p = \pi(\gamma L^* a_1)/[(1-\gamma)La_2^*]$ by (18), yielding a ray from the origin in log space, with slope equal to the inverse of North's terms of trade p/π. The price p^0 associated with certainty ($\ln \pi = 0$) is given by

$$p^0 = \frac{\gamma}{1-\gamma}\frac{N^*/a_2^*}{N/a_1}.$$

[30] It is convenient to solve for $r^* = R^*/N^*$, the proportion of population engaged in predation. Define $n = N/N^*$ and evaluate at zero enforcement. The roots of the quadratic are complex, with real parts that both may lie in the unit interval. If so, use the smaller root.



The implications are simpler than in the case of predation on North's export. E and E^* act directly on North's terms of trade by rotating the $P(\pi)$ schedule. Shifts in the $\Pi(p)$ schedule have no effect on North's terms of trade p/π. In contrast, South's terms of trade move inversely to security. The implications for enforcement policy are that each opposes the other's enforcement, as follows. For North enforcement, the rightward rotation in $P(\pi)$ as E increases guarantees a rise in North's terms of trade p/π. The upward shift in $\Pi(p)$ induces a further rise in p, a further deterioration in South's terms of trade. South enforcement E^* raises p and harms North by lowering p/π. South's gain in terms of trade is offset by the upward shift in $\Pi(p)$ but South gains a terms of trade improvement on net so long as $dL^*/dE^* = -(1 + dR^*/dE^*) < 0$, the same necessary condition for South enforcement as with predation on North goods.

7.1 Mafia Predation by South on South Goods

As with predation on North goods, the indifference condition of predator free entry is replaced by a monopoly Mafia selection of the profit maximizing number of predators based on

understanding the predator prey relationship taking prices and the productive labor supply as given. The analysis remains qualitatively identical to the free entry case and the logic of Figure 2 continues to hold. The difference is that predation is lower and the Mafia makes a profit $\mathcal{M}$.