Does international trade cause detrimental specialization in developing economies? Evidence from countries south of the Suez Canal*

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ABSTRACT When opening up to trade, countries specialize according to their comparative advantage. However, developing countries are often *dis*advantaged in production that requires contract enforcement or other institutions. In those countries, trade liberalization can eliminate the demand for contract enforcement, implying a detrimental impact on institutional development. This paper evaluates this argument of detrimental specialization. To identify the causal impact of trade isolation on specialization, I examine the impacts of a war-induced closure of the Suez canal on agricultural trade of the East African countries that suffered longer trade routes. Trade isolation of developing countries hurts the sectors that require good institutions—the opposite of what the detrimental specialization argument predicts. I offer a potential explanation by combining the standard models of international trade and endogenous institutions.

Keywords: international trade, specialization, institutional development, quasi-natural experiment

JEL-codes: F63; O19; N77; F11; F12; O43; F43

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1. Introduction

International trade helps countries develop in the long run. At least, that is the presumption of the many development policies that promote trade. Trade encourages production and investments, along with the necessary property rights and contract enforcement. However, international trade also leads countries to specialize according to their comparative advantage. Since most developing countries have comparative *dis*advantages in institutional quality, opening up to trade specializes developing countries into production that does not require good institutions. If trade delays the demand for good institutions, it may also delay development: through such "detrimental specialization" into sectors that do not need good institutions, the promotion of international trade may have adverse effects on development (Levchenko, 2007, 2013, Stefanidis, 2010, Nunn and Trefler, 2013, Dippel et al., 2015). This paper examines whether such detrimental specializations occur.

The idea that trade leads to long-run development motivates large aid budgets. Organizations such as the UN and the OECD (OECD/WTO, 2013) support aid-for-trade programs, originally pioneered by the World Trade Organization. Aid-for-trade funds finance the infrastructure that supports international trade, and they encourage countries to specialize in their best sectors or value chain tasks, for instance (Lederman and Maloney, 2012; OECD/WTO, 2015). Aid for trade is also a mainstay of the European Union's development programs, and the United States Trade and Development Agency extensively pairs development aid with the promotion of exports. In 2013, the UK government concluded that "ultimately, trade is the most important driver of growth."[2] Given this widespread underpinning of aid policies, it is important to understand whether trade is beneficial to development.

History certainly provides plenty of examples to suggest that trade shapes the long-run fate of a country. Greif (1989) shows how trade in the Mediterranean encouraged traders to set up institutions to deal with distant trade partners. In Europe, rising trade and the desire to protect non-local merchants' interests led to improved property rights formulated in Merchant Law (Greif et al., 1994). Michalopoulos et al. (2017) argue that trade stimulated the adoption of Islam and its facilitation of pre-industrial trade. Jha (2013) shows that medieval Muslim long-distance shipping to India initiated institutions to organize trade across Muslim and Hindu ethnic groups and shows that

[2] Secretary of State for International Development Greening in July, 2013 (see https://www.gov.uk/government/speeches/justine-greening-global-trade-can-help-us-end-the-need-for-aid).

these institutions persist to reduce conflict in Indian cities today. Fenske (2014) argues that in pre-colonial African societies, a high local ecological diversity guaranteed larger gains from trade, and as a result, developed stronger, centralized states that allowed trade to flourish.

Importantly, the long-run effects of trade often depend on *who* benefits from trade liberalizations. Puga and Trefler (2014) show that the growth of long-distance trade enabled Venetian merchants to constrain the Doge. The access to trading routes to the East empowered merchants to set up a parliament and improve contracting institutions. Acemoglu et al. (2005) contend that merchants' increased wealth derived from Atlantic trade was crucial in limiting European monarchical power, at least in those countries where trade benefited merchants more than monarchs. A country's comparative advantage in natural resources similarly foretells its institutional development. Sokoloff and Engerman (2000) and Bruhn and Gallego (2012) argue that the cultivation of scale-intensive crops, such as that of cotton and sugar, has led to inequality and less-inclusive institutions; while natural advantages in small-scale production, as with grain in the U.S. and Canada, have led to inclusive institutions. Similarly, Fenske (2013) argues that land abundance delays the establishment of land rights and, eventually, public institutions. Mayshar et al. (2015) show that soil suitability for storable crops (as opposed to perishable crops) generates demand for protection from expropriation. Dippel et al. (2015) show that falling world prices of sugar reduced the coercive power of sugar plantation owners.

Today, the impacts of international trade on institutional development still vary with who stands to gain from trade. For countries with a comparative *dis*advantage in institutions, trade liberalization may expand the sectors that do not require good institutions (Nunn, 2007; Levchenko, 2007). As the demand for high-quality institutions falls, trade liberalization may be detrimental to institutional development in countries that already lag institutionally (Levchenko, 2013). Similarly, trade liberalization undermines financial development in countries with a comparative disadvantage in financially intensive goods (Do and Levchenko, 2007). Trade may also free up resources that reinforce the quality of policy: leaders that support poor institutions use the resources to secure contract breaches, but others use them to enforce contracts (Stefanidis, 2010). Parallel arguments that (trade-induced) specialization might delay long-run development can also be found in macroeconomics and economic geography. For lagging countries with a comparative advantage in agriculture, international trade could delay the development of sectors that cause long-run growth (Matsuyama, 1992; Rodrik, 2016). Under technological complementarities or localized externalities, trade may lead to specialization into sector patterns with limited prospects for productivity growth, diversity, or innovation (Brezis et al.1993; Martin, 2010; Harrison and Rodríguez-Clare, 2010). Yet there is no consensus on whether lagging countries suffer detrimental specialization in institutions with trade liberalization. Nunn and Trefler (2013) argue that the lack of evidence on comparative advantage effects in institutions is a shortcoming of the literature and conclude that, potentially, "trade's confusingly diverse impacts on domestic institutions [can be] explained by comparative advantage."

This article examines the direct specialization effects of trade on institutionally lagging countries. It focuses on the central mechanism in the argument for detrimental specialization: whether the wrong sectors benefit from trade liberalization. The paper uses a sectoral approach (Nunn, 2007) to examine differential effects of a trade cost shock. To consider the *causal* impacts of trade shocks on patterns of specialization, the analysis exploits the fact that a war between Israel and Egypt sealed the Suez Canal over the years 1967-1975, isolating countries on the Eastern coast of Africa from Europe. Feyrer (2009) proposed to study the Canal closure as a natural experiment. The canal closure was unanticipated and unrelated to most events in the East African countries in the sample, but it caused substantial trade adjustments. We consider whether the resulting trade isolation affected the exports of agricultural goods from East African exporters differently, depending on whether the production of those goods required high levels of contract enforcement. By identifying off the differences in institutional sensitivity, the analysis eliminates confounding country-level shocks as an explanation for trade dynamics. Therefore, combined with the exogenous shock of trade isolation, this paper complements the literature on the causal institutional impacts of trade, which uses (cross-country) instrumental variables for identification (e.g., Ades and di Tella, 1999; Rodrik et al., 2004; Giavazzi and Tabellini, 2005).

The results show no evidence of detrimental specialization. If anything, sectors that require better contract enforcement exported *less* than other sectors when they were hit with trade isolation. For example, the export of beef, which requires large, long-term investments, grew around 15% more slowly in countries for which the shortest route to Europe was through the Suez Canal, as compared to other countries. The export of hogs, by contrast, requires comparatively few up-front investments and relies far less on contract quality. In countries affected by trade isolation, exports of pork grew around 37% faster than elsewhere. This trade pattern—documented more formally below—suggests that lower trade costs do not favor the wrong sectors, as detrimental specialization would suggest.

To make sense of the empirical results, I describe a theoretical framework of international trade and institutions that embeds a common model for the development of institutions in standard sectoral new trade theory. The measure of institutional quality—contract enforcement—determines the country's export patterns; but international trade also encourages producers to exert political influence on the level of contract enforcement. On the one hand, the detrimental effect of trade surfaces. In institutionally lagging countries, lower trade costs may expand the sectors that prefer poorer levels of contract enforcement (Levchenko, 2007). On the other hand, low trade costs lead producers to push for better contract enforcement. Trade openness magnifies the revenue losses from setting high prices, so producers want to avoid contract insecurities in factor markets that drive up their marginal costs. Moreover, the social distortions of poor enforcement turn out to be graver in an open economy, providing policymakers in open economies to strive for contract enforcement. While comparable arguments have been made implicitly in the public debate, this paper is among the first to formalize such a beneficial channel.[3] I show that while the empirical results refute detrimental specialization, they may be consistent with (though not direct evidence of) the second channel, by which trade beneficially changes institutions.

The remainder of the paper is organized as follows. Section 2 describes the context of the Suez Canal, the data, and the identification of the specialization effects of the trade costs shock. Section 3 presents a theoretical framework that documents different ways in which trade costs affect institutions, and it proposes interpretations of the empirical results. Section 4 concludes.

2. Sectoral responses to the closing of the Suez Canal

Detrimental specialization for developing countries happens when opening up to trade harms the sectors that rely intensively on contract enforcement or other institutions. Or, vice versa, detrimental specialization implies growth in contract-intensive sectors in developing countries after they are isolated from world trade. This section evaluates whether that mechanism of detrimental specialization occurs. It examines which sectors declined fastest when trade costs rose due to the closing of the Suez Canal, following Nunn and Trefler (2013). This section briefly describes the

[3] Do and Levchenko (2009) compare poorer institutions to high firm-entry costs. The motivating model in this paper offers a parallel in assuming that the up-front costs are most easily expropriated. Levchenko (2013) argues that trade may improve institutions if countries' technologies are sufficiently similar, in which case institutional quality can be used to attract high-grade production. This is different from the current paper's focus on lagging countries. Dixit (2003) shows that larger markets require more formal enforcement. Some other papers argue that trade liberalization changes the demand for different skills and rates of expropriation (Ghosh and Robertson, 2012), and that trade may draw away labor from (labor-intensive) conflicts (dal Bó and dal Bó, 2011) or make civil wars more costly (Martin et al., 2008).

context of the Suez Canal closure as a source of exogenous trade cost variation and lays out the difference-in-difference identification of impact.

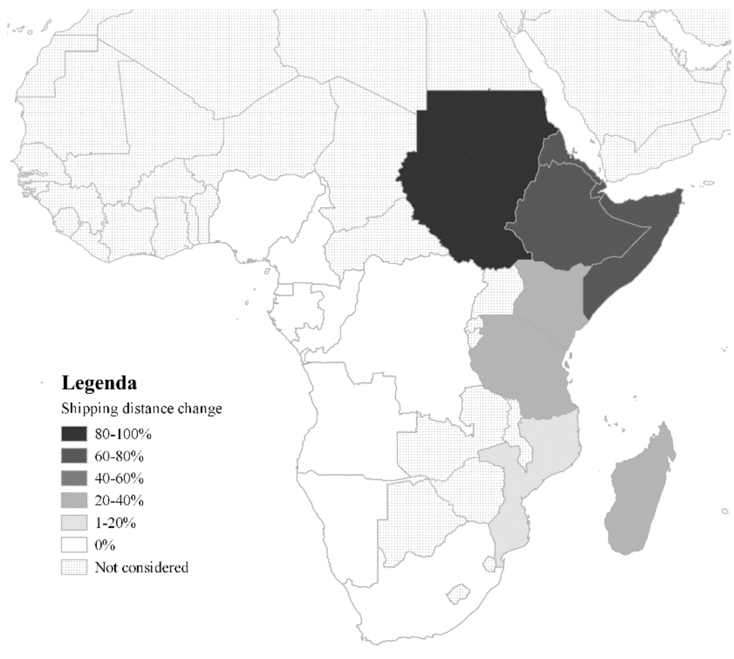
The Suez Canal and context of the trade shock

The Suez Canal was shut from 1967 to 1975. In 1955, after the Egyptian rapprochement with the Soviets, the UK withdrew its financial support for the construction of the Aswan (high) Dam, and the US followed in 1956. In response, Egyptian president Nasser nationalized the Suez Canal, earlier held by the British, to finance the Aswan Dam construction. To avert an Israeli (backed by the British and French) dispute with Egypt, in 1956, the United Nations passed the Pearson resolution, which left the Suez Canal freely navigable under UN control. It was not until the Six-Day War with Israel that Egypt closed the canal again. During the Six-Day War, Israeli forces took control of the Sinai Peninsula, turning the Suez Canal into a warfront. Egypt closed down the canal by sinking ships and, by the end of the war, had placed a substantial number of mines in the canal. The closure of the canal was unexpected. In fact, a group of ships (the "Yellow Fleet") were caught in the canal after its closure and were not released until 1975. In 1973, the canal was once again the scene of a war, this time the Yom Kippur war. By 1974, the UN had regained control over the Suez Canal, but the wartime debris and mines still left the canal unnavigable. After the canal was finally cleared, it was formally reopened on June 5, 1975.

The closing of the Suez Canal poses a possible quasi-experiment for the countries south of the Suez Canal. Egypt was clearly involved in the conflict that led to the closing of the canal, but many coastal countries south of the canal were only bystanders of the conflict. They exported mainly agriculture and resources by ship, and the Suez conflict obstructed the sea routes. By contrast, passenger and air travel between Europe and the African countries in the sample did not become much slower, and flows of news and other information were not vulnerable to the barred sea routes. Thus, the Suez Canal shutdown posed a trade costs shock with little contamination from barriers to information flows or the mobility of people. Moreover, as Feyrer (2009) argues, the conflict broke out unexpectedly and continued over the duration of the canal closure, so the change in transport costs was neither anticipated nor avoidable.

To proxy for the change in transports costs, I exploited the change in kilometers of sea navigation required for a set of African countries to reach a European port. For countries on the East coast of Africa, the closing of the Suez Canal implied a shipping route around the South Cape. For countries on the West coast (that is, South Africa and countries located more West), shutting down the eastern route had no consequences for the shortest path. To quantify these changes, I took sea route data from searates.com (see Appendix B) for shipping to the largest port in Europe, Rotterdam. I compared the length of the route in kilometers via the Suez Canal with the route via South Africa.[4] The analysis involves only countries that have access to the ocean because for land-locked countries such as Zambia or Uganda, it is uncertain whether the shortest route was affected. Appendix C provides a list of the African countries in the sample and their main seaport, from which distances were calculated. Figure 1 summarizes the percentage change in shipping distance to Rotterdam. The mean distance to the port of Rotterdam before 1967 was around 10,600 kilometers. For the affected countries, the mean distance increased from 10,400 kilometers to 14,900 kilometers after the closure.

Figure 1. Shipping distance changes to Rotterdam due to Suez Canal closing, by country

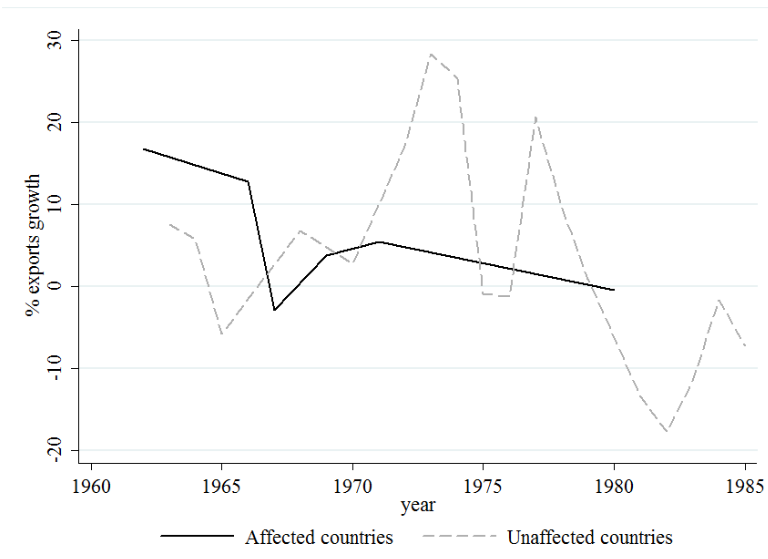


The closing of the Suez Canal had substantial effects on trade. Feyrer (2009) documents that it led to significant decreases in aggregate trade for country pairs whose quickest route used the canal. Focusing on agricultural exports, which constitute my main data, confirms this picture. Figure 2

[4] The second route is the sum of two parts, shipping to South Africa and subsequently shipping to Rotterdam. To infer the cost of the stop in South Africa, I compared the kilometers shipping from Mozambique to Botswana to the kilometers shipping from Mozambique to South Africa to Botswana. The results do not change whether subtracting this "South Africa stopover" difference from the imputed length of the southern route. I also used the shipment time, but as it is highly correlated to the kilometers, the results do not change between using time or kilometers.

traces the development of the (total) agricultural exports in my data for affected countries (those on the East African coast for which the shipping distances increased in 1967) and unaffected countries. Affected countries show a drop in exports in 1967; they did not experience the high export growth seen elsewhere on the continent. A simple difference-in-difference regression of the log of total exports on the interaction of dummies for being affected and for the years 1967-1975, as well as for country and time fixed effects, confirms this: the interaction term takes a coefficient -0.11, suggesting that affected countries had 11% lower exports than could be expected under the same circumstances as in the unaffected countries. It is less certain which transporters were most affected. British registered ships traditionally accounted for the lion's share of merchant shipping (Jeula, 1872); but by 1966, Liberian- and Norwegian-registered ships took large portions, too, due to the use of flags of convenience.[5] The British Minister of the Foreign Office noted that from 1967 to 1968, the number of British ships calling at South African ports tripled.[6]

Figure 2. Evolution of agricultural trade for affected and non-affected countries



If the basic forces of specialization do not operate in the sample, it may be difficult to identify whether or not the predicted detrimental specialization occurs. Trade responses could be muted if there were no functioning (international) markets or if production was fully planned in the sample countries

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[5] These statistics stem from the document "General Comparative Statistics: Panama and Suez Canals" that the Panama Canal Museum published in 1971.

[6] Lord Chalfont, House of Lords debate July 6, 1969, vol 303 c892WA

during the years of the sample. However, several observations suggest that this is not an insurmountable problem. First, planning or absence of markets would imply absence of the trade effects that are central to the model. A test using exports would, thus, be biased towards finding no conclusions if trade were unresponsive to international markets. That is not the case. Second, I find modest evidence that capital-intensive industries thrived with the closure of the Suez Canal—consistent with forces of neoclassical trade theory acting in the sample. Third, much of the available historical evidence for African countries suggests that more or less functioning markets were present, despite relatively many government interventions and occasional extreme outcomes following droughts. There is evidence that workers chose to work in different industries according to pay and risk. Layoffs of workers are not easy to detect in some countries in the sample, but competitive prices seemed to hold more or less: wages reflect human capital and urban premia in many parts of Africa (Boissiere et al., 1985). Countries probably relied on tariffs and taxes on exporting industries, although that did not stop trade; with the exception of Somalia, exports to OECD countries grew in sub-Saharan Africa (Dercon, 1993; Collier, 1991; Rodrik, 1998). A possible explanation for this relative responsiveness is that most African agricultural labor is flexible: workers often work several jobs, possibly to diversify sectoral climatic risk (Davis et al., 2014; Reardonet al., 1992). Agriculture saw outside pressure from large urbanization movements in all decades in my sample, and rural areas likely provided competitive (i.e., non-subsistence) alternative sectors of employment (Lanjouw and Lanjouw, 2001). Price controls were largely ineffective (Collier and Gunning, 1999), and in a robustness check, I find confirmation that they play a limited role in the results.

It also seems plausible that many firms in Eastern Africa between the 1960s and the 1980s experienced contracting difficulties, as the detrimental specialization argument assumes. Microevidence from that time is scarce, but later surveys suggest that uncertainty about contracts is widespread. Bigsten et al. (2000) show that for the several African countries that they study (including Cameroon and Kenya), contracts are renegable; court settlement functions imperfectly, and breaches of agreements are often solved by negotiations outside the courts. Dercon (1998) argues that in Tanzania, risk and imperfect access to credit led to sectoral allocation away from profitable sectors.

Empirical strategy

The key question of this paper is whether -- following the argument for detrimental specialization in developing countries -- trade isolation leads to relative growth in sectors that rely on contract enforcement. To examine detrimental specialization during the Suez Canal lockdown, I consider sectoral variation in export responses, in line with Nunn and Trefler (2013). I estimate a gravity equation for sectoral exports in which I allow the effect of the trade cost shock to vary with the sector's dependence on institutional quality.

The quantification of institutional sensitivity is an important step in the identification. I follow related literature in taking a firm's entry costs and up front-investment to quantify dependence on contract enforcement. Entry into production is difficult if institutions are poor (Do and Levchenko, 2009) or if poor contract enforcement complicates transactions for a fixed factor required in production (Levchenko, 2007; Levchenko, 2013). This is consistent with findings that poorer institutions prevent producers from adopting expensive, better technology (Amaral and Quintin, 2010), raising entry cost per se (Kletzer and Bardhan, 1987; Beck, 2002), financing size-conducive investments (Ponticelli and Alencar, 2016), and accessing long-term financing (Gopalan et al., 2016; Brown et al., 2017). The fixed or up-front cost of production is also viewed as an institutional obstacle in the literature on the finance of international firms (Manova, 2013) because poor enforcement makes external financing risky. Up-front costs can be measured easily and are prevalent in African agriculture: getting access to equipment or machinery, seeds, young animals or land tenure requires more-complex transactions than hiring day laborers, for which cooperation can be ended at little cost at the moment one party breaks the contract. The proportion of up-front costs also has limited correlation with capital intensity, so that potentially correlated shocks in capital prices do not explain why fixed-cost intensity affected the Suez Canal closure response. For robustness, I also report findings based on alternative measures of institutional sensitivity.

The identifying assumption in my baseline model requires that producers incur up-front costs and that these are not easily financeable. This setup is borne out by several empirical results on the countries in my sample, many in the overview of Collier and Gunning (1999). In Africa, the use of machinery is less prevalent than in other parts of the world, but animal power is more extensively used. There are positive but relatively low exports from sectors that require planting (trees) for long-term horizons, investments in cattle and livestock, and crops that require fallow land. African markets for capital and machinery are relatively illiquid: few firms use second-hand equipment, and used capital goods sell at large discounts (Collier and Gunning, 1999; Gunning and Pomp, 1995). There is significant uncertainty about land tenure and operating rights, often mixing between formal entitlement and traditional tenure and heritability. The lack of up-front investments in items such as tree crops demonstrates the uncertainty of the property status (Besley, 1995). Uncertainty about land tenure often also leads to more labor-intensive production strategies (Fenske, 2011). Similarly, African farmers spend windfalls on livestock investments, suggesting that their financing constraints are problematic (Dercon and Krishnan, 1996; Kinsey et al., 1998), and credit constraints and uncertainty prevent financing of indivisibilities in production (Bigsten et al., 2003). Together, these suggest that some sectors are held back by the quality of contracting institutions.[7]

The following gravity equation allows the impact of the closure of the Suez Canal to vary with the fixed-cost intensity of the sector. In the detrimental specialization argument, sectors that required high fixed costs for production would have grown disproportionately during the canal lockdown. The gravity equation is:

$$\begin{aligned} \text{logexports}_{ict} \quad = \quad & \beta_0 + \beta_1 \text{logdistance}_c + \beta_2 \text{fixed cost}_i + \beta_3 \left(\log\left(\text{distance}_{ct}^{shock} \right) - \log(\text{distance}_c) \right) \\ & + \beta_4 \text{fixed cost}_i \times \left(\log\left(\text{distance}_{ct}^{shock} \right) - \log(\text{distance}_c) \right) + \alpha_{it} + \mu_{ct} + \varepsilon_{ict}. \end{aligned} \tag{1}$$

The variable " $\text{distance}_c^{shock}$ " reflects the shipping distance during 1967-1975, which is higher than the pre-1967 or post-1975 shipping distance ("distance_c") for affected countries. The term $\log\left(\text{distance}_{ct}^{shock}\right) - \log(\text{distance}_c)$ is zero for years in which the Suez Canal was open.

The coefficient of interest in the regression is β_4. Coefficient β_4 shows how the exports of a specific commodity respond to the shock in transport costs, depending on whether that commodity relies heavily on fixed costs of production. The comparison of different sectors in the same country allows ruling out confounding explanations for the association between trade and institutions, such as the facts that trade is easier in institutionally advanced countries, that trade shocks incite political change, or that conflicts affect both trade and institutions.

The fixed effects α_{ic} and μ_{ct} control for crop-country- and country-time-specific explanations of trade. Countries may have different initial conditions and comparative advantages—for instance, in Ricardian advantages or the constitutional environment. In as far as these could correlate with the

[7] Slavery might go against the assumption that labor is hired at "piece rate." While slavery may play a prominent role in the (lack of) organization of inclusive institutions (e.g., the Sokoloff and Engerman, 2000, argument), it is not obvious how it affects this analysis of contract enforcement. In any case, slavery is not prevalent in the sample. Italy's invasion of Ethiopia effectively ended most slavery in 1935. The British and the Sultan of Zanzibar banned maritime slave trade in 1876, and the British banned slavery inland after WW I. In Mozambique, one of the last colonies to become independent, forced labor was abolished in 1961.

geography of the trade cost shock impact, they are absorbed in α_{ic}. Similarly, country-specific shocks that may or may not be caused by institutional change—such as a failed coup attempt (Kenya in 1978), the instatement of a one-party system (Tanzania in 1977) or independence (Djibouti in 1977)—could affect exports by bringing about different economic policies or exchange-rate management. Any correlation between the trade shock and such national events is controlled for by the country-year fixed effects, as long as such events do not systematically affect sectors differently.[8] As the interaction arguments "log distance$_c$" and "fixed cost$_i$" are collinear with the fixed effects μ_{ct} and α_{it}, their parameters β_1 and β_2 are not identified. Effectively, this equation is a "dif-in-dif-in-dif" specification because it compares the exports of different products over trade cost differences over time.[9]

The sensitivity of different products to institutions, proxied by fixed cost intensity, is quantified using data on expenses from the Costs of Production Surveys from the US Department of Agriculture in 1975 (or for some industries, the earliest possible date). I use the crosswalk reported in Appendix D to match animals and crops from the USDA classification with the trade classification of the FAO. I take the share of total costs classified as fixed costs as the measure of fixed cost and the capital expenditure shares to calculate the capital intensity of a crop or animal.

This proxy for the institutional sensitivity of crops assumes that the natural characteristics of crops lead to different demands on the contract environment. Such natural characteristics work out similarly across locations: the high up-front investment that offsets cow farming from sugar production in the US also holds, in relative terms, in African countries. Thus, I assume that the ordering of crops by fixed cost intensity is similar across the US and African countries. An advantage of using the US cost structure is that it is insensitive to African prices of labor, capital, or inputs. A

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[8] Many of the major political events do not coincide with the Suez closure: for most countries, independence occurred between 1940 and the early 1960s. In Mozambique, war started in 1964, resulting in independence in 1975. Dropping Mozambique from the sample does not change the results. Sub-Saharan African countries also saw waves of trade liberalizations, but they took place predominantly in the 1980s.

[9] The alternative "diff-in-diff-in-diff" formulation would be:

$$\text{logexports}_{ict} = \beta_0 + \beta_1 \text{logdistance}_c + \beta_2 \text{ fixed cost}_i + \beta_3 \left(\log(\text{distance}_c^{shock}) - \log(\text{distance}_c)\right) + \beta_4 \text{D(1967-1975)} + \beta_5 \text{ variable cost}_i \times \left(\log\left(\text{distance}_{ct}^{shock}\right) - \log(\text{distance}_c)\right) + \beta_6 \text{D(1967-1975)} \times \left(\log\left(\text{distance}_{ct}^{shock}\right) - \log(\text{distance}_c)\right) + \beta_7 \text{D(1967-1975)} \times \text{ fixed cost}_i \times \left(\log\left(\text{ distance}_{ct}^{shock}\right) - \log(\text{distance}_c)\right) + \alpha_{ic} + \mu_{ct} + \varepsilon_{ict},$$

where D(1967-1975) is a dummy indicating the years 1967 to 1975. The coefficient of interest is then β_7, equal to β_5 discussed in the section.

disadvantage is that if technologies for crops differ randomly between the two continents (meaning that the crop characteristics have little impact on how they are produced), the regression might incorrectly suggest that there is no result. For that reason, I also i) report estimates based on the same sector-specific measure constructed from African cost surveys; ii) check whether high-fixed-cost products are, indeed, exported significantly less from institutionally poorer countries; and iii) report regressions based on alternative measures of institutional sensitivity altogether.

The export data, taken from the FAO, reflect goods flows from the respective country to the entire world, from 1960 to 1985. The focus on agricultural exports is not very restrictive, as mineral and agricultural exports accounted for most of African exports in the sample years. The sectoral export data allow no distinction by destination for this period. Historical data suggest that Europe was, by far, the most common destination.[10]

For the estimation of equation (1), I employ a Poisson quasi-maximum likelihood estimator with clustered standard errors. This estimator takes into account trade flows of value zero (Silva and Tenreyro, 2006). As these are sectoral data, around 60% of the possible country-year-crop export observations are zero. A model using a regular log-transformation of the trade flow would lead to a substantial and non-random neglect of observations. I cluster the standard errors for different product groups by country and period (pre-treatment, during treatment, post-treatment). The trade cost shock occurs at the country level and persists for several years, so its observations are not independent. This clustering strategy avoids underestimating the standard errors.

Evidence from agricultural data

Table 1 presents the results of the main regressions. Most importantly, the coefficient on the interaction between fixed cost shares and the trade cost shock is negative. The negative coefficient suggests that sectors that required larger up-front investments were hit significantly harder by the increased transport costs than sectors that required little up-front investment. The estimate implies that the average transport distance shock led to around a 40% lower export if a crop required one

[10] Estimates by Fouquin and Hugot (2016) suggest that in the 1960s, exports to Europe accounted for around 70% of African exports, while exports to Asia and other African countries were much smaller, at 7% and 8%, respectively. For Eastern African countries (UN definition), Europe accounted for around 65% of the exports and Asia for around 12%.

standard deviation (about 10% point of total costs) more fixed costs. Thus, the results imply that institutionally intense sectors suffered most from the rise in transport costs.[11]

Capital intensity may also determine the sectoral reallocation when trade costs change. Neoclassical trade theory predicts that when trade costs rise, a country with scarce capital experiences an expansion of its capital-intensive sectors. The regression in column 2 controls for the capital cost share, interacted with the trade cost shock. Its coefficient is positive but insignificant. The coefficient of the fixed cost interaction hardly changes. That is not surprising because the capital cost shares and the fixed cost shares have limited correlation across sectors (see Figure 1 in Appendix B). The coefficient for the interaction of the capital cost share and trade costs is significant when clustering by country-years instead of country-treatment period (at the 1% level). In sum, the fixed-cost interaction coefficient is unaffected by the capital cost interaction, and capital-intensive sectors saw relatively higher exports, if anything, in trade isolation.

Table 1. Agricultural products: Effects on log exports

	(1)	(2)	(3)	(4)	(5)	(6)
				Pre 1971	Post 1971	Placebo
Fixed-cost share x	-8.38**	-8.45**	-12.25***	-5.94***	-7.84**	
shock log km	(3.53)	(3.69)	(3.59)	(2.30)	(3.18)	
Capital cost share x		17.19	154.17***	5.11	24.59**	
shock log km		(11.26)	(11.90)	(16.38)	(10.77)	
Fixed-cost share x						7.96
placebo shock						(12.14)
Observations	9,714	9,714	9,714	3,553	6,484	9,204
Country-Year FE	yes	yes	yes	yes	yes	yes
Country-Crop FE	yes	yes		yes	yes	yes
Crop-Year FE			yes			

Notes. Dependent variables: log Exports. Estimated by PPML. Standard errors clustered at country-treatment period in parentheses (see text). *** p<0.01, ** p<0.05, * p<0.1.

[11] As the maximum likelihood model is non-linear, the regression coefficients may not accurately reflect the interaction effect as an OLS regression does. To check this possibility, I explore the interaction graphically in Appendix E.

The fixed effects structure controls for initial crop conditions and country-specific developments, but not for the swings in agricultural prices on the world market. In order to consider whether that biases the results, column 3 reports a regression in which the country-crop conditions are substituted for crop-year-specific fixed effects. That fixed effects structure accounts for any global impacts on crop prices caused by the Suez Canal closing. The results on fixed-cost shares are similar, if somewhat larger, and the effects on capital intensity are larger and significant. The regression with all potential fixed effects (country-year; country-crop; crop-year) gives similar results: the coefficient of interest is -7.60 (with a p-value of 0.12 spell-clustered standard errors; and a p-value of 0.01 under year-clustered standard errors). However, the large amount of fixed effects renders convergence of the maximum likelihood function more difficult.

The closing and the opening of the canal represent two shocks, and the impacts might vary. To see if opening and closing had different impacts, I split the sample at the year 1971 (the middle of the treatment spell). Columns 4 and 5 present the results of running the same regression in the sample before 1971 and after 1971. The results remain similar: the blocking of the canal and its subsequent reopening had effects of similar magnitude—they are less than a standard error apart. The canal's closing led to a decline in exports from institution-intensive sectors, while the reopening led to an expansion of institution-intensive sectors. The role of capital intensity follows comparative advantage when the canal reopened, but plays no discernible role when it closed. The reopening of the canal in 1975 might have been anticipated, as mine clearers started operating in 1974. To see if the anticipation of the canal's reopening affects the results, I reran the regression, allowing the shock to trade costs to end in 1974 and in 1973. Similarly, to consider if yearly noise plays a large role in the data, I have reran the regression on (pre-, during- and post-) treatment spell averages, reducing the sample to three (averaged) time periods. The (unreported) regressions show no change in results.

Robustness

To investigate the sensitivity of the baseline result, this section reports a number of robustness checks. The checks consider diagnostics (e.g., placebo regressions, parallel trend assumptions, and the role of a country's institutional environment as a source of comparative advantage in high-fixed-cost sectors), ruling out other explanations (such as sectoral differences in distance decay or public price assistance) and stability with respect to other definitions of institutional sensitivity.

Placebo and pre-trends

To rule out spurious explanations, column 6 of Table 1 reports a placebo regression. It uses the same sample and the same transport-costs shock. However, the regression is run as if the shock hit between 1960 and 1963, relatively peaceful years in the Suez Canal. As column 3 shows, artificially dating the shock earlier in time leads to insignificant results, as expected. The coefficient is closer to zero when running a placebo regression, when assigning the placebo shock to random years, or when assigning the placebo shock randomly across countries.

Ideally, to lend credibility to the results, the trends of affected and unaffected countries should be similar before the shock. The placebo regression in Table 1 shows no divergent trends in crop sensitivity among countries that would later be affected and those that would remain unaffected. To check for trends in exports related to a sector's fixed cost intensity that differed before 1967 between affected and unaffected countries, I ran the exports regression containing the interaction between fixed-cost shares and eventual treatment. The results are reported in Appendix F; they show no diverging trends in the difference between low- and high-fixed-cost sectors across affected and unaffected countries.

African data on fixed costs

The baseline regression considers cost shares from the United States. If U.S. cost structures are not representative of African cost structures, in relative terms, the baseline regressions will not identify institutional sensitivity. As an alternative, I consider African microdata, which are dated after the shock but reflect African rather than North-American circumstances. I use the farm household survey questionnaire from the Center for Environmental Economics and Policy in Africa (Waha et al., 2016) carried out in 11 African countries in 2003. To proxy for institutional sensitivity, I use the share of labor employed in non-production stages per main crop reported. I also use the cost share of heavy machinery, assuming that heavy machinery is most sensitive to contracting imperfections. Additionally, I use the capital cost share per crop as a control.

Table G1 reports the results using the same methodology as the baseline, and the results are qualitatively similar. Crops that required large employment up-front saw exports decline relatively strongly when the trade costs increased (column 1). Adding capital cost shares interacted with the trade cost shock as a control shows no significant change, although there is no distinguishable effect of capital cost shares (column 2). Column 3 shows that crops that intensively used heavy machinery were hit more severely by the trade cost shock. Column 4 shows that adding capital sensitivity to the model retains that result, despite the fact that capital-intensive crops thrived with trade isolation (consistent with comparative advantage).

The relation between fixed costs and exporter institutional quality

The identification in the baseline regression requires that up-front investments are sensitive to the institutional environment. In Appendix H, I consider this assumption in trade data from the same FAO source. However, I look at later years, so the data can be joined with institutional indexes from the World Governance Indicators. There is a positive correlation between the quality of the exporter's "rule of law" variable and the average fixed-cost intensity of products exported by a country. I also report a gravity equation with fixed effects for the origin-year and destination-year, as well as fixed effects for the product-year. This rules out country-level explanations of institutional quality that can correlate with the country's economic openness or world market demand shocks. Conditional on the fixed effects, countries with higher institutional scores export more goods that require up-front investments.

Distance decay

Exports of goods that require large fixed costs could also have dropped more during the canal lockdown if such goods had a larger sensitivity to distance or if they were exported disproportionately to Europe. Either would bias the results. To investigate whether this is an issue, Appendix I considers bilateral export data of the same agricultural crops—FAO data dating back to 1986 (the end of the baseline sample).

There is no structural association between the fixed-cost share of a product and its distance sensitivity. The absence of this relation suggests that the differential impact of trade costs does not mechanically yield the main result: based on variation in destinations, one would not expect the goods with high-fixed-cost shares to be more sensitive to trade costs. Similarly, Europe—the market that was shut down—does not import significantly fewer or more of the goods that had higher-fixed-cost shares as compared to other goods.

To allow for general differences in distance decay to play a role, I account for crop-specific distance decay in the shock sensitivity. First, I estimate product-specific distance decay parameters from the bilateral exports. Then I impute the percentage decrease in export flows for each product to be expected following the Suez Canal closure. Because the data before 1986 are not bilateral, to be conservative, I impose the condition that the decrease occurs on all exports (not just those to

Europe). The first stage shows no significant difference in distance decay when varying the fixed-cost shares of the goods. Second, subtracting the predicted export reductions before running the baseline dif-in-dif regression does not change the results. If there are differences in the distance decay across products, they are too small to account the export responses to the Suez Canal closure.

Price assistance

Governments' responses to the trade cost shock can affect the estimate of the trade cost impact if government support is selective across sectors. If a government supports sectors with low fixed costs during trade isolation, then the decline of sectors with high fixed costs due to trade costs is overstated. Price assistance data were available for a subset of the sample (see Appendix J for a further analysis). The change in assistance measures shows no jump in 1967 but develops strongly in 1975, when the canal was reopened. I find modest evidence that government supported the sectors with higher fixed costs (which were hit more severely). Therefore, the decline in sectors with high fixed costs due to the trade cost shock is understated rather than overstated. Directly controlling for observed assistance shows little change in the results.

Shocks to Asian countries

Finally, the trade cost shock was not unique to Africa. In the Middle East and Central Asia, another set of countries had more than the average exposure to trade cost shocks. Moving east from the Suez Canal along the coast, the group of countries with harbors on the Indian Ocean and no obvious land routes to Europe included: Yemen (main port, Aden); Oman (Sultan Qaboos); Pakistan (Karachi); India (Mumbai); Bangladesh (Chittagong); Myanmar (Thilawa) and Malaysia (Port Kelang). For these countries, the average increase in shipping distance to Europe was 53%. However, unlike the African sample, in the Asian geography, the ordering of countries in absolute change and in relative change in sea miles may not have been the same: the extra sea miles in absolute terms was roughly equal between India and Malaysia, but the relative impact was lower in Malaysia because its trade route to Europe was longer. To avoid defining assumption on trade costs, I report sectoral export regressions with a treatment dummy (equal to 1 between 1967 and 1975) interacted with sectoral fixed costs. It uses the same fixed effects as the baseline regressions. The interaction coefficient is -1.82***, implying that during the closure of the Suez Canal, if a sector had a 10% higher fixed-cost share, its exports declined 8% faster. This is consistent with the earlier results. However, more caveats apply to this sample. There is no control group of countries with unaffected sea routes, so the coefficient is identified solely from variation over time. Moreover, the alternative export destinations are less clear: Malaysia, for instance, may have had easier access to other markets, such as Japan or the U.S.

Evidence from manufacturing goods[12]

The differentiation of a product and the complexity of its inputs may signal the product's institutional dependence, as well. In this subsection, I use export data on manufactured goods to check whether the results are robust to using definitions of institutional sensitivity based on product characteristics, instead of relying on institutional frictions on the factor market. Manufacturing products represent a far smaller share of total exports, but there is substantial export variation across such products.

In the following regressions, I proxy for a product's contract intensity by using the Rauch (1999) classification of differentiated and homogeneous goods (i.e., goods that have reference prices or goods sold on organized exchanges). This primarily follows Ranjan and Lee (2007) and Berkowitz et al. (2006), who argue that a good's degree of differentiation determines how intensively its sales rely on institutions. Homogeneous goods are easily sold to a third party if a trade partner cannot be held to his contractual obligations and, therefore, runs less risk when contract enforcement is poor. Differentiated goods, which cannot easily be substituted and are often tailored to the buyer, require larger relationship-specific investments, which have high exposure if contracts fail. Both Ranjan and Lee (2007) and Berkowitz et al. (2006) show that good institutions are conducive to trade, especially in differentiated goods. I also follow Nunn (2007), who argues that the contractual intensity of a good depends on the type of goods that it requires as inputs: firms that need differentiated products from upstream suppliers rely more heavily on contract enforcement. Nunn similarly shows that institutional quality works as a comparative advantage, as high indexes of institutional quality in a country lead to relative specialization into production that uses differentiated inputs.

The export-to-world data for these regressions are from the COMTRADE database, based on an SITC4 classification. These are matched with the Rauch classification and the upstream product characteristics from Nunn.[13] The empirical strategy is the same as described in the previous subsection.

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[12] The appropriability of cereals and tubers serves as a third classification of institutional sensitivity. Following Mayshar et al. (2015), I checked whether exports of non-perishable crops (which are easily taxed or appropriated and require more formal institutions) see differential export effects following the trade cost shock. The results and sensitivity checks holds for this classification as well. As the classification is more crude, I report the results in Appendix K.

[13] I use the crosswalk from James Markusen.

Table 2 present the results using product differentiation as a measure of the dependence on contract enforcement. The negative coefficient of the interaction shows that when the trade cost shock took place due to the Suez Canal closure, firms that produced differentiated goods were particularly hit. The coefficient suggests that in affected countries, the trade cost shock reduced exports in differentiated sectors around 23% more than in non-differentiated sectors. The second column of Table 2 shows a regression for reference-priced goods, which are least sensitive to contract enforcement. It shows that these goods saw a relative upswing when trade costs increased (the complementary group, consisting of goods sold on organized exchange, is argued to be between the other two in terms of dependence on institutional context). Following the argumentation of Nunn (2007), the third column considers an industry's dependence on differentiated inputs, rather than differentiation of its final product. The coefficient implies that a sector's trade decline was on average 10% stronger relative to its unaffected counterpart, if those sectors have 17% (one sample standard deviation) more differentiated inputs. Hence, the impact is comparable across definitions of a product's institutional sensitivity.

Table 2. Differentiated products: effects on log exports

	(1) PPML	(2) PPML	(3) PPML
Shock log km x Differentiated	-8.00*		
	(3.75)		
Shock log km x Reference		5.17***	
		(1.92)	
Shock log km x Inputs diff.			-19.51***
			(6.38)
observations	4,765	4,765	3,899
country-year FE	yes	yes	yes
crop-country FE	yes	yes	yes

Notes. Dependent variables: log Exports. Estimated by PPML. Standard errors clustered at country-treatment period in parentheses (see text). *** p<0.01, ** p<0.05, * p<0.1.

3. A framework of trade and institutional quality

The empirical results are not in line with the theory of detrimental specialization. To offer a potential interpretation of the results, this section develops a framework of international trade with endogenous levels of contract enforcement. This helps to develop an intuition for the interactions between international trade and contract frictions. The trade model also produces a gravity equation like the one estimated (eq. 1), to give a structural interpretation to estimated parameters.

In the model, different producers influence the policy maker to establish their preferred level of contract enforcement—the measure of institutional quality. International trade affects the motives of producers in different sectors to push for contract enforcement. On the one hand, trade liberalization expands the sectors that have low prices relative to world prices (i.e., in which the home country has a comparative advantage). If institutionally non-intensive sectors expand, then the support for poor institutions grows. On the other hand, when trade liberalizes, lower trade costs amplify the importance of producing at low marginal costs. Low marginal costs, especially for attracting capital, depend on the quality of institutions. As a result, producers may put less effort into sabotaging institutions when the economy is more open. Furthermore, poor enforcement policies are more distortive to social welfare in open economies than in closed economies. For that reason, too, policymakers with social welfare as a partial objective are more inclined to enforce contracts when trade costs are lower.

The model of intersectoral international trade with imperfect competition builds on Helpman and Krugman (1985), Arnold (2013) and Bernard et al. (2007). The development of institutions follows a Grossman-Moore-Hart model, as also studied in endogenous trade policy (Ornelas, 2005) and endogenous institutions (Levchenko, 2007). In short, capital owners lend to firms but lose a proportion of their capital due to ill-defined property rights. Firm owners benefit from poor property rights and bribe policy makers to permit expropriation. It is important to note that the aim of this section is to provide a potential explanation for the results in the empirical section, as the empirical section does not provide evidence for this particular interpretation.

Contract frictions

Firms require an up-front investment to start production. They use external capital, and the contract for the transfer of capital is imperfect. Due to contract imperfections, the firm can withhold some of the capital from its owner without punishment. Capital could mean anything from physical capital and trade credit to intellectual property. In the agricultural setting above, machinery, young animals or crop seeds may be an appropriate interpretation.

I assume that the capital transaction occurs in four stages. First, the firm and the supplier negotiate a rental price r^* per unit of capital. The rental price can be verified costlessly. Second, capital is transferred to the firm, which makes the up-front investment of size k_f. Third, the firm starts producing in a variable stage, using capital (k_q), labor, and natural resources. Fourth, the firm pays the capital owners for the use of capital. A share ϕ of the up-front capital is relation-specific, reflecting that it is adapted for the firm's use (following the notation of Levchenko, 2007), and the firm may expropriate it. I assume that up-front investments, rather than the capital used in the variable stages of production, are subject to expropriation. The reason is that piece-rate capital transactions may be terminated at any time, providing the capital owners with a punishment strategy. The up-front investments cannot be recovered. A stylized example of this relation could be a farmer borrowing seeds and equipment. As the farmer sells his products, he can pay the rent for the equipment (which might otherwise be returned to the supplier), but the supplier cannot recover the up-front investment of the sown seeds easily.[14]

The firm's demand for capital is determined by setting the value of the marginal product of capital pdq/dk_q equal to the negotiated price of capital, r^*. The (Hicksian) demand for capital in the variable stage is $k_{q,d}(p, r^*)$. The firm's total demand for capital also includes the capital that it requires as up-front investment, k_f:

$$k_d = k_{q,d}(p, r^*) + k_f. \tag{2}$$

Firms negotiate with one capital supplier. For the firm and the capital supplier, it is costly to initiate negotiations with another partner. Capital suppliers supply capital iso-elastically based on the effective return $\bar{r}$ that they receive per unit of capital:

$$k_s = \bar{r}^{\alpha}. \tag{3}$$

[14] Alternatively, the model could be developed with labor as the only production factor. The entrepreneur would employ workers in a fixed stage of production, promising a delayed payment. This leads to similar results, as the fixed stage of production would be exposed to contracting frictions. The empirical section reports robustness checks on labor-based fixed costs. The current focus of the model is on capital (e.g., land tenure, seeds or machinery), however, because it helps to identify any confounding effects of capital use in a neoclassical trade setting.

Clearing on the market for capital is solved by backward induction. The firm rationally expropriates ϕk_f of the capital stock at the end of the transaction, as the expropriation goes unpenalized. Consequently, the supplier of capital realizes that the return per unit of capital is diminished by a fraction $\phi k_f / k_d$, so the received payment per unit $\bar{r}$ is less than the rate agreed on in stage one: $r^*(1 - \phi k_f / k_d)$. Capital supply is, then, $k_s = [r^*(1 - \phi k_f / k_d)]^\alpha$. Capital demand k_d is strictly decreasing in r^* (shown later), while capital supply is strictly increasing in r^*, so that a unique rate clears the capital market at $k_s = k_d$.

Three results on the capital market are important. First, if property rights are poorer, and ϕ is higher, the equilibrium price of capital r^* is higher. The intuition is that capital suppliers require higher rates to compensate for an expected expropriation. Second, if property rights are poorer (ϕ is higher), the capital price r^* is higher for firms for which the up-front requirements for production k_f are larger. The intuition is that firms pay larger risk premia if larger shares of their employed capital suffer from poorly defined property rights. Third, if property rights are poorer (ϕ is higher), the total costs of capital are lower for the firm. The total costs of capital are given by $KC = r^*(k_{q,d}(p, r^*) + k_f - \phi k_f)$, which is the cost of capital net of the fraction that is never returned, ϕk_f. While the costs per unit of capital rise, the rise is more than offset by the reduction in the units of capital eventually paid for. A proof for these three results is in Appendix A.1.

The imperfect contract in this setup effectively requires a relation-specific investment, as the capital supplier realizes that a share of his initial capital is not retrievable. Due to the relation-specific costs, the model is similar to other models of property rights or factor protection (Aghion et al., 2004; Noeldeke and Schmidt, 1998; Tang, 2012). Maskin and Tirole (1999) show that the contracting problem is much like bilateral monopoly models (Hart and Moore, 1988), in which a hold-up situation emerges from the partner-specific investments. The essence of the argument is that the incomplete enforcement of contracts yields an advantage for the firm that has hold of the institution-intensive factor.

The trade model

Firms export from a small country that has no impact on world prices, and there are many firms in every sector. Firms are imperfectly competitive. This assumption is consistent with substantial markups and fixed costs associated with production in African agriculture (especially for risky crops;

see the discussion in Section 2); and it explains the existence of a non-variable stage of production, where institutions may play an important role.[15]

Firms use labor (l), capital (k) and sector-specific resources e. The sector-specific resources can be thought of as land (expressed in productivity terms), natural advantages or infrastructure specific to a sector. The production function is Cobb-Douglas: $q = cl^{1-\beta-\delta}k^{\beta}e^{\delta}$, where $c \equiv (1-\beta-\delta)^{\delta+\beta-1}\beta^{-\beta}\delta^{-\delta}$ is a positive constant. The price of labor, capital and the sector-specific factor are w, r, and ρ, respectively. The country's endowment of the sector-specific production factor is E_z, and it is priced at ρ_z at its marginal productivity. Firms and capital suppliers negotiate the return on capital r_z, which depends on the sector z characteristics. Labor is mobile across sectors, and wages equalize across sectors. To pin down the equilibrium, I take the wage rate as numéraire, $w = 1$.

Minimizing a firm's total costs under a production quantity constraint implies that the marginal cost equals $mc_z = r_z^{\beta}\rho_z^{\delta}$. Moreover, demand for each factor is strictly downward-sloping in its respective price, and, as factor supply is fixed (resources and labor) or rising in the factor price (capital), there is a unique clearing price for all factors.

Consumers view goods within a sector as imperfect substitutes with an elasticity of substitution $\sigma > 1$. The preference over different sectors is unit-elastic. The consumers' utility function is:

$$U = \int b_z \ln C_z dx; \quad C_z = \left[\int_{i \in z} c_i^{(\sigma-1)/\sigma}\, di\right]^{\sigma/(\sigma-1)}, \tag{4}$$

where b_z is effectively the budget share for industry z, and i indexes individual firms. For a representative consumer, the demand function is:

$$c_i = \frac{\overline{p}_i^{-\sigma}}{\int_{i \in z} \overline{p}_i^{1-\sigma}\, di} b_z y, \tag{5}$$

[15] Perfect competition in the standard neoclassical trade model, with zero profits and marginal cost pricing, would be inconsistent with firms' ability to bribe and with most models of institutional frictions in the factor market or the output market.

where y denotes the income, and the bar over p indicates delivered prices. For further reference, I use the harmonized price index of a sector as $P_z = \left[\int_{i\in z} \overline{p}_i^{1-\sigma}\, di\right]^{1/(1-\sigma)}$. Facing the iso-elastic demand function, markup pricing is optimal for the firm:

$$p_i = \frac{\sigma}{\sigma - 1} mc_z. \tag{6}$$

Output prices are proportional to marginal costs. When shipping to a foreign country, the firm faces iceberg transport costs: it needs to ship τ units for one unit to arrive. Under constant elasticity of demand, the firm charges a premium for the trade costs to foreign consumers, so the sector-specific delivered price in a foreign country is $\overline{p}_z = \frac{\sigma}{\sigma-1} \tau mc_z$.

In equilibrium, firms export to the foreign country from the small home country. The firm's profit function consists of revenue less costs for all production factors and any political contributions the firm might make, ω_i. The profit is:

$$\pi_i = (\tau p_i)^{1-\sigma} \frac{b_z Y}{P_z^{1-\sigma}} - TKC_i - \rho_z e_i - l_i - \omega. \tag{7}$$

Firms enter as long as the profits are positive. In equilibrium, $\pi_i = 0$, and as $d\pi_z/dn_z < 0$ and $\pi_z \to \infty$ as $n_z \to 0$ (because $\rho_z \to 0$), the zero-profit condition implies a unique number of firms.

The trade equilibrium is closed by balanced trade with the outside world. Similar equilibria are discussed in Helpman and Krugman (1985, chapter 7) and Arnold (2013). The current framework contains a Ricardian motive with the introduction of sector-specific resources E_z. It causes firms in a sector to become extremely productive if their number tends to zero, so that all sectors are active. In terms of trade patterns, this resembles the Bernard et al. (2007) model of comparative advantage with heterogeneous firms, where some very productive firms survive even in sectors with comparative disadvantages.

Politics

The level of institutional quality is determined by a policy maker. I assume that the beneficiaries of poor property rights can send political contributions to the policy maker to make him change the level of contract enforcement. I follow Grossman and Helpman's (1994) assumption that there is a single policy maker who is sensitive to political bribes. The policy maker has an interest in maximizing social welfare—for example, for ethical reasons or because he wants to be re-elected. The policy maker is also motivated by political bribe income that finances his private consumption of foreign goods. In a less intimately linked interpretation, policy formation in this model could also be understood as political elitism. The elite's motivation is to extract contributions while maintaining high enough welfare to avoid unrest or forceful threats (as underlie the coup or conflict models in, for example, Acemoglu and Robinson, 2006).

A country's policy maker has two objectives: political contributions (or bribes) and social welfare. The relative weight λ determines how much funds are needed to make the policy maker worsen contract enforcement. The susceptibility to bribes reflects the policy maker's preferences or constitutional constraints, for instance. The political objective function is:

$$G = \lambda S(\phi) + (1 - \lambda)\Omega, \tag{8}$$

where S denotes social welfare and Ω denotes the sum of political contributions. If $\lambda = 1$, the policy maker is perfectly benevolent. If λ is smaller than 1, the policy maker is increasingly corrupt. I assume that the policy maker can freely choose the quality of property rights (i.e., no explicit law enforcement sector is modeled), and bribes are the only thing preventing him from developing optimal institutions (for which $dS/d\phi = 0$).

The first-order condition for the policy maker implies that:

$$-\frac{\lambda}{1-\lambda}\frac{dS}{d\phi} = \frac{d\Omega}{d\phi}. \tag{9}$$

The social costs of deteriorating institutions (the left-hand side of this equation) are weighed against the benefits of income from political contributions. The rate at which the marginal social costs are weighed against financial contributions is higher if the policy maker is less corrupt (λ is higher). The degree to which the policy maker permits expropriation by firms is determined simply by the amount of contributions he receives, so (9) provides a measure of the equilibrium institutional quality. Consequently, the effects of trade liberalization on property rights are determined by how trade liberalization changes the incentive to bribe the policy maker and by the policy maker's willingness to violate social welfare.

The policy maker receives bribes from firms. Firms have sectoral lobbies to influence to policy maker.[16] Firms bribe in order to establish their preferred quality of institutions, realizing that their preferred quality of institutions implies a specific contribution. Maximizing the profit function with respect to the level of institutions, applying the envelope condition and the inelasticity of entry ($\frac{dn_z}{d\phi} = 0$), the first-order condition is:

$$\frac{d\omega}{d\phi} = (1-\sigma)\left(\frac{\tau p_z}{P_z^w}\right)^{1-\sigma} b_z Y \beta_z \frac{dr_z/d\phi}{r_z} - \frac{dTKC_i}{d\phi}, \tag{10}$$

where p_z is the output price in sector z, and P_z^w is the harmonized world price in that sector. The left-hand side of the first-order condition is the change in required contributions when the level of contract enforcement changes. The right-hand side of this first-order condition lists the impact of poorer contract enforcement on the value of sales and expropriation. In the first term, poorer institutions increase the marginal costs by raising r_z, thus reducing sales (note that $1-\sigma<0$). This effect is stronger for firms with a high capital intensity of production (the degree to which capital price increases imply higher marginal costs, β_z). Second, as shown above, poorer contract enforcement reduces total costs of capital for the firm. Following the result for capital markets, firms with lower up-front investments benefit more from expropriation: their marginal costs rise slowly and total capital costs reduce quickly when institutions deteriorate. Summarizing, the willingness to bribe $d\omega/d\phi$ is lower for industries that face larger fixed costs and for capital-intensive firms, assuming that poor contract enforcement raises marginal costs.

The institutional effects of trade liberalization

Trade cost changes influence the policymaker's tradeoff in several ways, leading to changes in the equilibrium level of contract enforcement. To make the different impacts of trade costs more insightful, I examine how trade costs with the outside world affect i) firms' willingness to bribe the policy maker; and ii) the impact of poor contract enforcement on social welfare.

Bribe income is the first motive for the policy maker to choose a level of contract enforcement. The policy maker's total bribe income is the sum of bribes ω from firms n over different sectors z: $\Omega =$

[16] Firms have no monopolistic power in the output market. This assumption seems sensible when the country is small, as there is no collusion with firms on the world market. If the country is large, strategic behavior on the world market would complicate the model.

$\sum_z n_z\,\omega_z$. The marginal increase in bribe income is $\frac{d\Omega}{d\phi} = \sum_z \left(n_z \frac{d\omega_z}{d\phi} + \frac{dn_z}{d\phi}\omega_z\right)$. The question of interest is whether trade costs change the bribe income returns to permitting expropriation. If trade costs increase these returns (i.e., $\frac{d^2\Omega}{d\phi d\tau} > 0$), then trade isolation may drive up equilibrium expropriation. The impact of trade costs on bribe income sensitivity (derived in more detail in Appendix A.2) is:

$$\frac{d^2\Omega}{d\phi d\tau} = \sum_z n_z \left(\begin{array}{c} \underbrace{\left(\frac{dn_z/d\tau}{n_z} + \frac{dr/d\tau}{r}\right)}_{\text{sectoral reallocation}} \underbrace{r^*\left((1-\sigma)R_z i_z \varepsilon_z^{r\phi} - k_f\left[(1-\phi)\varepsilon_z^{r\phi} - 1\right]\right)}_{\text{sectoral willingness to bribe}} \\ + \underbrace{(1-\sigma)^2 R_z i_z \varepsilon_z^{r\phi}\left(\frac{1}{\tau} + \beta_z \frac{dr_z/d\tau}{r_z}\right)}_{\text{change in individual bribe incentives}} \end{array} \right), \qquad (11)$$

where $\varepsilon_z^{r\phi}$ is the sector-specific elasticity of the capital price with respect to the level of expropriation (see Appendix A.1).

There are two distinct impacts of trade costs on the policy maker's ability to raise bribe income. I will discuss them here informally; for a more formal discussion, see Appendix A.2.

First, there is a specialization effect: some sectors expand while others shrink—captured on the first line of eq. (11). As sectors have different propensities to bribe, the total bribe income changes with the sectoral composition of the economy. In an economy that has no capital abundance, capital-intensive sectors usually shrink with trade liberalization (though that requires some extra assumptions to be generally true: see Appendix A). The reallocation term $\frac{dn_z/d\tau}{n_z} + \frac{dr/d\tau}{r}$ lists the number of firms *and* the effective value of their capital, both of which contribute to the total funds available for bribers. The number of active firms and the price of capital move in the same direction following trade costs changes (see Appendix A), and their expansion depends on whether the sector's revenue rises or falls with trade cost shocks. The term $(1-\sigma)R_z i_z \varepsilon_{r\phi}(k_f) - k_f[(1-\phi)\varepsilon_{r\phi} - 1]$ captures the willingness of a firm in sector z to bribe. The firm is willing to commit more bribes if that does not reduce revenue much, while increasing the value of its expropriation. As shown earlier, capital-intensive firms and firms with large up-front investment are less likely to bribe.

In a country with a comparative disadvantage in capital-intensive production, trade liberalization may increase the policy maker's incentive to seek bribe income. Trade liberalization leads to the expansion of sectors that have a high willingness to pay the policy maker for poorer contract enforcement. This mechanism is parallel to the one outlined in Levchenko (2007). It is important to note that specialization in this model could be detrimental, but it does not need to be.[17]

Second, trade liberalization changes individual firms' incentives to seek expropriation. This is captured in the term $(1-\sigma)^2 R_z \beta_z \varepsilon_{r\phi} \left(\frac{1}{\tau} + \beta_z \frac{dr_z/d\tau}{r_z}\right)$, which is positive for all firms. The firm's optimal bribe level changes because lower trade costs increase the reduction in revenue when the firm charges higher prices to cover factor market risk premia.

On balance, the policy maker's income from bribes may increase or decrease with trade costs, depending on which mechanism dominates. Trade liberalization always leads to less incentive for an individual firm to bribe. However, the sectoral specialization of the economy may both increase and decrease the amount of bribes.

The second motive for choosing a level of contract enforcement involves the damage it does to social welfare. When trade costs fall, an increase in the expropriation rate may be more harmful to social welfare. The social welfare function is:

$$S = \int_i \pi_i \, di + \int_z E_z \, \rho_z dz + \int_i k_i \, r_i di - \phi \int_i k_{f,i} \, r_i di + \int l_i di + \int \omega_i di, \qquad (12)$$

which aggregates across firms i the firm profits, the value of natural resources, capital returns, the value of labor, and the bribe proceedings. [18] The policy maker trades off distortions to the welfare function, $dS/d\phi$, with the bribe income. Differentiating the welfare function gives that: [19]

[17] Capital intensity is not the only predictor of how bribe income changes when trade costs change. First, there is a Ricardian motive for trade. If Ricardian advantages dominate factor abundance, trade liberalization might still lead to specialization in capital-intensive sectors. Second, a larger required up-front investment k_f also leads a firm to demand better contract enforcement, as the firm's capital intensity does. However, up-front investment does not predict sectoral specialization. Thus, if capital-intensive sectors have little up-front investment, the specialization effect could still lead to demand for better contract enforcement.

[18] One might exclude the bribe income of the policy maker from the welfare function. In that case, firms' reduced profits due to contributions are not offset by the policy maker's received contributions. The violation of social welfare would be larger in that case.

[19] This uses the envelope condition, such that $\frac{d\pi_j}{d[l^*, e^*, k^*]} = 0$; the marginal indifference of capital suppliers to supply more capital; and the welfare neutrality of transfers $\frac{d \int_j \pi_j dj}{d\rho_z} - \frac{d \int_z E_z \rho_z dz}{d\rho} = 0$, $\frac{d \int_j \pi_j dj}{dr_z} - \frac{d \int_j k_j r_j dj}{dr_z} = 0$, and $\frac{\partial \int_j \pi_j dj}{\partial \phi} - \frac{d}{d\phi} \phi \int_j k_{f,j} \, r_j dj = 0$.

$$\frac{dS}{d\phi} = (1-\sigma)\beta_z R_z \frac{dr_z/d\phi}{r_z} < 0. \tag{13}$$

To see the impact of trade costs on incentives to enforce contracts, we need to understand whether trade costs amplify the social distortions of a given level of contract enforcement or not. The impact of trade costs on the distortionary effects of increasing ϕ is:

$$\frac{d^2S}{d\phi d\tau} = \int_j \left(\underbrace{(1-\sigma)^2 \beta_j R_j \frac{dr_j/d\phi}{r_j} \frac{1}{\tau}}_{\text{output distortion}} + \underbrace{(1-\sigma)\beta_j R_j \frac{d}{d\tau} \frac{dr_j/d\phi}{r_j}}_{\text{capital market distortion}} \right) dj. \tag{14}$$

When trade liberalizes, social welfare losses from expropriation change for two reasons. First, higher capital prices due to risk premia distort sales, and that effect is amplified when trade costs are low. Technically, the output distortion term $(1-\sigma)^2 \beta_j R_j \frac{dr_j/d\phi}{r_j} \frac{1}{\tau}$ is strictly positive: when trade costs τ are higher, the marginal social distortion of expropriation $dS/d\phi$ is higher (or less negative). For the capital market distortion, the direction is less clear. The sign of the impact depends on how the risk premia in the firm's sector $\frac{dr_j/d\phi}{r_j}$ respond to trade costs. This depends on the firm's capital demand, which may increase or decrease depending on the firm's comparative advantage. Thus, the social costs of permitting expropriation may go either way, as well. Lower trade costs amplify the social costs of output distortion, but the value of distortions on the capital market depends on whether the capital price rises or falls with trade liberalization, depending on how the economy specializes.

In sum, trade liberalization in this fairly standard trade model can move contract enforcement either way. Several incentives run through the model. On the one hand, trade liberalization punishes high risk premia in factor markets. To avoid high output prices associated with factor market distortions, firms pay fewer bribes. Moreover, when trade costs are low, the value of output is higher, and expropriation-induced distortions are costlier to social welfare. On the other hand, if institutions are poor, trade liberalization favors the firms that do not require good institutions. The specialization leads to larger support for permission of expropriation. Depending on which of these forces dominates, the impact of trade costs on the equilibrium rate of expropriation, $d\phi/d\tau$, can be positive or negative.

What is measured in the gravity equation?

The trade model is consistent with the empirical analysis in Section 2. Aggregating the individual demand functions (eq. 5) and multiplying by the number of firms operating in a sector gives the trade flow of a particular sector to the rest of the world, $n_z R_z$: the gravity equation. Using Y as the world income and P^w as the harmonized world price, the trade flow is

$$n_z q_z p_z = \frac{n_z (\tau p_z)^{1-\sigma} b_z Y}{P_z^w}. \qquad (15)$$

Log differentiating the trade flow and simplifying gives that

$$\frac{d(n_z q_z p_z)/d\tau}{n_z q_z p_z} = \frac{1-\sigma}{\tau} + (1-\sigma)\beta_z \frac{\partial r_z/\partial \tau}{r_z} + \frac{d\phi}{d\tau}(1-\sigma)\frac{\partial r_z/\partial \phi}{r_z} + \frac{dn_z/d\tau}{n_z} + (1-\sigma)\delta_z \frac{d\rho_z/d\tau}{\rho_z}, \qquad (16)$$

where the impact of trade costs on the capital price, $dr/d\tau = \frac{\partial r}{\partial \tau} + \frac{\partial r}{\partial \phi} * \frac{d\phi}{d\tau}$, is the composite of a direct trade cost effect on capital prices $\partial r/\partial \tau$ and a general equilibrium effect $\partial r/\partial \phi * d\phi/d\tau$.

The gravity equation shows different effects of trade cost on the trade flow. The direct impact, captured by the term $(1-\sigma)/\tau < 0$, shows that an increase in trade costs reduces export revenue, simply because exporting is more expensive. A trade-induced rise in the price of capital and resources, leading to a rise in marginal costs, also decreases exports.

The indirect effect $\frac{d\phi}{d\tau}(1-\sigma)\frac{\partial r_z/\partial \phi}{r_z}$ reflects the key outcome of the empirical section. It suggests that as the rate of expropriation changes in equilibrium due to changes in trade costs, sectors with sensitivity to poor contract enforcement $\frac{\partial r_z/\partial \phi}{r_z}$ show different export responses to the trade cost shock. In the model, $\partial r_z/\partial \phi$ is determined by k_f, z, so that the fixed costs associated with production signal higher sensitivity to production. As such, the interaction coefficient (β_4 in the empirical specification) would be estimated to take the value of $(1-\sigma)d\phi/d\tau$. The estimate of $\beta_4 < 0$ implies that $d\phi/d\tau > 0$ (realizing $1-\sigma < 0$).

Thus, the negative estimate for β_4, the interaction between fixed costs and the trade costs shock, suggest that trade isolation hurts institutions, rather than shielding the country imports that transfer the demand for good institutions to other countries. Interpreted in a standard trade model with endogenous institutions, the negative estimate for β_4 means that a countervailing force dominates the effect of detrimental specialization.

The gravity equation in (16) also shows potential confounding explanations. First, if the institutional sensitivity $\partial r_z/\partial\phi$ and the capital intensity β_z are correlated, failing to control for capital intensity may lead β_4 to reflect both the effect of changing factor prices due to trade cost changes and the equilibrium institutional effect. Second, failing to control for the natural advantages of a sector-country pair $\frac{d\rho_z/d\tau}{\rho_z}$ may lead to a biased estimate of β_4 if the natural advantages correlate with the quality of institutions. Third, the trade cost parameter τ may be sector-specific. Estimating distance decay in (log) averages, say $\overline{[(1-\sigma)/\tau]}$, leaves a term $(1-\sigma)/\tau_z - \overline{[(1-\sigma)/\tau]}$ in the error term. If the sector-specific distance decay τ_z correlates with a production technology that also determines institutional sensitivity k_f, the regression might simply pick up distance decay effects. Fourth, the equilibrium prices may be the result of forces outside the model. Governments may strategically support the sectors in which contract enforcement is difficult, generating a correlation between the support and $\partial r_z/\partial\phi$. These confounding explanations are addressed in the baseline identification and the robustness checks.

4. Conclusions

This paper examines whether trade liberalization of developing countries could lead to specialization patterns that delay institutional development. Countries with low-quality institutions might specialize into production that does not require good institutions, thus eliminating the demand for contract enforcement or property rights (e.g., Levchenko, 2013). The paper examines the specialization patterns of African countries, considering the lockdown and opening up of the Suez Canal as an exogenous shock to trade costs (Feyrer, 2009).

The evidence is not consistent with detrimental specialization. Trade isolation benefited sectors that are insensitive to institutions, relative to institutionally intensive sectors. Thus, lower trade costs seem associated with more, not less, institutionally intense production. These results hold across different sources of data and different definitions of institutional sensitivity, as well as controlling for alternative explanations such as country-level shocks and sectoral differences in trade cost sensitivity.

To rationalize these results, the paper examines the development of contract enforcement in a fairly standard model of international trade. The standard model suggests that the impact of trade on institutions may go either way. On the one hand, there may be detrimental specialization: trade may specialize countries into sectors that support poor contract enforcement. On the other hand, increased market access amplifies losses in revenue if there are institutional frictions in factor markets. Moreover, when trade costs are lower, the distortions of poor contracting can have greater social welfare costs.

How does this result contribute to our insights in the role of trade in long-run development? They indicate that even if neoclassical forces are at work (in the sense of specialization according to capital abunce), they do not predict institutional developments well. The concern that aid-for trade policies undermine development in the long run therefore seems less grave. That said, the results should not be taken as evidence that aid-for-trade policies work because the evaluation is incomplete – aid for trade are not certain to increase actual trade levels, and they may have other impacts than specialization, not examined here (see, e.g., Cadot et al., 2014; Hühne et al., 2014). Related papers studying the institutional impacts of trade have predominantly examined cross-sectional instruments or described developments after trade liberalization (e.g., Giavazzi and Tabellini, 2005; Levchenko, 2013). The quasi-experimental setting of this paper complements the identification of causal impacts.

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A. Analytical Appendix

A1. Contract frictions on the factor market.

This subsection discusses three results on the capital market: i) higher expropriation rates lead to higher equilibrium capital prices; ii) poorer institutions command higher capital premia in sectors that have larger up-front requirements; and iii) higher expropriation rights reduce the total costs of capital for the firm.

On the capital market, the firm and the capital supplier first agree on a capital price r^*. Then, the owner transfers the capital required before production commences - for instance seeds or a machine.

The firm sinks the fixed costs and starts producing. When the production is finished, the firm transfers the value of capital back to the owner.

The capital chooses his supply by backward induction. As the expropriation of the fixed share of capital is unpunished, the capital supplier rationally expects ϕk_f to be expropriated. The effective supply function of capital is $k_s = \left[r^*\left(1 - \phi k_f/k\right)\right]^{\alpha}$. Equating the supply of capital to the Hicksian demand, the clearing condition is $k_q^*(r^*) + k_f = \left[r^*\left(1 - \phi k_f/k\right)\right]^{\alpha}$. Given capital market clearing, three results follow:

Lemma A higher equilibrium rate of expropriation ϕ leads to higher equilibrium capital prices r^*.

Proof Total differentiation of the clearing condition implies that:

$$\frac{dr^*}{d\phi} = -\frac{\left(\frac{\partial k_q}{\partial r} - \frac{\alpha}{r}k^*\right)\frac{dr}{d\phi} + \alpha k^* \frac{k_f/k}{1-\phi k_f/k}}{\frac{\partial k_q}{\partial r} - \frac{\alpha}{r}k^*}. \tag{17}$$

Dividing by $r^*$and simplifying yields:

$$\frac{dr^*/d\phi}{r^*} = \frac{1}{2}\frac{k_f/\left(k^* - \phi k_f\right)}{1 - \frac{\partial k_q}{\partial r}\frac{r}{k^*}/\alpha}. \tag{18}$$

The left-hand side of this equation takes the sign of $dr^*/d\phi$ as $r^* > 0$. Furthermore, $k - \phi k_f > 0$, $\alpha > 0$ and $\frac{\partial k_q}{\partial r}\frac{r}{k^*} < 0$. As a result, $dr^*/d\phi > 0$

Lemma The capital price r^* rises faster in the equilibrium rate of expropriation ϕ for sectors with relatively large shares of up-front capital k_f/k.

Proof This follows from eq. 18, the numerator increases in k_f/k while the denominator decreases in k_f/k. Jointly, this implies that $dr^*/d\phi/r^*$ increases in k_f/k.

Lemma The total costs of capital decreases in the equilibrium rate of expropriation

Proof The total capital costs of a firm, TKC, is given by:

$$TKC = k_d r^* = r^* k_q^* + k_f r^* - \phi k_f r^*. \tag{19}$$

Differentiating the capital costs with respect to rate of expropriation ϕ yields:

$$\frac{dTKC}{d\phi} = \frac{dr^*}{d\phi}\left(k^* - \phi k_f\right) - k_f r^* + \frac{dk_q}{d\phi} r. \tag{20}$$

Inserting the capital price effect of expropriation (eq. 18) and simplifying gives that:

$$\frac{dTKC}{d\phi} = k_f r^* \left(\frac{1}{2\left(1 - \frac{\partial k_q}{\partial r}\frac{r}{k^*}/\alpha\right)} - 1 \right) + \frac{dk_q}{d\phi} r. \tag{21}$$

Since $\frac{dk_q}{d\phi} r < 0$, a sufficient condition for $\frac{dTKC}{d\phi}$ to be negative is that $2\left(1 - \frac{\partial k_q}{\partial r}\frac{r}{k^*}/\alpha\right) > 1$.Since $\alpha > 0$ and $\frac{\partial k_q}{\partial r}\frac{r}{k^*} < 0$, this holds true.

A2. The effect of trade liberalization on political contributions

Contributions are the incentive for the policymaker to deviate from social optimal institutional quality. The policymaker chooses the effective rate of allowed expropriation, ϕ, by balancing the marginal social costs to welfare allowing larger rates of expropriation with the marginal benefits of receiving bribes, Ω. The marginal change in bribe income increased permitted exproporiation ϕ is $d\Omega/d\phi$. This Appendix lists how the marginal impact of increasing the expropriation rate on bribe income changes, when the trade costs change.

Comparative advantage and sectoral change

Trade liberalization in this model leads to sectoral changes. The pattern of sectoral change depends on the economy's prices relative to world prices. Therefore, a prediction of sectoral change requires additional assumptions on the economy that is studied. Here, I will develop the predictions for a country whose capital scarcity explains trade impacts. This serves intuition; it is not required for the results.

If factor abundance dominates other motivations for trade, an increase in trade costs leads to a relative expansion of capital-intensive industries in a country where capital is scarce. I proceed in three steps; showing that firm entry follows the impact of trade costs on the sector's typical profit function; that the profit function falls in trade cost according to the marginal costs relative to world marginal costs; and that there is an indirect effect operating through capital prices that takes the same sign as the direct effect.

First, if trade costs increase, the sign of entry in the sector is the sign of the impact of trade costs on the profit function. This follows from implicit differentiation of the profit function:

$$\frac{dn_z}{d\tau} = -\frac{\partial\pi_z/\partial\tau}{\partial\pi_z/\partial n_z} \tag{22}$$

By free entry, $\partial\pi_z/\partial n_z < 0$, which follows from the fact that the demand for the natural resource is downward-sloping in its price, and the resource clearing condition $e_z^* n_z = E_z$. The right-hand side is increasing in $\partial\pi_z/\partial\tau$, and $sign(dn_z/d\tau) = sign(\partial\pi_z/\partial\tau)$.

Second, the impact of trade costs on the profit function is:

$$\frac{\partial\pi_z}{\partial\tau} = (1-\sigma)R_z\left[\frac{1}{\tau} + \beta_z\frac{dr_z/d\tau}{r_z}\right] - \frac{dTKC_z}{dr_z}\frac{dr_z}{d\tau}, \tag{23}$$

where β_z is the capital intensity of the sector. The impact on factor employment is marginally zero by the envelope condition.

Following the direct impact of trade costs, $(1-\sigma)R_z/\tau$, profits fall faster in trade costs if the sector z has a comparative advantage relative to z', such that $R_z > R_{z'}$. In a country where capital is scarce, trade isolation (an increase in τ) implies higher relative revenue for sectors that use capital intensively. The ratio of revenue of firms from two different sectors z and z' is:

$$\frac{R_z}{R_{z'}} = \left(\frac{r_z^{\beta_z}\rho_z^{\delta_z}/\left(r_{zw}^{\beta_z}\rho_{zw}^{\delta_z}w_w^{1-\beta_z-\delta_z}\right)}{r_{z'}^{\beta_{z'}}\rho_{z'}^{\delta_{z'}}/\left(r_{z'w}^{\beta_{z'}}\rho_{z'w}^{\delta_{z'}}w_w^{1-\beta_{z'}-\delta_{z'}}\right)}\right)^{1-\sigma}\frac{b_z}{b_{z'}}. \tag{24}$$

In countries where capital is scarce, $r_z > r_{zw}$, and $r_{z'} > r_{z'w}$ so marginal costs in z may be higher than z' if $\beta_z > \beta_{z'}$. However, this is not sufficient for the impact of higher trade costs to favor capital intensive sectors in (23), as revenue is also determined by the cost of resources ρ_z and b_z. I will label the case for factor dominance where $\partial\pi_z/\partial\tau > \partial\pi_{z'}/\partial\tau$ if $\beta_z > \beta_{z'}$.

Third, there is an indirect impact of trade costs as the capital price changes with trade isolation: $(1-\sigma)R_z\beta_z\frac{dr_z/d\tau}{r_z}$. This indirect effect takes the same sign as the direct effect, however. Intuitively, sectors that make (relatively) more profit when trade costs rise, will expand production and push up capital prices due to extra demand; and experience more firm entry. Therefore, the sign of the sectoral expansion $\frac{dn_z/d\tau}{n_z}$ coincides with the sign of $\frac{dr_z/d\tau}{r_z}$. To see this, consider the following steps. i) A change in trade costs τ affects the equilibrium quantity q produced by a firm and the associated revenue pq. ii) By minimizing total cost $rk+e\rho+l$ given the equilibrium output q^* , the demand for natural resources and capital can be written as $e^*=c'q^*r^\beta\rho^{\delta-1}$ and $k^*=c''q^*\rho^\delta r^{\beta-1}$, where c' and c'' are positive constants. iii) Using the Cobb-Douglas factor demand conditional of fixed costs, both demand curves shift upward in the equilibrium output, irrespective of price changes of the other factor. iv) The clearing condition for the natural resource e_z is that $n_ze_z=E_z$, and $\frac{dn_z/d\tau}{n_z}=-\frac{de_z^*/d\tau}{e_z^*}$. v) Given iii), capital demand is strictly downward-sloping in the capital price and $sign(dk^*/d\tau)=-sign(dr^*/d\tau)$. Using this $dn_z/d\tau$ and $dr_z/d\tau$ are either both positive or both negative.

Altogether, this suggests that if factor abundance dominates comparative advantage ($\partial\pi_z/\partial\tau>\partial\pi_{z'}/\partial\tau$ iff $\beta_z>\beta_{z'}$), then in a country where capital is scarce, trade isolation expands sectors that intensively use capital relative to sectors that do not use capital. When factor abundance does not dominate comparative advantage, this does not need to hold as Ricardian advantages in the natural resources or sectoral differences in the production function may affect marginal costs. However, I raise the possibility to facilitate an interpretation of the impacts of trade on contract enforcement.

The impact of trade costs on bribe income sensitivity

We can now turn to deriving the impact of trade costs on the marginal bribe income to poorer contract enforcement. The marginal bribe income for the policymaker is:

$$\frac{d\Omega}{d\phi}=\sum_z\left(n_z\frac{d\omega_z}{d\phi}+\frac{dn_z}{d\phi}\omega_z\right). \tag{25}$$

Note first that the impact of poorer contract enforcement on entry $dn_z/d\phi$ is zero at the margin. Implicit differentiation of the profit function leads to $dn_z/d\phi=-(\partial\pi/\partial\phi)/(\partial\pi/\partial n_z)=0$, by the first-order condition on bribing. The change of marginal bribe income in enforcement due to trade costs is:

$$\frac{d^2\Omega}{d\phi d\tau} = \sum_z \left(\frac{dn_z}{d\tau}\frac{d\omega_z}{d\phi} + n_z \frac{d^2\omega_z}{d\phi d\tau}\right). \tag{26}$$

This suggests that the change in marginal bribe income has two margins: the composition of firms over sectors changes ($\frac{dn_z}{d\tau}\frac{d\omega_z}{d\phi}$), and the willingness of firms inside each sector changes $\frac{d^2\omega_z}{d\phi d\tau}$. To characterize the trade-induced changes in marginal bribe income further, I write out the constituent parts using the expression for ω in section A.1.

First, for the compositional effect. Changes in the willingness to bribe come from revenue changes and reduction in the total cost of capital:

$$\frac{d\omega_z}{d\phi} = \frac{dR_z}{d\phi} - \frac{dTKC_z}{d\phi}, \tag{27}$$

in which revenue changes can be written as:

$$\frac{dR_z}{d\phi} = (1-\sigma)R_z\beta_z\frac{dr_z/d\phi}{r_z}, \tag{28}$$

and changes in the total costs of capital are:[20]

$$\frac{dTKC_z}{d\phi} = k_f\left((1-\phi)\frac{dr_z^*}{d\phi} - r_z^*\right). \tag{29}$$

It proves useful to write the elasticity of the capital price with respect to the level of contract enforcement shorthand, such that $dr^*/d\phi = \varepsilon_{r\phi}(k_f)r$, where from A.1,

[20] Again, seeing that (27) is effectively the profit function, changes in factor input use due to changes in ϕ have marginally zero impact on the willingness to bribe the envelope condition.

$$\varepsilon_{r\phi}(k_f) \equiv \frac{1}{2} \frac{\frac{k_f}{(k^* - \phi k_f)}}{1 - \frac{\frac{\partial k_q}{\partial r}\frac{r}{k^*}}{\alpha}}, \tag{30}$$

in which case $\frac{dTKC_z}{d\phi} = r_z^* k_{fz}[(1-\phi)\varepsilon_{r\phi} - 1]$. Using this, the impact of contract enforcement on the optimal level of bribes is:

$$\frac{d\omega_z}{d\phi} = r^* \left((1-\sigma)R_z\beta_z\varepsilon_{r\phi} - k_f[(1-\phi)\varepsilon_{r\phi} - 1]\right). \tag{31}$$

It is no surprise that this impact scales to the price of capital. The impact of changes in the expropriation rate on profits and bribe rates are measured in capital value because expropriation affects the units of capital that can be expropriated, it affects the revenue because the price of capital drives up the marginal costs. This expression helps to characterize the sectoral margin of adjustment for bribe income.

The second effect in (26) is the change to the willingness to bribe by individual firms. The firm-level adjustment of bribe income requires understanding trade-induced changes in individual firms' incentive to bribe, $n_z \frac{d^2\omega_z}{d\phi d\tau}$. Differentiating $d\omega/d\phi$ from eq. (31) yields:

$$\frac{d^2\omega_z}{d\phi d\tau} = \frac{d\omega_z}{d\phi}\frac{dr_z/d\tau}{r_z} + (1-\sigma)^2 R_z\beta_z\varepsilon_{r\phi}\left(\frac{1}{\tau} + \beta_z\frac{dr_z/d\tau}{r_z}\right). \tag{32}$$

Collecting terms for the two margins (eq. 31 and eq. 32) in the expression $\frac{d^2\Omega}{d\phi d\tau}$ and simplifying gives that:

$$\frac{d^2\Omega}{d\phi d\tau} = \sum_z n_z \begin{pmatrix} \left(\frac{dn_z/d\tau}{n_z} + \frac{dr/d\tau}{r}\right) r^* \left((1-\sigma)R_z\beta_z\varepsilon_{r\phi} - k_f[(1-\phi)\varepsilon_{r\phi} - 1]\right) \\ +(1-\sigma)^2 R_z\beta_z\varepsilon_{r\phi}\left(\frac{1}{\tau} + \beta_z\frac{dr_z/d\tau}{r_z}\right) \end{pmatrix} \tag{33}$$

Lemma A detrimental specialization effect can occur. Suppose factor endowments dominate comparative advantage. Trade isolation (an increase in τ) in a capital-scarce country leads capital intensive sectors to expand, reducing the marginal bribe income of setting higher expropriation rates ϕ, ceteris paribus.

To see this, note that the specialization effect can be written as $\sum_z n_z \left(\frac{dn_z/d\tau}{n_z} + \frac{dr/d\tau}{r}\right)\frac{d\omega}{d\phi}$. If factor endowments dominate the comparative advantage, from the discussion in Appendix A.1, an increase in τ leads to expansion capital-intensive sectors as well as a capital price increase in those sectors. Moreover, from the marginal propensity to bribe (eq. 10), all else equal, capital-intensive sectors have lower optimal bribes, $\frac{d^2\omega}{d\phi d\beta_z} < 0$. Consequently, an increase in trade costs lowers the average level of bribes across firms.

The more intuitive way of stating this may be opposite. If trade costs fall, capital-intensive sectors shrink and labor or natural resource-intensive sectors grow. The labor- and natural-resource intensive sectors have larger incentive to bribe, keeping everything else constant. Thus, a trade liberalization changes the sectoral composition of the economy such that the average willingness to bribe reduces.

Lemma Lower trade costs can reduce individual firms' incentives to bribe. The marginal bribe income of setting higher expropriation rates is higher, when trade costs are higher.

The impact of trade costs on individual firms' willingness to bribe for expropriation is $\sum_z n_z \frac{d^2\omega_z}{d\phi d\tau} = \sum_z n_z (1-\sigma)^2 R_z \beta_z \varepsilon_{r\phi} \left(\frac{1}{\tau} + \beta_z \frac{dr_z/d\tau}{r_z}\right)$. Note that the term $1/\tau$ reflects the relative output value change, while the term $\frac{dr_z/d\tau}{r_z}$ reflect the change in capital prices due to trade costs. Given the unit-elastic demand for capital and $\beta_z < 1$, $\frac{1}{\tau} + \beta_z \frac{dr_z/d\tau}{r_z} > 0$. Consequently, the term $\sum_z n_z \frac{d^2\omega_z}{d\phi d\tau}$ is strictly positive.

B. Figures

Figure B1. Shipping distance calculator from searates.com

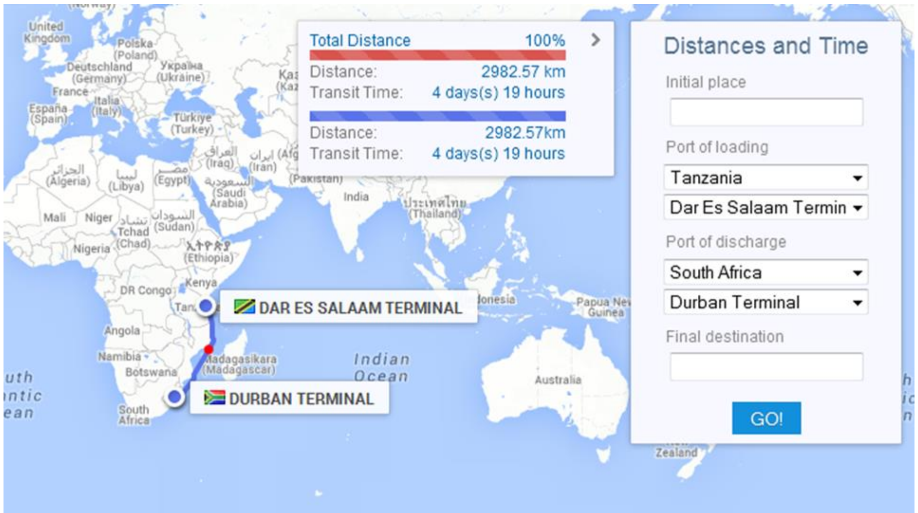
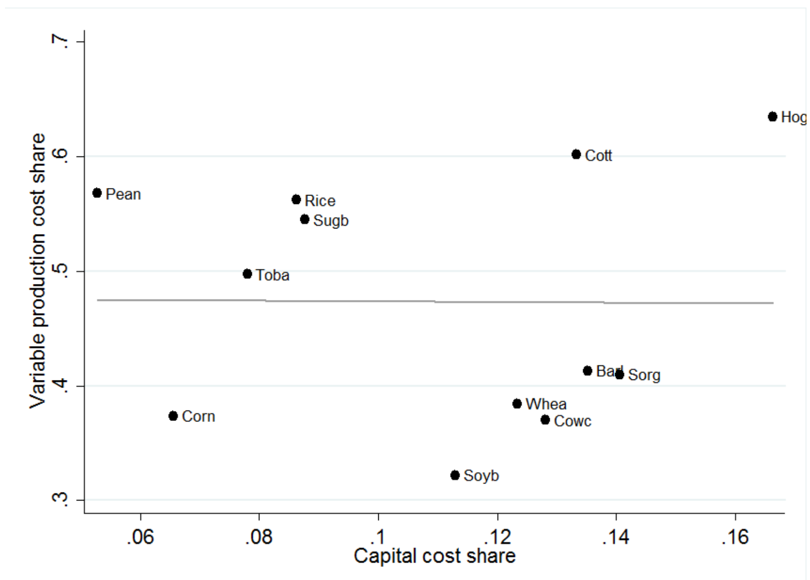


Figure B2. Capital cost share and variable input cost share for different industries



C. Countries in the sample and their main ports

Angola (Luanda); Cameroon (Douala); Congo (Pointe Noire); Democratic Republic of the Congo (Matadi); Djibouti (Djibouti); Equatorial Guinea (Bata); Eritrea (Assab); Ethiopia PDR (Djibouti); Gabon (Libreville); Kenya (Mombasa); Madagascar (Toamasina); Mozambique (Beira); Namibia (Walvis Bay); Nigeria; Somalia (Mogadishu); South Africa (Durban); Sudan (former) (Port Sudan); United Republic of Tanzania (Dar Es Salaam).

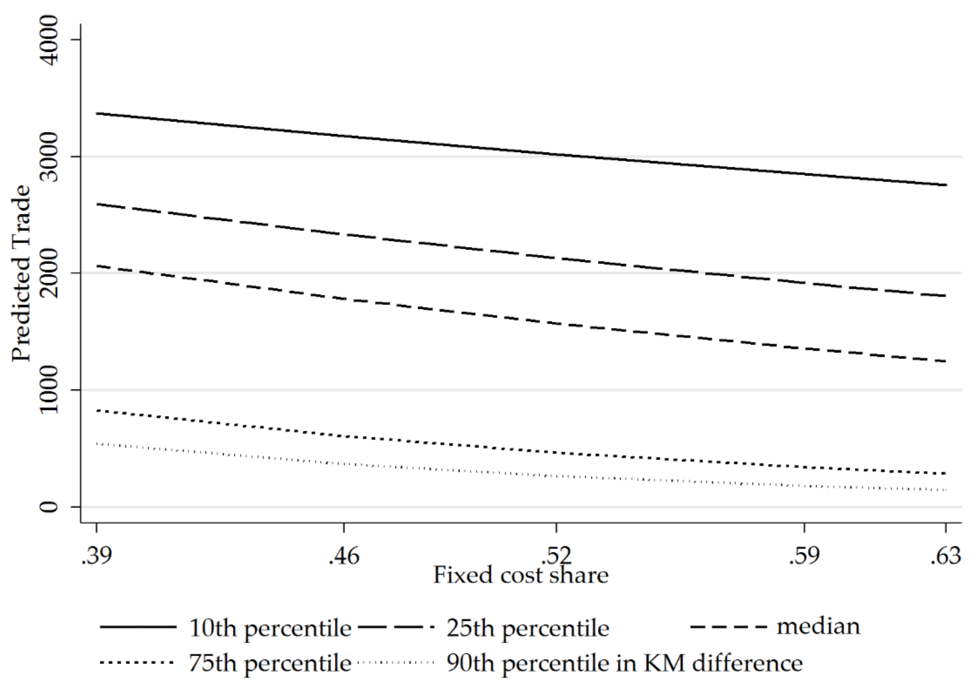
D. Products by category

Category (USDA)	Crops (FAO)
Barley	Barley; Barley (pearled)
Corn	Sweet corn (frozen); Sweet corn (preserved); Flour (maize); Maize; Oil, maize; Cake, maize
Cotton	Cotton lint; Cotton waste; Cottonseed; Cotton, carded, combed; Oil, cottonseed; Cake, cottonseed
Cow/Beef	Butter (cow milk); Cheese (whole cow milk); Milk, skimmed cow; Milk, whole fresh cow; Skins, calve; Meat beef preparations; Meat, cattle boneless (beef and veal)
Hogs	Meat, pig; Meat, pig sausages; Meat, pig, preparations; Meat, pork
Rice	Rice – total (Rice milled equivalent); Bran, rice
Sorghum	Sorghum; Flour, mixed grain; Grain, mixed
Soybeans	Oil, soybean; Soya sauce; Soybeans; Cake, soybeans
Sugar	Sugar beet; Sugar Raw Centrifugal; Sugar refined; Sugar, nes
Tobacco	Tobacco, unmanufactured; Tobacco products nes
Wheat	Wheat; Bran, wheat; Buckwheat; Flour, wheat

E. Interaction coefficient in the Poisson maximum likelihood estimates

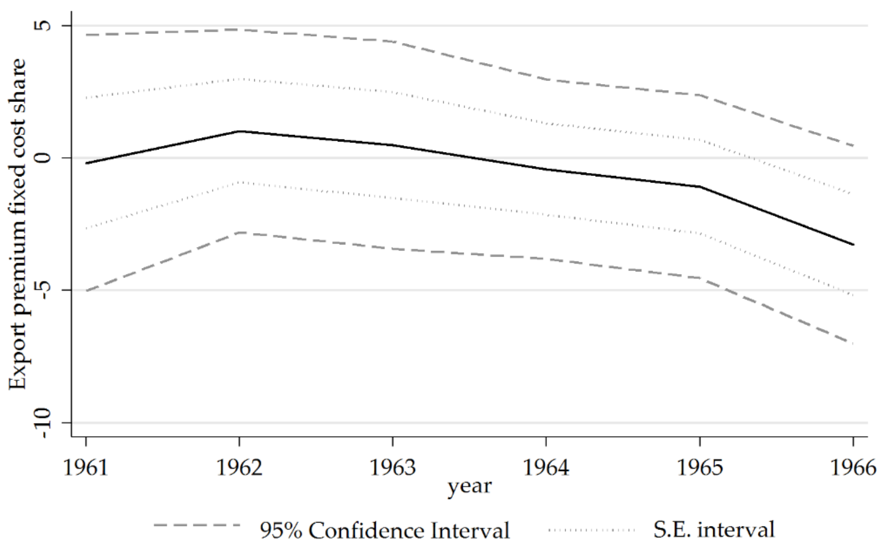
The interaction coefficient between transport costs and fixed cost shares could mask a positive interaction effect on subsegments, because the model relies on the Poisson distribution. To check for such non-linearities, I plot the predicted marginal means of exports by levels of the distance shock over different fixed cost shares (at average of the estimation sample). Figure E1 shows that larger increases in the trade distance are associated with lower export flows. This effect is stronger conditional on higher fixed cost share (the scale runs from the 10th percentile to the 90th percentile). Together, there is no evidence to suggest that the negative interaction coefficient obscures any positive interaction effects.

Figure E1. Predicted exports for different magnitudes of the cost shock, according to fixed cost share (conditional on covariates)



F. Pre-shock export differences for high fixed costs share sectors

Figure F1. Effect of having a higher fixed cost share on exports in affected vs unaffected countries before the Suez Canal closure



Estimates of divergence before the trade cost shock are obtained by running the regression: $\log \text{exports}_{ict} = \mu_{ct} + \mu_{ic} + \sum_t \beta_t \times D_{treat} D_{year} \times \text{fixed cost share} + u_{ict}$ where μ indicates a multiplicative fixed effects along time (t), country (c) or crop (i) dimensions. D_{treat} denotes a country that is eventually affected by the trade cost shock. The coeffient β_t captures, for year t, the additional sensitivity of exports to a higher sectoral fixed cost share in pre-affected countries. Figure F1 reports the estimates for β_t in different years before the shock.

G. Production measures based on African data

Table G1. Effects on log exports: CEEPA survey measures

	(1)	(2)	(3)	(4)
	export	export	export	export
	PPML	PPML	PPML	PPML
Non-production employment share x shock log KM	-5.35**	-5.43**		
	(2.73)	(2.59)		
Capital cost share x shock log KM		-8.59		31.75**
		(19.80)		(15.69)
Heavy machinery share x shock log KM			-0.49***	-0.57***
			(0.10)	(0.10)
observations	6,018	6,018	6,018	6,018
country-year FE	yes	yes	yes	yes
country-crop FE	yes	yes	yes	yes

Notes. Dependent variables: log Exports. Estimated by PPML. Standard errors clustered at country-treatment period in parentheses (see text). *** p<0.01, ** p<0.05, * p<0.1.

Discussion in the main text.

H. Institutional sensitivity by crop

An important identifying assumption drawn from the theory is that fixed costs pose barriers if institutions are poor. Because there is little measurement of institutional quality in African countries in the 1960s, it is hard to confirm the correlation between fixed costs and institutions directly. Yet, it is desirable to verify whether fixed costs indeed pose institutional barriers.

To check whether fixed costs are indeed more of a barrier in institutionally poor countries, I check the predictions in a sample with more information on institutions. I compare the FAO trade data to the institutional indexes of the Worldwide Governance Indicators by the World Bank. The "Rule of Law" variable is a widely used measure of institutional quality and seems applicable in the context of my theory: it comprises the enforcement of contracts and property rights, the quality of police and courts, and the likelihood of crime. I match the indicator with bilateral trade data from the FAO that follows the same product classification as the data used earlier. The overlap produces a dataset of 156 countries over the years 1996-2011.

Figure H1. Rule of Law and the average fixed costs involved in exports

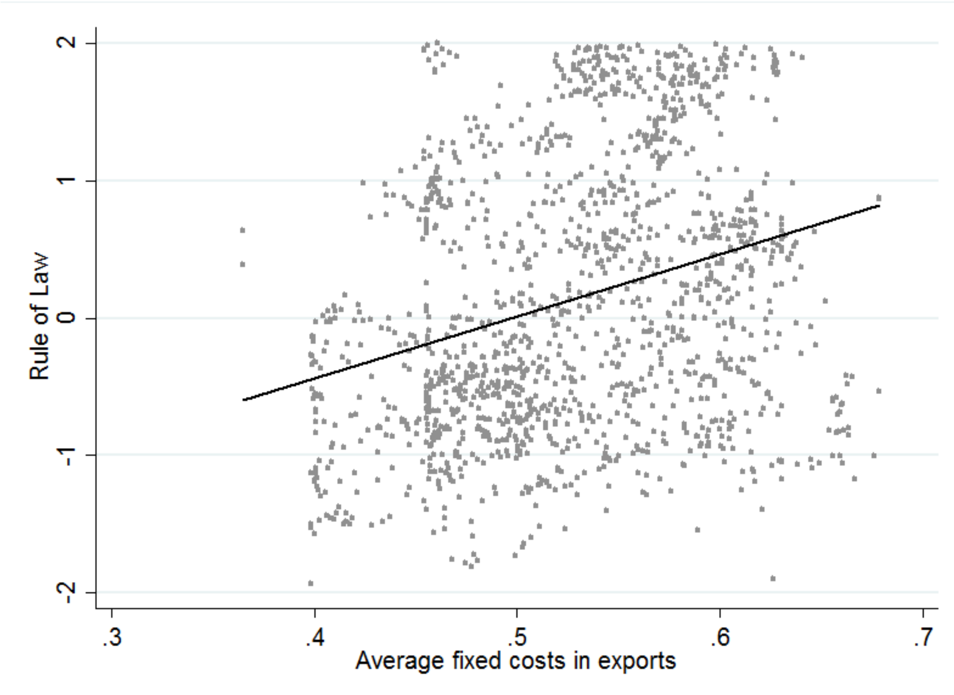


Figure H1 scatters the Rule of Law indicator and the fixed costs involved in exports. The fixed costs are calculated as the export-weighted fixed cost share for each country in each year. The data confirm that countries with higher institutional scores have higher average fixed costs shares in exports. A one standard deviation increase in the Rule of Law score is associated with higher fixed cost shares in exports of around a third of the sample standard deviation (significant beyond the third decimal).

The association between institutional indicators and exports' fixed costs shares may be driven by confounders, however. To exclude that country- and product-level variables explain the association, I also estimate a gravity equation. The gravity equation uses bilateral product-level data from the FAO - the data of the above scatterplot in their bilateral version. To control for any effects at the product-level and the country-level, I introduce product-year and origin and destination country-year fixed effects. [21]

[21] This is the most conservative fixed effects strategy. Restricting to time-invariant fixed effects or dropping product-specific fixed effects gives the same results.

Table H1 present the results from estimating the gravity in the larger sample. The first column shows coefficients consistent with most other estimated gravity equations: an estimated distance elasticity around minus unity and significant border effects. In column 2, there is an interaction between the institutional index (Rule of Law) of the origin country and the fixed costs share involved in the production being exported. The individual arguments of this interaction are absorbed by the fixed effect: the institutional indicator by the origin-year fixed effect and the fixed costs share by the product-year fixed effect. Thus, the interaction suggests that conditional on any country and product level characteristics, fixed costs intensive products are exported more often from institutionally advanced countries.

Further regressions confirm the result that fixed-costs intensive industries rely on institutions. To exclude capital sensitivity as an explanation, column 2 shows the interaction between capital shares and institutional quality in addition to the fixed costs share interaction. Conforming to intuition, better institutions foster capital intense exports. Importantly, this does not affect the estimated effects of fixed costs qualitatively. That adding capital intensity does not change the results regarding fixed costs is no surprise, as fixed costs share and capital intensity show no strong correlation. The last columns repeat the analysis for the other institutional indexes from the World Governance Indicators, each confirming the earlier result.

Table H1. Institutional sensitivity: Effects on log exports

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		RL	RL	CC	GE	PV	RQ	VA
Distance (log)	-0.85***	-0.85***	-0.87***	-0.87***	-0.87***	-0.87***	-0.87***	-0.86***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Border	0.80***	0.81***	0.82***	0.81***	0.82***	0.81***	0.81***	0.81***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Fixed x IQ		1.10***	1.44***	1.37***	1.61***	2.27***	1.53***	1.65***
		(0.05)	(0.05)	(0.05)	(0.06)	(0.06)	(0.06)	(0.06)
Cap. x IQ			8.79***	8.32***	8.37***	10.44***	8.90***	8.33***
			(0.19)	(0.17)	(0.20)	(0.22)	(0.22)	(0.20)
observations	243,228	243,228	243,228	243,228	243,228	243,212	243,228	243,228
origin-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
destination-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
sector-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes. Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Fixed: fixed cost share in production. Cap.: capital cost share. IQ: the respective measure of institutional quality (see column title, RL: rule of law; CC: control of corruption; GE: government effectiveness; PV: political stability and absence of violence; RQ: regulatory quality; VA: voice and accountability).

I. Distance decay and fixed costs

Table I1 Fixed costs, distance and destinations

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:	Distance	Log Export	Log Export	Log Export	Log Export	Log Export[a]
Sample:	World	World	African exporters	World	African exporters	Main sample
Fixed cost share	-894.36					
	(1282.03)					
log Distance		-0.99***	-0.88	-0.46***	0.43	
		(0.35)	(0.99)	(0.06)	(0.46)	
Fixed cost share x		0.89	2.53			
log Distance		(0.72)	(2.57)			
Fixed cost share x						-6.99*
shock log km						(3.62)
Capital cost share x						17.05
shock log km						(11.91)
Fixed cost share x				-0.58	1.44	
Europe				(1.35)	(3.80)	
observations	578	14,731	372	14,731	372	4,422
origin FE	yes	yes	yes	yes	yes	
destination FE		yes	yes	yes	yes	
crop FE		yes	yes	yes	yes	
country-year FE						yes
country-crop FE						yes

Notes. Clustered standard errors in parentheses. [a]Export purged from predicted decay (see text).

*** p<0.01, ** p<0.05, * p<0.1.

The baseline regressions require the assumption that a sector's higher up-front costs imply higher sensitivity to poor contracting. That assumption might lead to misleading conclusions, if high fixed costs are not associated to elevated institutional sensitivity. Similarly, if goods that embody high upfront costs also face higher transport costs, or if they are exported disproportionately to affected destinations, that could explain their relative decline - apart from the institutional sensitivity.

The regressions in Table I1 show no evidence of such distortions. The first column exploits bilateral trade data from 1986 (the first available year). The dependent variable is the mean distance shipped of an export crop from a specific country (the export distance weighted by the size of exports). Conditional on the origin fixed effects, fixed cost shares embodied in the agricultural products do not predict export distance in this sample.

The second and third column in Table I1 allow distance decay conditional on fixed cost shares of the exports. The interaction of fixed costs shares is insignificant, suggesting that the distance decay in the 1986 agricultural exports is not systematically associated with the fixed costs embodied in the products. This holds for the global sample (column 2), as well as for the subsample of African exports (column 3).

The second and third column in Table I1 test whether exports to Europe represent significantly higher fixed costs, by interacting fixed cost shares with a dummy for export flow destined to Europe. Europe does not import agricultural goods that rely more on fixed costs, both from the world, and from African countries.

The last column in Table I1 runs the original dif-in-dif regression, with a modification for expected export changes from the distance shock. The modification consists of two steps. First, I estimate the specific distance decay for every product in the bilateral trade dataset. It is a standard gravity equation, explaining log exports from log (population-weighted) distance and borders using importer and exporter fixed effects. Based on the percentage trade distance shock from the Suez Canal closing, I predict the change in exports for every product for all affected countries - these are predictions based on the distance-sensitivity of the product. In the second step, I take export changes predicted by the distance decay out of the observed export flows, before running the original dif-in-dif model. The assumption here is that the model now examines export variation after the trade cost shock above and beyond what would be expected based on the sensitivity to distance of each product. The results are reported in column 6. They suggest that the interaction between fixed cost shares and the trade cost shock is slightly less clear (from -8.45*** to -6.99***, around 20% decrease in magnitude) but the qualitative conclusions are similar.

J. Price assistance

Many African countries in the 1960s and 1970s supported agricultural production by pricing instruments. The effective support by product is available for a subset of the data in the paper. For the crop classification used in the main results, there are observations on price assistance on the countries Cameroon, Ethiopia, Kenya, Madagascar, Mozambique, and Tanzania (Anderson and Valenzuela, 2013). These allow a comparison of changes in price assistance to changes in export patterns.

To examine overall changes in the assistance patterns, I examine how often they change. Figure J1 tracks the changes in nominal assistance rates. Nominal rates of assistance are the effective estimated price supports in percentage terms. The Figure shows for what share of all crops in all countries in the sample, price assistance rates changed. There is an upward trend: in the 1960s, on average, one in five sectors (in a given country) saw changes in assistance, but that number has risen towards 80 percent in the 1980. There is no clear change in the years around the closure of the Suez Canal, but the number of changes triples around the re-opening of the Suez Canal.

Fig J1. Share of the country-crop pairs that experienced a changing assistance pattern by year

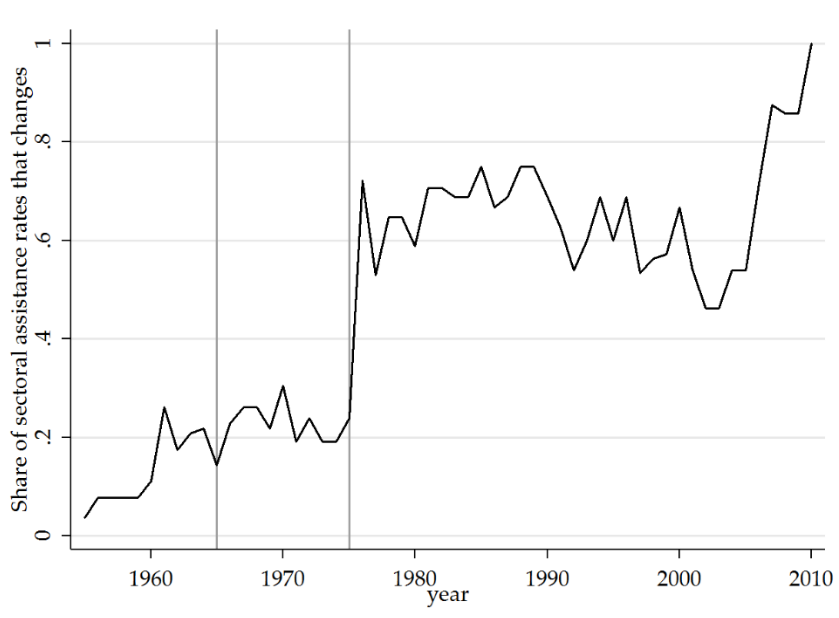


Table J1 presents further analysis of the nominal assistance rates. The first column considers how the trade cost shock affects assistance rates according to fixed cost shares. It suggests that during the closure of the Suez Canal, sectors with higher fixed cost shares received no lower or higher price assistance. Column 2 reports a regression focusing on a time-span two years before and after the closure. It suggests that at the start of the closure, assistance was higher for industries with higher fixed cost shares. This suggests the results from Table 1 may be understated, the sectors in decline received stronger government support. At the re-opening of the Suez canal, Figure J1 shows a marked increase in changes in the assistance rates. Column 3, however, suggests those changes are not correlated to fixed costs shares.

Table J1. Nominal rates of assistance

	(1)	(2)	(3)	(4)	(5)	(6)
	Assistance	Assistance	Assistance	Export	Export	Export
	OLS	OLS	OLS	PPML	PPML	PPML
		65 to 69	73 to 77			
Rate of assistance				-0.46		-0.46
				(0.66)		(0.66)
Fixed cost share x	0.86	1.56***	0.52	-78.91***	-77.52***	-79.28***
shock log km	(0.91)	(0.00)	(0.84)	(24.06)	(23.60)	(24.44)
Capital cost share x						-1.31
shock log km						(46.84)
observations	1,338	138	223	989	989	989
country-year FE	yes	yes	yes	yes	yes	yes
crop-country FE	yes	yes	yes	yes	yes	yes

Notes. Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Columns 4 to 6 report the baseline regressions on the sample for which price assistance rates are observed. It is consistent with earlier results, but shows large sample selection. Introducing price assistance as a control confirms earlier results, if significantly larger than in the original sample. This is not due to the introduction of the price assistance control: running the baseline regression on the same sample (column 5) shows that the estimate is almost unaltered. The same holds when introducing capital cost shares.

The second column shows that controlling for the observed assistance changes does not affect the main result - the shock has a larger negative impact on sectors that face higher fixed costs. The coefficients are identified from a much smaller sample than the sample in the main text. To benchmark the coefficient, I estimate the baseline regression in the sample for which assistance is observed, in column 3. The results show that the coefficient is negative, and that controlling for assistance attenuates the estimate of the fixed costs effect in the export decline by around 10%. Overall, the coefficients represent much larger effects, however. The sample for which price support is recorded does not seem to be representative for the larger sample.

Columns 4, 5, and 6 show the same regression results, but with the interaction between a sector's capital share and the trade costs shock included. Controlling for the capital cost shares again does not change the results much. When explaining the level of assistance, introducing the trade cost interaction with capital cost share reduces the coefficient of the fixed cost share and trade costs interaction by around 60%, suggesting that capital intensity may pose a stronger motive for price support. In unreported regressions, I used border market price supports instead of general price supports. The correlation between the measures is very high (0.97) and the results show no change.

K. Crop appropriability

The appropriability of a crop determines whether its production requires good institutions. I follow Mayshar et al. (2015) in distinguishing between cereals, on the one hand, and roots and tubers, on the other. Roots and tubers, such as potato and cassava, are high-calorie substitutes for cereals in many parts of Africa. However, tubers and roots cannot be stored; unlike cereals, they rot shortly after harvesting. As a result, cereal crops are much easier to confiscate than tubers. Indeed, storage time explains a large part of the risk of theft (Fafchamps and Minten, 2001).[22] The distinction between crops according to their sensitivity to theft, confiscation or other appropriation is founded in the anthropological literature, too. That literature describes the social effects of crops and food sources that provide immediate consumption versus those that come with delay between effort and consumption (e.g. the front-back loaded model of Tushingham and Bettinger, 2013).

To check my results with a different measure of institutional sensitivity, I examine the differential effects between cereal crops and tubers. I use the same difference-in-difference approach, which examines whether cereal exports increased relative to tubers from countries that saw isolation in international trade. Cereals in my sample constitute rice, maize, wheat, barley, oats, rye, sorghum and

[22] Not just in African countries: a 2005 Hawaii survey by the U.S. National Agricultural Statistics Service shows that theft losses are 3-13 times higher for preservable goods like coffee and nuts than they are for perishables like fruit and vegetables.

millet. Tubers and roots are potatoes, sweet potatoes and cassava. I include the directly derived products (cake and bran) in these groups.

Table K1 shows the results of the regressions explaining crop exports for cereals versus tubers. The dummy *cereal* is one for cereal crops and zero for roots and tubers (other crops are not in the sample). The first column shows a negative coefficient for the interaction between the trade cost shock and cereals, using the pseudo Poisson estimator. Consistent with earlier results, the more institutionally-intensive cereals saw a drop in exports compared to tubers when trade costs increased. The coefficient implies that during the shock, the average decline in cereal relative to tubers was around 19 percentage points.

The identification relies on the assumption that good institutional quality facilitates cereal production relative to tubers. To check that assumption, column 2 reports the results of the gravity model for agricultural exports run on a sample of countries over the years 1995-2001, controlling for origin-year and destination-year-specific fixed effects. It shows that given the country-year effects, the exports of cereals were high relative to tubers when the country had high levels of the rule-of-law indicator. In unreported regressions, this result is confirmed for other institutional indicators. It is important to note that the perishability of roots and tubers might also have made them more sensitive to longer trade routes. However, running the same bilateral gravity equation for 1986 data, as in the above sensitivity check (also detailed in Appendix I), there is no evidence of that possibility.[23]

[23] A gravity equation with origin and destination fixed effects and an interaction for the dummy cereal and distance suggests that cereals have no significantly different distance sensitivity, although the coefficient of the interaction (cereal X log distance) is positive (0.42, p-value 0.29). As before, I estimate crop-specific distance decay parameters from bilateral data and impute the direct export loss due to the canal closure by crop. After taking the imputed direct export shocks out of the data, the regression shows a slight attenuation of the coefficient of interest. The coefficient reported in column 1 changes to -6.65***, not leading to qualitative changes in the conclusions.

Table K1. Institutional sensitivity: Effects on log exports for cereal and non-cereal crops

	(1)	(2)
	PPML	PPML: later sample
Cereal x Shock log KM	-6.71***	
	(1.47)	
log Distance		-0.84***
		(0.16)
Border		0.58***
		(0.12)
Cereal x Exporter Rule of Law		0.52**
		(0.24)
observations	1,500	4,884
country-year FE	yes	yes
country-product FE	yes	
destination-year FE	n.a.	yes

Notes. Dependent variables: log Exports. Estimated by PPML. Standard errors clustered at country-treatment period in parentheses (see text). *** p<0.01, ** p<0.05, * p<0.1.