

Efficient Policy in a Predatory Economy: To him who hath shall be given?*

James E. Anderson
Boston College and NBER

April 19, 2010

Abstract

Trade subject to predation generates externalities within and between markets. Efficient tax, infrastructure and enforcement policies internalize the net externality — more trade \Rightarrow fewer predators but drawn to trade at rising cost. The balance is positive (negative) as enforcement is weak (strong). Dual economies pair weak Periphery and strong Core enforcement markets. Efficient taxation and infrastructure promote the Core at the expense of the Periphery. Efficient enforcement promotes both. Tolerance (intolerance) of smuggling is efficient when Core enforcement is weak (strong). Tolerance of informal market Mafias that provide enforcement and infrastructure is efficient when Core enforcement is strong.

JEL Classification: F13, O17, K42.

Keywords: dual economy, Core-Periphery, predation.

Contact information: James E. Anderson, Department of Economics, Boston College, Chestnut Hill, MA 02467, USA.

*I thank two referees for very helpful comments on an earlier version of this paper, “Commercial Policy in a Predatory Economy”.

For unto every one that hath shall be given, and he shall have abundance: but from him that hath not shall be taken away even that which he hath. (Matthew 25:29, King James version.)

High rent low crime markets (the Core) are commonly found alongside low rent high crime markets (the Periphery). This structure looks inefficient and unfair, yet governments left and right often follow tax, infrastructure and enforcement policies that foster rich areas at the expense of poor. This paper provides an efficiency rationale.

The rationale is due to the nature of trade subject to predation.¹ Extortionists and thieves commonly prey on trade.² The cost imposed by predation appears likely to be endogenous to trade, to enforcement, to the opportunity cost of labor in legitimate work and to opportunities to work and prey on trade in nearby markets. Dual (Core-Periphery) structure arise endogenously in the model of this paper when gross margins differ, even when labor markets are integrated.

Intuition about policy initially suggests fostering trade with tax breaks in poor high crime districts, investing in low infrastructure districts and redirecting enforcement effort to high crime districts. But endogenous insecurity of trade suggests externalities within and between markets. Analysis is needed to sort out the various effects.

In the simple model of this paper, two opposing externalities of trade act through the labor market. The demand for labor in trade rises, pushing up the wage due to diminishing returns to labor with fixed infrastructure. On the one hand security improves for all traders because the increased wage raises the opportunity cost of predation, reducing the number of predators. On the other hand, the increased supply of workers drawn from predation requires an increased wage, raising infra-marginal labor costs for all traders.

¹The leading quote is from Jesus' parable of the talents. The master redistributes the poor servant's only talent, which from fear of predators he had hidden rather than invested, to the rich servant with ten talents who doubled his initial endowment in trade.

²Port workers require payments off the books, petty theft is common, officials demand bribes. Africa provides spectacular examples. Headlines report Somali pirates hijacking ships for ransom. *The Economist* (Dec. 19, 2002) tells the story of a beer truck that loses 1/3 of its load to extortionists at 47 roadblocks along 313 miles of road from Douala to Bertoua in Cameroon. Anderson and Marcouiller (2002) provide econometric evidence that insecurity reduces international trade. They illustrate with a calculation that insecurity is as destructive to international trade of Latin American countries as their protectionist trade policies. Brunetti, Kisunko and Weder (1997) report survey evidence that corruption (official extortion) is ranked second only to taxation as an obstacle to business.

The net externality is positive (negative) as enforcement is weak (sufficiently strong) in terms of parameter conditions explained below. Intuitively, the relative importance of the negative externality rises with enforcement effort because (i) trade volume rises with enforcement and (ii) labor required per unit rises with trade volume while the benefit of improved security per unit is proportional to the willingness to pay of buyers, weakly falling with trade volume.

The dual economy arises endogenously in the model when Core markets with sufficiently strong enforcement are paired with Periphery markets with weak enforcement. The differing enforcement regimes are due to gross margins — willingness to pay minus cost of service — in Core exceeding those in Periphery, and can arise even when enforcement effort is efficiently chosen.³ Dualism does not rely on economies of scale or differences in the cost of infrastructure or segmented labor markets, though these may indeed explain some instances of asymmetry. Efficient government policy need not eliminate dualism, even when political economy or tribalism do not cause government to treat regions differently.

The object of efficient policy is to raise legitimate income from trade by appropriate play against the predators. Efficient public provision (of enforcement and infrastructure with efficient access charges) internalizes the externalities. Externalities between markets arise when several markets in a region are connected through a common labor pool that supplies traders and predators as well as enforcers. A regional government acts to coordinate (or not) the actions of the local market authorities. A striking result is that efficient cooperative commercial and infrastructure policy in dual economies ordinarily requires fostering the rich Core at the expense of the poor Periphery, exacerbating inequality. The dilemma is not resolved by utilitarian governments that care as much about the poor as the rich — the qualitative properties of efficient policy are the same with any set of political economy weights on the interests of labor, capital and government revenue.

Efficient cooperative enforcement in the dual economy, in contrast, raises enforcement effort in both Core and Periphery. While the parallel incentives might appear to ease cooperation, the initial increase in enforcement relative to its Nash equilibrium level lowers Periphery government welfare and suggests resistance.⁴

³Dual economy here is used to describe separate linked markets, but the mechanism is very different from the one usually associated with dualism.

⁴Moreover, police authority is notoriously difficult to coordinate for reasons of bureau-

Interpreting the dual economy as parallel formal and informal goods markets, informal traders (e.g., smugglers) evade taxes but draw off predators from legal trade. Tolerance of smuggling is efficient for a revenue-motivated government when enforcement is weak, but intolerance is efficient with strong enforcement. An example of each is provided by American colonial history. Prior to 1763, in the age of Caribbean piracy, British policy was legendarily tolerant of smuggling. After 1763 the British Navy eradicated Caribbean piracy and British policy switched to intolerance. The model provides an economic rationale. The model also provides a rationale for legitimate governments to have differing stances toward informal sector enforcement and infrastructure. Tolerance of Mafias and informal infrastructure is beneficial to Core governments when Core enforcement is strong and detrimental when enforcement is weak.

The model is an extension of Anderson and Bandiera (2006). This paper develops the implications of essentially the same model for tax, infrastructure and enforcement policies. To adequately deal with the policy menu, the Anderson-Bandiera model is extended to allow for endogenous enforcement effort, including allowance for enforcement cost that varies with the volume of trade; and to consider a government objective function with labor interests as well as capital interests. While the model is very simple, the insights it generates appear to be valid in models with more realistic complexity.

The model is related to a literature on institutions and insecurity (for example, Dixit, 2004, and references therein) and a smaller literature on trade and insecurity (for example, Skaperdas and Syropoulos, 2001, 2002). The novelty of the present line of research is that, very plausibly, predation occurs on the trade activity itself. Anderson and Marcouiller (2005) investigate the existence of insecure trading equilibrium in a two country two good Ricardian general equilibrium trade model with fixed trade costs. Much of the commercial policy analysis of the paper fits into the strategic trade policy literature pioneered by Brander and Spencer (1985). It differs from that literature in that the sources of market interdependence are due to insecurity and internationally linked labor markets.

Section 1 sets up the model. Section 2 characterizes efficient commercial policy, Section 3 infrastructure policy and Section 4 enforcement policy. Section 5 applies the setup to economies with informal markets. Section 6 concludes.

cratic rivalry outside the model.

1 A Model of Insecure Markets

The basic economic mechanism of the model is the income maximizing choice of labor between trade and predation. The payoff to each activity is based on technology and the local and external prices of goods. Traders supply the goods obtained at a fixed external price c to a local market at increasing cost. Predators capture a share of the goods shipped. The equilibrium interaction of traders and predators combines equality of returns in the two activities, the rational expectations equilibrium shipment success rate, the labor market clearing condition and the zero arbitrage profit condition in trading. The model is developed in Anderson and Bandiera (2006), elaborated here to include the choice of infrastructure capital and enforcement by patrols drawn from the common labor pool, as well as efficient tax/subsidy policy.

Trade services are produced by a neoclassical (concave, homogeneous of degree one, twice continuously differentiable) production function that combines labor and infrastructure capital. Infrastructure is comprised of two components, private (warehouses) and public (marketplaces), with their contribution specified for simplicity as a sum (i.e., ‘warehouses’ and ‘marketplace’ size are perfect substitutes).⁵ The essential properties of the model hold for any neoclassical production function but sharper results are derived by restricting the production function to be Cobb-Douglas, dual to the cost function: $c = w^\alpha r^{1-\alpha} q$ where α is the parametric cost share for labor, w is the wage, r is the service price of capital and q is the volume of trade.

The short run cost function of trade with fixed capital K is given by $\bar{C} = kwq^{1/\alpha}$, where $k = [(1-\alpha)/K]^{(1-\alpha)/\alpha} > 0$.⁶ The trade services unit cost, equal to the marginal cost of a price-taking (including the service price of capital) competitive trading firm, is given by:

$$t(q, w) = kwq^{(1/\alpha - 1)}. \quad (1)$$

The demand for labor in trade services is equal to⁷

$$\alpha q^{1/\alpha} k. \quad (2)$$

⁵The simplification is inessential. Specifying the relationship as Cobb-Douglas adds another variable for the government to control with its infrastructure policy but makes no difference to the results.

⁶This is formed by using $(1-\alpha)w^\alpha r^{-\alpha} q = K$ to solve for $r(w, K, q)$, then substituting for r in the cost function to obtain $\bar{C}(w, K, q) = kwq^{1/\alpha}$.

⁷This follows from Shephard’s Lemma $C_w = \alpha C/w = \alpha \bar{C}/w$.

Two important properties in results below are that unit cost given by (1) is increasing in q and that labor demand given by (2) is completely inelastic with respect to the wage. These properties also hold for the general neoclassical case; the Cobb-Douglas differs in having constant elasticities with respect to volume q and capital K .

Predators extract a portion of the volume of trade and sell it in a ‘thieves’ market at a price normalized to 1. The proportion extracted combines the probability of a predator finding its prey with the probability of evading enforcement and the extortion share then agreed on between the predator and prey. Predators, prey and enforcers all independently and randomly intersect on the approaches to the market. Predators win all encounters with prey but enforcers frustrate all predator/prey encounters that they match with. The objective probability of successful evasion of predators by a shipment is modeled as a logistic function

$$F = \frac{1}{1 + \theta B/q}$$

where θ is a parameter reflecting the relative efficacy of predators in pursuit of prey that attempt evasion, B is the number of predators and q is the volume of prey, proportional to the number of shipments. A predator/prey encounter yields only $1 - M \in [0, 1]$ units of loot because a fraction of encounters are frustrated by enforcement and even those not frustrated by enforcement yield only the extortionists’ fraction of the full shipment.⁸ The distinction between extortion and theft turns out to be irrelevant for most purposes in the paper, so it is simpler to think of predation in the model as theft and of M as reflecting enforcement.

The patrolling technology is Ricardian: $H = aqM$ is the labor requirement for patrols. This assumption plausibly implies that $M = (H/q)(1/a)$, the probability that a shipment that is attacked is successfully defended is proportional to the ratio of patrol force to volume of shipments.⁹ The probability of successful shipment in this case is given by $F + M(1 - F)$, an

⁸The extortion fraction can be derived from a formal bargaining game. The reason that the predator does not steal all is that the threat point of the prey reflects his ability to destroy or impair the goods. More loosely, such sharing rules can be rationalized as social norms.

⁹The setup abstracts from the important problem of corrupt patrol agents. Effectively a represents a layer of monitors who deter extortion by the patrols. A deeper treatment that endogenizes the monitors is beyond the scope of this paper. See Acemoglu and Verdier (2000) for analysis of a related problem.

increasing function of the ratio of enforcers to prey and a decreasing function of the ratio of predators to prey.

The alternative to predation is legitimate work at the equilibrium wage, either as a trader or as an enforcer. Labor is indifferent between predation and wage work when

$$w = [1 - F - M(1 - F)]q/B = (1 - M)(1 - F)q/B. \quad (3)$$

Under these circumstances Anderson and Bandiera show that the rational expectations equilibrium probability of successful shipment in an insecure market is given by

$$\pi = w/\theta + M. \quad (4)$$

w/θ gives the endogenous component of the success rate. A rise in w increases the opportunity cost of predation and thus reduces the number of predators, increasing the success rate of shippers.

1.1 Equilibrium

Competitive traders buy goods at price c and sell them in the market for price $b(q)$, $b' \leq 0$. The gross expected profit margin is $\pi b - c$. Competitive equilibrium implies zero expected profit¹⁰

$$\pi b - c - t = 0. \quad (5)$$

When a second market is introduced, traders can provide services to either market. The second market has variables denoted with a * and will be called ‘Periphery’ in distinction to the unstarred ‘Core’ market variables. The focus on asymmetric markets implies that secure gross margins in Core are larger than those in Periphery: $b(0) - c > b^*(0) - c^*$.

Core and Periphery are economically connected because all labor is drawn from a common pool — traders, predators and enforcers in both goods markets are all mobile and must earn the same return everywhere. The ‘demand’ for labor in predation is derived using (4) in (3) to solve for B :

$$B = (1 - M - w/\theta)q/w. \quad (6)$$

¹⁰Risk neutrality is appropriate in a setting where, in the background, merchants make many independent shipments, and can invest shares in one another’s shipments for further risk diversification.

Enforcement at success rate M requires enforcers in the amount aqM , $a > 0$. Trade requires workers in the amount $kq^{1/\alpha}$.

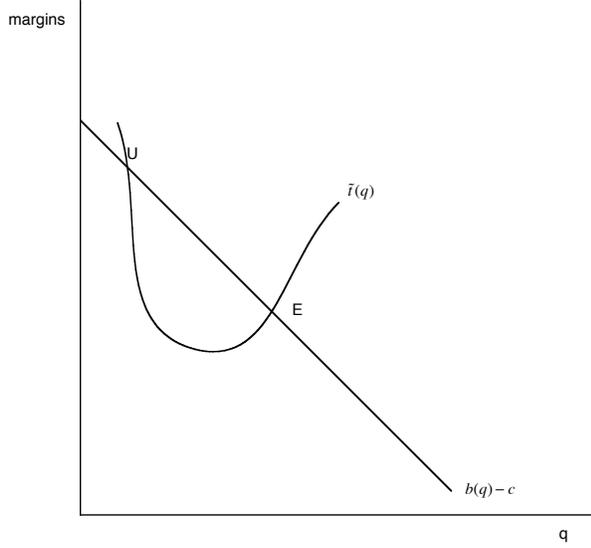
Labor market clearance implies $N = \alpha kq^{1/\alpha} + (1 - M - w/\theta)q/w + \alpha k^*(q^*)^{1/\alpha} + (1 - M^* - w/\theta^*)q^*/w + aqM + a^*q^*M^*$ where N denotes the number of workers. Solving for the equilibrium wage rate $w = W(q, q^*; k, k^*, M, M^*)$ where

$$W(\cdot) = \frac{q(1 - M) + q^*(1 - M^*)}{N - \alpha kq^{1/\alpha} - \alpha k^*(q^*)^{1/\alpha} - aqM - a^*q^*M^* + q/\theta + q^*/\theta^*}. \quad (7)$$

The model of economic interaction is now complete. For given values of M, M^*, k, k^* substitute (4) into (5) and solve with (7) for the equilibrium pair w, q in the one market case. Use the analogs of (4) into (5) for the two market case and solve for w, q, q^* .

A depiction of equilibrium determination (in the single market case) emphasizes the idea of predation as a transaction cost. The gross margin $b(q) - c$ is equal in equilibrium to the full transactions cost $\tilde{t}(q) = W(q)kq^{1/\alpha-1} + [1 - M - W(q)/\theta]b$ where the second term is the expected transactions cost of predation $(1 - \pi)b$. $\tilde{t}(q)$ is first decreasing and then increasing in trade volume q . U is an unstable equilibrium while E is stable. \tilde{t} may lie everywhere above $b(q) - c$, eliminating trade. Equilibrium $q > 0$ if $\tilde{t}(0) < b(0) - c \Rightarrow Mb(0) - c > 0$.

Figure 1. Equilibrium FullTransactions Costs



For subsequent analysis it is convenient to develop the equilibrium rents to infrastructure here. The surplus accruing to capital (due to access to public infrastructure plus use of private infrastructure) in the one market case is given by $S(q, w, M) = [\pi b(q) - c]q - \int_0^q t(x)dx$ where x is a variable of integration. Using previous steps:

$$S(q, w, M) = (M + w/\theta)[b(q) - c]q - \alpha w k q^{1/\alpha}. \quad (8)$$

Competitive trading implies $S_q|_b = \pi b - c - t = 0$.

A key variable in the analysis carries the externalities of trade: $S_w w/q = (\pi - M)b - \alpha t$. Replacing t with $\pi b - c$, $S_w w/q = (1 - \alpha)w/\theta + \alpha(c - Mb)$.

Then

Lemma *With insecure trade $S_w > 0$ when enforcement is weak, $M < c/b$, and $S_w < 0$ when enforcement is sufficiently strong,*

$$M > \frac{c}{b} + \frac{1 - \alpha}{\alpha} \frac{w}{\theta b}.$$

Intuitively, the relative importance of the negative cost push externality rises with M because (i) enforcement raises q , and (ii) labor required per unit $\alpha t(q)/w$ rises with q while the benefit of improved security per unit $b(q)/\theta$ is constant or falling with q .¹¹

The maximum value of the wage rate while trade remains insecure is $\theta(1 - M)$.¹² Provided trade remains insecure, the Lemma implies $S_w < 0$ if $M > [\alpha c + (1 - \alpha)]/[\alpha b + (1 - \alpha)]$, a parametric restatement. With secure trade, all the externality issues disappear: $S = (1 - \alpha)tq = (1 - \alpha)(b - c)q$, invariant to w .

Equilibrium in the two market model requires $\pi b - c - t = 0$, $\pi^* b^* - c^* - t^* = 0$ and $w = W(q, q^*)$. Figure 2 depicts the inter-dependence of trade volumes in the two markets, where the zero expected profit conditions are labeled as $S_q[q, W(q, q^*)] = 0$, $S_{q^*}[q^*, W(q, q^*)] = 0$ respectively for home and foreign traders.¹³ The upward sloping schedules depict the case of weak enforcement in both markets, where *weak enforcement is defined as $c - Mb > 0$* and similarly $c^* - M^*b^* > 0$. Strong enforcement is defined as $c - Mb < 0$ and similarly $c^* - M^*b^* < 0$, resulting in downward sloping S_q, S_{q^*} .¹⁴ In Figure 2, trade volumes are ‘strategic complements’, in quotes denoting that the diagram looks like a best response function diagram but the actors are not strategic and the q, q^* volumes are market equilibrium outcomes.

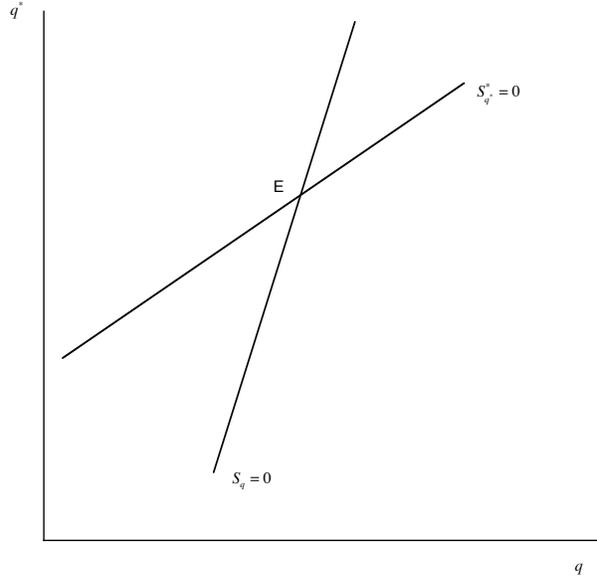
¹¹ $c - Mb(0)$ is minus the expected gross margin when $q = w = 0$, positive when enforcement is weak and negative when it is strong. Increases in the wage raise rents when the expected gross margin is positive. The condition of the Lemma evaluates willingness to pay at $b(q)$.

¹²See Anderson and Bandiera for details on the existence of insecure trading equilibrium.

¹³The labeling connects with development of optimal policy below in terms of merchant profits S .

¹⁴As noted in the discussion of Figure 1, strong enforcement is a sufficient condition for positive trade.

Figure 2. Equilibrium in Two Markets



The slopes in Figure 2 are signed as follows. A rise in home market volume raises the wage associated with any given foreign volume q^* and vice versa. $S_{qq} < 0, S_{q^*q^*} < 0$ is required for stability, hence the slope of the market equilibrium responses depends on $S_{qq^*} = (c - Mb)W_{q^*}/W$ and $S_{q^*q}^* = (c^* - M^*b^*)W_q/W$. The expressions on the right hand side follow from differentiating S_q and using the equilibrium condition $S_q = 0$. Any combination of upward sloping and downward sloping (weak and strong enforcement) market equilibrium schedules is possible.

A key characterization of the two market economy is whether it exhibits dualism or not.

Definition *A dual economy exhibits $S_w S_w^* < 0$.*¹⁵

S_w carries the net externality in the model across markets. The markets are referred to as Core (no *) and Periphery (*) in much of the paper. The Core-Periphery usage is especially apt with $S_w < 0$ and $S_w^* > 0$ — the dual economy.¹⁶

The dual economy essentially is characterized by divergent enforcement regimes. Section 4 shows that a necessary condition for the dual economy is $a^* < a$, enforcement is less costly in patrol effort in Periphery than in Core. This is plausible in most Core-Periphery settings, standing in for higher patrol requirements in more complex Core and especially when allowing for a wage premium in the Core.

1.2 Government Objectives

Government policy consists of tax policy that shifts c, c^* ; infrastructure policy that shifts K, K^* ; and enforcement policy that shifts M, M^* .¹⁷ The government maximizes its objective function. With two markets, the local governments may compete or cooperate.

Political economy determines how various interests are weighted in the government objective function. Any combination of capital and labor interest is expressible as proportional to the merchant interest in the model, so the subsequent analysis of infrastructure policy is in terms of merchant interest for simplicity.

¹⁵Dualism in this sense describes economies in both developed and underdeveloped countries or regions and the mechanism analyzed applies to both. Authority for this usage of dualism is Vines and Zeitlin (2008), who in their survey of dual economy models say “Dual economies have asymmetric sectors, the interaction between which influences the path of development. ... The relevant asymmetries are not merely technological but also include institutional, behavioral and informational aspects.” The asymmetry that justifies the application of the notion of dualism is a sufficiently large difference in the security of trade, endogenously determined by the interaction of predators and prey and the underlying determinants of the return to productive and enforcement activity.

¹⁶The traditional setting for dualism is an economy of rural and urban sectors, which makes the Core-Periphery usage a natural physical one. The insecurity of trade mechanism proposed here differs from the traditional labor surplus mechanism or the modern credit/constraint information asymmetry mechanism of Banerjee and Newman (1998).

¹⁷Issues with the time path of accumulation due to costs of adjustment or the need to accumulate from local resources are assumed away to focus on the externality issues that would in any case affect the time path of accumulation.

The Core government hires enforcers and pays them $waMq$. And it charges for access to its market at rate $c - c^0$ where c^0 is the fixed external cost of the goods traded. The government can also potentially add a unit of infrastructure K at service price r . Suppose first that the government sets policy to maximize the sum of the rents of merchants, S , given by (8) and the government budget surplus. The merchant interest Core government objective function is

$$G(c, K, M) = S[q, W(q, q^*; K, M, K^*, M^*), K] + \lambda[(c - c^0)q - waMq - Kr] \quad (9)$$

where $\lambda \geq 1$ is the Marginal Cost of Funds that must be raised from alternative revenue sources. For simplicity λ is assumed to be constant. $q(c - c^0)$ is the revenue raised by a tax $c - c^0$ when this is positive or the subsidy required when $c - c^0$ is negative. There is also an expected consumers surplus $C(q) = \Pi(q)[\int_0^q b(x)dx - b(q)q]$. Merchants enjoy a fraction $\epsilon \in [0, 1]$ of the surplus. When $b_q < 0$ and ϵ is not negligible, the merchant's interest includes their share of consumer surplus. It simplifies the discussion of efficient policy to assume ϵ is negligible (or $b_q \rightarrow 0$), but the difference it makes will be noted where appropriate.

Alternatively, suppose the Core government objective function incorporates the interests of legitimate labor, a utilitarian objective function. While it is natural to focus on the merchants' interest because they are inevitably localized and receive residual payments,¹⁸ legitimate labor may also become localized. Including labor's interest turns out to make no difference to the analysis below (when $b_q \rightarrow 0$), essentially because labor and the merchants claim constant shares of total income.¹⁹ The wage bill in legitimate work is $w(\alpha kq^{1/\alpha} + aqM)$. The utilitarian objective function adds the wage bill to G , yielding²⁰

$$G^U(c, K, M) = S[q, W(q, q^*; K, M, K^*, M^*), K]/(1-\alpha) + waMq + \lambda[(c - c^0)q - waMq - Kr].$$

There are two inessential differences between G and G^U . The former debits enforcement cost at $\lambda waMq$ while the latter debits enforcement cost at $(\lambda -$

¹⁸If the merchants own some mobile capital T then the return to the mobile capital can be regarded in the single market case as forming a part of S .

¹⁹Consumer interest is assumed away here for simplicity because it acts in very well known ways.

²⁰ $w\alpha kq^{1/\alpha} = \alpha tq$ while $S = (\pi b - c)q - \alpha tq = (1 - \alpha)tq$ using $\pi b - c = t$. The sum of factor payments in trade is $tq = S/(1 - \alpha)$.

1) $waMq$. The small difference this makes to policy will be noted below. The second inessential difference is that in G^U the surplus is scaled upward by $1/(1 - \alpha)$. All the foregoing statements apply to the class of government objective functions that are convex combinations of G and G^U , so the analysis below applies to a wide range of political economy stories.

2 Efficient Commercial Policy

The government sets efficient access charges to the market $c - c^0$. These could be subsidies or taxes.

2.1 Efficient Policy in a Single Market

The government influences the choice of q by altering c with a tax or subsidy. Let $q_c = dq/dc < 0$ (see the Appendix for a derivation). Competitive traders determine a trade volume such that $S_q = 0$. Note that $S_c = -q = \partial tq/\partial c$.

The optimal policy of a merchant interest government is given by

$$c - c^0 = waM \left(1 + \frac{W_q q}{W} \right) + \frac{\lambda - 1}{\lambda} \frac{q}{-q_c} - S_w W_q. \quad (10)$$

The first term on the right hand side of (10) is the efficient charge for access arising from patrolling costs, internalizing the cost to the government of one more unit of trade q . The direct expense waM is augmented by the monopsony power factor $1 + W_q q/W$ because the government internalizes the wage increasing cost of patrols. The second term is the Ramsey optimal tax arising from the revenue motive. The third term is the Pigouvian tax or subsidy arising from the motive to internalize the net externality. When merchants consume a non-negligible fraction of consumers' surplus, there is a fourth term on the right hand side, $-(\epsilon/\lambda)(\Pi_q q/\Pi)C(q)/qc \leq 0$, representing a consumer protection motive acting toward subsidy to improve security. Except as an aside, this term is suppressed for simplicity in what follows.

The optimal tax policy on behalf of the legitimate sector internalizes a pecuniary externality in the labor market (via $S_w W_q$) that arises because labor is in effect supplied to the legitimate sector from the predatory sector at increasing cost. Developing the case of the utilitarian government makes clear why this is efficient. The first term on the right hand side of (10) for a utilitarian government is multiplied by $(\lambda - 1)/\lambda$, reducing the efficient

access charge as compared to the merchant interest government. The last term is multiplied by $1/(1-\alpha)$, increasing the internalization term in absolute value. These inessential differences do not change the qualitative properties of efficient taxation. With $\lambda = 1$ the first two terms vanish and the optimal policy internalizes the net externality $-S_w W_q/(1-\alpha)$. The usual intuition that pecuniary externalities don't require intervention does not hold in this model because predators income does not count. The usual intuition would be restored if utilitarian preferences expanded to include the predators.

Proposition 1 *The optimal policy of the merchant interest government combines an efficient charge for patrol costs with a Ramsey optimal revenue tax and a subsidy to trade when enforcement is weak, $S_w > 0$, and a further tax on trade when enforcement is sufficiently strong, $S_w < 0$.*

2.2 Cross-Market Externalities

In the two market model, equilibrium trade volumes are determined by

$$\begin{aligned} S_q[q, W(q, q^*), c] &= 0 \\ S_{q^*}[q^*, W(q, q^*), c^*] &= 0. \end{aligned}$$

This system of equations yields the equilibrium volumes $q(c, c^*), q^*(c, c^*)$.

For simplicity in modeling government objectives, assume henceforth that $\lambda = 1 = \lambda^*$, so there is no revenue motive. Any subsidies are assumed to be paid from lump sum taxes. The objective functions of the two governments are given by $G = S\{q(c, c^*), W[q(c, c^*), q^*(c, c^*)], c\} + q(c - c^0) - Kr - W(\cdot)AMq$ and the analogous expression for the Periphery government.

An added component of the merchant interest government objective function is needed when the merchants' capital includes mobile capital T and T^* , 'trucks' that can operate in either market. The equilibrium truck rental rate $r_T(q, q^*, T + T^*)$ is increasing in both trade volumes.²¹ The merchants' interest is $S + r_T(\cdot)T$ at home and $S^* + r_T(\cdot)T^*$ in the foreign market. The inessential difference that truck owners' interest makes to efficient policy is noted below.

²¹ r_T with a Cobb-Douglas technology is given by $\beta W(q, q^*)\alpha[kq^{1/\alpha} + k^*(q^*)^{1/\alpha}]/(T + T^*) = r_T(q, q^*, T + T^*)$, where r_T is the common equilibrium truck rental rate, $T + T^*$ is the total truck supply and β is the Cobb-Douglas share of payments W that is actually paid to truck rental. The term in square brackets is total employment in trade services.

2.2.1 Nash Tax Policies

Each government sets tax/subsidy policy to maximize its objective function given the policy of the other government. The Nash equilibrium in noncooperative tax policies is determined by:

$$\begin{aligned} G_c &= 0 \\ G_{c^*} &= 0. \end{aligned}$$

The tax or subsidy pair implied is

$$c - c^0 = WaM \left(1 + \frac{W_q q}{W} \right) - S_w W_q + q(WaM - S_w W/q) \frac{W_q}{W} \frac{dq^*}{dq} \Big|_{S_{q^*}^* = 0}. \quad (11)$$

$$c^* - c^{*0} = Wa^* M^* \left(1 + \frac{W_q^* q^*}{W} \right) - S_w^* W_q^* + q^*(Wa^* M^* - S_w^* W/q^*) \frac{W_q}{W} \frac{dq}{dq^*} \Big|_{S_q = 0}. \quad (12)$$

The first term on the right hand side of each equation is the efficient access charge for patrol costs and second term represents the local internalization motive. These are qualitatively the same as in the single market case.

The properties of the model sign the Nash policies according to the enforcement regimes. $\frac{dq^*}{dq} \Big|_{S_{q^*}^* = 0}$ has the sign of $c^* - M^* b^*$ while $WaM - S_w W/q$ has the sign of $waM + (1 - \alpha)w/\theta + \alpha(c - Mb)$ which can be negative for sufficiently large M (provided $\alpha b > wa$). Analogous conditions hold for Periphery policy. Thus:

Proposition 2 *When enforcement is weak or is sufficiently strong in both markets, the cross-market externality motive of Nash strategies acts to subsidize trade in both markets. In the dual economy, the cross market motive of Nash strategies acts to tax trade in both markets.*

As compared to unconnected markets, a dual economy with Nash commercial policies amplifies the divergence of regions by restricting trade in Core regions where congestion outweighs safety in numbers while also restricting trade in Periphery regions where the opposite is the case. Economic integration in the sense of improved labor mobility between markets can thus widen inequality.

In the case where the mobile capital T is owned by the merchants, G_c, G_{c^*} pick up an additional term $T dr_T/dc$ and $T^* dr_T/dc^*$ respectively. The added terms differ inessentially because because the two merchant interest governments have coincident interests in raising that part of rents due to mobile

capital. Their motives on this account always pushes toward trade subsidy when enforcement is weak and ordinarily do so when enforcement is strong. The localized capital interests continue to diverge, so it is a harmless simplification to concentrate on the simpler case where mobile capital is owned by the trader/predators.

2.2.2 Cooperative Tax/Subsidy Policies

Cross-market cooperation in commercial policy could be enforced by a regional government that can constrain the local authorities in the two markets. The joint surplus maximizing choice of c and c^* is defined by

$$\begin{aligned} 0 &= G_c + G_c^* \\ 0 &= G_{c^*} + G_{c^*}^*. \end{aligned}$$

Here the new cross effects G_c^* , G_{c^*} incorporate the effect of local policy on the other local government's objective function through both revenue and externalities via the labor market.

The jointly optimal commercial policies are defined by²²

$$(c - c^0) = WaM + (aMq + a^*M^*q^*)W_q - (S_w + S_w^*)W_q \quad (13)$$

and the analogous expression for the Periphery policy. The first two terms together comprise the efficient access charge for enforcement costs. As compared to the Nash policy, the cooperative access charge counts the enforcement cost increase in the partner's market. The third term internalizes the externality of trade in insecure markets. The implications are:

Proposition 3 *When externality internalization policies are set cooperatively, (a) trade should be subsidized (taxed) in mutual weak (strong) enforcement equilibrium. (b) In the dual economy, trade should ordinarily be taxed.*

The qualifier 'ordinarily' arises because the Core market should ordinarily be larger than the Periphery market, hence $S_w + S_w^*$ ordinarily has the sign of S_w . Compare (11) to (13). While cooperation reduces the Nash internalization tax that would be freely chosen by Core, it also imposes on Periphery a cooperative internalization tax instead of the Nash internalization subsidy that would be freely chosen by Periphery. Thus cooperative commercial policies tend to amplify differences between markets.

²²The derivation differentiates and divides through by dq/dc and dq^*/dc^* respectively. (13) satisfies the resulting equations.

3 Efficient Infrastructure Policy

The local ‘Core’ government or the local merchants can add a unit of infrastructure capital K at rental rate r . With secure markets, the optimal capital stock in the merchants’ interest would be the solution to $S_K(K, \cdot) = r$. Insecurity gives rise to externalities. The Core government sets its infrastructure policy to optimally internalize these externalities, and thus it controls both its own and the private capital stock to do so. At the margin, the private decisions are controlled with a tax or subsidy $S_K - r$. The local ‘Periphery’ government similarly can purchase infrastructure capital K^* at rental rate r . It optimizes to internalize externalities with a tax/subsidy $S_{K^*}^* - r^*$. When a regional government coordinates infrastructure policies, the internalization includes cross-market externalities that the Nash playing local governments do not internalize. All decisions are made for given (optimal) enforcement and commercial policy; i.e., no sequential decision-making.

3.1 Non-cooperative Policy

Efficient infrastructure policy is implied by

$$G_K = S_K - r + S_w[W_K + W_q q_K] + S_w W_{q^*} q_K^* + \lambda(c - c^0)q_K - r = 0. \quad (14)$$

Commercial policy is efficiently set, implying

$$G_c = 0 = \lambda(c - c^0) - (1 - \lambda)q/q_c + S_w W_q + S_w W_{q^*} \frac{dq^*}{dq} \Big|_{S_{q^*}^* = 0}. \quad (15)$$

Substituting from (15) into (14) yields

$$S_K - r = -S_w W_K + (\lambda - 1)qq_K/q_c. \quad (16)$$

S_K is the private rate of return, so in the absence of externalities ($S_w = 0$) and revenue motives ($\lambda = 1$), laissez faire is efficient. The right hand side represents the optimal tax or subsidy when either of these conditions is violated. Since $q_K > 0$, $q_c < 0$, the revenue motive implies it is efficient to subsidize infrastructure because it raises tax revenue, given the optimal trade tax.

The internalization motive is the key object of the analysis. $W_K < 0$ because a rise in capital at constant q implies that less labor is needed in trade

services, pushing down the wage rate.²³ Let $E = \alpha kq^{1/\alpha}$ denote employment in trade services. Formally

$$\frac{W_K K}{W} = -\frac{1-\alpha}{\alpha} \frac{E}{N-E-aMq+q/\theta} < 0. \quad (17)$$

in the single market case (while in the two market case the denominator in the second ratio expands to include $-E^* - aM^*q^* + q^*/\theta^*$). Note that the sign of W_K does not depend on the Cobb-Douglas specification: any neoclassical labor demand E would be wage inelastic.

Proposition 4 *Efficient internalization policy on infrastructure is a subsidy when enforcement is sufficiently strong ($S_w < 0$) and a tax when enforcement is weak ($S_w > 0$).*

The perverse consequence of insecure markets is that at the margin where tax/subsidy policy is efficient, infrastructure investment is actually harmful when enforcement is weak or even insufficiently strong: the reduction in employment at the efficient volume drives down wages and increases insecurity such that any measure of welfare falls.

3.2 Coordinated Regional Policy

The two competing local market authorities that set infrastructure policies independently do not internalize cross market externalities. A regional government can compel coordination.

Assume that commercial policies of both local governments are set to maximize joint surplus as in Section 2. Consider in sequence the Nash and coordinated infrastructure policies. For simplicity suppress the revenue motive: $\lambda = 1$.

The Nash policies are defined by

$$S_K - r + S_w W_K = 0 \quad (18)$$

$$S_{K^*} - r^* + S_w^* W_{K^*} = 0. \quad (19)$$

Both market authorities tax infrastructure when enforcement is weak and subsidize when enforcement is sufficiently strong.

²³The contrast with the usual intuition that an increase in K will raise the wage arises because W_K is evaluated at constant q . The full comparative static equilibrium effect incorporates the trade volume channel. The rise in K lowers unit trade cost at constant w , hence induces a rise in q which raises employment and in turn acts to raise the wage, $dw/dK = W_K + W_q dq/dK$.

The coordinated policies are defined by

$$S_K - r + (S_w + S_w^*)W_K = 0 \quad (20)$$

$$S_{K^*} - r^* + (S_w + S_w^*)W_{K^*} = 0. \quad (21)$$

In comparison to the coordinated policies, the Nash policies tax too little when enforcement is weak and subsidize too little when enforcement is sufficiently strong. When enforcement regimes are the same in both markets, coordinated policies just act in the same direction as the Nash policies but do more.

The dual economy case is defined by $S_w < 0, S_w^* >$. $S_w + S_w^*$ will be dominated, typically, by the strong enforcement market that, all else equal, has larger volume. Then

Proposition 5 *Efficient infrastructure policy in dual economies ordinarily subsidizes infrastructure in both markets, to the benefit of the Core and to the detriment of the Periphery.*

3.3 Growth

Economists are often optimistic about growth solving problems. The preceding discussion makes clear that capital accumulation need not solve the dual economy dilemma. The capital stocks are optimally selected given the conditions. In contrast, technological progress does indeed solve the dilemma and eventually all issues with insecurity of trade.

Growing economies of the type modeled above experience rising labor force N at rate n . Steady state growth implies that the capital stocks K, K^* , the trade volumes q, q^* rise at rate n . With these rates of change it is easy to verify from (7) that the equilibrium wage rate is unchanged because $q/K, q^*/K^*$ are constant. Insecurity in the two markets is unchanged because B, B^* rise at rate n . To be consistent with steady state growth, the other prices b, c, b^*, c^*, r, r^* in the partial equilibrium system must be constant.

Technological progress, in contrast, can eventually remove all externalities associated with insecurity. In the very long run, at least, the backward market will emerge into strong enforcement and then eventually secure trade.

4 Efficient Enforcement

Efficient enforcement solves the collective action problem posed by the provision of security and also internalizes the net externality arising from $S_w \neq 0$.²⁴ In Periphery such governmental effectiveness may not obtain, in which case M can be regarded as institutionally constrained. Coordination in a dual economy, in contrast to commercial and infrastructure policy, does not trade off equity for efficiency. The advantage of partial alignment of Core and Periphery interests in coordinated enforcement must be set against costs not modeled here of establishing efficient coordinated enforcement, especially in Periphery.

Enforcement requires patrols drawn from the common labor pool. Patrols cost $waMq$. The government pays for the patrols by billing traders the Nash efficient per unit charge $waM(1 + W_qq/W)$ or its cooperative analogue. Evaluating at the efficient commercial policy $c - c^0$ of Section 2, the efficient level of enforcement M turns out to be determined by the direct benefit of improved security S_M versus the cost arising from wage effects times the net externality: $-S_w W_M$.

Consider the effect of M on the wage, W_M . A rise in M has two effects on labor demand: it raises the patrol requirement for labor and it lowers the number of predators because it lowers the success rate of predation. The balance of these two effects determines the sign of W_M . Formally, labor market clearance implies the equilibrium wage is given by $W(q, M, q^*, M^*, k, k^*)$:

$$W(\cdot) = \frac{(1 - M)q + (1 - M^*)q^*}{N - aqM - aq^*M^* + q/\theta + q^*/\theta^* - \alpha kq^{1/\alpha} - \alpha k^*(q^*)^{1/\alpha}}.$$

Then

$$W_M = -\epsilon W(1 - aW)/(1 - M),$$

where $\epsilon \equiv q(1 - M)/[q(1 - M) + q^*(1 - M^*)] \in [0, 1]$. Hence

$$W_M > (<)0 \iff aw > (<)1$$

Analogously $W_{M^*} = -(1 - \epsilon)W(1 - a^*W)/(1 - M^*)$ with analogous sign conditions. The dual economy will typically have $W_M W_{M^*} < 0$, hence it is important to note that $W_M > 0$ and $W_{M^*} < 0$ is possible only if $a^* < a$, Periphery enforcement patrol labor costs are smaller than those of Core.

²⁴This setup abstracts from private enforcement such as arming by the traders, plausibly rationalized by the negative consequences of armed confrontations.

$a > a^*$ may be a plausible description of the *physical* requirements a, a^* in some potential dual economy settings, where the more complex and anonymous Core market requires more intense patrolling to achieve any given success rate. A slight extension of the model plausibly covers most Core-Periphery situations, reinterpreting a^* as the product of the physical force requirement and a Periphery market wage discount.²⁵

Efficient enforcement choice of a merchant interest government solves

$$\max_M S[q, W(q, M), M] + \lambda(c - c^0)q - Kr - W(\cdot)aM. \quad (22)$$

With $\lambda = 1$ for simplicity, the first order condition evaluated at the efficient commercial policy of Section 2²⁶ is

$$S_M + S_w W_M = 0. \quad (23)$$

$S_M = bq > 0$ while for an interior solution $S_w W_M < 0$. For low wage rates, $S_w > 0$ while $W_M < 0$ and for high wage rates $S_w < 0$ and $W_M > 0$, so interior solutions are possible in either range.²⁷

In the two market setting (23) and the analogous condition for the ‘Periphery’ market imply the Nash policies. Core $S_M = bq$ is likely to exceed Periphery $S_{M^*} = b^*q^*$.²⁸ For this reason, all else equal, the larger richer Core will enjoy better enforcement than Periphery.

²⁵Suppose there are segmented labor markets such that there is an equilibrium Periphery wage discount $\delta < 1$ (i.e., workers originating in Periphery can move to Core employment only by paying a migration cost). Then the Periphery wage is $w\delta$, and the wage equation above becomes

$$W(\cdot) = \frac{(1 - M)q + (1 - M^*)q^*/\delta}{N - aqM - aq^*M^* + q/\theta + q^*/(\delta\theta^*) - \alpha kq^{1/\alpha} - \alpha k^*(q^*)^{1/\alpha}}.$$

In this case W_{M^*} is signed by $-(1 - a^*\delta W)$.

²⁶Efficient commercial policy implies

$$c - c^0 = -S_w \left(W_q + W_{q^*} \frac{dq^*}{dq} \Big|_{S_{q^*}^* = 0} \right).$$

²⁷The analytic second order conditions are too complex to yield useful insight on conditions that restrict the possible solutions. Numerical simulations confirm that interior solutions exist for all policy instruments within reasonable parameter ranges.

²⁸Willingness to pay is higher in the richer Core, $b(x) > b^*(x)$, while equilibrium $q > q^*$. If demand is elastic, revenue must be greater in the larger market.

The connection between the two markets through the labor market implies a useful necessary condition for dual economy Nash enforcement equilibria. In the limiting case of equal patrol cost requirements $a = a^*\delta$, the labor market connection eliminates the dual economy because W_M and W_{M^*} must have the same sign. Taken together with the Nash policies (23) and its analog for Periphery, this implies that S_w and S_w^* have the same sign. *The dual economy arises only if $a^*\delta < a$.* Moving outside the model, the dual economy also arises with $a = a^*\delta$ but with an exogenous limit on Periphery patrol size representing local difficulties in enforcement provision.²⁹ With enforcement exogenously limited, $S_{M^*}^* + S_w^*W_{M^*} > 0$.

Nash policies do not internalize the cross-market externality. For example, the objective function of the ‘Periphery’ market authority changes with a small change in Core M by

$$S_w^*W_M$$

When enforcement is weak in the Periphery but strong in the Core, $S_w^*W_M$ is likely to be positive, implying that the Core does not sufficiently value enforcement, setting M too low. $S_wW_{M^*} > 0$ in a dual economy, so Periphery enforcement is similarly too low.

Coordinated enforcement policy internalizes the externality. The first order conditions imply

$$S_M = -(S_w + S_w^*)W_M \tag{24}$$

$$S_{M^*}^* = -(S_w + S_w^*)W_{M^*}. \tag{25}$$

Proposition 6 *Coordinated enforcement effort relative to Nash enforcement (a) in the dual economy rises in both Core and Periphery, (b) rises with mutual weak enforcement ($S_w, S_w^* > 0$). (c) falls with mutual strong enforcement sufficient to cause ($S_w, S_w^* < 0$).*

W_M and W_{M^*} must have the same sign in coordinated enforcement equilibrium since the left hand sides of the preceding equations are positive. As compared to Nash equilibrium in a dual economy, the equilibrium wage must be higher in order to flip the sign of W_{M^*} . A dual economy ($S_wS_w^* < 0$) remains possible. Periphery must benefit from the higher wage and the higher

²⁹Difficulties in governance limit public good enforcement effort, especially in the Periphery market. Uncoordinated Periphery enforcement by atomistic merchants fails due to the free rider problem. Larger merchants might sustain equilibria with positive enforcement. Modeling governance in Periphery or Core is an important topic beyond the scope of this paper. See Dixit (2004) for an interesting start on modeling governance.

M^* . In contrast to commercial and infrastructure policy, coordination of enforcement effort does not penalize the Periphery to benefit the Core. Relative to dual economy Nash equilibrium, Core benefits from better enforcement but loses from the higher wage. The net effect can be positive or negative.

While the benefit of coordinated enforcement suggests that Periphery would readily cooperate, the initial movement from Nash enforcement necessarily lowers government welfare G^* and suggests resistance to cooperation.

5 Formal and Informal Markets

Parallel formal and informal markets are modeled by interpreting Periphery as the informal market. Smuggling is common and simplifies the analysis of formal Core government policy toward informal Periphery because consumption of the smuggled good does not directly harm Core's interest. The Periphery 'government' is interpreted as a Mafia that provides enforcement and infrastructure access to smugglers. The interpretation suggests that weak enforcement obtains for Periphery, so that is assumed here: $c^* - M^*b^* > 0$. Core may similarly have weak enforcement, or it may be strong enough to form a dual economy with Periphery.

The only new analytical element is that Core policy includes tolerance or intolerance of the informal activity, interpreted to mean the Core government can affect the cost of the smuggled goods c^* , the size of informal infrastructure K^* and the quality of informal enforcement M^* . Thus Core government is characterized by a limiting case of extreme power relative to the Mafia. More realistic cases require modeling the interaction of Mafia and government.

5.1 Commercial Policy with Smuggling

The comparative statics of commercial policy yield a few useful implications. Weak enforcement Core markets with smuggling will have larger dq/dc than those without smuggling. Strong enforcement in the Core market with weak enforcement in the gray market implies a smaller, perhaps even negative response in legal trade volume to a fall in external price. The presence or absence of smuggling thus may help to explain puzzling cross market differences in the response of observed trade to common stimuli.

Efficient legal trade policy is determined by the sum of (11) and the efficient revenue tax $\tau^R = (\lambda - 1)q/(-q_c)\lambda$. The implication is that revenue

motives conflict with internalization in weak enforcement regimes. This suggests that high tax/high smuggling equilibria are costly in not being able to fully address the internalization motive.

Anti- or pro-smuggling policy can improve efficiency. Suppose c^* can change by some costless action, such as permitting or denying smugglers access to port facilities. The effect gives the benefits of anti-smuggling policy, against which any costs of anti-smuggling would have to be set. The effect of anti-smuggling policy on the government objective function is

$$G_{c^*} = [\lambda\{(c-c^0)+W_aM(1+W_qq/W)\}+S_wW_q]dq/dc^*+[S_wW_{q^*}+\lambda aMqW_{q^*}]dq^*/dc^*. \quad (26)$$

With efficient $c - c^0$ defined by (11) substituted into (26), after canceling and rearranging, the implication is

$$G_{c^*} = \lambda\tau^R \frac{dq}{dc^*} \quad (27)$$

With weak enforcement in Core, $dq/dc^* < 0$, while with strong enforcement $dq/dc^* > 0$.

Summarizing the implications:

Proposition 7 *With revenue-motivated efficient trade taxes, efficient smuggling policy: (a) encourages smuggling when enforcement is weak, (b) suppresses smuggling when enforcement is strong.*

The analysis illuminates a crucial regime change in British policy toward its American colonies around 1763, the end of the Seven Years War (called the French and Indian War in its North American aspect). Official toleration of smuggling prevailed for a century prior to 1763 as smugglers almost openly used the major American ports. Afterwards, British intolerance of smuggling fueled resentment leading to the American Revolution. Trade tax revenue was important throughout.

Think of British policy toward a single port town. Weak enforcement in legal and gray markets prevailed prior to 1763 as British naval forces contended with their European rivals. In terms of the model, $dq/dc^* < 0$ and dq^*/dc^* was large. After 1763, the released British naval forces suppressed piracy in its Caribbean bases. By implication the legal market equilibrium shifted to a strong enforcement regime where $dq/dc^* > 0$ and intolerance of smuggling became rational for a government in the *legal* merchants' interest.³⁰

³⁰The model offers a novel economic interest explanation of the bitter divisions within

In contrast, the usual economic explanation for the regime change of 1763 is the increased demand for revenue by the British government following its expensive war with the French.³¹ In terms of the model, however, an increased appetite for revenue cannot cause a regime change from tolerance to intolerance of smuggling. A revenue motivated government would have still more incentive to accommodate smuggling when enforcement was weak. In contrast, if enforcement had been strong throughout, the incentive to attack smuggling would have been present throughout, although the incentive is increased by the rise in λ , G_{c^*} rises.

A limitation of the model is that the exogeneity of b to q^* shuts down a possible motive for anti-smuggling policy which could raise the willingness to pay for legal goods. However, this motive would also have operated before 1763, so it cannot explain the regime shift.

5.2 Infrastructure and Informal Markets

Informal markets are commonly found alongside formal ones. The efficient policy of the Core government in this setting reverts to its Nash policy, because the ‘legitimate’ government naturally cares much less about agents in the informal market. A new element is introduced because the formal market government can adopt policy to discourage or encourage informal sector capital. In such settings, the revenue motive is normally important; the informal market evades taxes that the formal market pays.

Suppose that the government has some control over the amount of informal capital K^* . The benefit to the formal market of a reduction in informal

the colonies during the Revolution: the switch to intolerance benefitted legal merchants while harming the merchant capital tied up in the illegal market, along with harming the common sailors. Loyalists have been estimated to comprise as much as 1/3 of the population during the Revolution. In contrast, prior to 1763 the British policy of ‘benign and salutary neglect’ aided all three groups.

³¹The increased revenue demand story is somewhat problematic because the revenue motive operated during and prior to the war years too, when Americans under threat from the French and their native allies had a strong incentive to cooperate with the British in raising revenue for their defense, as indeed they did with funding colonial militias. Another problem with the revenue demand story is the relatively small revenues involved in actual British tax plans. The economic motive of this paper complements a plausible non-economic story offered by historians. After 1763 there was a shift to centralized and rational bureaucratic administration throughout the British Empire.

capital (for given q, M, q^*, M^*) is given by:

$$S_w W_{K^*} \tag{28}$$

The implication is:

Proposition 8 *When enforcement is weak in the formal market, government policy discourages informal infrastructure. When enforcement is sufficiently strong, informal infrastructure is encouraged.*

Proposition 8 provides a rationale for the tolerance often shown by legitimate governments toward capacity building in informal sectors.

A promising alternative is for the government to take over the informal market, reverting to the coordinated optimal policies of the preceding subsection. This is certainly more efficient, absent cost considerations, than the stance of Proposition 8. But when enforcement is sufficiently strong in the formal market and weak in the informal market, the dual economy dilemma arises again, meaning that the informal market agents lose from the takeover. The resistance of the informal actors may prevent a formal takeover and certainly would raise its cost.

5.3 Enforcement in Informal Markets

Applied to formal and informal market pairs in a dual economy, the Core authorities have an incentive to tolerate the informal Periphery enforcement provided by Mafias or gangs: $S_w W_{M^*} > 0$.³² Notice the similarities and differences of the rationale here with the tolerance for smuggling in Section 3 and the tolerance for informal sector capacity building in Section 4. Smuggling is tolerated when Core enforcement is weak and discouraged when it is strong. Informal market enforcement and infrastructure building are tolerated when Core enforcement is strong and discouraged when it is weak. These predictions of the model give insight into the apparent variety of government stances toward informal sector activity.

6 Conclusion

his paper provides a formal model of efficient tax, infrastructure and enforcement policy in an economy where trade is subject to predation. The

³²Mafias are often thought to provide enforcement to productive activity against petty predators. See Dixit (2004) for example.

interaction of trade and predation is a mechanism that gives an efficiency rationale for the apparent prevalence of Core-Periphery structures in which government policy amplifies or at best does not ameliorate inequalities in crime rates and prosperity within regions or cities. Efficient policy internalizes the externalities of trade on cost and security. Cross-market externalities impel regional cooperation in setting policies. Cooperation in commercial and infrastructure policy helps the Core at the expense of the Periphery. Cooperation in enforcement will ultimately help Periphery but initial moves toward cooperative enforcement harm it. Thus, as with commercial and infrastructure policy, Periphery has reason to resist cooperation with Core.

Periphery is less secure than Core as an equilibrium outcome, an important element of realism. But government agents with revenue (tax/subsidy) or enforcement (patrol) responsibilities are uniformly honest. Extending the model to explain equilibrium levels of corruption that are larger in Periphery than in Core would be an important advance in realism. Acemoglu and Verdier (2000) offer clues about modeling equilibrium corruption in a different setting.

Informal markets governance is thinly characterized: either the same as formal governance, or completely under Core governance. A more realistic treatment of the interaction between legitimate government and Mafias should be fruitful. Moreover the institutions of informal market governance themselves can fruitfully be analyzed as endogenous. Presumably, more dispersed markets are more difficult to organize for any type of governance.

7 References

Acemoglu, Daron and Thierry Verdier (2000), “The Choice Between Market Failures and Corruption”, *American Economic Review*, 90, 194-211.

Anderson, J. E. and O. Bandiera (2006), “Traders, Cops and Robbers”, *Journal of International Economics*, 70(1), 197-215.

Anderson, James E. and Douglas Marcouiller (2002), “Insecurity and the pattern of trade: an empirical investigation”, *Review of Economics and Statistics*, 84, 345-52.

Anderson, James E. and Douglas Marcouiller (2005), “Anarchy and Autarky: Endogenous Predation as a Barrier to Trade”, *International Economic Review*, 46, 189-214.

Banerjee, A.V. and Newman, A.F. (1998), “Information, the Dual Economy and Development”, *Review of Economic Studies*, 65, 1011-34.

Brunetti, Aymo, Gregory Kisunko and Beatrice Weder (1997), “Institutional Obstacles to Doing Business: Region-by-region Results from a Worldwide Survey of the Private Sector”, World Bank Policy Research Paper No. 1759.

Dixit, Avinash K. (2004), *Lawlessness and Economics: Alternative Modes of Economic Governance*, Princeton: Princeton University Press.

Skaperdas, Stergios and Constantinos Syropoulos (2001), “Guns, Butter, and Openness: On the Relationship Between Security and Trade”, *American Economic Review, Papers and Proceedings*, 91(2), 353-357.

Skaperdas, Stergios and Constantinos Syropoulos (2002), “Insecure Property and the Efficiency of Exchange,” *Economic Journal*, 112, 133-146.

Vines, D. and A. Zeitlin (2008), “Dual Economies” in S.N. Durlauf and L.E. Blume, eds *The New Palgrave Dictionary of Economics*, 2nd Edition, Palgrave-Macmillan.

8 Appendix

8.1 Comparative Statics of Equilibrium

Increases in M ordinarily raise dq/dc , decreasing its absolute value, while increases in N ordinarily raise the absolute value of dq/dc . Here is the proof.

Competitive trade volume is determined by $S_q = 0$. Then since $S_{qc} = -1$, $dq/dc = 1/S_{qq} < 0$. Examining the effect of a rise in N in Figure 1, q decreases. $d^2q/dcdN = -S_{qqq}/S_{qq}^2 dq/dN$. $S_{qqq} < 0$ ordinarily, and necessarily so if $b_{qq} + S_w W_{qq} < 0$. Then dq/dc falls algebraically, hence rises in absolute value.

Differentiating S_{qq} with respect to M yields $d^2q/dcdM = -S_{qq}^{-2}[S_{qqM} + S_{qqq}dq/dM]$. Evaluating S_{qq} shows that its dependence on M comes through its dependence on w . Noting that $W_M = -W/(1 - M)$ and hence $W_{qM} = -W_q/(1 - M)$, $S_{qqM} < 0$. Moreover, $dq/dM > 0$ and $S_{qqq} < 0$ ordinarily. Then dq/dc is ordinarily increasing algebraically, becoming less responsive in absolute value, the greater is M .