

## **ANNEX 2**

# **Data Methodology and Reliability**

### **1. Data Selection**

The final database is composed by 192 observations along 11 routes including 10 international routes in 7 countries: Burkina Faso, Ghana, Cameroon, Chad, Uganda, Kenya, and Zambia. The selected corridors were chosen in terms of data reliability, route importance in terms of trade volume, and significant amount of observations available. Outliers have been excluded from the database.<sup>1</sup> In data selection few assumptions (mentioned below) were taken while preserving the original answers from the survey.

### **2. Variable Description**

#### **2.a. Transport Prices**

##### **2.a.i. Inputs**

**Distance:** Distance measured in kilometers. Source: Distance charts available in the countries.

**Payload utilization:** Yearly mileage on empty haul for the route  $i$  / Yearly mileage ( $i = 1;2;3;4$ ; or 5 for trucking companies and  $i = 1$  for truckers). Variable measured in kilometers.

**Turnarounds:** Number of turnarounds per year for a truck dedicated to this route.

**Yearly mileage:** Turnarounds \* Distance. Variable measured in kilometers.

**Average load:** Average load in tons from origin to destination (base value for return trip).

**Price per trip:**

```
If [unit = Tons] [Price per unit * Average load]
If [unit = Container] [Price per unit]
If [unit = Liters] [Price per unit * Average load * 1000]
If [unit = Kilometers] [Price per unit * Average load * Distance]
Else [Price per unit * Average load * Distance]
```

Price per trip is measured originally in local currency (converted into current U.S. dollars using IMF exchange rates) for a standard load (container of truck load).

*Assumption:* Because of the lack of information about when the truck is empty we assume that:

If [Average route Price per trip to go >= Average route Price per trip return] [Price per trip = Price per trip to go]

Else [Price per trip = Price per trip return]

**Principal product:** Principal product transported<sup>2</sup> categorical variable.

*Assumption:* Because of the lack of information about when the truck is empty we assume that

If [Average route Price per trip to go >= Average route Price per trip return] [Principal product transported = Principal product transported to go]

Else [Principal product transported = Principal product transported return]

### 2.a.ii. Outputs

**Yearly revenue:** Yearly revenue to go + Yearly revenue return. Revenue is measured in terms of full truckload equivalents.

Given the lack of information about when the truck is empty, we assume that if price discrepancies exist between the price to go and the price return, the truck is going full loaded one way and partly loaded the other way.<sup>3</sup> Therefore, payload utilization impact is attributed to the least profitable way, using the following formulas:

### **Yearly revenue to go:**

- If [Price per trip to go > Price per trip return] [Price per trip to go \* Turnarounds]
- If [Price per trip to go = Price per trip return] [Price per trip to go \* Turnarounds \* Payload utilization]
- If [Price per trip to go < Price per trip return] [Price per trip to go \* Turnarounds \* (Payload utilization)\* 2]

### **Yearly revenue return:**

- If [Price per trip to go < Price per trip return] [Price per trip to go \* Turnarounds]
- If [Price per trip to go = Price per trip return] [Price per trip to go \* Turnarounds \* Payload utilization]
- If [Price per trip to go > Price per trip return] [Price per trip return \* Turnarounds \* (Payload utilization–0.5) \* 2]

## **2.b. Transport Costs**

**Fleet:** New vehicles + Secondhand vehicles

**Age:** New vehicles \* Average age of new vehicles + Secondhand vehicles  
\* Average age of secondhand vehicles] / Fleet

**2.b.i. Fixed costs** per day is the sum of staff costs, license costs, overhead costs, insurance costs, communication costs, security costs, losses, financial costs, and depreciation costs. All fixed costs are calculated as an average for a truck owned by the company (that is, Total costs divided by Fleet) and per calendar day (divided by 365). The original values are in local currency and were converted into current U.S. dollars using IMF exchange rates.

**Staff:** Cost of labor, including wages, salaries, and bonuses and social payments / Fleet

**License:** Cost of licenses / Fleet

**Overhead:** Overhead costs, including rental of land/buildings, equipment, and furniture and excluding all the other fixed costs / Fleet

**Insurance:** Insurance cost / Fleet

**Communication:** Cost of communication / Fleet

**Security:**

If [The establishment paid for security = Yes] [Total annual security cost / Fleet] or [Annual cost as percentage of total sales \* Total sales / Fleet]  
Else [0]

### **Losses:**

If [The establishment experienced losses as a result of road accidents or theft and robbery = Yes] [Total annual losses / Fleet] or [Percentage of total sales \* Total sales / Fleet]

Else [0]

**Finance:** Interest rates provided by the survey respondents are supposed to be actual annual percentage rates (APR) for truck purchases. Companies that do not have access to bank loans to finance their trucks (cash financing) are supposed to bear no financial costs.

If [Percentage of recent purchases financed by bank loan is all blank] [0] (i.e., the establishment has not bought trucks in the last 3 years and has therefore no bank loan to repay)

If [Percentage of recent purchases financed by bank loan is all null] [0] (i.e., the establishment does not finance its fixed assets through bank loans)

Else, [Percentage of bank loan finance purchase/100 \* Interest rate/100 \* Purchase price of the truck]

**Depreciation:** All companies bear depreciation costs. These costs are, however, inversely proportionate to the number of years of use and are therefore almost null for companies that use their truck for a large number of years. Some companies do not fully depreciate their new trucks and secondhand trucks and keep a good resale value. We have modeled the resale value drop of an average new truck owned by the establishment by the following formula:

Drop new = minimum(logarithm(Years of use / 4 \* (exponential (0,5)-1)+1);1) and the resale value drop of an average secondhand truck owned by the establishment by the formula value:

Drop secondhand = minimum(logarithm(Years of use / 5 \* (exponential (0,5)-1)+1);1).

The main assumption here is the logarithmic drop of the truck resale value, with an estimated residual value of 50 percent reached after 4 years for new trucks and 5 years for secondhand trucks. After 11 years and 14 years, respectively, for new and secondhand trucks, the residual value would be null. The periods have been extrapolated from local interviews of transport companies. As for the purchase value, we use the value provided by the person interviewed or a default value when data were not provided. We differentiated between years of use on the road for new trucks and years of use on the road for secondhand trucks.

Depreciation costs = (Depreciation costs new + Depreciation costs secondhand) / Fleet

If [New vehicles > 0] [Depreciation costs new = New truck purchase value \* New vehicles \* minimum[Drop new; 100 percent] / Years of use]  
Else [0]

If [Secondhand vehicles > 0] [Depreciation costs secondhand = Secondhand truck purchase value \* Secondhand vehicles \* minimum [Drop secondhand; 100 percent] / Years of use]  
Else [0]

**2.b.ii. Variable costs** per kilometer is the sum of fuel costs, tire costs, maintenance costs, and bribes. Variable costs are route specific ( $i = 1; 2; 3; 4; \text{ or } 5$ ). Survey data, however, do not relate variable costs to routes traveled (except for bribes), and we assume that fuel and tire consumption and maintenance costs are uniform within the company fleet. The original values are in local currency and were converted into current U.S. dollars using IMF exchange rates.

**Fuel:** Companies have provided the average fuel consumption of light-weight, mediumweight, and heavyweight trucks. The tonnage ranges used in the questionnaire are, respectively, 0–5 tons for light weight, 5–7 tons for medium weight, and 7+ for heavy weight. However, feedback from interviewers has encouraged us to use different ranges: 0–10 tons, 10–20 tons, and 20–30 tons, respectively, because these are more representative of actual loads.

The unit fuel cost (LCU per liter) has been derived from “International Fuel Prices (2007), 5th edition data preview, GTZ (2006 values) using the IMF-IFS exchange rates (Q4 2006). We have used the super gasoline price (3 to 10 percent higher than the diesel price in the countries selected) as an estimate of the fuel plus lubricant unit cost (no relevant source of lubricant cost available).

For trucking companies, fuel cost per km is:

If [Actual load  $\leq 10$ ] [Fuel consumption light weight/100 \* Unit fuel cost]

If [ $10 > \text{Actual load} \geq 20$ ] [Fuel consumption medium weight/100 \* Unit fuel cost]

If [ $\text{Actual load} > 20$ ] [Fuel consumption heavy weight/100 \* Unit fuel cost]

For truckers, fuel cost per km is calculated using the same formula as for trucking companies but using systematically the default value for fuel consumption because average consumption data is not available.

**Tires:** The questionnaire provides us with extensive data on the companies, and truckers' new tire, secondhand tire, and retread tire consumption. The unit tire cost is not always provided, and the category average in the country is used as default value. We assume that trucks use an average 12 tires and the distribution of new, secondhand, and retread tires is homogeneous in the establishment's truck fleet.

Tire cost per km=  $12 * [\text{percentage of new} * \text{Cost of New} / \text{Life of new} + \text{percentage of secondhand} * \text{Cost of secondhand} / \text{Life of secondhand} + \text{percentage of retread} * \text{Cost of Retread} / \text{Life of retread}]$ . Where unit cost or average life in km was not provided we used the default value.

**Maintenance:** Annual maintenance costs per km are provided by trucking companies for each truck category:

For trucking industry Maintenance = Annual maintenance costs (or default value) / Yearly mileage

For truckers, Maintenance = Cost of servicing, repairs, spare parts, excluding fuel tires and lubricants / (Fleet \* Yearly mileage). We assume yearly mileage is homogeneous within the same truckers' fleet.

**Bribes:** Bribe paid on the selected route / Distance

### **2.b.iii. Fixed-variable cost ratio:**

$[(\text{Fixed Cost per day} * 365 / \text{Turnarounds}) / (\text{Fixed Cost per day} * 365 / \text{Turnarounds} + \text{Variable cost per km} * 2 * \text{Distance})] \text{ percent} -$   
 $[(\text{Variable cost per km} * 2 * \text{Distance}) / (\text{Fixed Cost per day} * 365 / \text{Turnarounds} + \text{Variable cost per km} * 2 * \text{Distance})] \text{ percent}$

**Note about default value.** When data were not available, we calculated a default value as the average of available data on that variable.

**Note about the sources.** With the exception of Distance, Unit fuel cost, and the exchange rates, all the data are coming from the trucking survey.

## **2.c. Profitability**

### **Profit margin per turnaround:**

$(\text{Yearly revenue} / \text{Turnarounds}) / (2 * \text{Variable costs} * \text{Distance} + \text{Fixed costs} * 365 / \text{Turnarounds}) - 1$

## 2.d. Quality Indexes

**2.d.i. Transport quality:** This infrastructure quality index by country has been calculated as a weighted average of other indexes using the following weights:

Parameters	Weighting coefficients
Education	2
Experience	1
Domestic competition	2
Contracts	2
Tracking system	1
Fleet	1
Age	3
Number of employees	1

**Education:** Weighted average<sup>4</sup> of the highest level of education of the top manager.

**Experience:** Average of years of managerial experience working in this sector of the top manager.

**Domestic competition:** Weighted average<sup>5</sup> of the importance of the pressure from domestic transporters on reducing operating costs of existing transport services or expanding services.

**Contracts:** Average of the percentage of all the freight business obtained through contracts with clients.

**Tracking system:** Percentage of companies with a communication tracking system.

**Number of employees:** Average amount of full-time employees including managers, truck drivers, and mechanics (service/repair).

**Note about the transport quality index.** All fields have been normalized between 0 and 1. The index is calculated considering absolute averages for education, experience, domestic competition, and contracts; and relative indices with respect to the country maximum value as reference for tracking system, fleet age, and number of employees.

**Note about the source.** The data come from the trucking survey.

**2.d.ii. Negotiation power:** Average of the sum of the percentage of all the freight businesses for which price is determined by negotiating with clients. Freight business could be obtained by independent freight agents, through public-private institutions in charge of freight allocation,

by telephone/fax from customers, by trucks waiting at lorry parks, by drivers finding their own loads, and through contract with clients. Index normalized between 0 and 1.

**2.d.iii. Logistic perception index (LPI):** The LPI is a set of indicators that measure perceptions of the logistics environment of 140 countries on several logistics dimensions (such as transport cost, infrastructure, customs, and so forth). The survey uses an anonymous, Web-based questionnaire that asks respondents to evaluate their country of residence, as well as eight countries they are dealing with, on several logistics dimensions:

- International transportation costs
- Domestic transportation costs
- Timeliness of shipments
- Tractability of shipments
- Transport and IT infrastructure
- Customs and other border procedures
- Logistics competence

*Source:* Global facilitation partnership for transportation and trade.

**2.d.iv. Infrastructure condition:** This index measures the percentage of the road section in good and fair condition. Index normalized between 0 and 1. *Source:* Africa transport unit.

### **2.e. Other Variables**

**Rail competition:** Categorical variable<sup>6</sup> that represents the level of obstacle that rail competition represents to the current transport operations of the establishment.

**Taxes:** Taxes paid on the establishment / Fleet. The original values are in local currency.

**Number of borders:** Number of borders crossed by the truck (route specific variable).

**Region:** Regional<sup>17</sup> dummy variable.

## **3. Regression Analysis**

### **3.a. Regression Variables**

In the regression analysis, the variables are measured in current U.S. dollars per kilometer per truck. The original variables were recalculated as

**Prices per km:** Price per trip / Distance

**Fixed costs per km:** Fixed costs \* 365 / (Distance \* Turnarounds)

**Variable costs per km:** Variable costs

### 3.b. Data Reliability

Variables	Data reliability
<b>Prices</b>	Reliable
<b>Fixed costs</b>	
Staff costs	Reliable/dubious
License costs	Reliable/dubious
Overhead costs	Reliable/dubious
Insurance costs	Reliable/dubious
Communication costs	Dubious/unreliable
Security costs	Reliable/dubious
Loses costs	Reliable/dubious
Finance costs	Reliable
Depreciation costs	Reliable/dubious
<b>Variable costs</b>	
Fuel costs	Reliable/dubious
Maintenance costs	Dubious/unreliable
Tire costs	Reliable/dubious
Bribes	Reliable/dubious
<b>Others</b>	
Distance	Unreliable
Number of turnarounds	Reliable
Payload utilization	Dubious
Taxes	Dubious/unreliable

### Notes

1. Nine outliers with respect to prices or costs were omitted from the database (two observations in Cameroon, four observations in Chad, two observations in Ghana, and one observation in Kenya). An extreme example comes from the Nairobi-Eldoret route: the observation excluded was more than 8,500 percent smaller than the average price value and 8,200 percent smaller than the smallest value considered in the average.
2. Principal product transported is classified as oil-related products, food imports, agricultural exports, general goods, production inputs, equipment, and empty.
3. Total payload utilization = (Payload utilization to go + Payload utilization return)/2.
4. The weights are MBA (3), other postgraduate degree (PhD, Master's) (2.5), graduate degree (2), vocational training or some university training (1), secondary school (0.75), primary school (0.5), and no education (0).

5. The weights are very important (1), fairly important (2/3), slightly important (1/3).
6. Levels of obstacle are classified as no obstacle, minor, moderate, major, and very severe obstacle.
7. West Africa: Ghana, Burkina Faso; Central Africa: Cameroon, Chad; East Africa: Kenya, Uganda; Southern Africa: Zambia.