The Long-Term Effects of Africa's Slave Trades

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Abstract

Can part of Africa's current underdevelopment be explained by its slave trades? To explore this question empirically, I combined data from ship records with data from various historical documents reporting slave ethnicities, and construct estimates of the number of slaves exported from each country during Africa's slave trades between 1400 and 1900. I find a strong robust negative correlation between the number of slaves exported from a country and its current economic performance. To better understand if the relationship is causal, I examine the historical evidence on selection into the slave trades, I use instrumental variables, and I control for observable country characteristics. The results suggest that the relationship between slave exports and current economic performance is causal. I then test for potential channels of causality. Consistent with the historic evidence, the data indicate that the effects of the slave trades are through ethnic fractionalization, weakened states, and a decline in the quality of domestic institutions.

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1 Introduction

Africa's economic performance in the second half of the twentieth century has been poor.[1] One, often informal, explanation for Africa's underdevelopment is its history of extraction, characterized by two events: the slave trades and colonialism. Bairoch (1993, p. 8) writes that "there is no doubt that a large number of negative structural features of the process of economic underdevelopment have historical roots going back to European colonization." Manning (1990, p. 124) echoes Bairoch, but focuses on the slave trades, writing: "Slavery was corruption: it involved theft, bribery, and exercise of brute force as well as ruses. Slavery thus may be seen as one source of precolonial origins for modern corruption."

Recent empirical studies suggest that Africa's history can explain part of its current underdevelopment. These studies focus on the link between countries' colonial experience and current economic development (Bertocchi and Canova, 2002; Englebert, 2000a,b; Grier, 1999; Lange, 2004; Acemoglu *et al.*, 2001, 2002). However, the other important event in Africa's history, its slave trades, has yet to be examined empirically. There are reasons to expect that the slave trades may be at least as important as official colonial rule for Africa's development. For a period of nearly 500 years, from 1400 to 1900, the African continent simultaneously experienced four slave trades. By comparison, official colonial rule lasted from 1885 to about 1960, a total of approximately 75 years.

This paper provides the first empirical examination of the importance of Africa's slave trades in shaping subsequent economic development. In doing this, I construct measures of the number of slaves exported from each country in Africa, in each century between 1400 and 1900. The estimates are constructed by combining data from ship records on the number of slaves shipped from each African port or region with data from a variety of historical documents that report the ethnic identities of slaves that were shipped from Africa. I find a robust negative relationship between the number of slaves exported from each country and subsequent economic performance. The African countries that are the poorest today are the ones from which the most slaves were taken.

This finding cannot be taken as conclusive evidence that the slave trades *caused* differences in subsequent economic development. An alternative explanation that is just as plausible is that countries that were initially the most economically and socially underdeveloped selected into the slave trades,

[1] See Artadi and Sala-i-Martin (2003) for a recent survey.

and these countries continue to be the most underdeveloped today. In other words, the slave trades may be correlated with unobserved country characteristics, resulting in biased estimates of the effect of the slave trades on economic development.

I pursue a number of strategies to better understand the reason behind the relationship between slave exports and current economic performance. First, I review the evidence from African historians on the nature of selection into the slave trades. I also use historic data on pre-slave trade population densities to examine whether it was the less developed parts of Africa that selected into the slave trades. Both sources of evidence show that it was actually the most developed areas of Africa that tended to select into the slave trades. I discuss the reason behind this seemingly paradoxical relationship in detail. Second, I use two sets of instruments to estimate the causal effect of the slave trades on subsequent economic development. The first instruments are the sailing distances from each country to the nearest location of demand for slave labor in each of the four slave trades. The second is initial population density, controlling for current population density in the second stage. Like the OLS coefficients, the IV coefficients are negative and significant, suggesting that increased extraction during the slave trades caused worse subsequent economic performance. The final strategy that I pursue is to control for a number of additional observable country characteristics. These results also indicate that the slave trades did have a negative effect on subsequent economic development.

I then explore the precise channel of causality underlying the relationship between slave exports and subsequent economic development. Using historical evidence as a guide, I examine whether the procurement of slaves through internal warfare, raiding, and kidnapping resulted in subsequent state collapse, ethnic fractionalization, and a deterioration in the quality of judicial institutions. I find support for the view that the slave trades resulted in weak, politically fragmented states, ethnic fractionalization, and poor judicial institutions.

These findings complement the research of Engerman and Sokoloff (1997, 2002) and Sokoloff and Engerman (2000), which shows that slavery in the New World resulted in the evolution of institutions that were not conducive for economic growth.[2] My results show that not only was the use of slaves detrimental for a society, but the production of slaves, which occurred through domestic warfare, raiding, and kidnapping, also had negative

[2]Also see Lagerlöf (2005) who shows that within the U.S., the states that relied the most heavily on slavery in the past have the lowest income levels today.

impacts on subsequent development.[3]

The paper is structured as follows. In the following section, I provide an overview of Africa's slave trades, providing a detailed historical overview of the manner in which slaves were procured, and the resulting adverse effects. In Section 3, I describe the construction of the slave export figures. Section 4 documents the correlations that exist in the data, and Section 5 turns to the issue of causality. In Section 6, guided by the historical evidence, I test for potential channels of causality. Section 7 reports the robustness and sensitivity checks, and Section 8 concludes.

2 The History of Africa's Slave Trades

2.1 General Overview

Between 1400 and 1900, the African continent experienced four simultaneous slave trades. The largest and most well-known is the trans-Atlantic slave trade where, beginning in the 15th century, slaves were shipped from West Africa, West Central Africa and Eastern Africa to the European colonies in the New World. The three other slave trades – the trans-Saharan, Red Sea, and Indian Ocean slave trades – are much older and predate the trans-Atlantic slave trade. The beginning of the trans-Saharan and Red Sea slave trades dates back to at least 600AD (Lovejoy, 2000). During the trans-Saharan slave trade, slaves were taken from south of the Saharan desert and to Northern Africa. In the Red Sea slave trade, slaves were taken from inland of the Red Sea and shipped to the Middle East and India. In the Indian Ocean slave trade, slaves were taken from Eastern Africa and shipped either to the Middle East and India or to plantation islands in the Indian Ocean.

2.2 Potentially Long-Term Consequences of Africa's Slave Trades

A number of characteristics of Africa's slave trades, particularly the trans-Atlantic slave trade, make them distinct from previous slave trades. First,

[3] Also related is Acemoglu *et al.*'s (2005) research on the effects of the Atlantic three-corner trade in Europe. The authors find that in Europe, the Atlantic trade strengthened economic and political institutions conducive for economic growth. Similarly, Inikori (2002) argues that Britain's involvement in the Atlantic trade was a key determinant of its industrialization.

the total volume of slaves traded was unprecedented. During the trans-Atlantic slave trade alone, approximately 12 million slaves were exported from Africa. This figure does not include those who were killed during the raids or those who died on their journey to the coast.[4] Africa's slave trades were also unique because, unlike previous slave trades, individuals of the same or similar ethnicities enslaved one another. This aspect of the slave trades had particularly detrimental consequences.[5] According to historical evidence, the external demand for slaves impeded state development, causing weakened states, promoted political and social fragmentation, causing ethnically fractionalized societies, and resulted in a deterioration of domestic institutions, particularly judicial institutions.[6]

2.2.1 Ethnic Fractionalization

The detrimental impacts of the slave trades arise because the capture of slaves occurred by Africans raiding other Africans. The most common manner in which slaves were taken was through villages or states raiding one another (Lovejoy, 1994; Northrup, 1978). Where groups of villages had previously developed into larger scale village federations, relations between the villages tended to turn hostile (Inikori, 2000). Villages began raiding each other, destroying the established codes of conduct concerning warfare that had promoted peace to this time. Kusimba (2004, p. 66) writes that "insecurity confined people within ethnic boundaries constructing spheres of interaction". Hubbell (2001) documents this process for the region of Souroudougou, which is located on the border of Burkina Faso and Mali. The networks and federations of villages that had formed, were destroyed as a result of the increased warfare, conflict, banditry, and suspicion generated

[4]The Roman slave trade comes closest to matching the volume of the trans-Atlantic slave trade. Scheidel (1997) estimates that in the early Roman Empire, over a period of four centuries, between 10,000 and 15,000 slaves were shipped into the Empire annually. This is a total of 4 to 6 million slaves, which is less than half of the volume of the trans-Atlantic slave trade.

[5]In early Rome, the primary source of slaves were prisoners captured by Roman soldiers during wars of expansion. In later periods, slave populations were sustained primarily through slave breeding (Bradley, 1987). In Greece, clear regulations and institutions prevented the enslavement of people of Greek origin, even when they were imprisoned, or captured in local civil wars (Garlan, 1987).

[6]Because the effects of the slave trades were not homogenous across all regions of Africa, it is potentially dangerous to generalize the experience of the entire continent. I focus here on the effects of the trans-Atlantic slave trade in particular. This is because, as I show in Section 7, the empirical results are driven by the trans-Atlantic slave trade. This is not surprising given that this is the largest of the four slave trades.

by the slave trade in the nineteenth century.

Because the slave trades weakened ties between villages, they also discouraged the formation of larger communities and broader ethnic identities. Therefore, the slave trades may be an important factor explaining Africa's high level of ethnic fractionalization today. If this is the case, then this is a potential channel through which the slave trades may have long-term effects. The relationship between ethnic fractionalization and economic development was first documented by Easterly and Levine (1997). More recently, research by La Porta *et al.* (1999), Alesina *et al.* (2003), Aghion *et al.* (2004), and Easterly *et al.* (2006) looks more deeply into the importance of ethnic fractionalization, finding that it is also a primary determinant of social cohesion, domestic institutions, domestic polices, and the quality of government. Other research finds that ethnic fractionalization also reduces the provision of public goods (e.g., Alesina *et al.*, 1999; Miguel and Gugerty, 2005; Banerjee and Somanathan, 2006), which may in turn affect development.

2.2.2 State Fragmentation and the Weakening of States

The conflict between communities, caused by the external demand for slaves, resulted in conflict within communities. Because of the general environment of uncertainty and insecurity at the time, individuals required weapons, such as iron knives, spears, swords or firearms, to defend themselves. These weapons could be obtained from Europeans in exchange for slaves, which were often obtained through local kidnappings. This further perpetuated the slave trade and the insecurity that it caused, which in turn further increased the need to enslave others to protect oneself (Mahadi, 1992; Hawthorne, 1999, pp. 108–109). Historians have named this vicious cycle the 'gun-slave cycle' (e.g., Lovejoy, 2000) or the 'iron-slave cycle' (e.g., Hawthorne, 2003). The result of this vicious cycle was that communities not only raided other communities for slaves, but also members of a community raided and kidnapped others within the community. Well-documented examples come from the Balanta, of modern day Guinea-Bissau, who "became involved in slaving, often preying on other Balanta communities" and the Minyanka, of modern day Mali, who were forced by rival states "into participation in slave-raiding and bitter conflict between [other] Minyanka villages" (Klein, 2001, pp. 56–57). The most extreme example is the Kabre of Northern Togo, who during the nineteenth century developed the custom of selling their own kin into slavery (Piot, 1996).

Europeans played a role in promoting political instability. Because those involved in the buying and selling of slaves benefited from a larger supply

of slaves, when possible they intervened in the political process to promote internal conflict and instability (Barry, 1992; Inikori, 2003). Slave merchants and raiders formed strategic alliances with key groups inside villages or states in order to extract slaves. Typically, the alliances were with the younger men of the community who were frustrated by the control of power by the male elders. The consequence of this was increased internal conflict and political instability (Klein, 2003).

In the end, the consequences of internal conflict and insecurity were increased political instability, and in many cases the collapse of pre-existing forms of government (Lovejoy, 2000, pp. 68–70). Historians have documented numerous examples of this. In 16th century Northern Senegambia, the Portuguese slave trade led to the eventual disintegration of the Joloff Confederation, which was replaced by the much smaller kingdoms of Waalo, Kajoor, Baol, Siin and Saalum. Further south, in Southern Senegambia, the same pattern is observed. Prior to the slave trades, complex state systems were in the process of evolving. However, this evolution stagnated soon after the arrival of the Portuguese in the 15th century (Barry, 1998, pp. 36–59).

The most dramatic example of the weakening of domestic political institutions is the Kongo Kingdom of West Central Africa. As early as 1514, the kidnapping of local Kongo citizens for sale to the Portuguese had become rampant, threatening social order and the King's authority. In 1526, Affonso, King of Kongo, wrote to Portugal complaining that "there are many traders in all corners of the country. They bring ruin to the country. Every day people are enslaved and kidnapped, even nobles, even members of the king's own family." (Vansina, 1966, p. 52). This break-down of law and order resulted in the weakening and eventual fall of the once powerful state (Inikori, 2003). For many of the other Bantu speaking ethnicities, stable states also existed in earlier periods, but by the time the slave trades were brought to an end few ancient states remained (Colson, 1969, pp. 36–37).[7]

[7]The research of Tilly (1990) and others argue that the modern system of nation states in Europe was the result of constant conflict and competition between states. However, in Africa the conflict caused by the slave trades did not result in the development of strong states. Instead, the result was an increase in internal conflict, which retarded, rather than facilitated, state development. The reason for the difference is that during the slave trades, individuals had an option of protecting themselves from the external insecurity by engaging in kidnappings and slave raiding within the community. Here, the individual could gain at the expense of the community. In Europe, members of a community did not have this option and as a result, their interests were aligned with the interests of the community or state as a whole. It was in everyone's best interest to maintain and promote strong stable states. Lovejoy (2000, p. 70) addresses this difference between Africa and Europe, writing that "the record of warfare that fills the accounts of past [African] states

Pre-existing governance structures were generally replaced by small bands of slave raiders, controlled by an established ruler or warlord. These bands were unable to develop into large, stable states. Colson (1969, p. 35) writes that "both the bands and the new states they created retained an air of improvisation. Few band leaders were able to hand power to a legitimate successor. Even where a band leader had become the ruler of a state, succession remained a problem. Leadership was a personal role, rather than an established office."

Two states in Western Africa did manage to emerge during the slave trades: Oyo after 1650 and Asante after 1700. But they were never able to become large, especially relative to non-African states at the time (Lovejoy, 2000, p. 69). The Oyo empire was short lived. It eventually weakened, disintegrated, and then collapsed – a process that began in the 1780s (Law, 1977).

This consequence of the slave trades may be important for current development. Recent empirical research shows that a country's history of state development is an important determinant of current economic performance. Bockstette *et al.* (2002) find that 'state antiquity', measured using an index of the depth of experience with state-level institutions, is positively correlated with real per capita GDP growth between 1960 and 1995. Gennaioli and Rainer (2005) find that within Africa, countries with ethnicities that had centralized pre-colonial state institutions today provide more public goods, such as education, health and infrastructure. Herbst (2000) argues that Africa's poor economic performance is a result of "state failure". He argues that because of low population densities, the process of state development that took place in Europe did not occur in Africa. As others have pointed out (Robinson, 2002), Africa's slave trades was an important factor affecting state development directly and indirectly by depopulating the continent.[8]

Political fragmentation also reinforced the effect that the slave trades had in promoting ethnic differences. Historically, having strong stable states was an important determinant of the subsequent ethnic and cultural homogeneity of the populations. On this point, Fearon (2003) correctly notes that most of the countries that are ethnically homogenous today were very fragmented 500 years ago. The subsequent development of strong states facilitated the transition to the cultural, ethnic, and linguistic homogeneity

and rulers may not seem very different from the history of contemporary Europe or Asia, except that here the enslavement of people was the result, and no large states emerged that could provide some semblance of unity and safety."

[8]For recent theoretical research on the detriment of weak states for economic development see Acemoglu (2005).

that prevails today.[9]

2.2.3 Deterioration of Legal Institutions

The slave trades also had a direct effect on legal institutions. An alternative way to obtain slaves was by falsely accusing others of witchcraft or other crimes. According to samples of slaves from Lovejoy (2000), Northrup (1978), and Koelle (1854), 4, 11, and 17% of the slaves entered slavery in this manner. Klein (2001, p. 59) writes that "communities began enslaving their own. Judicial penalties that formerly had taken the form of beatings, payment of compensation or exile, for example, were now converted to enslavement." In many cases, leaders themselves supported or instigated this abuse of the judicial system (Mahadi, 1992; Klein, 2001). To protect themselves and their community, leaders often chose to pay tribute to avoid being raided by other communities. The slaves needed for tribute were often obtained through the judicial system. Hawthorne (1999, 2003) provides detailed studies of this process among the Cassanga of modern day Guinea Bissau. The chief of the Cassanga used the 'red water ordeal' to procure slaves and their possessions. Those accused of a crime were forced to drink a poisonous red liquid. If they vomited, then they were judged to be guilty. If they did not vomit, they were deemed not guilty. However, for those that did not vomit this usually brought death by poisoning, and their possessions were then seized, including all family members and relatives, who were then sold into slavery.

The detrimental effects of the slave trades on the judicial system may be important for current development if previous experience developing and maintaining a well-functioning judicial system is helpful for implementing and sustaining legal institutions after independence. This may in turn be critical for development given the importance of domestic institutions for economic development (e.g., Acemoglu *et al.*, 2001, 2002; Acemoglu and Johnson, 2004).

The fact that the consequences of the slave trades may operate through multiple channels, particularly domestic institutions and ethnic fractionalization, is important. This is because recent research by Easterly (2001) and Miguel (2004) shows that strong domestic institutions and nation building policies can reduce the detrimental consequences of ethnic fractionalization. If the slave trades not only resulted in increased ethnic fractionalization, but also in weak states with poor domestic institutions and policies, then

[9] See Gellner (1983) for a description of the relationship between centralized states and the creation of a common national culture or identity.

the negative consequences of ethnic fractionalization become much more important.

2.2.4 Persistence of Predatory Behavior

The final channel through which the slave trades may operate is through the persistence of predatory behavior. Theoretical research shows that societies can remain trapped in inefficient equilibria characterized by high levels of predation and low levels of production. Murphy *et al.* (1993) and Acemoglu (1995) show that under general conditions multiple equilibria can arise, some with low levels of predatory behavior and some with high levels of predatory behavior. If the slave trades caused parts of Africa to transition from a high income equilibrium to a low income equilibrium, then the slave trades will have persistent impacts. Nunn (2006*b*) puts forth an explanation of this nature as one possible reason why Africa's history may be an important determinant of its current underdevelopment.[10]

2.2.5 Positive Effects

Although the slave trades caused political and social fragmentation, and weakened domestic institutions, evidence suggests that they may have resulted in a strengthening and consolidation of networks of exchange and credit (Lovejoy, 2000, p. 68). The efficient export of slaves not only required political violence and instability, but also some strong commercial networks. As well, an additional consequence of the slave trades was the introduction of high yielding varieties of crops, such as maize, manioc, groundnuts, and lima beans (Vansina, 1990, pp. 211–216). These crops were imported by slave traders as a response to the sharp decline in food production that resulted because of the insecurity generated by the slave trades.

In the end, whether the total effect of the slave trades on economic development was positive or negative is an empirical question to which I now turn.

[10] As well, the persistence and importance of culture and social capital may be alternative reasons why the slave trades may matter. If the slave trades had a detrimental impact on the culture or social capital of societies, then the effects of the slave trades may continue to be felt today.

3 Slave Export Data

3.1 Construction of Estimates

In this section I provide an overview of the data sources and methodology used to construct the slave export figures. Full details of the data construction are in Nunn (2006*a*).[11]

To construct the slave export estimates, I rely on two types of data. The first are data that report the total number of slaves exported from each port or region in Africa. I refer to these data as shipping data. For the trans-Atlantic slave trade, the data are from the updated version of the *Trans-Atlantic Slave Trade Database* constructed by Eltis *et al.* (1999).[12] The database records 34,584 voyages from 1514 to 1866. The shipping data are originally from various documents and records located around the world. In most European ports, merchants were required to register their ships, declare the volume and value of goods transported, pay duties, and obtain formal permission to leave the port. Therefore, for each ship and voyage, typically, there exists a number of different registers and documents. As well, shipping news and information published in newspapers and periodicals provide additional sources of information. In the database, 77% of the trans-Atlantic slave voyages after 1700 have shipping information from more than one source. Voyages are documented in as many as sixteen different sources and the average number of sources of data for each voyage is six. According to the authors' estimates, the database contains 82% of all trans-Atlantic slaving voyages ever attempted (Eltis and Richardson, forthcoming).

Data for the early period of the Atlantic slave trade not covered by the *Trans-Atlantic Slave Trade Database* are from Elbl (1997). For the Indian Ocean, Red Sea and trans-Saharan slave trades data are from Austen (1979), Austen (1988), and Austen (1992). The data from these sources are based on estimates from all available documents, records and accounts by observers and government officials on the location and volume of slaves exports.

With the shipping data one can calculate the number of slaves that were shipped from each country. However, the data do not provide a reliable

[11] The estimates only quantify Africa's external slave trades, and therefore do not include slaves that entered into domestic slavery. Because of a lack of data on the numbers and origins of domestic slaves, I am unable to include these slaves in my estimates.

[12] In Nunn (2004), I used the original version of the database. The new edition represents a significant improvement in the quality and completeness of the data. The updated database includes the records of 8,005 new voyages and adds additional information for 18,000 pre-existing voyages. In particular, the new database has 75% more information on the slaves' ports of embarkation (see Eltis and Richardson, forthcoming).

estimate of how many slaves were enslaved or taken from each country. This is because slaves shipped from the ports of a coastal country may have come from a country located further inland. To estimate the proportion of slaves shipped from the coast that came from inland countries, I use a second source of data that reports the ethnicity identity of slaves that were shipped outside of Africa. This information comes from a variety of sources: records of sale, plantation inventories, slave registers, slave runaway notices, court records, prison records, marriage records, death certificates, baptismal records, parish records, notarial records, and slave interviews.

There were a number of ways of identifying the ethnicity or 'nation' of slaves. A slave's ethnicity could often be determined from ethnic markings, such as cuts, scars, the filing of teeth, and hairstyles (Karasch, 1987, pp. 4–9). Oldendorp (1777, p. 169) writes that "the people of all Negro nations are marked with certain cuts on the skin. As far as I have been able to learn from the Negroes themselves, these serve to distinguish one nation from another." Each ethnicity's markings were well-known at the time, and were formally documented in Oldendorp (1777).

Because slaves were legally defined as property, those engaged in the buying and selling of slaves had a strong incentive to correctly identify the birthplace or 'nation' of slaves (Wax, 1973). The ethnicity of slaves also mattered to their owners because the skills of slaves varied by their ethnicity. Ethnicities possessed different technical skills, such as rice cultivation, mining of metals, or livestock herding. Africans also worked as pearl divers, blacksmiths, weavers, tanners, ship builders, fisherman, hunters and herders (Hall, 2005, pp. 20, 67–68). Slave owners also cared about slave ethnicities because of perceived differences in physical strength, frequencies of suicide, and rebelliousness (Lovejoy, 2003, p. 32). Moreno Fraginals (1977, p. 190) writes about the importance of slave ethnicities to slave owners and the care taken to correctly identify and record the ethnic identity of slaves. He writes that "the slave trade was the business that involved the greatest amount of capital investment in the world during the eighteenth and nineteenth centuries. And a business of this size would never have kept up a classificatory scheme had it not been meaningful (in overall general terms, in keeping with reality) in designating in a *very precise* way the merchandise that was being traded." Because of the importance of ethnicity for slave owners, much better records were kept for slaves than for free persons (Hall, 2005, p. 32). Slaves' ethnicities were also evident from the name that they were given after arriving from Africa. Slaves were usually given a Christian first name and a last name that identified their ethnicity.

A concern is whether Europeans were able to correctly understand the

ethnicities of Africans. Hall (2005) finds that in American documents, the identification of ethnicities was made by the slaves themselves. Given the limited role played by European slave traders and slave owners in identifying the ethnicities of slaves, the accuracy of the documented ethnicities does not likely depend on the extent of the Europeans' knowledge of African ethnicities.[13]

In all, data on the ethnic identity of slaves shipped during the trans-Atlantic slave trade come from 53 different samples, totalling 80,631 slaves, with 229 distinct ethnic designations reported. The ethnicity data for the Indian Ocean slave trade come from four samples, with a total of 12,885 slaves and 33 reported ethnicities. The data for the Red Sea slave trade are from 2 samples: one from Jedda, Saudi Arabia and one from Bombay, India. The samples provide information for 67 slaves, with 32 ethnicities recorded. In the original documents the same ethnic designations are often referred to by different names or different spellings, depending on the language of the original documents or the year the documents are from. A great amount of research by African historians and ethnographers provides the information needed to map the ethnicities in the documents to modern political boundaries (e.g., Murdock, 1959; Curtin, 1969; Hall, 2005). Full details of the mapping of ethnicities to modern countries are documented in Nunn (2006*a*). Table 1 summarizes information about the samples used in the trans-Atlantic slave trades. Detailed information for the samples from the other slave trades is reported in Nunn (2006*a*).

For the trans-Saharan slave trade two samples are available: one from Central Sudan and the other from Western Sudan. The samples provide information on the origins of 5,385 slaves, with 23 different ethnicities recorded. The main shortcoming of the ethnicity data is that they do not provide a sample for the whole region that slaves were taken from during this slave trade. However, the shipping data from Austen (1992), not only provide information on the volume of trade, but also information on which caravan slaves were shipped on, the city or town that the caravan originated in, the destination of the caravan, and in some cases, the ethnic identity of the slaves being shipped. Because there were only six trade routes that crossed the desert, the information on the volume, origins, and destinations of the

[13] Given that African ethnicities were self-identified, a second concern arises. If Africans of different ethnicities learned to communicate at different rates, then this may result in documented ethnicities that are not representative of the population. Although this is possible, data from slave runaway notices gathered by Gomez (1998, pp. 167–185) shows empirically that different ethnic groups did not demonstrate different abilities to learn European languages.

Table 1: Slave Ethnicity Data: Trans-Atlantic Slave Trade

Region	Years	Num. Ethnic.	Num. Obs.	Record Type
Valencia, Spain	1482–1516	77	2,675	Crown Records
Dominican Republic	1547–1591	26	22	Records of Sale
Peru	1548–1560	16	202	Records of Sale
Mexico	1549	12	80	Plantation Accounts
Peru	1560–1650	30	6,754	Notarial Records
Lima, Peru	1583–1589	15	288	Baptism Records
Colombia	1589–1607	9	19	Various Records
Mexico	1600–1699	28	102	Records of Sale
Dominican Republic	1610–1696	33	55	Government Records
Chile	1615	6	141	Sales Records
Lima, Peru	1630–1702	33	411	Parish Records
Peru (Rural)	1632	25	307	Parish Records
Lima, Peru	1640–1680	33	936	Marriage Records
Colombia	1635–1695	6	17	Slave Inventories
Guyane (French Guiana)	1690	12	69	Plantation Records
Colombia	1716–1725	33	59	Government Records
French Louisiana	1717–1769	23	223	Notarial Records
Dominican Republic	1717–1827	11	15	Government Records
South Carolina	1732–1775	35	681	Runaway Notices
Colombia	1738–1778	11	100	Various Records
Spanish Louisiana	1770–1803	79	6,615	Notarial Records
St. Dominique (Haiti)	1771–1791	25	5,413	Sugar Plantations
Bahia, Brazil	1775–1815	14	581	Slave Lists
St. Dominique (Haiti)	1778–1791	36	1,280	Coffee Plantations
Guadeloupe	1788	8	45	Newspaper Reports
St. Dominique (Haiti)	1788–1790	21	1,297	Fugitive Slave Lists
Cuba	1791–1840	59	3,093	Slave Registers
St. Dominique (Haiti)	1796–1797	56	5,632	Plantation Inventories
American Louisiana	1804–1820	62	223	Notarial Records
Salvador, Brazil	1808–1842	6	456	Records of Manumission
Trinidad	1813	100	12,460	Slave Registers
St. Lucia	1815	62	2,333	Slave Registers
Bahia, Brazil	1816–1850	27	2,666	Slave Lists
St. Kitts	1817	48	2,887	Slave Registers
Senegal	1818	17	80	Captured Slave Ship
Berbice (Guyana)	1819	66	1,127	Slave Registers
Salvador, Brazil	1819–1836	12	871	Manumission Certificates
Salvador, Brazil	1820–1835	11	1,106	Probate Records
Sierra Leone	1821–1824	68	605	Child Registers
Rio de Janeiro, Brazil	1826–1837	31	772	Prison Records
Anguilla	1827	7	51	Slave Registers
Rio de Janeiro, Brazil	1830–1852	190	2,921	Free Africans' Records
Rio de Janeiro, Brazil	1833–1849	35	476	Death Certificates
Salvador, Brazil	1835	13	275	Court Records
Salvador, Brazil	1838–1848	7	202	Slave Registers
St. Louis/Goree, Senegal	1843–1848	21	189	Emancipated Slaves
Bakel, Senegal	1846	16	73	Sales Records
d'Agoué, Benin	1846–1885	11	70	Church Records
Sierra Leone	1848	132	12,425	Linguistic and British Census
Salvador, Brazil	1851–1884	8	363	Records of Manumission
Salvador, Brazil	1852–1888	7	269	Slave Registers
Cape Verde	1856	32	314	Slave Census
Kikoneh Island, Sierra Leone	1896–1897	11	185	Fugitive Slave Records

slave caravans allows one to produce reasonable estimates of the origins of slaves shipped. A full description of the data and the construction of the estimates is in Nunn (2006*a*).

Although the data are more limited for the Red Sea and trans-Saharan slave trades, I show in Section 7 that the results of the paper are driven by the trans-Atlantic slave trade. None of the results reported in the paper rest on the estimates of the slaves exported during the Red Sea and trans-Saharan slave trades.

To illustrate the procedure that I use to combine the shipping data and the ethnicity data to construct my estimates, I use an example, which is shown in Figure 1. The figure is a hypothetical map of the western coast of Africa.

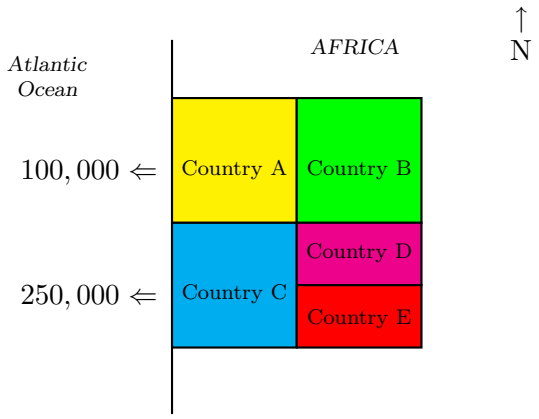

Figure 1: An Artificial Map of Africa's West Coast

From the shipping data, I calculate the number of slaves shipped from each coastal country in Africa. In the example, 100,000 slaves are shipped from Country A and 150,000 are shipped from Country B. The problem with relying on the shipping data alone is that many of slaves shipped from Country A may have come from Country B, which lies landlocked behind Country A. Using the ethnicity data, I construct the ratio of slaves from each coastal country relative to the landlocked countries to the interior of the coastal country. That is, I use the ethnicity data to determine the ratio of slaves from Country A relative to Country B, and from Country C relative to Countries D and E. Assume that the ratio of Countries A to B is 4 to 1, and Countries C to D and E is 3 to 1 to 1. Using the ratios I calculate

an estimate of the number of slaves shipped from the coast that came from the inland country. For example, an estimated $100,000 \times 1/5 = 20,000$ slaves shipped from Country A are from Country B. Therefore, the estimate number of slaves from Country B is 20,000 and from Country A is 80,000. Using the same procedure yields estimates of 150,000 slaves from Country C and 50,000 each from Countries D and E.

3.2 Measurement Error and Other Data Issues

There are a number of imperfections in the estimates that I have constructed. First, the shipping data and the ethnicity data likely contain significant measurement error. Slaves with similar but different ethnicities may have been grouped together under one ethnicity. However, because I am aggregating the data to the country level, this minimizes the bias introduced by ethnicity mis-classification. The aggregation when moving from ethnicities to countries can be seen in Figure 2, which maps African ethnicities based on Murdock (1959), as well as modern political boundaries. As shown, ethnicities are much finer than modern boundaries. Misclassification of slave ethnicities will only cause measurement error if the falsely attributed ethnicity is in a different country from the true ethnicity.

A second source of measurement error arises because slaves from the interior are likely under-represented in the ethnicity samples. There are two reasons for this. First, ethnicities originating inland sometimes, as they were being shipped to the coast, adopted the language of the coastal ethnicities. As a result, inland ethnicities may have then been grouped together with coastal groups. Second, only slaves that survived the voyage outside of Africa are in the ethnicity samples. The further inland a slave originated, the longer the journey was, and the more likely it was that he or she died along the way. Because of the high rates of mortality during the slave trades, this form of measurement error may be significant. Estimates of cross-Atlantic mortality rates ranged from 7 to 20% depending on the time period and the length of the voyage (Curtin, 1969, pp. 275–286; Lovejoy, 2000, p. 63). Death rates during the trek to the coast are known with less certainty, but estimates range from 10 to 50% (Lovejoy, 2000, pp. 63–64; Vansina, 1990, p. 218). I show formally in Section A of the appendix that the under-sampling of slaves from the interior results in OLS that are biased towards zero. In addition, any random measurement error present in the data will have the same effect. As well, one can use instruments that are uncorrelated with the measurement error to derive consistent estimates. I do this in Section 5.2.

A final source of measurement error may arise because of my assumption

Figure 2: African ethnicities and current political boundaries. Source: Murdock (1959).

Table 2: Total Slave Exports from Africa, 1400–1900

Slave Trade	1400–1599	1600–1699	1700–1799	1800–1900	1400–1900
trans-Atlantic	230,516	861,936	5,687,051	3,528,694	10,308,197
trans-Saharan	675,000	450,000	900,000	1,099,400	3,124,400
Red Sea	400,000	200,000	200,000	505,400	1,305,400
Indian Ocean	200,000	100,000	260,000	379,500	939,500
Total	1,505,516	1,611,936	7,047,051	5,512,994	15,677,497

that slaves shipped from a port within a country are either from that country or from countries directly to the interior. Slaves shipped from a country's coast may have originated from a neighboring coastal country. In the data appendix to the paper (Nunn, 2006*a*) I describe three different samples of slaves from which one knows both the ethnicity of the slaves and the port that they were shipped from. The three samples can be used to provide an estimate of the precision of my estimating procedure. For each of the three samples, my procedure would correctly identify the origins of 83.4, 84.9 and 97.6% of the slaves.

3.3 Data Summary

After the data have been constructed, I have estimates on the number of slaves shipped from each country in Africa during each of the four slave trades during four different time periods: 1400-1599, 1600-1699, 1700-1799, 1800-1900.[14] The data are summarized in Table 2. These estimates correspond closely with the general consensus among African historians regarding the total volume of slaves shipped in each slave trade. The only exception is that the total exports for the trans-Atlantic slave trade are slightly less than the standard estimate of 12 million slaves (e.g., Lovejoy, 2000). The lower total is explained by the fact that the database only contains approximately 82% of all trans-Atlantic slaving voyages (Eltis and Richardson, forthcoming).

Table 3 reports the total number of slaves taken in the top exporting countries. The estimates are consistent with the general view among African historians of where the primary slaving areas were. During the trans-Atlantic slave trade, slaves were taken in greatest numbers from the Bight of Biafra (Benin and Nigeria), West Central Africa (Zaire and Angola),

[14]Throughout the paper, I include Eritrea as part of Ethiopia.

Table 3: Total Slave Exports from 1400 to 1900 by Country.

Country	Trans-Atlantic Trade	Indian Ocean Trade	Trans-Saharan Trade	Red Sea Trade	**All Slave Trades**	**Share of Total**
Angola	3,616,027	0	0	0	**3,616,027**	**23.1%**
Nigeria	1,411,758	0	555,796	59,337	**2,026,891**	**12.9%**
Ghana	1,603,335	0	0	0	**1,603,335**	**10.2%**
Ethiopia	0	0	813,899	633,357	**1,447,256**	**9.2%**
Mali	524,102	0	509,950		**1,034,052**	**6.6%**
Sudan	615	0	408,260	454,913	**863,788**	**5.5%**
Dem. Rep. of Congo	752,828	0	0	0	**752,828**	**4.8%**
Mozambique	382,337	274,024	0	0	**656,402**	**4.2%**
Chad	823	0	409,367	118,673	**528,863**	**3.4%**
Tanzania	10,834	507,595	0	0	**518,429**	**3.3%**
Benin	461,782	0	0	0	**461,782**	**2.9%**
Senegal	222,359	0	98,732	0	**321,091**	**2.0%**
Togo	280,842	0	0	0	**280,842**	**1.8%**
Guinea	242,691	0	0	0	**242,691**	**1.5%**

and the Gold Coast (Ghana). All of these countries appear amongst the top exporting countries on the list. Ethiopia and Sudan are also among the top exporting countries. They were the primary sources of slaves shipped during the Red Sea and Saharan slave trades. As well, the relative magnitudes of exports from geographically close countries are consistent with the qualitative evidence from the African history literature. Manning (1983, p. 839) writes that "some adjoining regions were quite dissimilar: Togo exported few slaves and the Gold Coast many." The estimates are consistent with Manning's observation. Exports from Togo are far less than from Ghana.

4 Basic Correlations: OLS Estimates

I begin by testing for a relationship between past slave exports and current economic performance. To do this, I use the following estimating equation

$$\ln y_i = \beta_0 + \beta_1 \ln exports_i + \beta_2 \ln size_i + \mathbf{C}_i'\delta + \varepsilon_i \tag{1}$$

where $\ln y_i$ is the natural log of real per capita GDP in 2000; $\ln exports_i$ is the natural log of the total number of slaves exported between 1400 and 1900; $\ln size_i$ is a control for country size, either land area or population; and $\mathbf{C}$ is a vector of dummy variables that indicate the origin of the colonizer prior to independence, with the omitted category being for countries that were not colonized.

OLS estimates of (1) are reported in Table 4. The first column reports estimates without accounting for differences in the size of countries. In

column 2, I control for country size by the natural log of land area. An alternative strategy is to normalize the number of slaves exported by land area. This is done in column 3. In columns 4 and 5, I use the average population of a country in every century between 1400 and 1900 as a measure of country size.[15] The population data are from McEvedy and Jones (1978). In columns 6 to 10, I re-estimate the specifications from columns 1 to 5, except that indicator variables for the identity of the colonizer at the time of independence are included in the regression equations.[16] In each of the ten specifications, the slave export variables are negatively correlated with subsequent economic development and they are statistically significant. The results are independent of how one controls for country size and whether or not the identity of the colonizer is controlled for.

The relationship between the natural log of slave exports normalized by land area and the natural log of real GDP per capita in 2000 is shown in Figure 3. In the raw data one observes a statistically significant negative relationship between past slave exports and current income per capita.[17] Figure 4 shows the same graph with slave exports normalized by a country's average population between 1400 and 1900.

The partial regression plot for ln(exports/area) from the regression from column 8 of Table 4 is shown in Figure 5. The plot shows that the relationship is not driven by a small number of influential observations. I confirm this with more formal sensitivity and robustness tests in Section 7.

The estimated magnitudes of the relationship between slave trades and income are economically significant. The beta coefficients of the estimates for ln(exports/area) range from $-.45$ to $-.61$.[18] If, for purely illustrative purposes, one interprets the OLS estimates as causal, then according to the column 8 estimate, for a country initially with the mean level of income of \$1,249, a one standard deviation decrease in the slave export variable will raise income to \$2,850.

One obtains similar results if average annual per capita GDP growth between 1950 and 2000 is used as the measure of economic development.

[15] I have also used the initial population in 1400, 1450 or 1500, or the post-slave trade population in 1950 or 2000, as measures. Using any of these alternative population measures produces similar results.

[16] The results are robust if one uses alternative definitions of the colonizer for each country. I have also used indicator variables for the identity of the colonizer on the eve of World War I, rather than at independence. The results are nearly identical.

[17] Because the natural log of zero is undefined, I take the natural log of .1. As I show in Section 7, the results are robust to the removal of the zero slave export countries.

[18] The beta coefficient is the change in the dependent variable, measured in standard deviations, per one standard deviation change in the independent variable.

This is not surprising given that within Africa income levels in 2000 are highly correlated with economic growth from 1950 to 2000. The correlation between the two measures is .73.

Table 4: The Relationship between Income and Slave Exports. Dependent variable is ln real per capita GDP in 2000.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ln(exports)	$-.076^{***}$	$-.091^{***}$		$-.070^{***}$		$-.078^{***}$	$-.091^{***}$		$-.094^{***}$	
	(.019)	(.025)		(.025)		(.017)	(.050)		(.025)	
ln(exports/area)			$-.108^{***}$					$-.108^{***}$		
			(.025)					(.024)		
ln(exports/pop)					$-.111^{***}$					$-.113^{***}$
					(.027)					(.025)
ln(area)		.058					.050			
		(.063)					(.062)			
ln(pop)				$-.033$					.076	
				(.082)					(.082)	
Britain						.370	.353	.354	.337	.319
						(.483)	(.486)	(.481)	(.485)	(.485)
France						.318	.312	.316	.318	.336
						(.479)	(.481)	(.476)	(.479)	(.479)
Portugal						.156	.218	.217	.219	.221
						(.542)	(.549)	(.538)	(.547)	(.541)
Belgium						$-.980$	-1.02^{*}	$-.996$	-1.14^{*}	$-.999$
						(.600)	(.604)	(.597)	(.624)	(.602)
Spain						1.68^{**}	1.69^{**}	1.68^{**}	1.70^{**}	1.61^{*}
						(.804)	(.808)	(.800)	(.806)	(.809)
U.N.						1.17	1.04	.896	1.21	1.16
						(.780)	(.814)	(.802)	(.798)	(.797)
Italy						.973	0.862	.732	.966	.935
						(.789)	(.804)	(.790)	(.791)	(.791)
Number obs.	52	52	52	52	52	52	52	52	52	52
R^2	.25	.26	.27	.25	.25	.49	.50	.49	.50	.49

Notes: The dependent variable is the natural log of real per capita GDP in 2000. The slave export measures are the total number of slaves exported from each country between 1400 and 1900 in the four slave trades. The colonizer variables are indicator variables for the identity of the colonizer at the time of independence. Coefficients are reported with standard errors in brackets. ***, **, and * indicate significance at the 1, 5, and 10 percent levels.

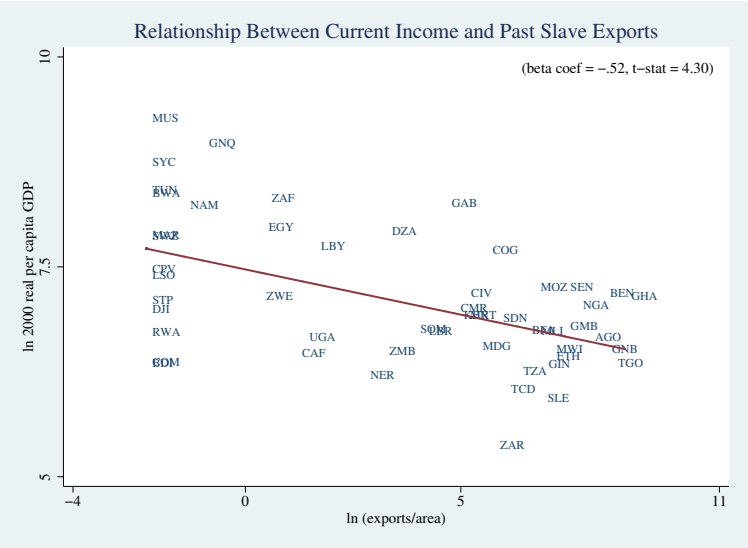

Figure 3: Raw data: ln real per capita GDP in 2000 and ln slave exports normalized by land area, ln(exports/area).

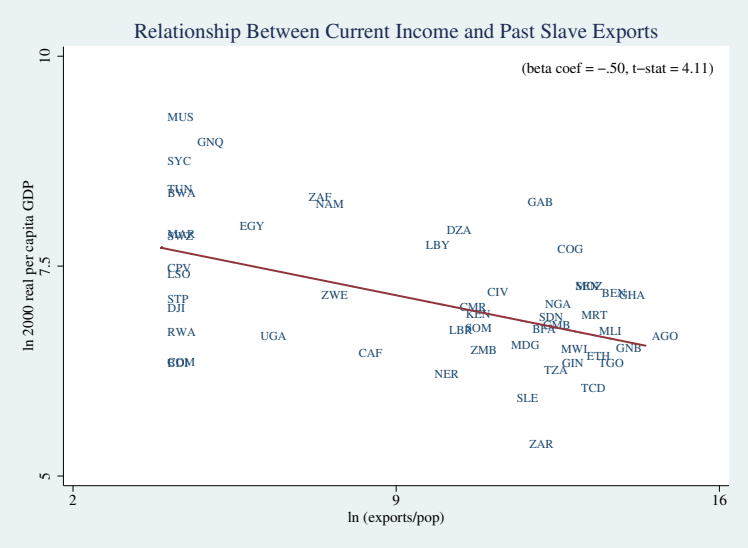

Figure 4: Raw data: ln real per capita GDP in 2000. and ln slave exports normalized by population, ln(exports/pop).

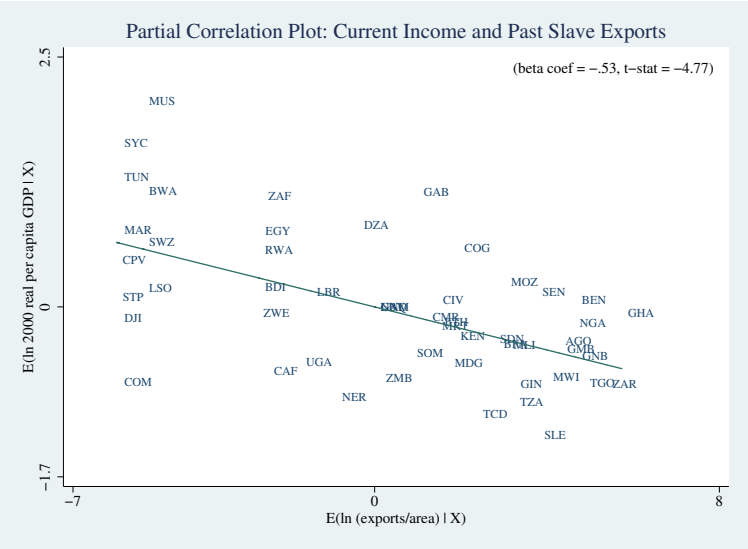

Figure 5: Partial correlation plot: ln real per capita GDP in 2000 and ln(exports/area), controlling for the identity of the colonizer.

5 Econometric Issues: Causality and Measurement Error

Although the OLS estimates show that there is a relationship between slave exports and current economic performance, it remains unclear whether the slave trades have a causal impact on current income. An alternative explanation for the relationship is that societies that initially had poor domestic institutions or were frequently engaged in conflict and warfare may have selected into the slave trades. These characteristics may persist today, adversely affecting current income. Therefore, one observes a negative relationship between slave exports and current economic development even though the slave trades did not have a causal effect on subsequent development.

I pursue three strategies in order to evaluate the causal effect of the slave trades. First, using historic data and qualitative evidence from African historians, I evaluate the importance and characteristics of selection into the slave trades. As I will show, the available evidence suggests that selection was important, but that it was the societies that were initially the most prosperous, not the most backward, that selected into the slave trades. Therefore, the strong relationship between slave exports and current income cannot be explained by selection. Rather, selection will bias the OLS estimates towards zero. Second, I use the distance from each country to the location of the demand for slaves to identify variation in slave exports that is uncorrelated with any African characteristics. Third, I control for observable country characteristics.

5.1 Historical Evidence on Selection during the Slave Trades

A large proportion of the early trade between Africans and Europeans was also in commodities other than slaves. During this time, only societies with institutions that were sufficiently developed were able to facilitate trade with the Europeans. Between 1472 and 1483, the Portuguese sailed south along the West coast of Africa, testing various points of entry looking for trading partners. They were unable to find any societies north of the Zaire river that could support trade. Vansina (1990, p. 200) writes that "the local coastal societies were just too small in terms of people and territory; their economic and social institutions were too undifferentiated to facilitate foreign trade." Sustained trade did not occur until the Portuguese found the Kongo Kingdom, located just south of the Zaire river. Because the Kongo Kingdom had a centralized government, national currency, and well-developed markets and trading networks, it was able to support trade with

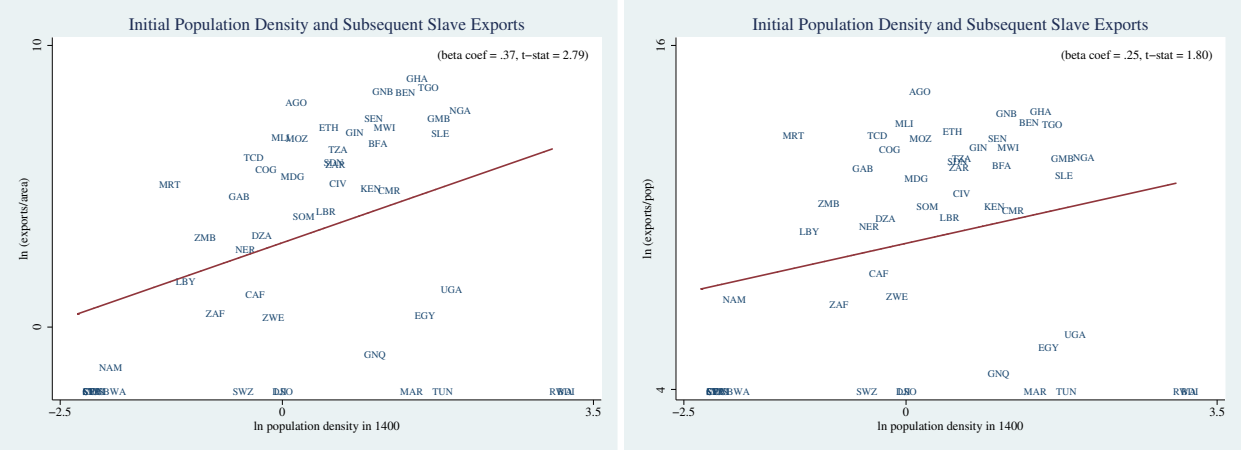

Figure 6: Left: ln population density in 1400 and ln(exports/area). Right: ln population density in 1400 and ln(exports/pop).

the Europeans.

When European demand turned almost exclusively to slaves, the preference to trade with the most developed parts of Africa continued. Because the more prosperous areas were also the most densely populated, large numbers of slaves could be efficiently obtained if civil wars or conflicts could be instigated (Inikori, 2003, p. 182). As well, societies that were the most violent and hostile, and therefore least developed, were often best able to resist the European's efforts to purchase slaves. For example, the slave trade in Gabon was limited because of the defiance and violence of its inhabitants towards the Portuguese. This resistance continued for centuries, and as a result the Portuguese were forced to concentrate their efforts along the coast further south (e.g., Hall, 2005, pp. 60–64).

Using data on initial population densities, I check whether it was the more prosperous or less prosperous areas that selected into the slave trades. Acemoglu *et al.* (2002) have shown that population density is a reasonable indicator of economic prosperity. Figure 6 shows the relationship between the natural log of population density in 1400 and the natural log of total slave exports from 1400 to 1900 normalized by either land area or average population from 1400 and 1900.

The data confirm the historical evidence on selection during the slave trades. Figure 6 shows that the parts of Africa that were the most prosperous in 1400, measured by population density, tend to also be the areas that were

most impacted by the slave trades.

A second potential source of selection may be that societies that initially had domestic slavery may have selected into the slave trades. If this is the case, then the estimates may be capturing a negative relationship between domestic slavery and subsequent economic development similar to that documented by Engerman and Sokoloff (1997, 2002), Sokoloff and Engerman (2000) and Lagerlöf (2005).

For the areas of Africa that were a part of the much older Islamic slave trades there was domestic slavery. It is unclear whether domestic slavery is a cause or a consequence of the external slave trades. However, for the parts of Africa that were previously untouched by the Islamic trades, recent evidence shows that prior to the trans-Atlantic slave trade, chattel slavery did not exist.[19] Hilton (1985) shows that in West Central Africa there was no trade in people prior to the arrival of the Portuguese. She provides evidence showing that in the sixteenth century, words that originally meant 'servant' or 'prisoner', were altered to take on the meaning of a traded slave. Historian and Anthropologist Jan Vansina (1989), using much more detailed linguistic data, confirms Hilton's finding that in West Central Africa there was no word previously for slave. Vansina also maps the origin of the word 'pika' which originally meant servant, but took on the meaning of a traded slave. The word originated at the coastal ports engaged in the slave trade and spread to the inland communities that were also involved in the trade (see Vansina, 1989, 1990). Additional studies from other regions also show that prior to the external slave trade domestic slavery did not exist (e.g., Harms, 1981; Inikori, 2000; Hall, 2005, p. 16).

5.2 Instrumental Variables

There are two potential sources of bias in the OLS estimates. One arises from the existence of country characteristics that are correlated with both slave exports and current economic performance. The other is the presence of classical and non-classical measurement error in the slave export estimates. A potential solution to the two problems is the use of instrumental variables. If one can find instruments that are correlated with slave exports, but uncorrelated with country characteristics and measurement error, then instrumental variables will yield consistent estimates. In the following two sections, I provide IV estimates using two different instrumenting strategies.

[19] Before this evidence was brought forth, there was debate in the literature over whether domestic slavery existed prior to European arrival (e.g., Fage, 1962; Rodney, 1970).

5.2.1 Distance to External Slave Markets

The first set of instruments that I use are the distances from each country to the locations of where slaves were demanded. The validity of the instruments relies on the presumption that although the location of demand influenced the location of supply, the location of supply did not influence the location of demand. For example, if sugar plantations began in the West Indies because the West Indies were close to the western coast of Africa, then the instruments are not valid. However, if instead many slaves were taken from Western Africa because it is relatively close to the plantation economies in the West Indies, then the instruments are valid.

According to the known history of slavery and the slave trades, it was the location of demand that influenced the location of supply and not vice versa. The location of the demand for African slaves was determined by a number of factors, all unrelated to the supply of slaves. An important factor was the location of climate and soil conditions suitable for plantation agriculture using slave labor. In the West Indies, Mauritius, and the Southern United States, slaves were imported because of climates suitable for growing highly valued, globally traded commodities such as sugar and tobacco (Engerman and Sokoloff, 1997, 2002; Sokoloff and Engerman, 2000). The existence of gold and silver mines was a determinant of the demand for slaves in Brazil. In the Northern Sahara, Arabia and Persia, slaves were needed to work in salt mines, and in the Red Sea area slaves were used as pearl divers. An area's religion was also a determinant of the demand for slavery. In the Muslim societies of North Africa and the Middle East, slaves were used as eunuchs, concubines, soldiers, government officials, and servants.

Conceptually, the instruments measure the distance from the interior of each country to the most important destinations in each of the four slave trades. In practice, the following five instruments are used:

1. The *overland distance* from the centroid of a country to the closest point along the coast.[20]

2. The *sailing distance* from the point on the coast that is closest to the country's centroid to the closest major market of the Atlantic slave trade. I use the nine largest importers of slaves, which are: Virginia,

[20] Because sailing distances are from the point on the coast closest to each country's centroid, a country that lies inland of another country will not have the same sailing distance as the coastal country. For the two countries the point on the coast that is closest to each country's centroid will be different.

USA; Havana, Cuba; Haiti; Kingston, Jamaica; Dominica; Martinique; Guyana; Salvador, Brazil; and Rio de Janeiro, Brazil.[21]

3. The *sailing distance* from the point on the country's coast that is closest to its centroid to the closest of the two major slave destinations of the Indian Ocean slave trade: Mauritius and Muscat, Oman.

4. The *overland distance* from a country's centroid to the closest port of export for the trans-Saharan slave trade. The markets are: Algiers, Tunis, Tripoli, Benghazi and Cairo.

5. The *overland distance* from a country's centroid to the closest port of export for the Red Sea slave trade. The ports are: Massawa, Suakin, and Djibouti.[22]

The distance instruments are also illustrated in Figure 7, which shows the five distances for Burkina Faso. Also shown are the locations of demand in each of the four slave trades. In the figure the ports and distance for each of the slave trades is shown in a different color. Further details of the construction of the instruments is given in the appendix.

Of the five instruments, there is particular concern that the distance from a country's interior to the coast is correlated with the error term in the second stage. It has been shown that easy access to the coast allows countries to more cheaply engage in international trade, which increases income (see Rappaport and Sachs, 2003). In addition, distance to the coast is correlated with the measurement error that results from the under-sampling of slaves from the interior. Even though the distance to the coast is problematic as an instrument, it is still useful to report the estimates with the variable included as part of the instrument set. As I show in Section B of the appendix, if the instrument is positively correlated with the measurement error and/or negatively correlated with the error term in the second stage, then the IV estimate will be biased towards zero. Therefore, the IV estimate with distance to the coast in the instrument set is still useful because it can be taken as a lower bound estimate of the effect of slave exports on income. I also report estimates after eliminating the distance to the coast variable from the instrument set.

[21] Data on slave imports are from Eltis and Richardson (forthcoming). There is a significant drop in the volume of slave imports between the 9th and 10th largest markets. Because of this natural break, I use the top 9 markets.

[22] For the island countries, one cannot reach the ports of the Saharan or Red Sea slave trades by traveling overland. For these countries I use the sum of the sailing distance and overland distance.

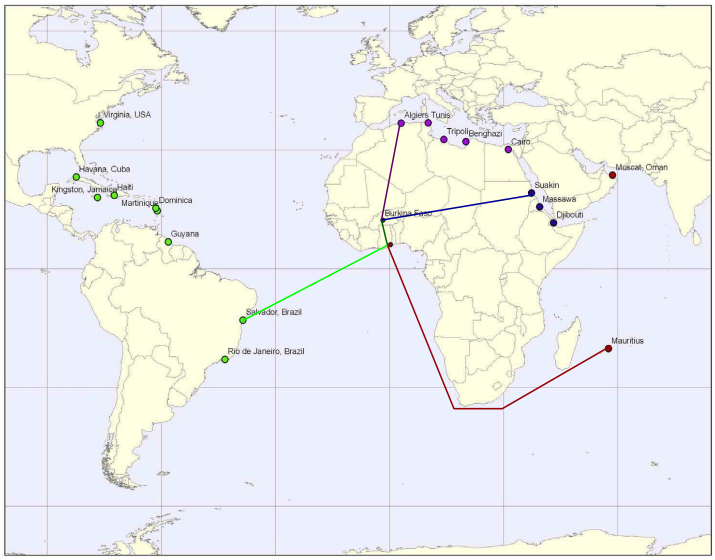

Figure 7: Example showing the distance instruments for Burkina Faso.

Table 5 reports the IV estimates. In columns 1 and 4, I report the OLS estimates, with and without colonial controls, for comparison. In columns 2, 3, 5, and 6, the IV estimates are reported. The first stage coefficients for the instruments are negative as expected, suggesting that if a country is further from slave markets, then less slaves are exported. All coefficients, except for the distance from each country's centroid to the coast and distance to the Red Sea ports, are statistically significant.

In the second stage, the estimated coefficient for ln(exports/area) remains significant and negative. Because the first stage F-statistics are low, I report Anderson-Rubin confidence intervals. In all specifications the magnitudes of the IV estimates are larger than the corresponding OLS estimates. This is expected given the classical and non-classical measurement errors in the slave exports variable, and the selection of the initially most prosperous societies into the slave trades, both of which result in OLS estimates that are biased downwards. If the instruments satisfy the necessary exclusion restrictions and are uncorrelated with both sources of measurement error, then the IV estimates will be larger in magnitude than the OLS estimates.

Table 5: IV Estimates Using Distances to the Locations of Demand as Instruments.

	OLS (1)	IV (2)	IV (3)	OLS (4)	IV (5)	IV (6)
	Second Stage. Dependent variable is log income in 2000					
ln(exports/area)	$-.108^{***}$	$-.182^{***}$	$-.192^{***}$	$-.108^{***}$	$-.185^{***}$	$-.188^{***}$
	$(-.025)$	$[-.61, -.17]$	$[-.48, -.14]$	$(.024)$	$[-.63, -.10]$	$[-.52, -.11]$
Colonizer fixed effects	No	No	No	Yes	Yes	Yes
F-stat	18.5	11.9	12.6	5.22	4.16	4.14
Number obs.	52	52	52	52	52	52
	First Stage. Dependent variable is ln(exports/area)					
Interior distance		$-.0006$			$-.0007$	
		$(.0014)$			$(.0016)$	
Atlantic distance		$-.0012^{***}$	$-.0011^{***}$		$-.0016^{***}$	$-.0015^{***}$
		$(.0004)$	$(.0004)$		$(.0005)$	$(.0004)$
Indian distance		$-.0008^{***}$	$-.0008^{***}$		$-.0009^{**}$	$-.0009^{***}$
		$(.0003)$	$(.0003)$		$(.0003)$	$(.0003)$
Saharan distance		$-.0019^{**}$	$-.0019^{**}$		$-.0021^{**}$	$-.0021^{**}$
		$(.0008)$	$(.0008)$		$(.0009)$	$(.0008)$
Red Sea distance		$-.0004$	$-.0002$		$-.0008$	$-.0006$
		$(.0008)$	$(.0008)$		$(.0009)$	$(.0008)$
Colonizer fixed effects		No	No		Yes	Yes
F-stat		3.33	4.19		2.08	2.30
Sargan test (p-value)		.04	.09		.24	.19
Hausman test (p-value)		.07	.04		.01	.01

Notes: Slave exports is the total number of slaves exported from each country between 1400 and 1900 in the four slave trades. The colonizer variables are indicator variables for the identity of the colonizer at the time of independence. Coefficients are reported, with standard errors in brackets. For the endogenous variable, Anderson-Rubin 95 percent confidence regions are reported rather than standard errors. The p-value of the Hausman test is for the Wu-Hausman chi-squared test. ***, **, and * indicate significance at the 1, 5, and 10 percent levels.

Table 6: IV Estimates Using Initial Population Density as an Instrument.

	OLS	IV	IV	OLS	IV	IV
	(1)	(2)	(3)	(4)	(5)	(6)
	Second Stage. Dependent variable is log income in 2000					
ln(exports/area)	$-.112^{***}$	$-.199^{***}$	$-.168^{***}$	$-.104^{***}$	$-.113^{**}$	$-.116^{**}$
	(.026)	$[-.54, -.06]$	$[-.34, -.06]$	(.025)	$[-.23, -.01]$	$[-.22, -.02]$
ln(2000 pop density)	$-.073$		$-.106$	.043		.032
	(.078)		(.088)	(.084)		(.091)
Colonizer fixed effects	No	No	No	Yes	Yes	Yes
F-stat	9.64	6.71	4.22	6.76	3.35	3.42
Number obs.	52	52	52	52	52	52
	First Stage. Dependent variable is ln(exports/area)					
ln(1400 pop density)		1.09^{***}	1.43^{***}		1.65^{***}	1.85^{***}
		(.392)	(.391)		(.436)	(.408)
ln(2000 pop density)			-1.07^{***}			-1.23^{***}
			(.401)			(.091)
Colonizer fixed effects		No	No		Yes	Yes
F-stat		7.81	7.91		2.59	3.68
Hausman test (p-value)		.14	.15		.88	.24

Notes: Slave exports is the total number of slaves exported from each country between 1400 and 1900 in the four slave trades. The colonizer fixed effects are seven indicator variables for the identity of the colonizer at the time of independence. Coefficients are reported, with standard errors in brackets. For the endogenous variable, Anderson-Rubin 95 percent confidence regions are reported rather than standard errors. The p-value of the Hausman test is for the Wu-Hausman chi-squared test. ***, **, and * indicate significance at the 1, 5, and 10 percent levels.

5.2.2 Initial Population Density

The second IV strategy is to use initial population density as an instrument. As shown in Section 5.1, slaves tended to be exported from areas with high initial population densities. This suggests that population density is a possible instrument for slave exports. However, it is unlikely that initial population density satisfies the necessary exclusion restrictions. There are two reasons for this. First, past population density will be positively correlated with good initial characteristics of the country, which may persist, affecting current income. However, this correlation, as I show in Section B of the appendix, results in an IV estimate that is biased towards zero. Therefore, the IV estimate can be taken as a lower bound estimate. Second, past population density is correlated with current population density, which may affect income directly. Herbst (2000) argues that low population densities are responsible for Africa's poor economic performance. Again, if this relationship exists, then the IV estimate will be biased towards zero, and can be taken as a lower bound estimate. I also control for current population density in the second stage.

The IV results are reported in Table 6. In all specifications, the estimated coefficient for the log of population density in 1400 is positive, as expected, and statistically significant. The IV estimates for ln(exports/area) are negative and larger in magnitude than the OLS estimates. In general, these IV estimates are lower than the IV estimates when the distance to slave markets (reported in Table 5) are used. This is consistent with the population density IV estimates being biased towards zero and therefore being lower bound estimates.

5.3 Controlling for Additional Country Characteristics

The third strategy is to control for additional country characteristics that may affect income per capita, and therefore bias OLS estimates, if omitted from the regression equations. The results are reported in Table 7. In the first column, I add to the estimating equation five region fixed effects: Central Africa, Western Africa, Southern Africa, Eastern Africa, and Northern Africa. The fixed effects control for any country characteristics that differ by region.

I also include variables that control for differences in countries' physical environment, endowments of natural resources, culture, and religion. In columns 2 to 4, I control for a country's geographic environment, by including distance to the equator, natural openness measured by the log

Table 7: Income and slave exports, adding control variables. Dependent variable is ln real per capita GDP in 2000.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln(exports/area)	$-.093^{***}$	$-.091^{***}$	$-.077^{***}$	$-.120^{***}$	$-.083^{***}$	$-.090^{***}$	$-.102^{***}$	$-.094^{***}$
	(.030)	(.030)	(.028)	(.028)	(.031)	(.029)	(.025)	(.029)
Absolute latitude		.012					$.022^{**}$	.014
		(.020)					(.010)	(.018)
ln(coastline/area)			$.108^{***}$				$.089^{***}$	$.069^{*}$
			(.038)				(.027)	(.036)
ln(gold prod/pop)				−.006			−.001	.006
				(.018)			(.017)	(.017)
ln(oil prod/pop)				$.118^{***}$			$.089^{***}$	$.087^{***}$
				(.031)			(.022)	(.030)
ln(diamonds prod/pop)				.017			−.015	.001
				(.047)			(.042)	(.046)
% Christian					.002		−.007	.002
					(.006)		(.005)	(.006)
% Islamic					.006		$-.010^{**}$	−.005
					(.005)		(.004)	(.005)
French legal origin						$.879^{*}$	−.238	.652
						(.457)	(.187)	(.437)
Colonizer fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Number obs.	52	52	52	52	52	52	52	52
R^2	.53	.54	.62	.67	.59	.58	.63	.77

Notes: The dependent variable is the natural log of real per capita GDP in 2000. Slave exports is the total number of slaves exported from each country between 1400 and 1900 in the four slave trades. The colonizer fixed effects are seven indicator variables for the identity of the colonizer at the time of independence. The omitted category is for countries that were not colonized. Coefficients are reported with standard errors in brackets. ***, **, and * indicate significance at the 1, 5, and 10 percent levels.

of coastline divided by land area, and countries' endowments of gold, diamonds, and oil, measured by the natural log of average production per capita between 1970 and 2000. In columns 5 and 6, I include measures of countries' cultural characteristics. I control for the fraction of a country's population that is Christian, the fraction that is Muslim, and for a country's legal origin. In the final two columns, I include all of the control variables together, without and with the region fixed effects and colonizer fixed effects.[23] In every specification, the coefficient of the slave exports variable remains negative and statistically significant.[24]

6 Examining Potential Channels of Causality

Given that the evidence suggests that the relationship between the slave trades and current economic performance is causal, I now turn to the potential channels through which the slave trades may affect economic development. Motivated by the research of African historians, I test the potential channels of causality summarized in Section 2.2. The most likely channels are subsequent state development, ethnic fractionalization, and the quality of domestic legal institutions.

When examining the effect that slave exports have on these factors, the question of causality remains important. If one finds a relationship in the data, it is unclear whether the slave trades affected this measure or whether the slave trades and the measure are both correlated with unobserved country characteristics. Here, I use the same instrumenting strategy that I used when considering the slave trade-income relationship. I use the distance from each country to the locations of demand for slaves as instruments. As I have shown, these measures were an important determinant of slave exports. More importantly, they are likely uncorrelated with initial characteristics of African countries that may affect subsequent state development, institutional change, or ethnic fractionalization, except through their impact on slave exports.

In Table 8, I report IV and OLS estimates of the relationship between slave exports and variables that measure the different channels of causality.

[23] The only control variables that are consistently significant are the production of oil and the log of the coastline divided by land area. These results are consistent with previous studies finding that oil production increases income (e.g., Easterly and Levine, 2003), and that natural openness increases income (e.g., Rappaport and Sachs, 2003).

[24] Although not reported here, the results also remain robust to the inclusion of additional geographic measures, such as elevation, temperature, humidity, rainfall, and frost days. The data are from Parker (1997).

I first test whether slave exports are correlated with the level of domestic state development after the slave trades, but prior to colonial rule. The measure of pre-colonial state development is from Gennaioli and Rainer (2005). The authors construct the measure using ethnographic data from Murdock (1967) on the indigenous political complexity of ethnic groups, measured by the number of jurisdictional hierarchies beyond the local community. The original measure ranges from 0 to 4, with 0 indicating "stateless" societies and 4 indicating societies with "large states" (Murdock, 1967, p. 52). Using this data, Gennaioli and Rainer (2005) construct a measure of the proportion of a country's indigenous population that belongs to an ethnic group that has 0 or 1 jurisdictional hierarchies beyond the local community. The variable provides a measure of how developed a country's indigenous states were prior to colonization. According to both the OLS and IV estimates, the slave trades are negatively correlated with state development. This result supports the research of African historians suggesting that the slave trades resulted in political instability and fragmentation. In all specifications the relationship is significant, although the significance is marginal for the IV estimates without colonizer fixed effects.

In the second row of the table, I consider the relationship between slave exports and a measure of current domestic legal institutions using an index of each country's rule of law in 2000 from Kaufmann *et al.* (2003). The estimates suggest that slave exports are negatively correlated with the quality of the rule of law in 2000, a result that is consistent with previous historical research. Next, I consider the possibility that the slave trades also caused ethnic and social fractionalization, which persists today. I use two variables to capture this channel. The first is a measure of ethnic fractionalization from Easterly and Levine (1997). The second is a measure of cultural diversity from Fearon (2003). Cultural diversity is a measure of ethnic fractionalization that also takes into account the cultural distance between the ethnicities of a country. Both measures are strongly correlated with slave exports, which is consistent with the view that the slave trades impeded political and social development, causing ethnically fragmented societies.[25]

The last row of the table reports the relationship between slave exports and income per capita in 1950. As shown, the relationship between slave exports and income in 1950 is negative, but weak. This result provides insight into the channels through which the slave trades operate. As discussed, the

[25]The results are similar if other measures of fractionalization are used. For example, using the other measures constructed by Fearon (2003) or measures from Alesina *et al.* (2003) yield very similar results.

Table 8: Testing potential channels of causality.

	Without colonizer fixed effects				With colonizer fixed effects			
	OLS		IV		OLS		IV	
	coef	s.e.	coef	s.e.	coef	s.e.	coef	s.e.
Dependent variable								
Pre-colonial state dev.	$-.026^{**}$	(.013)	$-.069^{***}$	(.025)	$-.026^{*}$	(.015)	$-.064^{**}$	(.025)
Rule of law	$-.073^{***}$	(.020)	$-.118^{***}$	(.039)	$-.078^{***}$	(.018)	$-.095^{***}$	(.032)
Ethnic fractionalization	$.040^{***}$	(.009)	$.065^{***}$	(.018)	$.041^{***}$	(.010)	$.066^{***}$	(.019)
Cultural diversity	$.029^{***}$	(.007)	$.050^{***}$	(.014)	$.031^{***}$	(.008)	$.051^{***}$	(.014)
ln per capita GDP in 1950	$-.026$	(.020)	$-.058$	(.038)	$-.030$	(.021)	$-.062$	(.037)

Notes: The coefficients and standard errors reported are for ln(exports/area). In the IV regressions, the instruments are the four distances to the markets of demand in each of the four slave trades. The colonizer fixed effects are indicator variables for the identity of the colonizer at the time of independence. Coefficients are reported with standard errors in brackets. ***, **, and * indicate significance at the 1, 5, and 10 percent levels.

effects of the slave trades may be through state development, domestic institutions, or ethnic fractionalization, which is an important determinant of domestic policies such as the provision of public goods. In 1950, nearly all countries were still under colonial rule, and therefore a country's domestic institutions and policies were externally imposed.[26] If the slave trades affect income through the development of *domestic* institutions and policies, then we would expect the relationship between the slave trades and income to be much weaker, or even non-existent, when a country's institutions and policies are determined externally by a colonial power. The weak relationship between slave exports and 1950 income is consistent with this.[27]

7 Robustness and Sensitivity Analysis

The first set of tests that I perform check the robustness of my results to the construction of the slave export data. As I noted in Section 3, the data used to construct the slave export estimates for the Saharan, Indian Ocean

[26] In 1950 only four African countries were independent. Ethiopia had never been colonized, while Liberia, South Africa, and Egypt had gained independence.

[27] An alternative way of expressing this is that income in 1950 may not be a good indicator of a country's economic development at that time. High income may simply reflect high levels of extraction by the colonizer rather than a good economic environment.

Table 9: Robustness to Data Construction. Dependent variable is ln real per capita GDP in 2000.

	Without colonizer fixed effects			With colonizer fixed effects		
	coef	s.e.	R^2	coef	s.e.	R^2
Baseline	$-.108^{***}$	(.025)	.27	$-.108^{***}$	(.024)	.49
Saharan exports set to zero	$-.052^{***}$	(.013)	.26	$-.058^{***}$	(.011)	.53
Indian Ocean exports set to zero	$-.049^{***}$	(.014)	.20	$-.055^{***}$	(.012)	.49
Red Sea exports set to zero	$-.048^{***}$	(.014)	.19	$-.055^{***}$	(.012)	.48
Atlantic exports set to zero	$-.026^{*}$	(.014)	.07	$-.032^{**}$	(.014)	.33
Atlantic exports only	$-.065^{***}$	(.021)	.16	$-.067^{***}$	(.020)	.41

Notes: The dependent variable is the natural log of real per capita GDP in 2000. The colonizer fixed effects are indicator variables for the identity of the colonizer at the time of independence. Coefficients are reported with standard errors in brackets. ***, **, and * indicate significance at the 1, 5, and 10 percent levels.

and Red Sea slave trades are of lower quality than the data used for the trans-Atlantic slave trade. Here I show that the results do not depend on the slave export estimates that are based on less precise data sources. This is shown in Table 9. In the first row, for comparison I report the baseline estimates without and with the colonizer fixed effects. In the second row, I recalculate my measure of total slave exports, setting slave exports from the Saharan slave trade to zero. This would be the preferred measure of total slave exports if one felt that the data from the Saharan slave trade were too unreliable to be used. Using the new measure, I re-estimate my baseline specifications. The third and fourth rows report the results when the Indian Ocean and Red Sea slave exports are set to zero. In all six of the specifications reported in rows 2 to 4, the estimated coefficient remains negative and statistically significant. Next, I recalculate my total slave exports figure after setting trans-Atlantic slave exports to zero. The estimated coefficient remains negative, but it is now only marginally significant. In the final row, I report the estimated coefficient if I use trans-Atlantic slave exports as my measure of total slave exports. That is, I simultaneously set slave exports in the Saharan, Red Sea and Indian Ocean slave trades to zero. The coefficient remains negative and is highly significant. These results show that the importance of total slave exports is primarily driven by the trans-Atlantic slave trade, and that the results are robust to using only the most precise

Table 10: Robustness and Sensitivity Checks. Dependent variable is ln real per capita GDP in 2000.

	Without colonizer fixed effects				With colonizer fixed effects			
Omitted Observations	coef	s.e.	N	R^2	coef	s.e.	N	R^2
None	$-.108^{***}$	(.025)	52	.27	$-.108^{***}$	(.024)	52	.49
South Africa	$-.105^{***}$	(.025)	51	.26	$-.104^{***}$	(.024)	51	.49
North African countries	$-.097^{***}$	(.027)	47	.23	$-.096^{***}$	(.025)	47	.47
Island countries	$-.104^{***}$	(.026)	47	.26	$-.110^{***}$	(.025)	47	.55
All of the above	$-.078^{***}$	(.028)	41	.17	$-.079^{***}$	(.027)	41	.53
Zero export countries	$-.139^{***}$	(.037)	39	.28	$-.087^{**}$	(.043)	39	.51
$\lvert\hat{e}_i\rvert > 2.0$	$-.103^{***}$	(.022)	47	.33	$-.109^{***}$	(.021)	48	.56
$\lvert\hat{e}_i\rvert > 1.8$	$-.106^{***}$	(.021)	46	.36	$-.109^{***}$	(.027)	48	.56
$\lvert\hat{e}_i\rvert > 1.5$	$-.096^{***}$	(.021)	45	.33	$-.101^{***}$	(.020)	46	.58
$\lvert\hat{e}_i\rvert > 1.0$	$-.099^{***}$	(.018)	35	.48	$-.102^{***}$	(.016)	35	.79
DFFITS	$-.105^{***}$	(.021)	44	.37	$-.108^{***}$	(.022)	49	.53
Cook's Distance	$-.108^{***}$	(.023)	48	.32	$-.108^{***}$	(.024)	51	.47
Welsch Distance	$-.088^{***}$	(.024)	50	.22	$-.108^{***}$	(.024)	51	.47

Notes: The dependent variable is the natural log of real per capita GDP in 2000. The colonizer fixed effects are indicator variables for the identity of the colonizer at the time of independence. Coefficients are reported with standard errors in brackets. ***, **, and * indicate significance at the 1, 5, and 10 percent levels. Influential variables were omitted using the following standard rules. DFFITS: omit if $\text{DFFITS}_i > 2\sqrt{k/n}$. Cook's distance: omit if Cook's distance $> 4/n$. Welsch distance: omit if Welsch distance $> 3\sqrt{k}$. n is the number of observations and k is the number of independent variables.

data to construct the total slave export estimates.

I perform additional sensitivity and robustness tests, which are summarized in Table 10. In the first panel of the table, I re-estimate my equations after omitting countries that may be different from the rest of the sample. It is possible that the results are being driven by a group of countries with peculiar characteristics that are unrelated to the slave trades. The first row of the table reports the baseline estimates for comparison. In the second row, I re-estimate my equations after omitting South Africa from the sample. Because this country has a large number of European settlers, economic performance may be different from other African countries for reasons unrelated to the slave trades. I repeat this procedure, omitting North African countries and omitting Island countries. In the fifth row, I simultaneously omit South Africa, North African countries, and Island countries. In the final row, I omit all countries with zero slave exports. For all specifications the coefficient for slave exports remains negative and statistically significant.

In the second and third panels of the table, I more formally identify potentially influential observations and check whether the results are driven by these. In the second panel, I re-estimate my baseline equations after sequentially omitting observations with 'studentized' residuals greater than 2.0, 1.8, 1.5, and 1.0.[28] In the third panel of the table, I identify influential observations using three rules that have been proposed in the literature (Belsley *et al.*, 1980; Welsch, 1982). Using each rule, I omit the observations identified as outliers and re-estimate my estimating equations. In every estimation, the results remain robust.

8 Conclusions

Combining data from shipping records and data from historical records reporting slave ethnicities, I have constructed estimates of the number of slaves exported from each country in Africa between 1400 and 1900. I found a robust negative relationship between the number of slaves taken from a country and its subsequent economic development.

I pursued three strategies to better understand if the relationship is causal or spurious. Countries initially with poor characteristics may have selected into the slave trades and these poor characteristics may persist

[28] Studentized residuals are calculated from a regression line that is fitted with the observation in question removed from the sample. This avoids the problem of an outlier influencing the estimated regression line, resulting in underestimated residual for the observations.

causing current underdevelopment. I first reviewed the historical evidence on the characteristics of African societies that were most affected by the slave trades. The qualitative and quantitative evidence show that it was actually the most developed parts of Africa, not the least developed, that tended to select into the slave trades. I also used instrumental variables to estimate the causal effect of the slave trades on subsequent economic development. The main instruments I used were the sailing and overland distances from each country to the closest locations of demand in each of the four slave trades. Like the OLS estimates, the IV estimates are negative, suggesting that increased extraction during the slave trades caused worse subsequent economic performance. As a final strategy, I controlled for observable country characteristics. These results also confirm that the slave trades had a causal impact on subsequent economic development.

I then examined the precise channel of causality underlying the relationship between slave exports and subsequent economic development. Using historical evidence as a guide, I then examined whether slave exports resulted in a fragmentation and weakening of states, ethnic fractionalization, and a deterioration in the quality of judicial institutions. I found support for the view that the slave trades resulted in weak, politically fragmented states, ethnic fractionalization, and poor judicial institutions.

A Deriving the Bias from the Under-Sampling of Slaves from the Interior

I show here that the non-classical measurement error present in the slave export data will result in OLS estimates of the effect of slave exports on income that are biased towards zero.

To see this, denote the true number of slaves taken from country i by s_i^*, the observed number of slaves by s_i, distance to the coast by d_i, and economic development by y_i. All variables are expressed as deviations from means. Assume the true relationship between the number of slaves exported and distance to the coast is given by

$$s_i^* = -\alpha d_i + \varepsilon_i \tag{2}$$

where $\alpha > 0$ and ε_i is i.i.d. drawn from a normal distribution. The relationship between the observed number of slaves exported s_i and the distance to the coast d_i is given by

$$s_i = s_i^* - \gamma d_i + \nu_i \tag{3}$$

where $\gamma > 0$ and ν_i is uncorrelated with ε_i. The true relationship between slave exports and development is given by

$$y_i = -\beta s_i^* + \omega_i \tag{4}$$

where $\beta > 0$ and ω_i is uncorrelated with all other variables.

If one estimates $y_i = bs_i + \xi_i$ by OLS, then the estimated relationship between s_i and y_i is

$$\hat{b} = \frac{\sum_i s_i y_i}{\sum_i s_i^2} \tag{5}$$

Substituting (2) into (3) gives

$$s_i = -(\alpha + \gamma)d_i + \varepsilon_i + \nu_i \tag{6}$$

Similarly, (2) and (4) give

$$y_i = \beta\alpha d_i - \beta\varepsilon_i + \omega_i \tag{7}$$

Substituting (6) and (7) into (5), and taking the plim of $\hat{b}$ gives

$$\text{plim } \hat{b} = -\beta \left[\frac{\sigma_{s^*}^2 + \gamma\alpha\sigma_d^2}{\sigma_{s^*}^2 + 2\gamma(\alpha + \gamma)\sigma_d^2 + \sigma_\nu^2} \right] \tag{8}$$

where $\sigma_{s^*}^2 = \alpha^2\sigma_d^2 + \sigma_\varepsilon^2$.

First, consider the case when the only source of measurement error is classical measurement error. Then $\gamma = 0$ and (8) reduces to the standard formula for attenuation bias: plim $\hat{b} = -\beta[\sigma_{s^*}^2/(\sigma_{s^*}^2 + \sigma_\nu^2)]$.

Next, consider the measurement error introduced by the under-sampling of slaves from the interior. The result of this is that the under-estimation of slave exports is increasing in a country's distance from the coast: $\gamma > 0$. Looking at (8), it is apparent that $2\gamma(\alpha+\gamma) > \gamma\alpha$ and therefore the presence of non-classical measurement error also biases towards zero the estimated coefficient, reinforcing the attenuation bias resulting from classical errors-in-variables. Asymptotically, $\hat{b}$ is biased even further towards zero because of the under-sampling of slaves from the interior.

B Deriving the Bias of the IV Estimates

I now consider the potential bias introduced to IV estimates if the instruments are correlated with the second stage error term, which may include measurement error in the slave export variable.

B.1 Using Distance to Slave Markets as Instruments

Let the instrument be denoted by z_i. I use the core equations presented in the previous section, but make one change to allow the instrument to be an additional determinant of the true number of slaves exported. Equation (2) is replace with

$$s_i^* = -\alpha_1 d_i - \alpha_2 z_i + \varepsilon_i \tag{9}$$

Substituting (9) into (3) gives

$$s_i = -(\alpha_1 + \gamma) d_i - \alpha_2 z_i + \varepsilon_i + \nu_i \tag{10}$$

and (9) and (4) give

$$y_i = \beta\alpha_1 d_i + \beta\alpha_2 z_i - \beta\varepsilon_i + \omega_i \tag{11}$$

If one estimates $y_i = bs_i + \xi_i$ by IV, using z_i as an instrument, then the estimated relationship between s_i and y_i is

$$\hat{b}_{iv} = \frac{\sum_i z_i y_i}{\sum_i z_i s_i} \tag{12}$$

Substituting (10) and (11) into (12), and taking the plim of $\hat{b}_{iv}$ gives

$$\text{plim } \hat{b}_{iv} = -\beta \left[\frac{\alpha_2\sigma_z^2 + \alpha_1\sigma_{zd}}{\alpha_2\sigma_z^2 + (\alpha_1 + \gamma)\sigma_{zd}} \right] - \frac{\sigma_{z\omega}}{\alpha_2\sigma_z^2 + (\alpha_1 + \gamma)\sigma_{zd}} \tag{13}$$

where I assume that the instrument is uncorrelated with the classical measurement error ($\sigma_{z\nu} = 0$).

If the instrument is uncorrelated with distance to the coast ($\sigma_{zd} = 0$) and if the instruments are valid ($\sigma_{z\omega} = 0$), then $\hat{b}_{iv}$ is consistent. Now consider an instrument that is positively correlated with distance to the coast. Then $\sigma_{zd} > 0$. As well, the instrument will be positively correlated with transportation costs, which negatively affect income directly: $\sigma_{z\omega} < 0$. Then the term in the square bracket is positive and less than one, while the term being subtracted is negative. Therefore, both the term in the square brackets and the term being subtracted cause the IV estimate to be biased towards zero (i.e., upwards): $\hat{b}_{iv} > -\beta_1$.

B.2 Using Initial Population Density as an Instrument

Next, consider initial population density as an instrument. Because this instrument is positively correlated with slave exports, Equation 9 is replace by

$$s_i^* = -\alpha_1 d_i + \alpha_2 z_i + \varepsilon_i \tag{14}$$

Following the exact same procedure as above yields the following expression for the plim of $\hat{b}_{iv}$

$$\text{plim } \hat{b}_{iv} = -\beta \left[\frac{\alpha_2 \sigma_z^2 - \alpha_1 \sigma_{zd}}{\alpha_2 \sigma_z^2 - (\alpha_1 + \gamma)\sigma_{zd}} \right] + \frac{\sigma_{z\omega}}{\alpha_2 \sigma_z^2 - (\alpha_1 + \gamma)\sigma_{zd}} \tag{15}$$

If initial population density is uncorrelated with the distance to the coast (and the non-classical measurement error), but is correlated with current population density, which is positively correlated with current income, then $\sigma_{zd} = 0$ and $\sigma_{z\omega} > 0$, and (15) reduces to

$$\text{plim } \hat{b}_{iv} = -\beta + \frac{\sigma_{z\omega}}{\alpha_2 \sigma_z^2} \tag{16}$$

In this case, the IV estimate using initial population density as an instrument is biased towards zero (i.e., upwards).

C Data

Real per capita GDP in 1950 and 2000 are from Maddison (2003). Land area, measured in millions of square kilometers, is from Parker (1997). Historic population figures, measured in thousands of people, are from McEvedy and Jones (1978). For some groups of the smaller countries of Africa, population data are only disaggregated to a regional level. In these cases the data are disaggregated to the country level using the distribution of population in 1950 from the United Nations. Data on the identity of the colonizer before independence are from the *Political Regimes and Regime Transitions in Africa, 1910–1994* data set (Bratton and van de Walle, 1997). The data on the production of diamonds, crude petroleum, and mined gold are from the British Geological Survey's *World Mineral Statistics* and *World Mineral Production*. All three variables are measured as the natural log of the average annual production per thousand inhabitants from 1970 to 2000. Diamonds include both gemstones and industrial diamonds and are measured in thousands of carats. Crude Petroleum is measured in thousands of tonnes and mined gold is measured in kilograms. Data on countries' legal origins are from La Porta *et al.* (1999). Ethnic fractionalization is from Easterly and Levine (1997), and cultural diversity is from Fearon (2003). Data on a country's coastline, religion, and average latitude are from Parker (1997). Countries' total coastline is measured in kilometers. The religion variables are the fraction of a country's population that are Christian and Islamic. Latitude is measured as the absolute value of the country's average latitude measured in degrees.

The rule of law in 2000 is from Kaufmann *et al.* (2003). It is an index ranging from -2.5 to 2.5 that measures the extent to which agents have confidence in and abide by the rules of society.

When taking the natural log of variables that may take on the value of zero, I replace the zero observations with 1×10^n, where n is the largest integer value possible subject to 1×10^n being less than the smallest non-zero observation in the data.

The distance instruments measure the shortest sailing distances to the location of demand in the trans-Atlantic and Indian Ocean slave trades, and the shortest overland distance to the locations of demand in the Red Sea and trans-Saharan slave trades. In practice, distances are calculated using the great circle distance between two locations. The formula for this is: $d_{ij} = \arccos\{\sin(La_i)\sin(La_j) + \cos(La_i)\cos(La_j)\cos(Lo_i - Lo_j)\} \times 111.12$, where d_{ij} is the distance in kilometers between location i and j, La_i is the latitude of location i in degrees, and Lo_i is the longitude of location i in degrees. When calculating the sailing distances, I do not allow ships to sail across land.[29] For example, for voyages from Northern Africa in the trans-Atlantic slave trades, I calculate the sailing distance through the Mediterranean sea and the Strait of Gibraltar to the closest market in the Atlantic Ocean. For the distance from these countries in the Indian Ocean slave trade, I calculate the sailing distance through the Mediterranean sea, and then south around the Cape of Good Hope. Similarly, when calculating distances from East African countries during the trans-Atlantic slave trade, and for distances from West African countries during the Indian Ocean slave trade, I calculated the sailing distance around the Cape of Good Hope.

The centroid of each country is calculated using the Centroid Utility in ArcGIS. For five countries where the centroid falls outside the land borders of the country (Gambia, Somalia, Cape Verde, Mauritius and Seychelles) the point within the country closest to the centroid is used. The location on the coast that is closest to each country's centroid is identified using the Proximity Utility in ArcGIS.

[29] As well, I do not allow ships to sail through the Suez Canal since it was not completed until 1869.

Table 11: Summary Statistics of Main Variables

Variable	Mean	std. dev.	Min	Max	N
ln real per capita GDP in 2000	7.13	.83	5.38	9.27	52
ln(exports/area)	3.12	3.98	−2.30	8.81	52
ln(exports/pop)	9.17	3.73	3.91	14.40	52
Rule of law 2000	−.55	.70	−1.97	1.14	52
Pre-colonial state dev.	.54	.32	0	1	42
Ethnic fractionalization	.57	.31	0	1	52
Cultural diversity	.40	.21	0	.21	48
ln real per capita GDP in 1950	6.65	.57	5.67	8.04	52

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