



ELSEVIER

Journal of Development Economics 83 (2007) 157–175

JOURNAL OF
Development
ECONOMICS

www.elsevier.com/locate/econbase

Historical legacies: A model linking Africa's past to its current underdevelopment

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Received 22 July 2004; received in revised form 24 November 2005; accepted 23 December 2005

Abstract

Recent studies have found evidence linking Africa's current under-development to colonial rule and the slave trade. Given that these events ended long ago, why do they continue to matter today? I develop a model, exhibiting path dependence, which provides one explanation for why these past events may have lasting impacts. The model has multiple equilibria: one equilibrium with secure property rights and a high level of production and others with insecure property rights and low levels of production. I show that external extraction, when severe enough, causes a society initially in the high production equilibrium to move to a low production equilibrium. Because of the stability of low production equilibria, the society remains trapped in this suboptimal equilibrium even after the period of external extraction ends. The model provides one explanation why Africa's past events continue to matter today.

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JEL classification: B52; C72; D72; D74; J24

Keywords: History dependence; Multiple equilibria; Africa; Colonialism; Trans-Atlantic slave trade

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doi:[10.1016/j.jdeveco.2005.12.003](https://doi.org/10.1016/j.jdeveco.2005.12.003)

1. Introduction

Africa's economic performance since independence has been poor. One explanation for this poor performance is Africa's unique history, characterized by two events: the slave trade and colonial rule. Recently, a number of empirical studies have found evidence supporting this explanation. These studies find that a country's colonial heritage (Bertocchi and Canova, 2002; Price, 2003) and the identity of the colonizer (Grier, 1999; Bertocchi and Canova, 2002) are important determinants of subsequent economic growth. Lange (2004) finds that among former British colonies, those that were governed by indirect rule are now less politically stable and have a worse rule of law. Englebert (2000a,b) finds that the inadequacies of arbitrarily imposed post-colonial institutions explains a significant proportion of the underdevelopment of the countries of sub-Saharan Africa. Acemoglu et al. (2001, 2002) show that in former colonies where the colonizer's focus was on extraction, weak institutions of private property were established and these poor institutions persist today. Nunn (2004) considers the long-run effects of Africa's slave trades. He finds that, looking across countries, the larger the number of slaves taken during the slave trades, the worse is the country's subsequent economic performance.

Given the mounting evidence of a relationship between Africa's past and its current economic performance, a natural question arises. Why do these events, which ended years ago, continue to matter today? I develop a model, exhibiting path dependence, which provides one explanation for why these past events may have lasting impacts. The model highlights the effect that colonial rule and the slave trade may have on the security of private property, and as a result, the level of production in the economy. The model focuses on one specific channel through which colonialism and the slave trade may affect Africa's underdevelopment. I do not believe that this is the only channel of influence. Many other channels are possible, although I do not explore them here. For example, I do not consider the possible effects of assassinations of indigenous leaders during colonialism, declines in indigenous populations during the slave trade, or the impact of colonial rule on current international economic relations.

The model developed has two stages. In the first stage, a colonizer chooses a policy that has two instruments: the rate of extraction and the amount of resources to devote towards the enforcement of domestic property rights. The model's second stage focuses on an important determinant of Africa's poor performance: the widespread presence of robbery, theft, fraud, corruption, and civil conflict (World Bank, 2005). To model these activities, I use a distinction recently made by Bhagwati (1982) and Baumol (1990) between 'productive' and 'unproductive' activities. Individuals engaged in productive activities receive a payoff by producing output. Those engaged in unproductive activities receive a payoff by appropriating the output of producers. Because unproductive activities simply redistribute value, those engaged in these activities gain at the expense of the producers that are taken from. Therefore, unproductive activities exert a negative externality on those engaged in productive activities, while productive activities do not exert a negative externality. This is the core difference between the two types of activities. A number of other studies make this same distinction (see Hirshleifer, 1991; Skaperdas, 1992; Murphy et al., 1991, 1993; Acemoglu, 1995; Grossman and Kim, 1995; Francois and Balland, 2000; Lloyd-Ellis and Marceau, 2003). In the analysis, I use the terminology of Baumol

(1990) and call individuals engaged in productive activities ‘productive entrepreneurs’ and those engage in unproductive activities ‘unproductive entrepreneurs’.

When the colonizer is absent, the second stage subgame always has an equilibrium with only productive entrepreneurs. I call this the high production equilibrium. In this equilibrium, because everyone is engaged in productive activities, the return to production is high, causing individuals to remain engaged in productive activities. The game may also have low production equilibria, where many entrepreneurs are engaged in unproductive activities. In these equilibria, because many entrepreneurs are engaged in unproductive activities, the return to production is low, and this further discourages individuals from engaging in productive activities. In the model, multiple equilibria arise naturally from the interaction between productive and unproductive activities. Others have developed models of rent-seeking (Murphy et al., 1993; Acemoglu, 1995) or predation (Mehlum et al., 2003) in which multiple equilibria arise through a similar channel.

When a colonizer is present and if she chooses a high enough level of extraction in the first stage, then in the second stage, the high production equilibrium disappears, leaving a unique low production equilibrium. This arises because of an asymmetry between those engaged in the two types of activities. Individuals engaged in unproductive activities are able to avoid extraction, while individuals engaged in productive activities are not. In the end, the introduction of foreign extraction can move a society initially in the high production equilibrium to a low production equilibrium. Following the period of colonial extraction, the high production equilibrium returns, but because of the stability of the low production equilibrium, the society remains trapped in this equilibrium.

This outcome describes one of two possible equilibria of the full game. I call equilibria of this type ‘underdevelopment equilibria’. There also exist ‘development equilibria’, in which the optimal colonial policy is one of low rates of extraction and high levels of protection of private property. In these equilibria, a society initially in the high production equilibrium remains in this equilibrium during and after colonial rule. Underdevelopment equilibria provide one explanation for the historical origins of Africa’s underdevelopment. To summarize, the model’s explanation is as follows:

- Prior to European contact, many African societies are located in high production equilibria.
- During contact, external extraction lowers the return to productive activities relative to unproductive activities. This causes the high production equilibrium to disappear, leaving a unique low production equilibrium.
- Individuals switch from productive activities to unproductive activities, as the society moves to the new equilibrium.
- After the period of extraction, the high production equilibrium again exists. However, the society is now trapped in a low production equilibrium. The stability of this suboptimal equilibrium makes moving to the more efficient high production equilibrium difficult.

This paper is related to Darity (1982) and Findlay (1990), who also model the impact that European contact had on Africa. The authors develop general equilibrium models of

three corner trade between Europe, Africa and the colonies in the Americas. The analysis here is most closely related to the focus of Darity (1982). In his model, Darity allows for the possibility that the slave trade resulted in higher costs of producing products in Africa, and that Africans were not fully compensated for the slaves taken from the continent. Darity then uses the model's predicted rates of income growth in Africa, Europe and the colonies to test the proposition that the Atlantic slave trade was responsible for Europe's development and Africa's underdevelopment.

In the following section, I describe the game in detail, characterizing the players' optimal strategies and the game's set of equilibria. In Section 3, I show that the predictions of the model are consistent with Africa's history. In Section 4, I show how the model provides insights into the findings of recent empirical studies. Section 5 concludes.

2. The model

The players of the game consist of a continuum of members of an African society and one foreign colonizer.

In the first stage, the colonizer moves, choosing a policy that consists of two instruments. The first is the rate of extraction τ . This is the fraction of each productive entrepreneur's production that is expropriated. The second instrument is the amount of resources devoted towards enforcing the security of private property in the society. These resources determine the proportion $q \in (0, 1)$ of a productive entrepreneur's output that an unproductive entrepreneur can steal in the second stage. The cost to the colonizer of a policy that generates q is $c(q)$, where $c'(q) < 0$ and $\lim_{q \rightarrow 0} c'(q) = \infty$.

In the second stage, each member of the society chooses whether to engage in productive activities or unproductive activities; these decisions are made simultaneously. Each individual engaged in productive activities produces the output A . Each individual engaged in unproductive activities, when successful, obtains the proportion q of the output of a productive entrepreneur. Search is costless and unproductive entrepreneurs can perfectly identify productive entrepreneurs. In this environment, the probability of an unproductive entrepreneur's success depends on the division of the population between productive and unproductive entrepreneurs. Denote the fraction of unproductive entrepreneurs by x . If there are fewer unproductive entrepreneurs in the society than productive entrepreneurs ($x < .5$), then each unproductive entrepreneur finds a productive entrepreneur to rob with certainty; otherwise, the probability of an unproductive entrepreneur's finding a productive entrepreneur to rob is $\frac{1-x}{x}$. Therefore, the probability of an unproductive entrepreneur's finding a productive entrepreneur can be written: $\Pr(\text{successful theft}) = \min\{\frac{1-x}{x}, 1\}$. By a similar logic, the probability of an entrepreneur's losing the fraction q of her output is: $\Pr(\text{stolen from}) = \min\{\frac{x}{1-x}, 1\}$.

A producer's expected payoff is equal to the net return when robbed, $(1-\tau)(1-q)A$, multiplied by the probability of being robbed, $\min\{\frac{x}{1-x}, 1\}$, plus the return when not robbed, $(1-\tau)A$, multiplied by the probability of not being robbed, $1 - \min\{\frac{x}{1-x}, 1\}$:

$$\pi_P(x, \tau, q) = \min\left\{\frac{x}{1-x}, 1\right\}(1-\tau)(1-q)A + \left(1 - \min\left\{\frac{x}{1-x}, 1\right\}\right)(1-\tau)A$$

Simplifying yields

$$\pi_P(x, \tau, q) = (1 - \tau)A \left(1 - q \min \left\{ \frac{x}{1-x}, 1 \right\} \right).$$

The expected payoff of an unproductive entrepreneur is equal to the return to successful theft, qA , multiplied by the probability of successful theft, $\min \left\{ \frac{1-x}{x}, 1 \right\}$. When unsuccessful, an unproductive entrepreneur receives a payoff of zero. Thus, an unproductive entrepreneur’s expected payoff is

$$\pi_U(x, \tau, q) = \min \left\{ \frac{1-x}{x}, 1 \right\} qA$$

Because the colonizer is unable to extract from individuals that do not produce, τ does not directly enter an unproductive entrepreneur’s payoff.

The colonizer receives revenues from expropriated production and incurs the cost $c(q)$ to maintain q . Thus, the colonizer’s payoff is

$$\pi_C(x, \tau, q) = \tau \left[A \left(1 - q \min \left\{ \frac{x}{1-x}, 1 \right\} \right) \right] (1-x) - c(q). \tag{1}$$

An important assumption of the model is that the colonizer is only able to tax entrepreneurs that produce. This captures an important feature of foreign extraction in Africa: those engaged in unproductive activities, such as bandits, slave raiders, warlords, and mercenaries, were better able to avoid European extraction than those engaged in productive activities. As I discuss in more detail in Section 3, Europeans had difficulty extracting from unproductive entrepreneurs because they were able to either retaliate, flee, or steal back from the Europeans. In addition, Europeans required their help to extract resources from the rest of the population. During the slave trade, slave raiders, slave traders and middlemen were needed to capture slaves and to bring them to the coast, and during colonial rule Africans were required to work in the colonial army, bureaucracy, treasury or police force.

2.1. Second stage: pre-contact Africa

The second stage of the game without extraction, $\tau=0$, and with the security of property q determined exogenously models pre-contact Africa. In this environment, payoffs are written as functions of x only: $\pi_P(x)$ and $\pi_U(x)$.

A strategy profile is a Nash equilibrium of the subgame if and only if either $x=0$ and $\pi_U(x) \leq \pi_P(x)$, $0 < x < 1$ and $\pi_U(x) = \pi_P(x)$, or $x=1$ and $\pi_U(x) \geq \pi_P(x)$. The set of possible Nash equilibria is most easily seen by graphing $\pi_P(x)$ and $\pi_U(x)$ against x for different efficiencies of theft q . This is done in Fig. 1.

As the figure shows, the slopes of the two value functions switch their relative sizes before and after $x=.5$. That is, $\frac{\partial \pi_U(x)}{\partial x} > \frac{\partial \pi_P(x)}{\partial x}$ if $0 \leq x \leq .5$ and $\frac{\partial \pi_U(x)}{\partial x} < \frac{\partial \pi_P(x)}{\partial x}$ if $.5 \leq x \leq 1$. This feature of the payoff functions is the reason for the game’s multiple equilibria. Here multiple equilibria arise because of the interaction between the two types.¹ Increases in

¹ In the models of Murphy et al. (1993), Acemoglu (1995) and Mehlum et al. (2003) multiple equilibria also arise through a similar interaction between the agents in the economy.

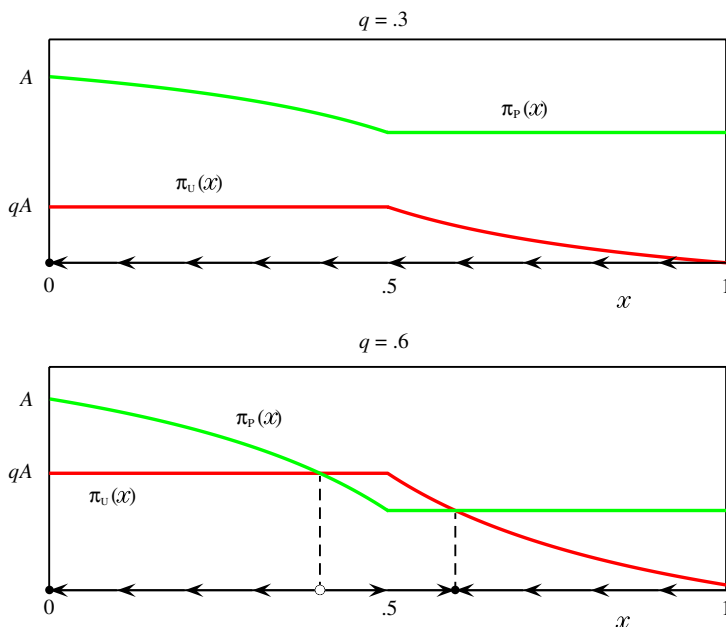


Fig. 1. $\pi_p(x)$ and $\pi_u(x)$ graphed against x , assuming different values of q . ● and ○ indicate Nash equilibria. ● indicates a stable equilibrium, and ○ indicates an unstable equilibrium.

x affect differently the returns to productive and unproductive entrepreneurs. When $x < .5$, an increase in x has no effect on unproductive entrepreneurs, because each unproductive entrepreneur still finds a productive entrepreneur to rob with certainty. However, an increase in x increases each productive entrepreneur’s probability of being robbed, and therefore decreases the expected payoff of productive entrepreneurs. When $x > .5$, then all productive entrepreneurs are stolen from with certainty and an increase in x no longer decreases a productive entrepreneur’s expected payoff. However, now the expected payoff to an unproductive entrepreneur is strictly decreasing in x , because an increase in x decreases each unproductive entrepreneur’s probability of finding a productive entrepreneur to steal from.

The following proposition describes the set of Nash equilibria.²

Proposition 1. *For all values of q and A , the second-stage subgame has a Nash equilibrium in which every person chooses to produce, $x^* = 0$. If $q < .5$, this equilibrium is unique. If $q = .5$, the subgame has one additional equilibrium with $x^* = .5$. If $.5 < q < 1$, the subgame has two additional equilibria; one with $x^* = 1 - q < .5$ and the other with $x^* = q > .5$.*

As stated in Proposition 1, absent external contact a high production equilibrium with $x = 0$ always exist and for low values of q this equilibrium is unique. For sufficiently high

² All proofs are available from the author’s web page: www.econ.ubc.ca/nunn.

values of q other equilibria with both productive and unproductive activities chosen also exist.

In the next section, I consider how the game’s set of Nash equilibria change with the introduction of foreign extraction.

2.2. Second stage: post-contact Africa

To analyze the changes that occur following European contact, I consider the model in a dynamic environment. As Krugman (1991) and Matsuyama (1991) discuss, in models with multiple equilibria, equilibrium selection can occur through history or expectations. My analysis here focuses solely on history. I do not consider the role expectations play in equilibrium selection.

I assume that in each period t the population is imperfectly informed about the value of x_t . In every period, each player with probability $\gamma > 0$ compares her payoff in the previous period to that of another randomly selected player. If the other player’s payoff is higher, then she switches. Otherwise, she maintains her original strategy. As Gintis (1997) shows, these assumptions give rise to the standard replicator dynamic, which in this environment is

$$\frac{x_{t+1} - x_t}{x_t} = \gamma [\pi_U(x_t, \tau, q) - \bar{\pi}(x_t, \tau, q)] \tag{2}$$

if $x_t > 0$, where $\bar{\pi}$ is the average payoff of the full population,

$$\bar{\pi}(x_t, \tau, q) = x_t \pi_U(x_t, \tau, q) + (1 - x_t) \pi_P(x_t, \tau, q). \tag{3}$$

I make the additional assumption that a very small proportion of the population $\varepsilon > 0$ is fully informed about the game³ and therefore these individuals choose in each period the strategy that yields the highest payoff.⁴ Therefore, when $x_t = 0$, if $\pi_U(0, \tau, q) - \pi_P(0, \tau, q) \leq 0$, then $x_{t+1} = 0$, but if $\pi_U(0, \tau, q) - \pi_P(0, \tau, q) > 0$, then $x_{t+1} = \varepsilon$. Combining this with (2) and (3) yields

$$x_{t+1} - x_t = \begin{cases} \varepsilon & \text{if } x_t = 0 \text{ and } \pi_U(0, \tau, q) > \pi_P(0, \tau, q) \\ F(x_t) & \text{otherwise} \end{cases}$$

where $F(x_t) \equiv x_t(1 - x_t)\gamma [\pi_U(x_t, \tau, q) - \pi_P(x_t, \tau, q)]$.

A Nash equilibrium x^* is stable if and only if $F'(x^*) < 0$. This condition ensures that a small perturbation of x away from x^* results in a subsequent movement in x back to x^* . It is useful to define the *basin of attraction* of a stable equilibrium x^* . The basin of attraction of x^* is the set of points x_0 such that a trajectory through x_0 converges over time to x^* .

The dynamics of the subgame are illustrated by the arrows on the x -axis in Fig. 1. As the figure shows, the high production equilibrium is stable and one of the two equilibria

³ It is assumed that ε is sufficiently small that the actions of this fraction of the population can be ignored in expression (2).

⁴ Without this modification members from a population with $x = 0$ do not switch to unproductive activities when $\pi_U(0, \tau, q) > \pi_P(0, \tau, q)$.

that exist when $q > .5$ is stable and the other is unstable. The following proposition completely states the dynamic properties of the subgame's equilibria.

Proposition 2. *For all values of q and A , the second-stage subgame has a stable Nash equilibrium with $x^* = 0$. If $q = .5$, the subgame has one additional unstable equilibrium with $x^* = .5$. If $.5 < q < 1$, the subgame has one additional stable equilibrium with $x^* = q > .5$ and one unstable equilibrium with $x^* = 1 - q < .5$. The unstable equilibrium defines the border of the basins of attraction of the two stable equilibria.*

I now consider the impact that European extraction has on the African society. From Proposition 2, we know that without extraction there always exists a high production equilibrium. However, as Proposition 3 states, if extraction is severe enough, then the high production equilibrium disappears, leaving a unique, stable low production equilibrium.

Proposition 3. *If $\tau > 1 - q$, then the game has a unique, stable Nash equilibrium with $x^* = \frac{q}{q + (1 - \tau)(1 - q)} > .5$.*

The logic behind Proposition 3 is illustrated in Fig. 2. As shown, increases in τ have asymmetric effects on the payoff to each activity. Increases in τ decrease the payoff to productive activities, while leaving the payoff to unproductive activities unchanged. Therefore, as τ is increased, eventually at $x = 0$ the payoff to unproductive activities becomes larger than the payoff to productive activities, and this leaves a unique low production equilibrium.

2.3. An explanation of Africa's underdevelopment

Using the properties of the model developed to this point, I provide one explanation for the historical origins of Africa's underdevelopment. The explanation is illustrated in Fig. 3. The top graph of the figure illustrates an African society initially located in the high production equilibrium x_0^* prior to European contact.

The situation after European contact is shown in the middle graph of Fig. 3. As shown, if the colonizer chooses a level of extraction so high that $\tau > 1 - q$, then the high production equilibrium x_0^* disappears, leaving a unique stable low production equilibrium x_2^* . Each period, individuals previously engaged in productive activities switch to unproductive activities, causing x to increase over time. This continues until x_2^* is reached.

The situation following independence is illustrated in the bottom graph of Fig. 3. After independence, τ returns to zero. If at independence, $x > x_B$, then after independence x will converge to the low production equilibrium x_3^* . In the end, colonial extraction permanently moves a society initially in the high production equilibrium x_0^* to a low production equilibrium x_3^* .

2.4. First stage—the colonizer's strategy

The model's explanation for the historical origins of Africa's underdevelopment relies on the assumption that it is optimal, at least under some conditions, for the colonizer to choose values of τ and q that satisfy $\tau > 1 - q$. I now consider the first stage of the game

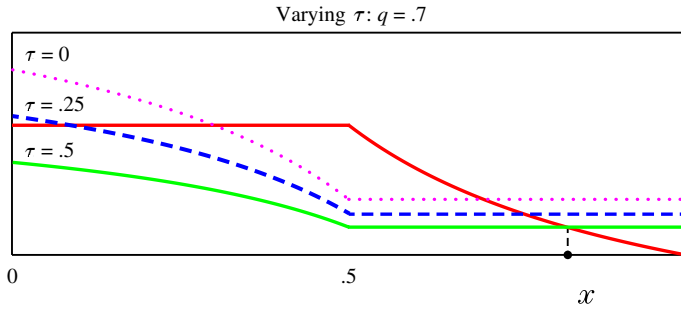


Fig. 2. Illustration of Proposition 3. If τ is high enough then a unique stable Nash equilibrium exists.

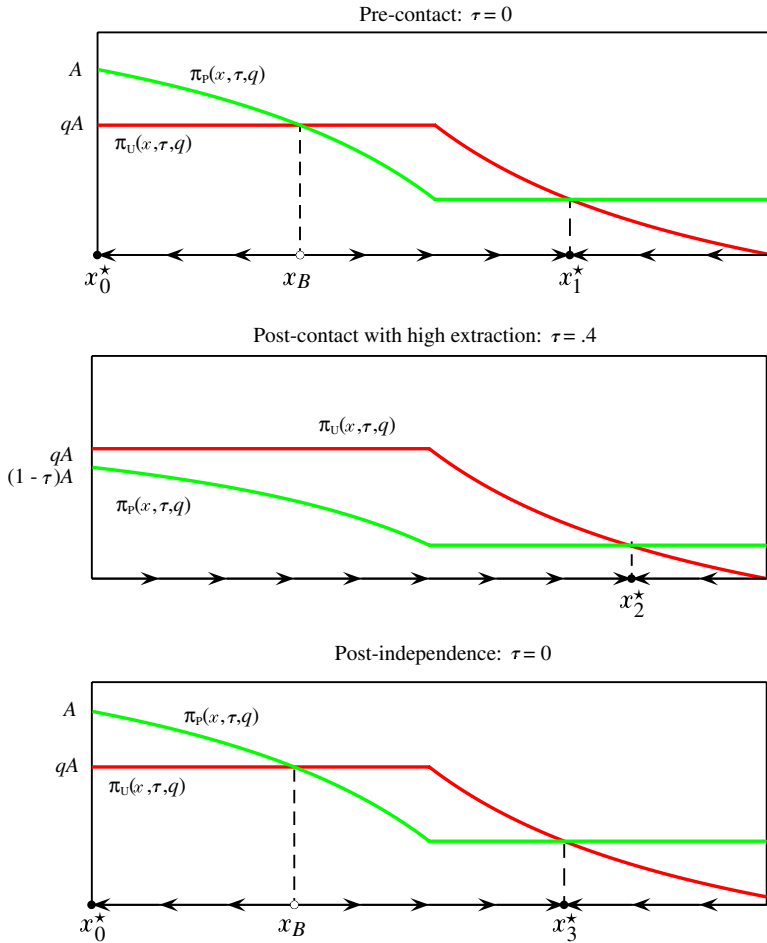


Fig. 3. An explanation for the historical origins of Africa's underdevelopment. In each figure $q = .7$.

and show that there are two possible optimal strategies for the colonizer and that under one of the two strategies $\tau > 1 - q$.

In choosing the rate of extraction τ and the protection of private property, which determines q , the colonizer is choosing what institutions to implement in the colony. Because in reality it is difficult to adjust these institutions each period, I assume that the colonizer's choice of (τ, q) is made once-and-for-all. I also assume that after each period of play, with probability $1 - \delta$ where $\delta \in (0, 1)$, the colonizer loses control of the colony. The colonizer's expected payoff over the infinite horizon is given by

$$\Pi_C(\tau, q) = (1 - \delta) \sum_{t=0}^{\infty} \delta^t \pi_C(x_t, \tau, q). \tag{4}$$

I consider a society that is initially located in the high production equilibrium $x_0=0$. Given this initial population distribution, the colonizer's optimal choice of (τ, q) must satisfy $\tau \geq 1 - q$. If $\tau < 1 - q$, then $x_t=0$ for all t , and from (1) and (4), the colonizer's payoff is given by $\Pi_C(\tau, q) = \pi_C(0, \tau, q) = \tau A - c(q)$, which is strictly increasing in τ . Any strategy (τ, q) , with $\tau < 1 - q$, is strictly dominated by the strategy (τ', q) with $\tau' = 1 - q$. Therefore, any strategy with $\tau < 1 - q$ is not optimal.

Among the strategies that satisfy $\tau \geq 1 - q$, I consider two types:

1. Strategies with $\tau > 1 - q$, which I call short-run strategies (SR). As shown, these strategies cause x_t to converge to $x^* = \frac{q}{q + 1 - (1 - \tau)(1 - q)}$.
2. Strategies with $\tau = 1 - q$, which I call long-run strategies (LR). These maintain the initial equilibrium with $x^* = 0$.

I argue that both LR and SR strategies can be optimal, and that which is optimal depends on δ . The first step of this argument is the following result.

Lemma 1. *For every LR strategy, there are SR strategies that yield a higher payoff in at least the first period.*

To prove this, I first note that the colonizer's payoff in the first period, which is equal to $\tau A - c(q)$, is increasing in both τ and q . Given any LR strategy (τ, q) , SR strategies can always be found that yield a higher payoff. Under each LR strategy, $\tau = 1 - q$. Therefore, SR strategies (τ', q) with $\tau' > \tau$ and SR strategies (τ, q') with $q' > q$ all yield a higher payoff in the first period.

The second part of the argument is given in Lemma 2.

Lemma 2. *There exists \bar{t} sufficiently large, such that the best LR strategy yields higher payoffs in each period $t \geq \bar{t}$ than do all SR strategies.*

To prove this, fix any SR strategy $(\hat{\tau}, \hat{q})$. Under this strategy, over time x_t increases from $x_0=0$ to $x^* = \frac{\hat{q}}{\hat{q} + 1 - (1 - \hat{\tau})(1 - \hat{q})} > .5$. Consider a period t large enough that under $(\hat{\tau}, \hat{q})$, $x_t \geq .5$. From (1), the colonizer's payoff in this period is

$$\pi_C(x_t, \hat{\tau}, \hat{q}) = \hat{\tau}(1 - \hat{q})A(1 - x_t) - c(\hat{q}). \tag{5}$$

Next, consider the best LR strategy. Under any LR strategy $x_t=0$, $\tau=1-q$, and the colonizer’s payoff each period is given by

$$\pi_C(0, \tau, q) = (1 - q)A - c(q). \tag{6}$$

Denote the value of (τ, q) that maximizes (6) by (τ^*, q^*) . This is the best LR strategy. Then, using (5) and (6), we have the following result

$$\begin{aligned} \pi_C(0, \tau^*, q^*) &= (1 - q^*)A - c(q^*) \geq (1 - \hat{q})A - c(\hat{q}) > \hat{\tau}(1 - \hat{q})A(1 - x_t) - c(\hat{q}) \\ &= \pi_C(x_t, \hat{\tau}, \hat{q}) \end{aligned}$$

That is, for t large enough that $x_t \geq .5$ under the SR strategy, the best LR strategy yields higher payoffs than any SR strategy.

To summarize, Lemmas 1 and 2 establish that in at least the initial period the SR strategy yields a higher payoff, but in later periods the LR strategy yields higher payoffs. This shows that the choice between the two types of strategies involves a trade-off between larger payoffs in early periods and larger payoffs in later periods. This trade-off is illustrated in Fig. 4, which shows how the payoffs to both types of strategies evolve over time. As shown, payoffs under the SR strategy are monotonically decreasing over time. This is because under SR strategies x_t increases over time, decreasing $\pi_C(x_t, \tau, q)$. Under the LR strategy $x_t=0$ for all t and thus $\pi_C(0, \tau, q)$ remains constant. Because of this trade-off, which of the two types of strategies is optimal depends on the government’s preference over the infinite horizon, which is determined by δ . More precisely, we have the following result.

Proposition 4. For any γ and A , there exists $\bar{\delta} \in (0, 1)$ such that the colonizer’s optimal strategy is an LR strategy if $\delta > \bar{\delta}$ and an SR strategy if $\delta < \bar{\delta}$.

If the colonizer has a secure hold on the colony, i.e., δ is high, then an LR strategy will be optimal. However, if the colonizer has a sufficiently tenuous grip on the colony, i.e., δ is low, then an SR strategy will be optimal.

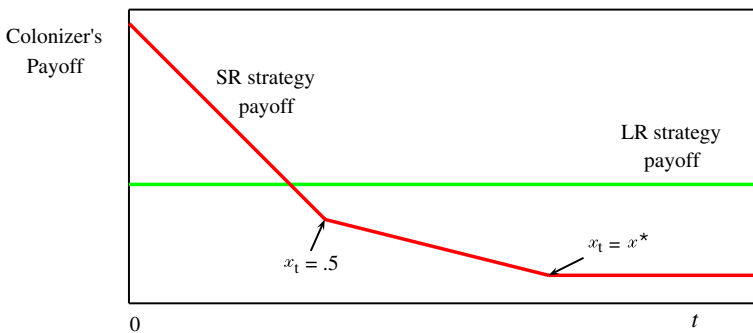


Fig. 4. The streams of payoffs under an LR strategy and an SR strategy.

2.5. Equilibria

The game's equilibria can be grouped into two types. In the first type, which I call 'development equilibria', the colonizer chooses an LR strategy, with $\tau = 1 - q$. In the second stage, every period each individual chooses to engage in productive activities and the economy remains in the high production equilibrium, with $x^* = 0$. After the colonizer exits the country and τ returns to zero, the society remains in the high production equilibrium. In the second type, which I call 'underdevelopment equilibria', the colonizer chooses an SR strategy, with $\tau > 1 - q$. Over time, individuals switch from productive activities to unproductive activities as the society converges to a low production equilibrium. If enough time has passed, then the society will be located within the basin of attraction of a post-colonial low production equilibrium. After independence the society remains trapped in this stable low production equilibrium.

3. Historical evidence

I have argued that the model's underdevelopment equilibria provide one explanation for the historical origins of Africa's underdevelopment. If this is true, then looking at Africa's past the following parts of the model's explanation should be observed: (1) prior to European contact, many African societies were located in high production equilibria (2) external extraction, during the slave trade and colonial rule, lowered the return to productive activities relative to unproductive activities (3) after European contact, the proportion of individuals engaged in unproductive activities increased over time. In this section, I show that Africa's history is consistent with each part of the explanation.

Part 1. Prior to European contact, many African societies were located in high production equilibria.

Although it is not possible to directly observe the proportion of pre-contact African societies that were in high production equilibria prior to European contact, the available evidence suggests that African societies had levels of economic and social development that were similar to other societies around the world. Amin (1972) writes that "Black Africa was not on the whole more backward than the rest of the world. The continent was characterized by complex social formations, sometimes accompanied by the development of the state, and almost invariably based on visible social variations which revealed the disintegration of the primitive village community" (p. 506). African societies had developed customs, laws, conventions, ethics or rituals to resolve conflict and enforce order. Many societies maintained order through kinship ties or a lineage system, where disputes were either resolved by consensus or through a council of elders. The more centralized societies had developed formal political systems and advanced legal institutions that resemble modern day courts (Bohannon and Curtin, 1988, pp. 147–167; Adejumbi, 2000).

One of the only first-hand written accounts from pre-contact Africa comes from the Moroccan traveller Ibn Battúta, who travelled to the empire of Mali in 1352. He describes the road from Walāta, located in modern Mauritania, to the capital of Mali as being safe and the

empire as well functioning with peaceful inhabitants (Ibn Battúta, 1929, p. 322). “The negroes possess some admirable qualities. They are seldom unjust, and have a greater abhorrence of injustice than any other people. . . . There is complete security in their country. Neither traveller nor inhabitant in it has anything to fear from robbers or men of violence.” (Ibn Battúta, 1929, p. 329).

One indicator of Africa’s initial prosperity and well being comes from data on urbanization and population density. As shown by Acemoglu et al. (2002), an area’s urban population is a good indicator of its level of economic development. Data on city size, available from Chandler (1987, pp. 282–301) and Bairoch (1988, p. 58), show that during the 15th century, many parts of sub-Saharan Africa were as prosperous as the rest of the world. In Central Sudan, Gao’s population reached 60,000, Kano’s was 50,000, Gobir’s population was 28,000, Timbuktu’s was 25,000, and Jenne’s was 20,000. In what is now Nigeria, Katunga, the capital of Oyo, had a population of 50,000, while the city of Benin had a population between 60,000 and 70,000. Further south, Mbanza Kongo, the capital of the Kongo Kingdom, had a population of 40,000. In Eastern Africa, prior to the arrival of the Portuguese, Kilwa’s population reached 30,000 and the population of the city of Zimbabwe reached 40,000.

Using data from McEvedy and Jones (1978) and Chandler (1987), and the methodology of Acemoglu et al. (2002) one can construct urbanization estimates for the countries of Africa in 1500. According to my calculations, Zimbabwe’s urbanization rate is 15%, Mali’s is 12.7%, Mauritania’s is 6.7%, Nigeria’s is 4.8%, Angola’s is 3.1%, Niger’s is 2.3%, Ethiopia’s is 2.7% and Tanzania’s is 1.7%. Outside of Northern Europe, these urbanization rates are amongst the highest in the world. The urbanization rate for Portugal is 5.8%, the urbanization rate of India is 1.8%, and the urbanization rates of Peru and Mexico, the locations of the Inca and Aztec empires, are 2.5% and 6.5%.

Part 2. External extraction, during the slave trade and colonial rule, lowered the return to productive activities relative to unproductive activities.

From the beginning of the 16th century to the mid 19th century, European contact with Africa primarily took the form of the trans-Atlantic slave trade. During this time approximately 12 million slaves were shipped to the Americas (Lovejoy, 2000). The external demand for slaves provided increased opportunities for individuals to engage in various unproductive activities. Slave raiders, slave traders and other middlemen were needed to capture slaves and bring them to coastal ports. Slave raiding and slave trading are unproductive activities because they do not create value. The source of the surplus gained by those engaged in these activities ultimately comes from the labor stolen from the slave. Although he does not use the model’s terminology, Darity (1992) describes the change in relative payoffs of the two types of activities writing that “the most lucrative activity throughout the 18th century for those Africans with the power to enslave rather than be enslaved was procurement of human exports for the slave trade.” (p. 165).

Beginning in the early 19th century, the trans-Atlantic slave trade was slowly brought to an end. As the slave trade declined, European colonization of the continent was beginning, with the Berlin Conference of 1884–1885 marking the beginning of official colonial rule. Although the period of colonial rule was very different from the slave

trade, it continued to alter the returns to productive activities relative to unproductive activities.

Colonial policies of land expropriation, taxation, and forced labor targeted those that produced. Poll, head and hut taxes were the main tools used to raise revenues for the colonies. Taxes also served as an indirect tool of extraction by forcing the African peasantry into extractive employment relations. Annual taxes, usually equivalent to about 30 days of work, could only be paid in the official colonial currency, not in-kind. As a result, natives were forced to sign restrictive labor contracts, lasting up to two years, in order to obtain the necessary currency to pay the taxes. Once signed, these contracts could not be broken by the native without severe punishment (Buell, 1928a,b; Nzula et al., 1979). Forced labor was also common. Peasants were required to engage in employment that was provided without compensation or for wages well below the market rates. In the Belgian Congo, natives were required to spend 40 hours each month gathering rubber for the colony, while in Uganda natives were obliged to provide 30 days of free labor a year on the roads (Buell, 1928a, p. 567,b, pp. 429–431;). In Kenya, in addition to an unpaid obligation to work 24 days a year, natives were also required to provide up to 60 days a year of compulsory, compensated labor (Berman and Lonsdale, 1980, p. 68).

Those engaged in unproductive activities were better able avoid European extraction. Some were able to work for the Europeans. Others fought against the Europeans or joined roaming bandit groups. Those that worked with the Europeans in the colonial administration, as part of the colonial army, bureaucracy, treasury or police force, were exempt from the taxation, forced labor and general coercion that was inflicted on the rest of the population. These individuals survived not by producing, but by obtaining a portion of the resources that were extracted from the peasantry. Those who were able to escape colonial extraction by joining rebel armies or bandit groups also did not produce. Bandits lived by raiding local communities and caravan routes. Rebel armies lived off the transfer of food and goods from rural peasants. At times the transfers were made voluntarily, but most often rebels plundered local peasant populations or extorted payment through threats of violence and other forms of coercion (Kriger, 1988; McCann, 1985).

Part 3. After European contact, the proportion of individuals engaged in unproductive activities increased over time.

The rise of unproductive activities during the slave trade has been well documented by African historians. Patrick Manning (1990) writes that “by the nineteenth century, much of the continent was militarized; great kingdoms and powerful warlords rose and fell, their fates linked to fluctuations in the slave trade Even in egalitarian communities, the temptation to profit from the sale of captives or culprits kept the slave trade alive.” (p. 147). Law (1991) writes that “the effects were seen not only in the increasing level of disorder, but also in the increasing prominence of groups for whom violence was a profession. The emergence of banditry and mercenary soldiering was paralleled by the militarization of existing ruling élites.” (p. 346). Among those that did not engage directly in the slave trade, some formed bandit groups that raided local agricultural communities for slaves and goods. Others became highway robbers and stole from caravans along trade routes (Miller, 1988, pp. 134, 147).

Trade data from the port of Quelimane, Mozambique, provide evidence of the extent of the switch from productive to unproductive activities during this time. Between 1806 and 1821, slave exports increased by 240%. At the same time, rice exports fell by 88% and wheat exports fell by 95% (Austen, 1987, pp. 68–71). In 1705, the Dutch Director-General wrote about similar drops in production that were occurring on the Gold Coast: “it has completely changed into a Slave Coast, and the natives nowadays no longer occupy themselves with the search for gold, but rather make war on each other to furnish slaves.” (Richards, 1980, p. 46).

During colonial rule, unproductive activities continued. Many of the Africans that had been involved in the slave trade made the switch to working for the colonial government. For example, the former Yao slave raiding chiefs Matipwiri, Chikumbo and Tambala of the Nyasa area all became assistants for the colonial government (Beachey, 1976, p. 219). Individuals were needed to work with the colonial authorities in the colonial army, police force or native treasury as tax collectors. Those engaged in these activities did not produce, but lived by receiving a portion of the value that was taken from the peasantry. In addition, colonial employment conferred power to these individuals that could be used to extract even greater resources from the peasant population (Buell, 1928b, pp. 431–432; Falola, 1996, pp. 86–95).

For others, the only way to escape the oppression of colonial rule was to flee and join bandit groups. These groups raided local African communities, looting goods, and stealing African women and children to sell into domestic slavery. Although data on the number of individuals who lived through theft and banditry are unavailable, historic accounts suggest that the practices were widespread. Studies have documented the pervasiveness of various forms of raiding, theft and banditry in Tanzania (Shorter, 1968); South Africa and Namibia (Lau, 1986); Angola (Clarence-Smith and Moorson, 1975; Clarence-Smith, 1985); Nigeria and Benin (Falola, 1996); Ethiopia (Caulk, 1978; McCann, 1985; Simpson, 1996); Sudan (Sikainga, 1989); and Mauritania (Taylor, 1995).

Another unproductive activity that increased during this time was rebellion against the colonizer. As Collier (2000) point out, “rebellion is large-scale predation of productive economic activities” (p. 3). Guerilla fighters did not produce, but lived through transfers from peasant populations obtained primarily through coercion, threats of violence or direct force (Kriger, 1988; McCann, 1985).

4. The model and empirical evidence

4.1. *Explaining Africa's economic deterioration since independence*

As documented by Artadi and Sala-i-Martin (2003), much of sub-Saharan Africa has been in economic decline over the past 30 years. Among the 40 countries of sub-Saharan Africa for which income data from independence are available, 18 or 45% were poorer in 2000 than at independence.⁵

⁵ The figures are based on my calculations using real per capita GDP ‘rgdpch’ from the Penn World Tables Mark 6.1.

The model provides an explanation for this deterioration since independence. To see this, consider the model's explanation for Africa's underdevelopment, shown in Fig. 3. As argued, if the colonizer chooses an SR strategy, then x will increase over time. If at independence x is between x_B and x_3^* , then after independence x will continue to increase and total production in the economy, given by $(1-x)A$, will continue to decrease. Therefore, the model is able to explain the fall in income levels that has occurred since independence in many African countries.

4.2. Institutions, settler mortality and equilibrium selection

The model developed here complements the empirical work of Acemoglu et al. (2001). The authors document that among former colonies, colonies where the European focus was on extraction did not develop economically. In colonies where the focus was not on extraction, the colonizer implemented institutions to enforce the rule of law and protect private property and today these colonies are among the richest countries in the world. The authors find that the disease environment was a primary determinant of which of the two strategies were followed. In areas with a high disease environment settlement was difficult and extractive institutions were implemented, while in areas with a low disease environment, settle was possible and institutions of private property were implemented.

By providing a theoretical framework for their analysis, the model helps clarify two points from Acemoglu et al. First, it is not clear why initially implemented institutions should persist and why they should continue to matter decades after the end of colonialism. The model provides one explanation. In colonies with a high disease environment, the focus was on extraction and domestic institutions to enforce the rule of law and protect private property were not implemented. Within the framework of the model, in these colonies the colonizer pursued an SR strategy, with $\tau > 1 - q$. This led to a permanent movement to a low production equilibrium. These colonies remain trapped in this equilibrium today. On the other hand, colonies with a low disease environment could be settled and institutions to protect private property were implemented. In these areas the colonizer pursued an LR strategy with $\tau = 1 - q$ and the colony remained in the high production equilibrium.

Acemoglu et al. (2001) assume that in areas with low disease environments, settlement occurred and colonizers did not focus on extraction, but instead chose to implement good institutions. The model provides support for this assumption by showing that it is an equilibrium outcome of the game. This can be seen as follows. At this time, because of competition between European nations, control over foreign territory was tenuous. The best way to secure control of a region was through settlement. If a country was able to settle an area, they could be more confident that they would have long-term control of the land. In the model this long-term control is given by δ , the probability of the game continuing for the colonizer. Low rates of settler mortality increased settlement, which decreased the probability of the colonizer losing control of an area, raising δ . From Proposition 4 we know that the higher is δ , the more likely it is that an LR strategy is chosen. Overall, in areas where settlement was feasible, δ was high, and the colonizer was more likely to choose an LR strategy with a lower rate of extraction and more secure property rights.

5. Conclusions

Findings from a number of recent empirical studies provide mounting evidence that Africa's poor performance in the second half of the 20th century can be partially explained by its unique history, which is characterized by two key events: the slave trade and colonial rule. Given this evidence, a natural question arises. Why do these events, which ended years ago, continue to matter today? I have developed a model, exhibiting path dependence, which provides one answer to this question. The model features multiple equilibria. There is one equilibrium with secure property rights and a high level of production and other equilibria with insecure property rights and low levels of production. I have shown that external extraction, when severe enough, causes a society initially in the high production equilibrium to move to a low production equilibrium. Because of the stability of low production equilibria, the society remains trapped in this suboptimal equilibrium even after the period of external extraction ends.

Acknowledgment

I thank Martin Osborne for his help throughout the process of writing this paper. I have received valuable comments and suggestions from two anonymous referees and the editor Dilip Mookherjee, as well as from Gareth Austin, Albert Berry, Loren Brandt, Jon Cohen, Azim Essaji, Ig Horstmann, Joseph Inikori, Kris Inwood, Martin Klein, Patrick Manning, Aloysius Siow, participants at the University of Toronto, CEA Annual Meetings, CNEH Future of Economic History Conference, and SSHA Annual Meetings.

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