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Sustainability under siege: Transport costs and corruption on West Africa's trade corridors

Daniel Bromley and Jeremy Foltz

Abstract

We use recent data on transport costs in West Africa, including the added burden of bribes and enforced delays, to show how such costs represent a deterrent to investment in — and therefore the sustainability of — agricultural assets. We focus on data for two important tree crops in West Africa, cashew and shea. We also have data for the transport of onions between Niger and the urban market in Accra, Ghana. Our data allow us to predict plausible increases in farm-gate prices from a reduction in transport costs and bribes. A 10% reduction in the total transport costs (actual costs plus corruption costs) of onions from Niger could result in a 12-13% price increase to onion farmers. Similar elasticities are 2% for cashew in Ghana and 7% for shea in Mali. These feasible price increases would encourage farmers to improve onion production, and to protect and improve production from cashew and shea trees, thereby enhancing the sustainability of agro-forestry in West Africa. We call these price increases the "sustainability dividend".

1. The problem

The sustainability of agriculture in sub-Saharan Africa continues to raise concerns among those in the development community. Evidence from 34 countries in the region depicts an ominous secular decline in per capita food production — a process we call immiserization — over the period during which most countries gained their independence in the early 1960s (Figure 1).[1] While there are many explanations for this trend, we suggest that one plausible explanation is to be found in the nature and quality of the economic infrastructure in much of the continent. Here we use the term *infrastructure* to refer to two distinct ideas. In the current vernacular, there is "hardware" and there is "software". In most discussions of infrastructure the focus is on the hardware — roads, rail networks, bridges and communications. Our emphasis here will be on the software — what we call the *institutional architecture* of an economy (Bromley, 1989; 2006). The two infrastructures work together to determine the efficacy with which the economy can accomplish its necessary signaling. If roads, rail, bridges and telecommunications are in serious disrepair, even the most efficacious institutional arrangements will be unable to create the conditions of high productivity and the prospects for growth. On the other hand, if the physical assets are ideal, and yet the legal and customary arrangements enable or encourage theft, bribery, and other forms of predatory behaviour, economic performance and livelihoods suffer.

Studies of institutional problems in marketing and transport have increased our understanding of this important component of a nation's economy (Shleifer and Vishny, 1993; Campos *et al.,* 1999; Fafchamps and Hill, 2005; Lambsdorff, 2006; Rose-Ackerman, 2006; Raballand and Macchi, 2008; Olken and Barron, 2009; Portugal and Wilson, 2009; Teravaninthorn and Raballand, 2009; Freund and Rocha, 2010). Some of this literature seeks to make a distinction between corruption that facilitates transactions ("grease") and corruption that impedes transactions ("sand") (Méon and Sekkat, 2005). The first corruption, familiar to those who study large multinational firms operating across many countries, actually facilitates investment and business in countries where obtaining licenses and permits can otherwise represent serious deterrents. One may think of this class of corruption as a *license to do business*. Indonesia and the Philippines are often cited as exemplars of this form of "crony capitalism"

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[1] The 34 countries included in this series are Benin, Botswana, Burkina Faso, Burundi, Chad, Democratic Republic of the Congo, Congo, Côte d'Ivoire, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Malawi, Mali, Mauritania, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe.

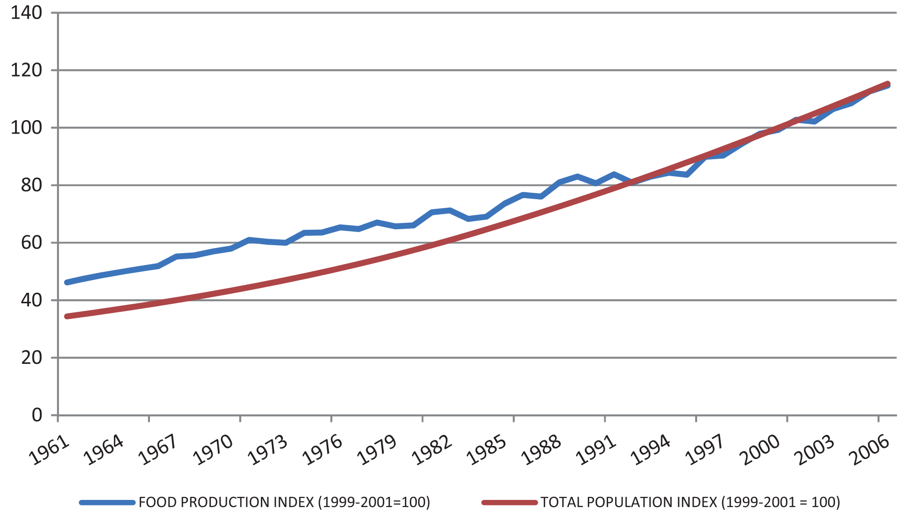

Figure 1. Creeping immiserization in sub-Saharan Africa.
Source: World Bank (2008).

— also known as "pay to play" corruption. We refer to this as *wholesale corruption*. Indeed, several large German companies, presumed to be paragons of commercial probity, fell under investigation for making payments to foreign suppliers to enhance the chances of favourable long-term contracts (*Wall Street Journal*, November 24-26, 2006).[2] The justification by those implicated in such practices is that one must participate in order to do business in particular countries.

The other corruption, here called *retail corruption*, concerns those settings in which frequent exactions are demanded to be allowed to continue to operate a business. This is precisely the context in which a number of the above studies are situated. The problem of weak ("soft") states and corruption has recently brought attention to the transport sector — that crucial logistical realm that joins producers and consumers — including exports to world markets (Olken and Barron, 2009; Portugal and Wilson, 2009; Freund and Rocha, 2010).

In a recent study, Freund and Rocha seek to understand delays in the transport sector of sub-Saharan Africa. In discussing delays at the port versus delays in transit, they write:

> All else equal, a one day delay should affect exports the same way no matter when it occurs. However, one reason it may not is if there is more uncertainty associated with high delays in some procedures than in others. Uncertainty will reduce exports because it makes delivery deadlines harder to meet (Freund and Rocha, 2010, p.11).

They then test this proposition by asking whether or not greater uncertainty related to inland transport times is more deleterious to exports than are the delays driven by the process of obtaining proper documents in ports. They estimate the effects of "time uncertainty" in each component of export times for a subset of the 24 countries in sub-Saharan Africa for which they have data.[3] They find a significant negative impact of "inland transit time" on the value of traded goods. A one-day increase in this variable seems to be associated with a 13% reduction in exports. In logs this means that a 1% increase in uncertainty leads to a 0.7% reduction in exports. The point is that delays in road transport times indeed jeopardize delivery targets. In terms of effects on economic performance, transport delays are more deleterious because port-related delays can often be reduced through preemptive arrangements. That is, these "bureaucratic" delays are, to some extent, similar and routine and such delays can often be factored into the planning process. But sending a truck across country is a different sort of problem. Unlike port delays, in which case trucking firms are dealing with a small and reasonably stable set of inspectors, the situation along several thousand kilometres of roads entails frequent interaction with an unstable and therefore unpredictable group of idiosyncratic officials representing customs bureaus, police, army security guards, and union officials. Here, unlike payments to expedite processing, a truck on a long-haul trip is out of the control of the exporter. The empirical work of Freund

[2] When the Foreign Corrupt Practices Act of 1977 was passed, foreign (but not domestic) bribes were tax deductible. Germany changed this under foreign pressure. However, European views on "side payments" remain generally unchanged.

[3] The data concern uncertainty between the maximum and the average number of days it takes for an exporter to complete each of the exporting procedures. The countries are: Benin, Botswana, Burkina Faso, Burundi, Cameroon, Republic of the Congo, Côte d'Ivoire, Ghana, Kenya, Madagascar, Malawi, Mali, Mauritania, Mozambique, Namibia, Nigeria, Rwanda, Sierra Leone, South Africa, Sudan, Tanzania, Uganda, Zambia and Zimbabwe.

and Rocha (2010) tends to show that road transit times, and the uncertainty associated with road transit, are both significant. That is our emphasis here.

We are interested in what we call the *institutional coherence* of an economy — in particular, the transport sector of West Africa. Access to recent data on bribes and delays along the transport corridors of West Africa offers us a unique opportunity to explore the implications of institutional incoherence for enterprise choice and market behaviour. And to the extent that institutional incoherence results in flawed price signals to farmers, we suggest that there is a link between corruption and the sustainability of agriculture in West Africa.

Below we will first present a general model of bribes and associated corruption across space. We will then draw on recent data from major transport corridors in West Africa to illustrate the implications of bribes and transit delays on the movement of three agricultural commodities — onions, shea and cashew.

2. A spatial model of transport corruption

Bromley and Chavas (1989) offered a spatial model illustrating how risky economic environments tend to undermine the willingness of economic agents to engage the market. The point in that work was to illustrate the concept of a willingness to pay for institutional coherence. Following up on that model, Bromley (2008) offered a spatially explicit elaboration of that same problem to suggest that agricultural assets — both those assets considered part of the "village commons" and those under the exclusive control of individual agents (that is, privately controlled assets) — face inevitable degradation if prevailing institutional arrangements are defective. This conclusion is important because the standard account suggests that private assets are optimally managed while assets managed in common will inevitably be dissipated. However, when institutional incoherence erodes net returns to land, even privately-owned assets become degraded. Degradation sets in because of the lack of adequate net returns from the farming operation to allow maintenance of — and investments in — the underlying asset base.

Here we build on this spatial model of institutional incoherence to connect economy-wide corruption with farmer enterprise choice — with indirect implications for sustainability. Consider a simple von Thünen model of net economic rent available at varying distances from an urban market to which agricultural products from the hinterland are transported to be sold.[4] The model incorporates two rent gradients — one without corruption (R) and a second one (R~) depicting the additional dissipation of net rent arising from bribes and delays along the transport corridors of West Africa. Notice that bribery reduces net returns to land such that the extensive margin is shifted towards the market (from k' to k~). While agricultural feasibility is threatened along the rent gradient, the danger is especially pronounced as one approaches the extensive margin. To the left of the extensive margin (k' or k~), institutional incoherence (numerous checkpoints demanding bribes and imposing unnecessary delays) distorts enterprise choice by lowering net rents on traded goods. It is here that particular low-value crops might be abandoned or tree crops would be cut down in favour of other enterprises.[5] In addition, bribery induces a movement away from tradable commodities and towards those that will be consumed close to where they are grown. Autarky emerges (Bromley and Chavas, 1989). And the shrinking extensive margin (the shift from k' to k~) implies a gradual abandonment of agriculture (Elnagheeb and Bromley, 1992; 1994; Larson and Bromley, 1991).

Let φ be an indicator of the level of corruption facing a farmer situated at point k. Here we treat φ as a cost premium per kilometre for bringing necessary inputs to the farm at point k, and also as farmers seek to move products from point k to the central market.[6]

So far our discussion has concerned a model of actual transport costs and corruption in Africa. A more complete picture requires that we provide some reference point for those costs. Doing so allows us to bring together a more complete model that captures the quality of West Africa's physical infrastructure with the coherence of the institutional dimensions in the transport sector. The reference we shall employ is a counterfactual transport system as it works in Western Europe. With that reference point, we can depict a situation in which ports and transport terminals are run at a high level of efficiency, the quality of roads and bridges allows for rather high-speed movement of trucks, and the quality of the rolling stock is such that breakdowns and related disruptions are low.

We can write the rent from parcel u at point k as:

$$R = Q[(p_t) - TC] - k[Q(c + \delta + \varphi)] \quad (1)$$

where Q is the average yield of a good produced per unit of land, p_t is the sale price of that good in the ultimate market, c is the counterfactual (Europe) transport costs per unit of Q per unit of distance from the market, δ is the cost premium for transport in West Africa per unit of Q per unit of distance from the market, and φ is the cost of corruption per unit of Q per kilometre distance from the market, TC is the average total and variable cost of producing a unit of Q at point k, and k is distance from that distant market. Ignoring corruption, if $\delta = 0$ then transport costs equal those found in Western Europe. When corruption is introduced, net returns fall. If corruption could be eliminated ($\varphi = 0$), and if the

[4] This could also be an export terminal for international trade.

[5] Our supposition here is that the unconstrained choice of crops and production processes with trade will be more sustainable than the constrained choice farmers make in autarky.

[6] These costs include both actual cash outlays for bribes and delays at the frequent checkpoints. Our data will pertain only to the product side of the market and will ignore the increased cost of purchased inputs.

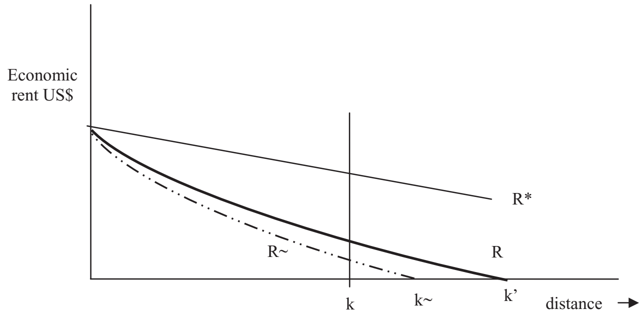

Figure 2. Three net rent gradients.
Source: Authors' elaboration.

cost premium in West Africa could be eliminated ($\delta = 0$), then Equation 1 reduces to the ideal von Thünen rent gradient (R^* in Figure 2). Eliminating corruption would bring $R\sim$ coincident with R, while eliminating other extraordinary transport costs in West Africa would bring R coincident with R*. We see that the transport cost premium and corruption work to shrink the zone of economic activity around the market centre. High transport costs and corruption fuel autarky and conspire to isolate rural economic activity, which in turn threatens agricultural sustainability.

3. The data: Transport costs in West Africa

Our data come from several sources. In a recent report concerning transport prices and costs in Africa we find data that allow assessment of transport costs in West Africa (Teravaninthorn and Raballand, 2009). A second source of data is two ongoing surveys of bribes and delays at the many checkpoints along the main trucking corridors of West Africa (WATH, 2009; WATH, 2010). These data sources allow us to estimate three essential parameters. First, we can derive a reference level of transport costs per kilometre based on data from Western Europe. Second, we can calculate a West Africa "premium" to reflect the additional costs per kilometre over and above transport costs in Western Europe. Finally we can calculate the costs of corruption in West Africa, focusing on the actual monetary value of requisite bribes per kilometre, as well as the implicit costs of enforced delays at the many checkpoints along the highways.

Our data on bribes and enforced delays at checkpoints (the combined effects will be called "corruption") come from two current studies sponsored by the West Africa Trade Hub (WATH). The first study is being conducted by the Improved Road Transport Governance (IRTG) project. The second study is being conducted by the Agribusiness and Trade Promotion (ATP) project. While seeking similar information, these two studies are conducted quite differently.

For the IRTG study, Figure 3 shows the truck routes that connect Mali and Burkina Faso with various seaports. Mali has several feasible options for getting goods to and from seaports — Dakar, Senegal; Conakry, Guinea; Abidjan, Ivory Coast; and Tema, Ghana (currently the preferred route). For Burkina Faso shippers have three likely routes — Abidjan, Tema, and Lomé, with the latter two being the most preferred. Both of these landlocked countries were heavily reliant on the port at Abidjan until the civil war in the Ivory Coast in the early 2000s.

West African trucking is characterized by many independent operators with a single truck. A few firms may have several trucks; and there are very few firms with a large number of trucks. We find support for the proposition that the transport sector is reasonably competitive (Zerelli and Cook, 2010). This is important because our subsequent analysis will suggest that eliminating corruption, and reducing the cost premium of West Africa transport, could yield important economic gains that would not be retained by a concentrated sector but would, in fact, be passed on to agricultural producers. Doing so would hold important implications for the sustainability of agriculture in West Africa.

At the time of our analysis, drivers are thought to earn approximately US$ 90 per month in Burkina Faso, US$ 125 per month in Ghana, and about US$ 85 per month in Mali and Togo.[7] For a typical trip, drivers are given a sum of money (the "fund") from the owner or transport contractor for petrol, to pay bribes along the way, and as an advance on a portion of their salary to pay for food and incidentals. The size of the "fund" is rarely enough to cover all of the incidental obligations of drivers, and this becomes a source of constant negotiation between drivers and truck owners. The cost of transport along these corridors is said to average between US$ 3.53-3.93 per kilometre for variable and fixed costs, with variable costs (including petrol, driver salaries, bribes and tolls) representing 40-45% of the total (Teravaninthorn and Raballand, 2009).

As seen in Figure 3 (for the period July-September 2009), the roads have checkpoints at varying intervals — 3 per 100 km in Mali, 4 per 100 km in Senegal, and 2 per 100 km in Ghana, Burkina Faso, and Togo. Figure 3 also reveals the level of bribes and extent of delays per 100 km of roads in each country. These have changed over time and so we will present more recent data below (Table 1).

The usual officials at checkpoints are police, customs, or gendarmerie (except in Ghana), as well as forestry agents, union officials and health inspectors. In addition to stops with barriers, all officials have random locations where they stop trucks. Those from drivers' unions, forestry agencies and health offices are more likely to have wildcat locations than police, customs officers and gendarmes.

When a truck is stopped, the official asks to see the driver's licence and registration papers. Once the official has these in hand the driver cannot leave without the

[7] Data from Lacina Pakoun, Transport Project, West Africa Trade Hub, 18 February 2010.

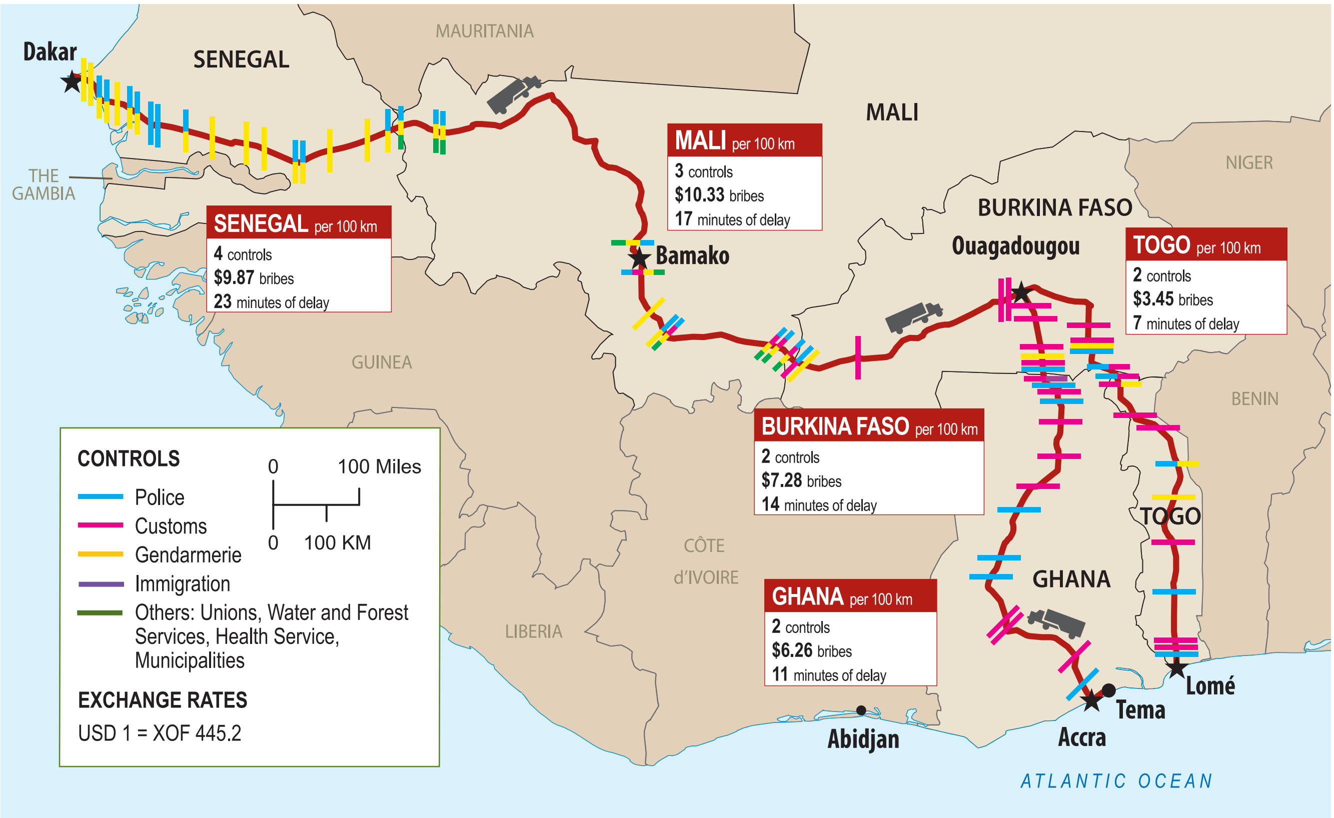

Figure 3. The IRTG Survey corridors and data for 1 July-30 September 2009.
Source: IRTG, 9th Report, 10 November 2009.

Table 1. Bribes on the truck corridors of West Africa

Country	Cargo	Bribe per kilometre
Burkina Faso[1]	General	0.17
Burkina Faso[2]	Onions for Accra Market	0.44
Ghana[3]	General	0.02
Ghana[4]	Onions for Accra Market	0.11
Mali[5]	General	0.18
Niger[6]	Onions for Accra Market	0.47

[1] WATH (2010). Data are from the IRTG study.
[2] Average of WATH (2009) and WATH (2010). Data are from the ATP study.
[3] WATH (2010). Data are from the IRTG study.
[4] WATH (2010). Data are from the ATP study.
[5] WATH (2010). Data are from the IRTG study.
[6] WATH (2009). Data are from the ATP study.

paperwork. It is here that the official threatens to delay the driver unless a bribe is paid, usually under the pretext that the papers are not in order or perhaps that the truck is overweight. Appiah (2010) suggests that many drivers do not wait to be asked for a bribe but simply include a payment when handing over the requested documents. Rarely is merchandise confiscated, although small gifts of certain types of goods might be asked for or offered.[8] Eventually the driver is allowed to proceed. In the countries using the CFA Franc as currency (Burkina Faso, Mali, Senegal and Togo), most bribes are for the amount of the smallest bills: 500, 1,000, and 2,000 with a few combinations of them. In Ghana, the amounts vary more widely with bribe levels in 1 and 2 new cedi price points.[9] Drivers can negotiate these bribes, sometimes even receiving change for large bills from officials, and often there is a standard rate for infractions. In these transactions, each side negotiates delay as a threat point — the official can delay the driver indefinitely, while the driver can delay the official, taking up his time and blocking the road with the offending truck.[10]

Our data below pertain to two quite different sample frames. The first frame (the IRTG study) is for trucks that are "legal" — that is, their papers are in order, they are confidently within weight limits, and the driver is a member

[8] Drivers can be convenient couriers of valued commodities from one country to another (e.g. cigarettes).

[9] For simplicity, all Cedi's (new and old) are converted to CFA francs and dollar values. We use 481 FCFA = US$ 1.00. There are 1.42 Ghana cedis (GHC) per US$ 1.00.

[10] Most of the truck stops have limited parking for trucks except for those at the entry and exit of major cities. The roads themselves are often two lanes wide so a large number of trucks waiting to pay bribes can easily block traffic.

of the appropriate union. For this survey, enumerators gave the surveys to truck drivers at the beginning of their trips in ports or inland depots. Notice that the IRTG study surveys only those trucks that are legal in their documentation and axle weight. When those conducting the survey approached the drivers with a survey, a trucking expert checked their papers and assessed if the papers for the truck and cargo were in order. If so, and if the driver agreed to take the survey, they were given a survey to fill out which was collected at the end of the trip. Only trucks scheduled to drive the whole trip were given surveys. Those conducting the survey estimate that trucks with their papers in order represented about one-third of the long-haul trucks on these routes.

Our IRTG data therefore, while accurately depicting the bribes and delays *per truck* along these corridors, represent an underestimate of the total bribes actually paid by *all trucks* along the corridors studied here. This follows from the fact that approximately two thirds of the trucking fleet surveyed by IRTG researchers do not have the appropriate papers and are, therefore, likely to have paid even higher bribes to be allowed to proceed. The delays to which the legal trucks are exposed are also much less than the delays imposed on the entire fleet of trucks — the vast majority of which are of dubious legal provenance.

The second survey, conducted by the Agribusiness and Trade Promotion (ATP) project, includes all trucks. This difference provides a useful comparison between bribes and delays affecting all trucks on a corridor (the ATP dataset), and the much lower bribes and delays pertinent to the one third of total vehicles that are in compliance with rules and regulations (the IRTG dataset). The route for the ATP sample is shown in Figure 4.[11] The pertinent data from these two surveys are summarized in Table 1.

It is important to think of these two sample frames as shedding light on the difference between the "sand" and "grease" of Méon and Sekkat (2005). The IRTG sample frame is restricted to legal trucks. If these trucks are fully legal, and if they are nonetheless exposed to the predation of bribes and enforced delays, this would seem to have all the markings of "sand." On the other hand, the complete sample of all trucks — both legal and illegal — in the APT sample suggests that the bribes and delays recorded here are a mixture of both "sand" and "grease". Legal trucks are being impeded when they should not be ("sand"), while the illegal trucks are required to pay to be allowed to proceed ("grease").

Consider Table 2. Here we depict the actual costs per kilometre in Western Europe (Teravaninthorn and Raballand, 2009). From this same source we then show the additional costs per kilometre encountered in West Africa. Finally, we add in the bribes from Table 1 to derive the total monetary costs on the transport corridors of West Africa.

[11] The ATP survey also includes data for Ghana that is not shown on this map, but it is included in Table 1.

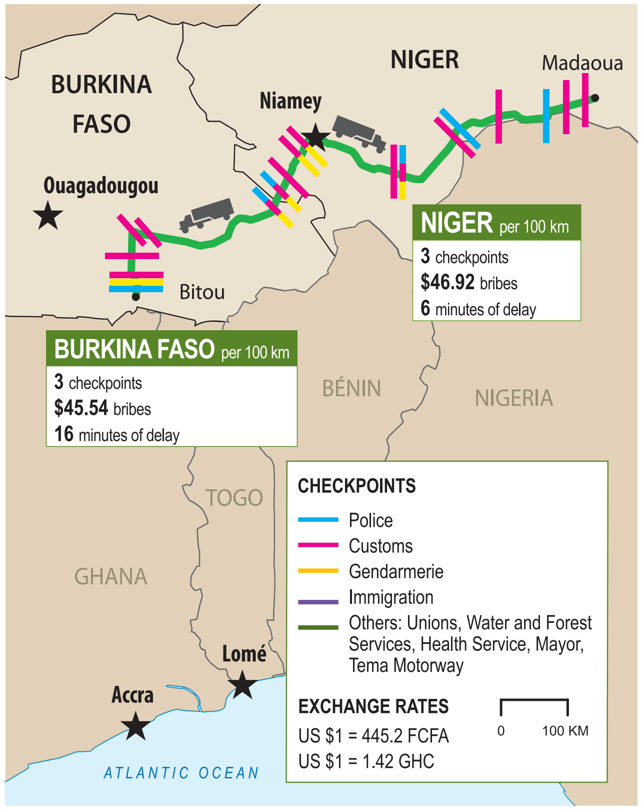

Figure 4. The ATP study (onions).
Source: IRTG, 9th Report, 10 November 2009.

As we see from Figures 3 and 4, the out-of-pocket bribes per kilometre are but a part of the corruption costs along the transport corridors. A second problem is the enforced delays at each of the many checkpoints. The costs of this downtime must be added to the above cash costs of transport.

To derive the opportunity cost of these delays, we start with data suggesting that transport companies in West Africa charge approximately US$ 3.70 per kilometre. We know that actual variable costs in West Africa are approximately one-half of this (Teravaninthorn and Raballand, 2009). We assume, therefore, that when a truck is sitting at a checkpoint the trucking firm is losing out on approximately US$ 1.85 per km of revenue *net of operating costs*.[12] If delays were eliminated on each of the three corridors, we can calculate the loss per kilometre. This is shown in Table 3.

Here we see that on the corridor between Madaoua, Niger and Accra, Ghana truckers endure average delays of 316 minutes. A trip that would require 61 hours at 33 km/hour requires 66 hours (at 30 km/hour) with these delays. The extra 5.3 hours represents a loss in net revenue of US$

[12] Note an alternate calculation of this opportunity cost of a truck sitting at a checkpoint can be gleaned from Table 4, where if US$ 3.70 is what a transporter is paid per kilometre, the revenue net of operating costs ranges from US$ 1.96 to US$ 2.23 depending on the corridor. Thus the US$ 1.85/km we use is likely a conservative estimate.

Table 2. Transport costs per kilometre in Western Europe, West Africa, and bribes

	Variable costs in Western Europe per km	West Africa premium per km	Total variable costs per km	Bribes in Mali	Bribes in Niger	Bribes in Burkina Faso	Bribes in Ghana	Total bribe costs	Total bribes per km
Onions from Madaoua, Niger to Accra, Ghana (1,994 km)[1]	0.72	0.73	1.45		304.56 for 648 km	176.00 for 400 km	100.76 for 916 km	581.32	0.29
Shea from Bamako, Mali to Tema, Ghana (1,489 km)[2]	0.72	0.73	1.45	77.76 for 432 km		29.92 for 176 km	17.62 for 881 km	125.30	0.08
Cashew from Wenchi, Ghana to Tema, Ghana (435 km)[3]	0.72	0.73	1.45				8.70 for 435 km	8.70	0.02

[1] This route is part of the ATP study.
[2] This route is part of the IRTG study.
[3] This route is part of the IRTG study.

Table 3. Minutes of enforced delays

	Delays in Mali	Delays in Niger	Delays in Burkina Faso	Delays in Ghana	Total trip delay (minutes)	Revenue loss per minute (US$)	Total revenue loss (US$)	Revenue loss per kilometer (US$)
Onions from Madaoua, Niger to Accra, Ghana (1,994 km)[1]		58 minutes	56 minutes	202 minutes	316	1.85	584.60	0.29
Shea from Bamako, Mali to Tema, Ghana (1,489 km)[2]	82 minutes		26 minutes	115 minutes	223	1.85	412.55	0.28
Cashew from Wenchi, Ghana to Tema, Ghana (435 km)[3]				57 minutes	57	1.85	105.45	0.24

[1] This route is part of the ATP study.
[2] This route is part of the IRTG study.
[3] This route is part of the IRTG study.

Table 4. Total transport costs per kilometre in West Africa

	Costs in Western Europe (US$)	West Africa premium (US$)	Corruption (US$)		Total corruption costs (US$)	Total transport costs (US$)	Corruption costs as percent of total transport costs
			Bribes	Delays			
Onions from Madaoua, Niger to Accra, Ghana (1,994 km)[1]	0.72	0.73	0.29	0.29	0.58	2.03	29
Shea from Bamako, Mali to Tema, Ghana (1,489 km)[2]	0.72	0.73	0.08	0.28	0.36	1.81	20
Cashew from Wenchi, Ghana to Tema, Ghana (435 km)[3]	0.72	0.73	0.02	0.24	0.26	1.71	15

[1] This route is part of the ATP study.
[2] This route is part of the IRTG study.
[3] This route is part of the IRTG study.
Source: Authors' elaboration.

584.60, or US$ 0.29 per km. Similar logic for shea and cashew yields Table 4.

Recall that our purpose here is to assess the probable impacts of high transport costs and corruption on the sustainability of certain agricultural enterprises in West Africa. We will accomplish this by drawing on the theoretical model in section 2 to derive plausible impacts on prices received by farmers. As in Bromley (2008), the mechanism concerns the depression of farm-gate prices arising from excessive costs — both cash outlays and delays — along transport corridors. Our first illustration concerns data from the Agribusiness and Trade Promotion (ATP) project covering the onion corridor from Madaoua, Niger to the urban market in Accra, Ghana.

4. The onion corridor

We now draw on the basic model of equation (1) to assess the farm-level economic impacts of high transport costs and corruption on the continued feasibility of onion production in West Africa. The interesting dimension of this dataset is that it includes all trucks — not just those that are legal. We have seen in Tables 1-4 the implications of this for bribe costs and the opportunity costs of delays at checkpoints. Here we are interested in deriving the implications of these costs for net returns to onion production — a major export to Ghana and a lucrative crop for farmers in Niger.

Typical yields for onions in the region appear to be from 20-35 MT per hectare (USAID, 2005). The trucks to Accra, Ghana carry 202 bags of onions, each weighing 120 kg, for a total of 24,240 kg. Notice that this is close to the average yield of a hectare of onions near Madaoua. Assume that average onion yields are 24.24 MT (24,240 kg) per hectare. This assumption means that each truck hauls the typical yield of a hectare of onions. A recent study reveals that a truckload would bring the farmer US$ 3,394 (US$ 0.14 per kg), and the production costs are estimated to be US$ 1,454 (US$ 0.06 per kg), implying a net return per hectare of onions of US$ 1,940 (US$ 0.08 per kg) (Martinez Rivas, 2009). The gross market value of a truckload of onions in Accra is US$ 8,726 (at US$ 0.36 per kg during the main onion season). But costs of moving the onions must be considered.

We see in Table 4 that transport costs along the onion corridor have three components: (1) the reference costs of US$ 0.72 per km in Western Europe; (2) a West African premium of US$ 0.73 per km; and (3) total corruption costs of US$ 0.58 per km. Thus, the transport of a truckload of onions costs US$ 2.03 per km. Referring to equation (1) we have:

$Q = 24,240$ kg;
$TC =$ US$ 0.06 per kg;
$p_t =$ US$ 0.36 per kg at Accra;
$c =$ US$ 0.72 per km of reference transport costs;
$\delta =$ US$ 0.73 per km cost premium in West Africa;
$\varphi =$ US$ 0.58 per km of corruption costs; and
$k = 1,994$ km.

The data here require that we now modify equation (1). Specifically, we are no longer considering transport costs per unit of agricultural produce from a unit of land k kilometres from the ultimate market. Rather, we are considering the *net value of a truckload of onions* originating k kilometres from that market. This means that equation (1) must now be rewritten as:

$$R = Q[p_t - TC] - k(c + \delta + \varphi) \qquad (2)$$

That is, our unit of analysis is not a hectare of land but rather the aggregate yield of a number of hectares surrounding a collection terminal k kilometres from the urban market (Accra). We know the weight of that cargo (Q), we know the price per kilogram of that cargo in the distant market (p_t), and we know the costs of producing a kilogram of cargo (TC). The assumption in equation (2) is that transport costs and corruption costs do not vary by the weight or the value of the cargo being hauled.[13] One other fact about equation (2) warrants mention here. The net rent R is *not* concerned with the farm-gate price of the commodity under consideration. Prices paid to producers are derived from the residual to the marketing agent or exporter and this is dependent on the ultimate market (or export) price and the costs of moving the product to market.

Below we will derive a schedule of possible offer prices as a function of transport costs. When those offer prices fall below farmers' break-even price they will cease to engage the market and will withdraw into subsistence production. Or they will modify their choice of enterprise.

Hence, the net value of the cargo is a function of only three variables: per kilogram production costs (TC), per kilogram price in the distant market (p_t), and the total cost of moving the cargo to the distant market τ (where $\tau = c + \delta + \varphi$).

We now have:

$$R = 24,240[(\$\ 0.36) - (\$\ 0.06)] - \underbrace{(1,994)(\$\ 0.72)}_{\substack{\text{Western Europe}\\ \text{Transport}\\ \text{Costs}}} - \underbrace{(1,994)(\$\ 0.73)}_{\substack{\text{West Africa}\\ \text{Transport}\\ \text{Premium}}} - \underbrace{(1,994)(\$\ 0.58)}_{\substack{\text{Corruption}\\ \text{Costs}}} \qquad (3)$$

Equation (3) indicates that the net value of the onion cargo at the collection terminal is US$ 7,272. Moving that cargo to market will cost US$ 2.03 per kilometre, for a total transport cost of US$ 4,048. This means the actual value of onions net of transport costs is US$ 3,224.

The obvious question concerns the impact on farm-gate prices and net returns to onion farmers if transport costs — including corruption — might be reduced or eliminated. Understanding the possible price effects of these improvements will help us apprehend the costs of what we call *institutional incoherence* on farming practices and sustainability. As above, the curves R and R^* in Figure 2 are reflective of the *willingness to pay* on the part of onion producers to have access to the benefits of improved transport services. That is, both R and R^* represent counterfactual *rent possibility frontiers*. Each shows, for producers at point k, the new income possibilities assuming that corruption might be eliminated (moving from R~ to R), and that high West African transport costs might be brought more in line with those in Western Europe (moving from R to R^*). We can derive R by calculating this new revenue curve with corruption costs (φ) removed from consideration in equation (2). We can then derive R^* by positing the elimination of the West African cost premium (δ) from equation (2). These three rent gradients for onions are shown in Figure 5.

[13] Bribes in West Africa are not easily correlated to the value of the cargo.

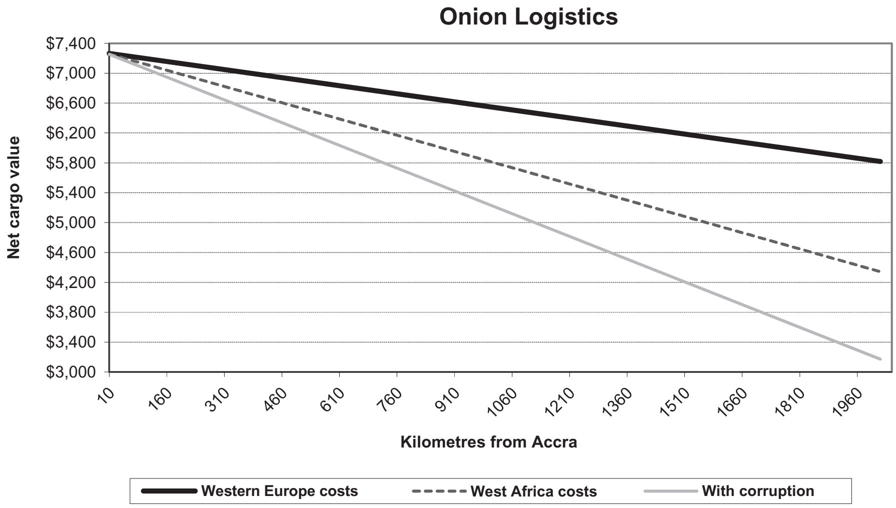

Figure 5. Net cargo value of onions under three cost scenarios.
Source: Authors' elaboration.

With these relationships pinned down, it is now possible to explore the *possible* price effects to onion farmers if corruption might be eliminated and if base transport prices in West Africa might be brought closer in line with those in Western Europe. Notice from equation (2) that if corruption could be eliminated it is possible that the value of a truckload of onions at Madaoua would be US$ 4,381 (eliminating the US$ 1,157 of costs attributable to corruption).[14] And if the extra costs of West African transport could be eliminated — that is, eliminating the premium over and above transport costs in Western Europe — the value of the cargo of onions at Madaoua would rise to US$ 5,836.[15] With both of these cost burdens eliminated we see that the marketing agent in whose hands the shipment resides *could* (i.e. *would* have the ability to) offer US$ 0.24 per kg for onions at the collection terminal (US$ 5,836 divided by 24,240 kg). Of course this higher offer price assumes that all reductions in transport costs and corruption would in fact show up as higher farm-gate prices to farmers. As we suggest above, the open-access nature of trucking in West Africa gives us some confidence that reductions in transport costs and corruption would indeed begin to work their way into higher prices for farmers.[16]

The point here is not to predict the salutary effects for farmers if corruption and other inefficiencies in the West African transport sector were eliminated. Rather, we seek to demonstrate the costs to farmers of the current system — costs that we suggest stand in the way of agricultural viability and sustainability in the region.

With this in mind we now derive a *price possibility frontier* for onions in Niger, predicated on a new schedule of prices ranging from those now experienced in West Africa (R~) to those pertinent to Western Europe (R*). The derivation yields the *implicit* farm-gate price as a function of transport costs. We call it the implicit price because it is implicit in the net revenue equation (2) and must be recovered as a function of transport costs τ.

$$R = Q[p_t - TC] - k\tau \tag{4}$$

We start by creating the identity

$$\beta \cdot P_F = Q[p_t - TC] - k\tau \tag{5}$$

and solving for β:

$$\beta = \left(\frac{1}{P_F}\right) Q[p_t - TC] - k\tau. \tag{6}$$

At the collection terminal at Madaoua, Niger we know the parameters so that equation (6) becomes:

$$\beta = \left(\frac{1}{.14}\right) 24,240[.36 - .06] - 1,994 \cdot 2.03 \tag{7}$$

which yields $\beta = 23{,}029$.

The implication here is that under the conditions existing at the collection terminal in Madaoua, the operator β allows us to derive a schedule of possible farm-gate prices implicit in the net value of cargo at the collection point under varying levels of transport costs (τ). We assume that all other parameters in equation (6) do not change. As we see, once transport gets under way the net cargo value falls by US$ 2.03 per km — unless of course transport costs can be reduced. As those costs per km fall from their current level (US$ 2.03), the ability of the exporter to increase the offer price for onions increases. Rewriting equation (5) in terms of farm-gate prices yields:

[14] This follows from the fact that corruption adds US$ 1,157 to the total transport costs of the truckload.
[15] This follows from the fact that we would eliminate an additional US$ 1,456 of transport costs.
[16] See Zerelli and Cook (2010).

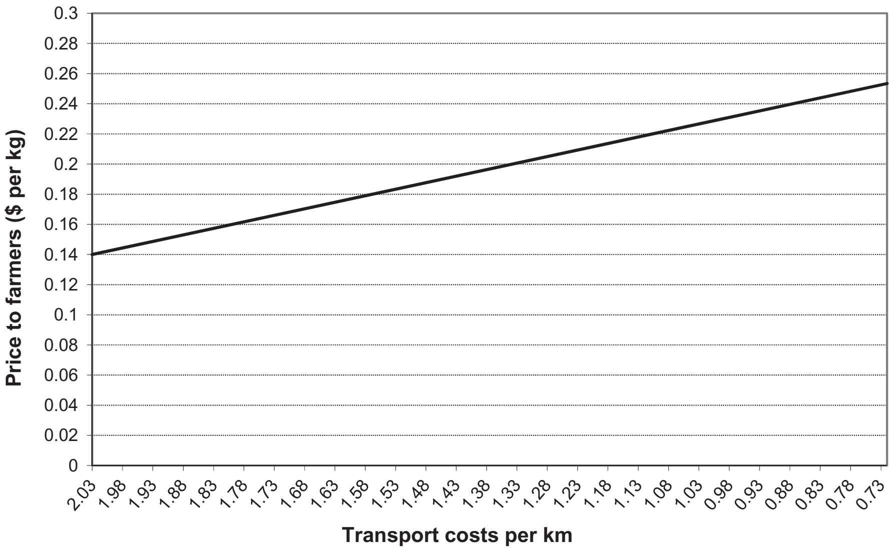

Figure 6. Price possibility frontier for onions with different transport costs.
Source: Authors' elaboration.

$$P_F = \left(\frac{1}{\beta}\right)[Q(p_t - TC) - k\tau]. \tag{8}$$

Plugging in the appropriate values yields:

$$P_F = \frac{\$7,272}{23,029} - \frac{1,994}{23,029}(\tau). \tag{9}$$

And this indicates that:

$$P_F = 0.3158 - (0.0866)\tau. \tag{10}$$

We see that:

$$\frac{dP_F}{d\tau} = -0.0866. \tag{11}$$

And thus for a given reduction in transport costs (τ) we can derive a price possibility curve indicating the *possible* change in farm-gate prices. This is shown in Figure 6.

From this relationship we can now introduce a novel form of price elasticity — the elasticity of farm-gate onion prices with respect to changes in total transport costs:

$$\left(\frac{dP_F}{d\tau}\right)\left(\frac{\tau}{P_F}\right), \tag{12}$$

which yields:

$$(-.0866)\left(\frac{2.03}{.14}\right) = -1.256. \tag{13}$$

This implies that a 10% reduction in transport costs could possibly give rise to a 12.56 % increase in onion prices to farmers at Madaoua. As above, if these reductions in corruption costs and basic transport costs in West Africa are simply retained by the transport sector then farmers will not benefit at all. We believe the transport is competitive enough that this would not be the case.

We now turn to a similar analysis of two tree crops.

5. Tree crops: Cashew and shea

While the sustainability of arable agriculture is a profoundly important matter (see Figure 1), the challenge of sustainability is most often discussed in the context of agro-forestry. This is especially the case in areas where soil erosion is a prominent concern. We will carry out a similar analysis for cashew and shea, two important agro-forestry products in West Africa. For this, the transport corridors shown in Figure 3, and the associated costs shown in Table 4, are pertinent.

5.1. Cashew

The Ghana cashew region is shown as the darkly shaded portion of Figure 7. The ideal rainfall regime is between 750-1300 mm. Cashew tends to grow well on marginal land, and it is considered an ideal crop for soil conservation and afforestation in the savanna belt of West Africa. Other countries where cashew thrives are shown in Table 5.

In Ghana, cashew production is generally undertaken by smallholders — those families with farms ranging between 0.8-2.5 ha. In 2007, it was estimated that approximately 60,000 farmers were cultivating cashew trees. At that time there were approximately 59,000 hectares of cashew in Ghana, with annual production estimated at 15,000 MT of raw cashew nuts (WATH, 2007). Cashew is an ideal agro-forestry crop, planted along with maize, millet, sorghum, yam, cassava, soybean, groundnuts or chillies. With close spacing and a closed canopy, or as young trees mature, inter-cropping ceases to be feasible.

In collaboration with researchers from the University of Ghana we collected data from 80 farmers for the 2009

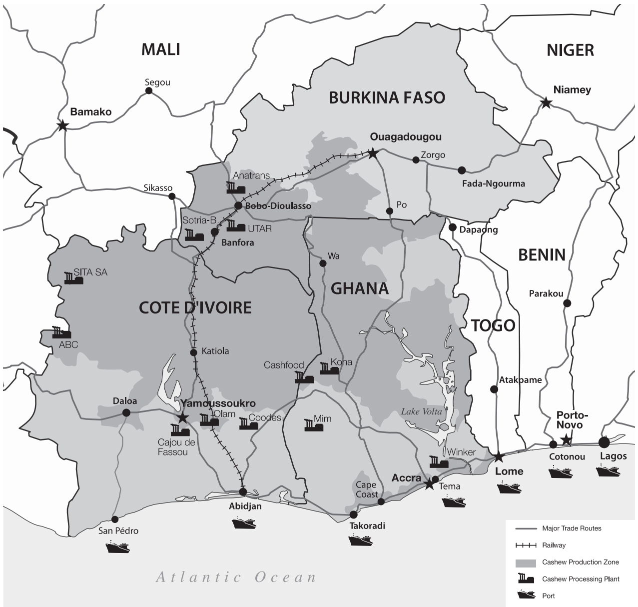

Figure 7. Major cashew production areas in Ghana.
Source: Authors' elaboration.

cashew season around Wenchi-Jaman-Techiman of the Brong-Ahafo region of Ghana. These farmers had average yields of 545 kg of raw cashew kernels per hectare which they sold to exporters at a nearby town (a "selling point") for an average price of US\$ 0.31 per kg. This point of sale for the farmers to the exporters was 435 km from the export terminal at Tema. As we see in Table 4, costs of moving a truck of cashews is estimated to be US\$ 1.71 per km. The raw kernels are usually transported in 20 foot containers with a loaded weight of 16 MT (16,000 kg) to the export hub at Tema.[17]

To illustrate the impact of high transport costs on cashew we return to the basic model in equation (2). The relevant parameters are:

$Q = 16,000$ kg;
TC = US\$ 0.28 per kg;
p_t = US\$ 0.60 per kg Free on Board (FOB) at Tema;
c = US\$ 0.72 per km of reference transport costs;
δ = US\$ 0.73 per km cost premium in West Africa;
φ = US\$ 0.26 per km of corruption costs; and
k = 435 km.

These parameters indicate the net value of the container of cashew at the selling terminal 435 km from the terminal at Tema.

[17] Calculations for various cargo weights have a minimal effect in terms of price possibilities.

$$R = 16,000[(\$\ 0.60) - (\$\ 0.28)] - \underbrace{(435)(\$\ 0.72)}_{\substack{\text{Western Europe}\\ \text{Transport}\\ \text{Costs}}} - \underbrace{(435)(\$\ 0.73)}_{\substack{\text{West Africa}\\ \text{Transport}\\ \text{Costs}}} - \underbrace{(435)(\$\ 0.26)}_{\text{Corruption}} \tag{14}$$

which simplifies to:

$$R = \text{US\$ } 5{,}120 - \text{US\$ } 313 - \text{US\$ } 318 - \text{US\$ } 113.$$

To summarize, the total net value of a 16,000 kg load of raw cashew nuts at the collection terminal is US\$ 5,120. It then costs an additional US\$ 631 to move the container to Tema, plus the exporter (or the transport firm) must pay bribes and absorb the implicit costs of delays totaling US\$ 113. The trajectory of net revenue attributable to cashew production is shown in Figure 8. We also depict a "reference" net revenue trajectory showing transport costs in Western Europe (see Table 4). This line corresponds to R^* in Figure 2. The line "West Africa" is the actual transport cost for moving a 16 MT container to Tema. This corresponds to the curve R in Figure 2 and it lies below R^* because of the higher costs of transporting goods in West Africa. In addition, the lowest line in Figure 8 depicts the additional decrement to net revenues arising from corruption. This corresponds to $R\sim$ in Figure 2.

As we did for onions, we want to derive the implicit price possibility frontier for reductions in transport costs and bribes. As previously, the relevant operator β is derived as:

$$\beta = \left(\frac{1}{.31}\right)16,000[.60 - .28] - 435 \cdot 1.71 = 14,116.$$

And so:

$$P_F = \left(\frac{5120}{14,116}\right) - \left(\frac{435}{14,116}\right)(\tau). \tag{15}$$

For cashew, the implicit price relation is:

$$P_F = \$0.3627 - .0308\tau. \tag{16}$$

We see that:

$$\left(\frac{dP_F}{d\tau}\right) = -0.0308. \tag{17}$$

The price elasticity with respect to a change in transport costs and bribes is given by:

$$\left(\frac{dP_F}{d\tau}\right)\left(\frac{\tau}{P_F}\right), \tag{18}$$

which yields:

$$-0.0308\left(\frac{1.71}{0.31}\right) = -.1699. \tag{19}$$

This implies that a 10% reduction in transport costs (including both corruption as well as underlying transport costs) could yield a 1.7% increase in cashew prices to farmers. This is depicted in Figure 9.

It may be wondered why this elasticity is so much less than that for onions coming from Niger. The answer has two

Table 5. Cashew production in West Africa (2007)

	Raw nut production MT*	Number of processors		Processing capacity MT	MT processed in 2006	Avg. kernel price/kg ($) supermarkets
		Large	Small			
Benin	45,000	1	5	1,730	30-50	$13.34
Burkina Faso	<15,000	1	2	2,000	500	$12.01
Côte d'Ivoire	200,000	2	3	10,100	>5,000	$20.22
Ghana	15,000	0	10	530	350	$20.70
The Gambia	<5,000	0	1	—	—	$20.37
Guinea-Bissau	100,000	3	26	4,080	—	$12.18
Mali	<5,000	0	0	—	—	$9.96
Nigeria	70,000	6	3	23,600	14,750	$17.69
Senegal	15,000	0	15	350	—	$16.94
Togo	<5,000	0	1	80	80	$16.36
Total	**<475,000**	**13**	**66**	**42,470**		**$15.98**

* No official statistics exist for raw nut production in any of these countries. These numbers are estimates based on recent studies and interviews with traders.
Source: WATH (2007).

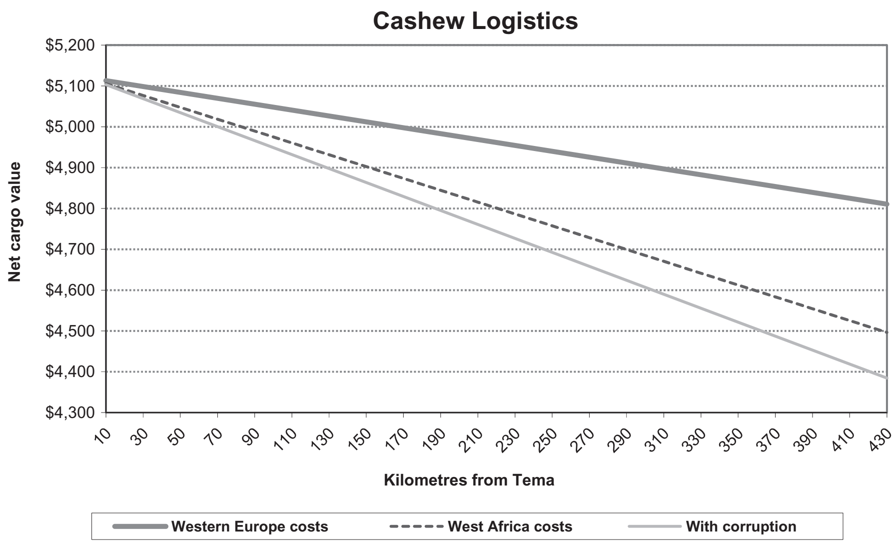

Figure 8. Net cargo value of cashews along the trade route.
Source: Authors' elaboration.

parts: (1) cashew is being moved 435 km as opposed to 1,994 km for onions; and (2) transport costs for cashew (US$ 1.71 per km) are just over 80% of those costs on the onion corridor (2.03).

In a recent survey, 62 cashew farmers in central Ghana were asked how they would respond to a 10% increase in cashew prices if that price increase was expected to last for several years. These same farmers were also asked their likely response to a 10% drop in cashew prices that was expected to persist for several years. Their responses, which show reasonably high levels of price responsiveness in their planning, are summarized in Table 6.

We conclude by considering the case for shea nuts.

5.2. Shea

The shea tree (*Vitellara paradoxa*) is found in a long narrow swathe approximately 600 km wide and 5,000 km long across northern sub-Saharan Africa, encompassing 18 countries from Senegal in the west to Sudan and Uganda (and a small corner of Ethiopia) in the east (Figure 10).[18]

[18] Subspecies *paradoxa* occurs in the western range of the shea belt covering 15 countries: Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Mali, Niger, Nigeria, Senegal and Togo. Subspecies *nilotica* occupies the eastern range and is found in four countries: Ethiopia, Sudan, Uganda and the Democratic Republic of Congo (FAO, 2004, pp. 52-53).

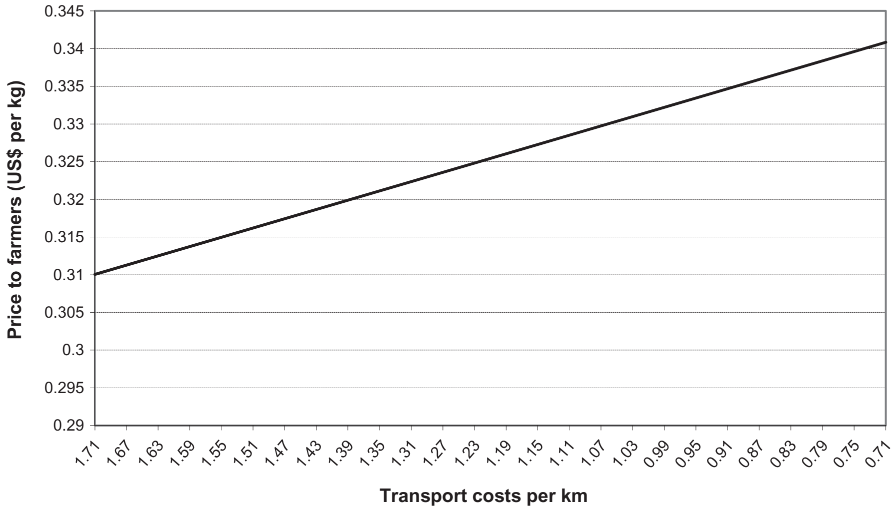

Figure 9. Price possibility frontier for cashew under different transport costs.
Source: Authors' elaboration.

Table 6. Likely action in response to changes in cashew prices (multiple responses)

Actions by farmers	Yes	Percentage
Persistent price increase of 10%		
Expand land area devoted to cashew	50	80.6
Spend more time on tree improvement	38	71.7
Increase spending on agrochemicals	49	79.0
Replace old trees with new ones	18	51.4
Plant new trees	1	1.6
Persistent price decrease of 10%		
Replace cashew trees with other crops	19	50
Abandon cashew farm	19	50
Spend less time on tree improvement	28	66.7

Source: Kwadzo and Kuwornu (2010).

The shea fruit is used in a variety of ways: the fruit pulp and the nut are eaten; cooking oil may be extracted from it; and edible butter and cosmetics may be manufactured from it. The shea belt is said to contain over 500 million trees across this semi-arid strip of Africa. In West Africa, the primary export market for shea butter is as a substitute for cocoa butter (Cocoa Butter Equivalent (CBE)) in the making of chocolate and various confections. A second export market — much smaller in volume but not in value — is for shea butter used in cosmetics. A third export market is for pharmaceuticals and edible fats (Ferris *et al*., 2001).

Given the scattered nature of the shea-forest savanna, and the informal nature of the shea economy, it is difficult to obtain accurate data on total production of nuts, the fraction of nuts kept for home use, the quantity sold to traders, and the proportion exported as nuts or as butter. It is estimated that only about half the available shea nuts are actually collected. There are very few exporters of processed shea and so reliable data — for confidentiality reasons — are virtually impossible to obtain. Table 7 shows estimates for what is thought to be the case in 2008 (Lovett, 2009).

We collected data from 40 shea compounds containing 239 adults in Koulikoro District, Mali (northeast of Bamako). Since shea is a nut crop from the open access forest-savanna, our data are not on a per-hectare basis as with onions and cashews but rather show *yields for the compound*. Women in these two villages produce shea for their own consumption and for making butter. Each compound sold, on average, 200 kg of shea kernels in 2009. The price received for these shea kernels was FCFA 100 per kg (approximately US$ 0.22 per kg). In Tema, the FOB price for shea kernels is assumed to be US$ 0.50 per kg.[19]

With reference to equation (1), we encounter a problem because of the absence of costs of production of shea nuts. As above, we know that the farm-gate price of shea is US$ 0.22 per kg. And we find it reasonable to assume that women would not bother to collect shea nuts if the costs of doing so, including the subsequent costs of drying and storing shea nuts, did not cover the market price of the nuts. This suggests that the costs of producing a kilogram of shea nuts must be less than US$ 0.22 per kg — how much less must remain unknown. But, it must be kept in mind that shea nuts are not actually produced — they are merely collected lying about on the ground. On the assumption that women have other important things to do with their time we will assign a shadow price of their labour at US$ 0.10 per kg. Drawing on equation (1) we have:

$Q = 16{,}000$ kg;
TC = US$ 0.10 per kg;
p_t = US$ 0.50 per kg FOB at Tema;
c = US$ 0.72 per km reference transport costs;
δ = US$ 0.73 per km West Africa transport costs;
φ = US$ 0.36 per km of corruption costs; and
$k = 1{,}489$ km.

[19] There is considerable seasonal variation in prices.

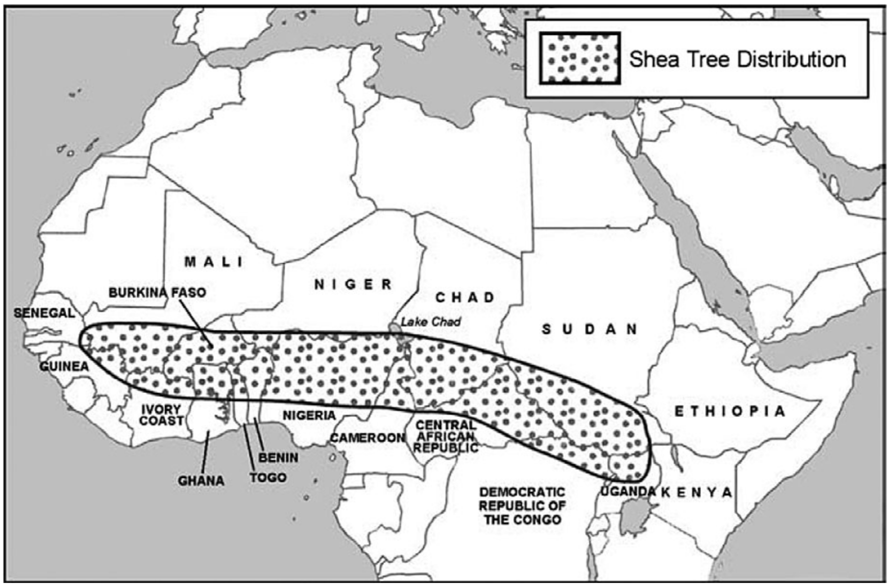

Figure 10. The African shea belt.
Source: Authors' elaboration.

Table 7. Shea production, consumption, and exports from West Africa (MT per annum)

Country (major stearin producers only: *Vitellaria paradoxa* subsp. *paradoxa*)	Potential maximum production for 2008 (t)	Estimated total maximum harvest 2008 (t)	Estimated local / intra-regional consumption (t)	Estimated total exports as sheanuts (t)	Est. shea butter converted preexport (kernel equivalent of country crop* t)	Estimated total shea export (t)
Bénin**	80,000	50,000	30,000	15,000	5,000	20,000
Burkina Faso***	150,000	100,000	30,000	45,000	25,000	70,000
Côte d'Ivoire	120,000	60,000	30,000	25,000	5,000	30,000
Ghana	150,000	100,000	50,000	25,000	25,000	50,000
Guinée-Conakry	30,000	10,000	3,000	6,000	1,000	7,000
Mali	200,000	120,000	50,000	60,000	10,000	70,000
Nigeria	180,000	90,000	50,000	30,000	10,000	40,000
Togo	50,000	30,000	15,000	10,000	5,000	15,000
	960,000	**560,000**	**258,000**	**216,000**	**86,000**	**302,000**

* All figures given as dry kernel equivalent, i.e. 1 ton butter exported requires 3 tons of sheanuts and so butter export is given as kernel (sheanut) equivalent.
** Figures for Benin are given as an esimate exclusive of imports from Nigeria.
*** Calculation of figures for conversion into butter where factory country is different from origin is confounded by customs data.
Source: Lovett (2009).

which yields:

$$R = 16,000[\$\ 0.50 - \$\ 0.10] - \underbrace{1,489(\$\ 0.72)}_{\text{Western Europe Transport Costs}} - \underbrace{1,489(\$\ 0.73)}_{\text{West Africa Transport Costs}} - \underbrace{1,489(\$\ 0.36)}_{\text{Corruption}}. \tag{20}$$

The first term is the value of the shea container at the collection point near Bamako, Mali (US\$ 6,400). It costs US\$ 2,159 to move that container to Tema, and corruption costs an additional US\$ 536. This is depicted in Figure 11.

Once again we derive a price possibility frontier. We first derive a value for β.

$$\beta = \left(\frac{1}{.22}\right)[(16,000)(0.4) - (1,489)(1.81)], \tag{21}$$

which yields β = 16,841.

Thus:

$$P_F = \left(\frac{6400}{16,841}\right) - \left(\frac{1,489}{16,841}\right)(\tau) \tag{22}$$

$$P_F = \$0.38 - 0.0884\tau. \tag{23}$$

This is shown in Figure 12.

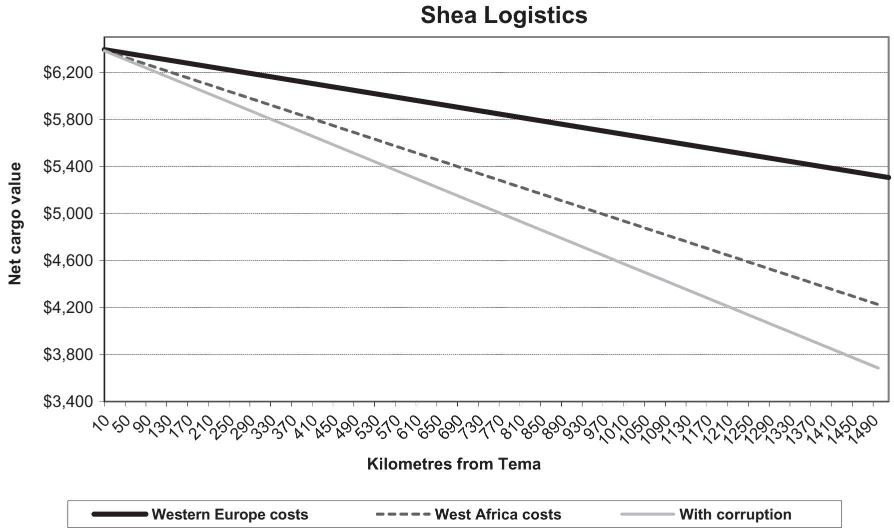

Figure 11. Net cargo value of shea along the trade route.
Source: Authors' elaboration.

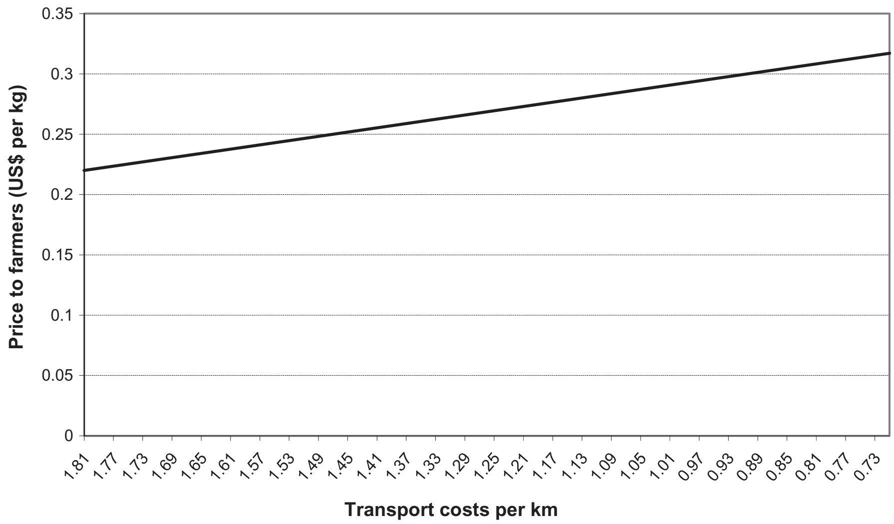

Figure 12. Price possibility frontier for shea under different transport costs.
Source: Authors' elaboration.

The price elasticity with respect to this price/transport-cost relation is:

$$\left(\frac{dP_F}{d\tau}\right)\left(\frac{\tau}{P_F}\right) \tag{24}$$

$$-0.0884\left(\frac{1.81}{.22}\right) = -.727. \tag{25}$$

This implies that a 10% reduction in transport costs could possibly give rise to a 7.3% increase in the price paid to farmers for shea at the point of first sale. While we do not have survey data on price responsiveness of shea-nut collectors, given that only half the nuts are currently collected, one could expect it to be reasonably easy to respond to higher prices with more production.

6. Implications

We have drawn on two datasets from West Africa to shed some light on two aspects of corruption. The first corruption — thought of as "sand" — affects the transport sector in a way that is detrimental to economic coherence. Here, the IRTG sample covered only legal trucks (one third of the total trucks on the corridor), and yet for the two commodities under study (shea from Mali and cashew from Ghana), we find corruption costs that are 15-20% of total transport costs. For the entire sample of trucks covered in the ATP project, meaning that both legal and illegal trucks were sampled, we find corruption costs that are almost 30% of total transport costs. It is here that one encounters both "sand" and "grease". The legal trucks in the ATP dataset must pay bribes for no good reason, while the illegal trucks must pay "grease" to be allowed to proceed when in fact they should be halted entirely.

We have used the high transport costs of West Africa, plus the additional burden of corruption, to draw some tentative implications for *price possibility frontiers* for onions, shea and cashew. These price possibility frontiers show the upper bounds on farm-gate prices from various reductions in transport costs in West Africa. We derive farm-gate price elasticities of transport costs that reveal a 10% reduction in total transport costs — actual costs plus corruption costs along each corridor — yielding price increases of 12-13% for onions, 2% for cashews, and 7% for shea.

The obvious question is whether or not reductions in transport costs (including corruption costs) would in fact result in higher prices to farmers. We suggest that trucking in West Africa is reasonably competitive and that there are good reasons to believe that farmers would indeed benefit from reductions in these costs. One piece of evidence for this assumption that the transport sector is reasonably competitive arises from the evidence that two thirds of total trucks on the major corridors are, in fact, running as illegal participants in the sector. If the transport sector were highly concentrated, it would be a surprise to see this proportion of illegal trucks operating. There are simply no barriers to entry — except, perhaps access to capital, and credit is not a relevant "barrier" to entry.

Finally we draw mild inferences about sustainability. Our chain of reasoning is that corruption and other problems in the transport sector strip economic rents out of the agricultural sector operating at considerable distances from the final market — either the export terminal at Tema, Ghana for shea and cashew, or the urban onion market in Accra. With rents suppressed, the net profitability of these commodities is undermined. When net returns are suppressed, investment is postponed or forsaken entirely, yields fall, net returns suffer, and farmers are caught in a cycle of falling productivity, reduced critical mass of tradable production, and perhaps even higher costs to arrange shipments. Shea trees become vulnerable to clearance for cotton or other crops. Cashew gives way to other enterprises. Onion cultivation ceases and the land reverts back to desert.

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