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TRANSPORTATION CHOICES AND THE VALUE OF STATISTICAL LIFE

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ABSTRACT

This paper exploits an unusual transportation setting to estimate the value of a statistical life (VSL). We estimate the trade-offs individuals are willing to make between mortality risk and cost as they travel to and from the international airport in Sierra Leone (which is separated from the capital Freetown by a body of water), and choose from among multiple transport options – namely, ferry, helicopter, hovercraft, and water taxi. The setting and original dataset allow us to address some typical omitted variable concerns, and to compare VSL estimates for travelers from different countries, all facing the same choice situation. The average VSL estimate for African travelers in the sample is US$577,000 compared to US$924,000 for non-African travelers. Individual job earnings can largely account for this difference: Africans in the sample typically earn less than non-Africans. The data implies an income elasticity of the VSL of 1.77. These revealed preference VSL estimates from a developing country fill an important gap in the existing literature, and can be used for public policy purposes, including in current debates within Sierra Leone regarding the desirability of constructing new transportation infrastructure.

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1. Introduction

This paper exploits an unusual transportation setting to estimate the value of a statistical life (VSL). We estimate the trade-offs individuals choose to make between mortality risk and costs as they travel to and from the international airport in Sierra Leone, which is separated from the capital Freetown by a body of water. Travelers choose from among multiple transport options, namely, ferry, helicopter, hovercraft, and water taxi. The setting and original dataset allow us to address some typical omitted variable concerns in order to generate some of the first revealed preference VSL estimates from a developing country, filling an important gap in existing literature.[1] We are also able to compare VSL estimates for travelers from 56 countries, including 20 African and 36 non-African countries, all facing the same choice situation.

One well-known methodological challenge in obtaining reliable VSL estimates is the endogeneity of risks that individuals consider taking on (Ashenfelter 2006). The underlying individual factors that affect the decision to enter into a risky situation – where in the existing literature, risky job situations are often considered – may be correlated with many unobserved individual characteristics. To credibly estimate the VSL, we would ideally exploit exogenous events that affect the costs and/or the fatality risk individuals face, e.g., Ashenfelter and Greenstone's (2004b) use of legal changes to U.S. highway speed limits, which leads them to estimate a VSL between US$1.0 and 1.5 million.

A strength of the study setting in the current paper is the fact that all individuals who wish to travel to or from Sierra Leone by air need to choose among the available travel options to cross from the international airport to Freetown. This partially overcomes typical concerns about endogenous risk: while it is certainly possible that some foreign travelers are deterred by the risky transport situation, many others will be compelled to travel to Sierra Leone for professional or personal reasons. Moreover, all Sierra Leoneans seeking to fly abroad are inevitably faced with the airport transportation choice, greatly reducing the degree of selection into the sample as a function of individual risk attitudes for them in particular.

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[1] Greenstone and Jack (2013) argue that "there is hardly a more important topic for future study than developing revealed preference measures of willingness to pay [for] … health" in developing countries.

We designed an original survey and administered it to 561 travelers in order to directly observe respondents making actual transport choices to and from the airport. This survey collected detailed information on a range of individual demographic, economic and attitudinal characteristics, as well as on travelers' perceptions about each of the different modes of transport, allowing us to control for many potentially important confounding factors.

Another notable aspect of the study setting is the relatively good information environment regarding transport risks in Sierra Leone. The rate of fatal accidents is high for the modes of transport we study, and accidents are widely publicized in the local (and international) media and the subject of frequent conversation in the capital. The topic of how best to travel between Freetown and Lungi is commonly discussed among foreign travelers (as the authors can attest to first hand, since precisely such a conversation was the genesis of the current paper). As we show further below, there is relatively good knowledge among respondents about the relative risks of the different modes of transport, and a particularly high degree of awareness about the riskiness of helicopter transport, the mode with the greatest fatal accident risk.

It is also highly unusual to have individuals from so many countries all in the same dataset and facing the same choice situation, and this allows us to generate comparable VSL estimates across many nationalities. The average VSL estimate for non-African travelers in our sample, who typically come from OECD countries, is US$924,000. This is slightly lower than most previous estimates from rich countries, which typically use hedonic labor market approaches and range from US$1 to 9.2 million,[2] although we obviously cannot rule out that some selection into Sierra Leone travel among the non-African travelers affects the estimates.

The only comparable revealed preference estimates available from less developed countries (that we are aware of) are for manufacturing workers in India and Taiwan and range from US$0.5 to 1 million (Liu et al. 1997 and Shanmugam 2001). These are in the same range as the estimates for the African travelers in our data.[3] Kremer et al. (2011) use a travel cost approach – namely, willingness to walk longer distances to cleaner drinking water sources – to estimate the

[2] See, for example: Viscusi and Aldy (2003); Ashenfelter and Greenstone (2004b), Lee et al (2012). Ashenfelter and Greenstone (2004a) argue that estimates in this literature are subject to an upward publication bias.

[3] In the African context, Deaton et al. (2009) use a subjective life evaluation approach, and find that the monetary value attached to the death of a relative is only about 30 to 40% of average annual income, which is less than one percent of most estimates for wealthy countries.

willingness to pay for avoiding a child diarrhea death by in a poor rural Kenyan region, and find that such willingness to pay is very low in that setting, at under US$1,000.

The fact that the estimated VSL for African travelers is somewhat lower than for non-African travelers (who are mainly from wealthy countries) is consistent with a growing body of research that documents the relatively low demand for health and life in less developed countries. The disease burden in low-income countries is much higher than in rich countries, and yet a number of scholars have documented surprisingly low investments in preventive health technologies (see Kremer and Miguel 2007; Kremer et al. 2011; Cohen and Dupas 2010). Common explanations (surveyed in Dupas 2011) range from a lack of information about new health technologies (Madajewicz et al 2007), pervasive liquidity constraints (Tarozzi et al 2013), time inconsistent preferences (DellaVigna and Malmendier 2006), agency problems within the household (Ashraf et al. 2010), shorter life expectancy (Oster 2009), cultural attitudes (and especially fatalism, the belief that fate governs major life outcomes)[4], and a high income elasticity of demand for health expenditures (Hall and Jones 2007).

Our dataset was designed to assess the role played by these leading explanations. We find strong evidence that individual earnings are positively correlated with the VSL, and that the average income differential between Africans and non-Africans in our sample can account for most of the gap in estimated VSL's. However, in contrast, individual perceptions of life expectancy, information about the modes of transport, and a range of attitudes, including those regarding fatalism and religiosity, have far less predictive power in our sample. The bottom line appears to be that individual economic conditions are key drivers of travelers' transportation risk choices, broadly in line with Hall and Jones (2007). The estimates imply an income elasticity of the VSL of 1.77, which is in the upper end of the range of existing estimates, as discussed below.

These VSL estimates can be used for a variety of public policy purposes, including in current debates within Sierra Leone regarding the desirability of constructing new transportation infrastructure, such as a bridge from Freetown to the airport or a new international airport in a different location. More broadly, public policy decisions regarding investments in environment, health, and transportation often require estimates of a society's willingness to pay to reduce the

[4] Many scholarly accounts highlight fatalism as a widespread cultural attitude in many African societies (Iliffe 1995; Fortes and Horton 1983; Bascom 1951).

mortality risks associated with alternative policies. These cost-benefit analyses reflect the dollar amount that should be spent on transport safety in order to save a certain number of lives (in expectation). For example, the California Department of Transport uses a VSL of US$2.7 million when assessing road safety investments.[5] Cost-benefit estimation of this sort is widespread in wealthy countries. However, the lack of credible VSL estimates in most low-income countries typically prevents the application of these methods for evaluating public projects, including the large number of infrastructure projects that are currently being undertaken in Africa.

The paper is organized as follows. In the next section we introduce the setting, section 3 discusses the model and estimation strategy, section 4 describes the data, section 5 presents the results. The final section discusses the potential public policy applications of our results, and provides a back-of-the-envelope calculation evaluating the cost-effectiveness of an infrastructure project that is currently being considered within Sierra Leone.

2. Background on Sierra Leone

To reach Sierra Leone's Lungi International Airport from the capital of Freetown, travelers must cross an estuary that is roughly 16 km across at its widest point (see map in Figure 1). There is no bridge and it is estimated that the best ground transport option around the estuary would take over six hours on unpaved and potentially dangerous roads, and thus we have no reports of travelers ever choosing this option. All travelers arriving at Lungi Airport must choose between up to four distinct transportation alternatives – the ferry, helicopter, hovercraft, or water taxi – to cross the estuary. Each of the alternatives varies in terms of historical accident risk, trip duration and monetary cost. Importantly for our estimation, fatal transportation accidents are widely reported in the media and well-known to most travelers.[6]

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[5] See: California Life Cycle Benefit Cost Analysis: Technical Supplement to User's guide, available at http://www.dot.ca.gov/hq/tpp/offices/eab/benefit_files/tech_supp.pdf, accessed August 10, 2013.

[6] The British High Commission advises (http://www.fco.gov.uk/): "Transport infrastructure is poor. None of the options for transferring between the international airport at Lungi and Freetown are risk-free. You should study the transfer options carefully before travelling". A Sierra Leone tourism site (http://www.visitsierraleone.org/) writes that: "Helicopters and Sierra Leone have a bit of a notorious past, with a couple of crashes widely reported"; and: "The cheapest option of all is to take the ferry to Freetown but it is certainly not the quickest option". The BBC reported the following: "A helicopter ferrying passengers to Freetown airport in Sierra Leone has crashed, killing 19 people, including Togo's Sports Minister Richard Attipoe." (BBC News 2007). Bloomberg News reported on a ferry accident: "105 people are feared to have drowned in Sierra Leone when a boat capsized." (Bloomberg News 2009). Local newspapers also regularly report on transport safety, including on a water taxi accident (along Sierra Leone's coast): "A passenger speed boat, Sea Master I, plying the Kissy Ferry Terminal/Tagrin route capsized at about 10:00 p.m. on

Table 1 presents summary statistics on the available modes of transport, and travelers' perceptions of their attributes. The cheapest transport option is the *ferry*, at just US$2 per trip (or US$5 in the so-called "VIP" section), though it is relatively slow, taking approximately 70 minutes to cross the estuary. On the Freetown side, the ferry terminal is located on the east side of the city at roughly the same distance from downtown (central) Freetown as the other modes' terminals, which are located on the west side (see Figure 1). On the Lungi Airport side, the ferry landings are a greater distance from the airport (relative to the other modes), adding another 30 minutes in a bus (and we factor in this additional time in our analysis). The ferry has the second worst recent safety record of the four modes: since 2005, there have been three major fatal ferry accidents in Sierra Leone (on all routes), almost certainly due to pervasive passenger overcrowding. Accounting for the frequency of ferry trips and the average number of passengers, this translates into a fatality risk of 4.43 per 100,000 passenger-trips.

The second mode of transport is the *water taxi*, a small craft able to accommodate 12 to 18 passengers. Although there have been multiple reports of these boats sailing without proper lights or navigation systems, it appears empirically to be the safest option, with just one recorded accident since it started operating, and an implied mortality risk of just 2.55 per 100,000 passenger-trips. The water taxi takes approximately 45 minutes and costs US$40.

The intermittently available *hovercraft* has an observed fatality risk of 3.88 per 100,000 passengers-trips (in five separate accidents, two of them fatal, with 17 passenger deaths overall). Its cost started at US$35 between December 2004 and May 2006, then rose to US$50 until April 2006. After a period in which it was out of service (following an accident), it reopened in September 2010 charging US$60. In 2012 it reduced its price to US$40.[7] The estimated travel time is about 40 minutes. In the analysis below, we consider the hovercraft as a possible alternative only during periods in which it was operating (see Figure 2).

Finally, the *helicopter* is the most expensive and also the fastest option, at only 10 minutes to cross, yet has the worst accident record. The sole provider of the service used poorly maintained

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Friday 27th February 2009 after making several distress calls to the pilot office of the Sierra Leone Ports Authority" (New Citizen Press 2009). There are many other such examples.

[7] In our data, which includes retrospective reports on prior trips, we include all options available at a given time point. See Figure 2 for details on the dates in which each mode of transport was operating.

Soviet-era helicopters. Since 2005, there have been two helicopter crashes where all of the crew and passengers died (Table 2). Taking into account the frequency of trips as well as the number of passengers per trip, the historical fatality rate over 2005-2012 for helicopter transport is 18.41 per 100,000 passenger-trips, which is much higher than the three other modes and at least 30 times the fatal accident rate per 100,000 flying-hours in U.S. helicopters.[8]

Our data collection effort includes retrospective reports from previous trips made by passengers. The fact that particular options were unavailable at certain periods of time is actually an advantage of our econometric identification strategy, as it provides largely exogenous variation in the choice set travelers face over time. In many cases, we observe the same passenger making transport choices at multiple points in time when facing different choice sets, providing more information about their preferences. Appendix Figure A.1 shows the distribution of the trips reported in our dataset: 41% of trips took place in the trimester of data collection, 23% took place earlier in 2012, and 36% date back before 2012.

In our experience observing literally hundreds of trips (during surveying), there are typically few or no transport capacity constraints: in other words, if a given mode of transport is full at the scheduled time, there are more crafts available or additional trips can be made by the existing fleet (i.e., there are usually extra water taxis parked at each dock, the helicopter can make extra round trips, or more people can be squeezed onto the ferry). Additionally, it is notable that the firms running the modes of transportation do not appear to be adjusting prices at high frequency or in a particularly sophisticated manner. Figure 2 shows the price charged on each of the modes of transport at over time. The ferry did not change its price at all during the study period, mostly due to the government's influence in setting the price, nor do the private firms running the other modes appear to adjust their prices due to changing market conditions, i.e., variation in fuel costs, or changes in the competitive environment when the supply of other transport services changes, for instance, due to the frequent disruption of service for the helicopter and hovercraft (which might lead other operators to raise their prices). For example, the water taxi has charged US$40 since it started operating, while the helicopter and hovercraft's pricing strategies do not seem to respond systematically to these other factors.

[8] U.S. helicopter accident figures come from www.helicopterannual.org (accessed October 2011).

3. Estimating the Tradeoff between Mortality Risk and Cost

In this section, we lay out a standard discrete choice travel cost model. To convey the core intuition of the model, the basic trade-off between VSL versus the value of time (i.e., the wage) is first portrayed graphically in Figure 3 and then laid out formally below. Here we include three loci that correspond to iso-utility curves for the main transport modes.[9] The horizontal axis represents the passenger's hourly wage, and the vertical axis plots the VSL. The relative risk and cost profiles of each transportation alternative determine the intercepts and slopes.

The water taxi is the least risky option but lies between the ferry and hovercraft in terms of cost, as captured in both the ticket price and time (Figure 2). The fastest but riskiest option is the helicopter, which is also the most expensive. As shown graphically, individuals with high wages effectively choose between the helicopter and the hovercraft (since the long travel time on the ferry generates high disutility). Those with sufficiently high value of life always choose the water taxi since it is safest, while those with lower valuations choose between the helicopter and hovercraft (if their wage is high) or pick the ferry (if their opportunity cost of time is low).

In essence, the VSL represents how much additional cost an individual is willing to take on in order to reduce mortality risk a certain amount. This trade-off can be formally portrayed as:

$$VSL_i \equiv \frac{\Delta W_i}{\Delta p_i} \tag{1}$$

where ΔW_i is the change in individual i's earnings for a reduction of Δp_i in mortality risk.

We model traveler i's decision to use transport alternative j ($j \in J$, for discrete finite J) to travel between Lungi Airport and Freetown using a random utility model of discrete choice:[10]

$$y_{ij} = \begin{cases} 1 & if\ alternative\ j\ is\ chosen \\ 0 & otherwise \end{cases}$$

where $\sum_j y_{ij} = 1$ and $\Pr(y_{ij}) > 0\ \forall\ j$. Passenger i's utility from choosing mode j is:

[9] For clarity, the locus corresponding to equal utility for the ferry and helicopter is not shown since it lies in a region where both options are dominated by the water taxi.
[10] Greenstone et al (2012) use a related approach to estimate the VSL for military personnel making choices between job assignments that entail different mortality risk and wages.

(2) $$U_{ij} = (1 - p_j)v_i - (c_j + w_i t_j) + \varepsilon_{ij}, \qquad \forall\, j$$

where v_i represents the value to individual *i* from safely completing the trip, which happens with probability $(1 - p_j)$. c_j is the monetary cost of transport mode *j*, $w_i t_j$ is the opportunity cost, expressed in terms of the time it takes to complete the trip on *j* (t_j) and the value of the individual's time (wage w_i). It is convenient to define $c_{ij} \equiv c_j + w_i t_j$. ε_{ij} is an i.i.d. type I extreme value error term unobserved by the researcher. The distributional assumption on ε_{ij} implies that $\varepsilon^*_{ijk} = \varepsilon_{ij} - \varepsilon_{ik}$ follows the logistical distribution ($\forall\, j \neq k$).

Empirically, we estimate the VSL using a conditional logit model (McFadden 1974). The probability of individual *i* selecting option $j \in J$ is given by:

(3) $$\Pr(y_{ij} = 1) = \frac{\exp((1-p_j)v_i - c_{ij})}{\sum_k \exp((1-p_k)v_i - c_{ik})}$$

From this expression, the relative odds of choosing mode *j* over *k* is:

(4) $$\frac{\Pr(y_{ij}=1)}{\Pr(y_{ik}=1)} = \frac{\exp(\left(1-p_j\right)v_i - c_{ij})}{\exp((1-p_k)v_i - c_{ik})}$$

$$= \exp\left(v_i\left((1-p_j) - (1-p_k)\right) - (c_{ij} - c_{ik})\right)$$

Building on the expression in equation (4), and with an appropriate normalization of the utility of the outside option *k*, the relative utility of choosing mode *j* is a function of the relative survival hazard of mode *j* versus mode *k* ($[\left(1 - p_j\right) - (1 - p_k)]$, for $j \neq k$), and the relative cost of taking the different modes of transport $\left(c_{ij} - c_{ik}\right)$:

(5) $$U_{ij} = \alpha + \beta_1\left(\left(1 - p_j\right) - (1 - p_k)\right) + \beta_2(c_{ij} - c_{ik}) + \varepsilon_{ij}$$

Totally differentiating equation (5), we obtain:

(6) $$dU_{ij} = \frac{\partial U_{ij}}{\partial\left(\left(1-p_j\right)-(1-p_k)\right)} d\left(\left(1 - p_j\right) - (1 - p_k)\right) + \frac{\partial U_{ij}}{\partial[c_{ij} - c_{ik}]} d(c_{ij} - c_{ik})$$

Setting $dU_{ij} = 0$ and recognizing that the coefficients β_1 and β_2 capture the relevant partial derivatives on the key terms, this yields an expression for the value of statistical life that closely resembles equation (1) above:

(7) $$-\frac{\beta_1}{\beta_2} = \frac{d(c_{ij}-c_{ik})}{d\big((1-p_j)-(1-p_k)\big)} \approx \frac{\Delta W_i}{\Delta p_i}$$

β_1 represents the marginal change in the likelihood of choosing a certain transport mode due to a change in the probability of survival, and intuitively this corresponds to the utility value of completing a trip. β_2 captures how the likelihood of choosing a mode changes with cost, and corresponds to the monetary value of a unit of utility. The negative of the ratio of these coefficients captures the trade-off between exposure to fatal risk and cost, which can be interpreted as the value of statistical life.[11]

In section 5, we follow the framework presented above to estimate a conditional logit model, and compute the average VSL for the different populations of travelers in our sample. Yet conditional logit models, though simple to interpret and implement, have well-known limitations: they impose the assumption of the independence of irrelevant alternatives (IIA), and do not allow for random taste variation across individuals or for correlation in unobserved factors over time (Train 2003). We are able to relax these assumptions by using a mixed logit model (McFadden and Train 2000). The IIA assumption is potentially problematic in our case since we have several trips made by the same individual under different choice sets, due to the intermittent operation of the hovercraft, the discontinuation of the helicopter service, and the introduction of the water taxi. The IIA assumption implies that the relative odds of choosing between two particular options remain constant when a new option is introduced. Further, conditional logit models assume that all agents in the population have the same preferences.

This can be relaxed in a mixed logit model by allowing for random taste variation. We are able to estimate individual level coefficients, and this allows us to recover the full distribution of the VSL in the population. Mixed logit probabilities are the integrals of standard logit probabilities over a distribution of parameters, as follows:

(8) $$\Pr(y_{ij}=1) = \int \left(\frac{\exp\{[(1-p_j)v_i - c_{ij}](\beta)\}}{\sum_k \exp\{[(1-p_k)v_i - c_{ik}](\beta)\}} \right) f(\beta)\, d\beta$$

[11] While in some cases measurement error in the explanatory variables leads to a bias toward zero and produces estimates that are bounds on the true effect, a simple attenuation bias of this sort is unlikely to hold in this case. The fact that the key statistic is a ratio makes it difficult to "sign" any bias generated by measurement error in the risk and cost terms, in the absence of detailed information about the nature and extent of the measurement error.

$f(\beta)$ is a density function and $[(1-p_j)v_i - c_{ij}](\beta)$ is the observed portion of the utility, which depends on the parameter vector β. The mixed logit probability is a weighted average of the logit formula evaluated at different values of β, with the weights given by the mixing distribution $f(\beta)$. The assumptions on the mixing distribution used for each random coefficient can be derived from theory. For instance, it is likely that β_1 is weakly positive for all passengers, if nobody prefers higher mortality risk on a given trip. Likewise, β_2 is plausibly weakly negative, implying that, ceteris paribus, passengers prefer lower cost options.

Given our limited sample size, and the potential for reporting errors, we sought to use a mixing distribution to minimize the possibility that outliers are driving our results. One distribution that fits this criterion is the triangular. This distribution is continuous and symmetric, and we constrain it to be weakly positive (weakly negative) for β_1 (β_2). The simplicity of the distribution makes estimation more tractable, and it is also attractive since it does not have the "thick tails" that characterize some other distributions (such the log normal).[12]

4. Data

The Transportation Choice Survey was collected in August and September 2012 at both Lungi Airport and Freetown, among travelers either arriving into or departing from Sierra Leone. We verified that all three of the main transportation modes (ferry, hovercraft and water taxi) were available on survey days; the helicopter was not operational during the months of the survey, but we did gather information on past trips during periods when it was available. Enumerators recorded each respondent's observed transport choice, and the survey included self-reported choices on earlier trips, namely on their immediately previous trip, and on their first two trips (if applicable), meaning that travelers provided information on up to four trips in total.[13]

As noted above, an advantage of having historical trips in the analysis is that we are able to observe individual choices at times when different options were available, including the helicopter. In practice, this means that we have within-individual variation in the choice set, effectively allowing us to obtain information on both individuals' first and second choices in some cases,

[12] Kremer et al (2011) also use a triangular mixing distribution in their travel cost analysis.
[13] Appendix Figure A.1 presents the timing of trips (including historical trips) contained in our dataset between 2005 and 2012. To provide incentives to complete the survey for passengers who were in a rush to get to the airport or home, each respondent received free cell phone air time worth about US$1 (enough for roughly 10 minutes of calls).

strengthening our econometric identification strategy. Further, the fact that we observe travelers from high and low income countries alike facing the same choice situation allows us to generate the first (to our knowledge) comparable revealed preference VSL estimates across nationalities.

Beyond the actual transportation choice, data was collected on respondents' demographic characteristics (including gender, age, nationality, permanent residence, and educational attainment), and current employment status and earnings.[14] Importantly, we ask respondents to rank their perceptions regarding the comfort, noise levels, crowdedness, convenience of the transfer location, and the overall "quality" of the clientele on each transport mode, allowing us to explicitly control for each mode's attributes in the analysis. We complement this survey data with information on all transportation accidents and associated fatalities between January 2005 and September 2012. This information was collected from the U.N.'s Engineering Department in Freetown, and cross-checked by the authors with multiple local and international newspapers. The list of all accidents is presented in Table 2.[15]

Table 3 presents descriptive statistics for the 561 respondents with complete information on the relevant variables. Overall, including the historical trips, 57% of trips were made using the ferry, 25% on the water taxi, 16% using the hovercraft, and 2% with the helicopter. Sixty percent of the total sample is African, from 20 distinct African countries, while the 225 non-African respondents come from 36 countries.[16] The travelers are mostly business travelers, government officials, or aid workers. Airport travelers in our sample are an average of 40.3 years old and 77% are male (Table 3). They are highly educated – 81% hold at least a university degree – and have relatively high incomes. Notably, our sample of African respondents is clearly "elite" in local terms: they are both highly educated (77% hold a university degree) and have significantly higher income than the average African, with a reported hourly wage of US$29.90 (PPP), or $62,360 per

[14] About one third of respondents have missing values for their earnings and wages. We impute missing observations with the average wage for other respondents with the same educational attainment category (namely, less than university, some/completed university, post-graduate), continent of residence (Africa or non-Africa), and employment sector (international organization/business, local organization/ business, unemployed).
[15] There were additional helicopter accidents during the tail end of the civil war in 2001-2002, but we restrict attention to the period when the war was definitively over, as it is most comparable to our post-conflict study period.
[16] 54% of the African respondents come from Sierra Leone, with the remainder from Nigeria (38% of non-Sierra Leoneans), Ghana (20%), South Africa (17%), Kenya (4.1%), Senegal (3.9%), Liberia, Zambia and Guinea (1.9% each), with smaller numbers from Zimbabwe (1.5%), Sudan and Gambia (1.4% each), Benin and Algeria (1.3% each), and other countries. On the other hand, non-Africans come from the former colonizer (UK, with 34.3% of non-Africans), followed by the USA (11.1%), India (9.4%), France (5.3%), China and Lebanon (3.7% each), Australia (2.6%), Italy (1.9%), the Netherlands and the Philippines (1.6% each), Finland and Ireland (1.4% each), among others.

year, which is higher than median U.S. household income. They, too, are a mixture of local and international business people, government officials and aid workers. Non-African respondents have an even higher average hourly wage of US$47.60 (US$99,000 per year).

African respondents report that they expect to live for an additional 42.7 years (until 82 years of age) on average, while non-Africans' stated remaining life expectancy is almost identical, at just one year less. This may be surprising at first but seems consistent with the fact that the African elites in our sample likely have good access to health care and are already 40 years old on average (above the early childhood ages where most of Africa's high mortality occurs). In terms of attitudes, the African travelers have much more fatalistic beliefs than the non-African travelers. When asked the extent to which they believe everything is determined by fate, versus believing they are able to influence their own future, they have an average fatalism score of 4.2 (out of 10), while non-Africans in the sample have an average of 3.3.[17]

Respondents report making transportation choices based on what appear to be largely objective criteria, suggesting that they are relatively well-informed. Appendix Table A.1 shows that most travelers who chose the ferry claim to do so because of its lower cost (64%) and safety (84%); note that ferry passengers are not significantly poorer or less educated on average. Travelers choosing the water taxi mention that their decision was based primarily on speed (85%) and safety (43%), while those choosing the hovercraft base their choice on safety (80%) and speed (73%). These patterns are broadly consistent with the intuition provided in Figure 3.

Further, the extent of information that passengers have about the mortality risk of each of the modes of transport is shown in Figure 4. The questionnaire asked travelers to rank the transport options based on their relative risk of fatal accidents. Overall, passenger perceptions are relatively well, although not perfectly, aligned with the actual observed risk of a fatal accident across modes. Consistent with the actual fatality risk, the helicopter is perceived as the most dangerous option by 65% of travelers, while over 25% think that the hovercraft is the second most dangerous. The ferry is thought to be the second safest option by 24% of passengers, while 63% perceive it as the safest

[17] Specifically, the question asked: "Some people feel they have completely free choice and control over their lives, while other people feel that what they have no real effect on what happens to them. Please use this scale where 1 means "no choice at all" and 10 means "a great deal of choice" to indicate how much freedom of choice and control you feel you have over the way your life turns out." We reverse this index to create a measure of fatalism.

mode; this is a case in which perceptions depart somewhat from observed accident risk. The water taxi's safety features are also not clearly perceived by most travelers: 7% believe it is the safest option while 24% believe it is the second safest mode.

5. Results

5.1. Value of Statistical Life Estimates

Table 4 shows the main conditional logit results. We regress the transportation choice indicator on the probability of successfully completing the trip (presented at x1000 for clarity) and the total travel cost. Each observation represents an individual trip, and is weighted to represent the true proportion of passengers travelling on each of the modes of transport; that is, we weight each observation by the inverse of its sampling probability, and we cluster standard errors at the passenger level to account for the potential correlation in choices made by each passenger.[18]

As expected, passengers clearly prefer transport modes with lower accident risk and lower cost. Column 1 in Table 4 shows an initial set of results for African travelers; we improve on this specification in several ways below. Following equation (7), we use the coefficient estimates on the safety and cost terms to estimate the average value of a statistical life. The estimated VSL is significantly different from zero, at US$319,985 (PPP). Similarly, Column 3 shows the analogous results for non-Africans. The estimates indicate that non-Africans are more sensitive to marginal changes in fatality risk and less responsive to cost.[19] The model suggests that the VSL for non-Africans is an order of magnitude larger than for Africans, at US$2,586,708, but the confidence interval in this case is large and includes zero.

A leading concern with the estimates presented in Columns 1 and 3 is omitted variable bias. For example, the ferry is often quite crowded while it is also relatively safe but slow. Not accounting for the correlation between the risk and cost terms and these other transport mode characteristics could bias the coefficient estimate on the safety term. Similarly, many passengers (including the authors) dislike the loud rotor noise of the helicopter. Since the helicopter is also

[18] The sampling probabilities for each transport mode are defined as: (Overall proportion of travelers using transport mode *j*) / (Proportion of survey respondents using transport mode *j*).
[19] Some passengers do not pay for the trip themselves but are instead reimbursed. Our results are robust to the exclusion of travelers who report that someone else paid for their trip (not shown). This is consistent with the fact that most of the variation in the total cost of the trip is driven by differences in wages across individuals.

the most expensive option and least safe, there is a further correlation between the cost and risk terms with a mode amenity that could again bias estimates. Likewise, the more expensive options could also be more comfortable; this likely holds for the hovercraft (which has reasonably comfortable seats, although it can get hot on board due to a lack of ventilation) but probably not for the helicopter, and so on. The general point is that perceptions of the various amenities of the different transport modes need to be accounted for in the analysis.

To address this issue, Columns 2 and 4 in Table 4 also account for individual level perceptions, as recorded in the survey, on multiple attributes of each transport mode. Particularly, we asked every passenger to rank specific attributes on a scale from 1 “very poor” to 5 “excellent” (and then re-scale them from zero to one in the analysis). Individuals might not have direct experience with each of the modes of transport but their perceptions are still relevant if they influence choices. Once we account for perceived transport mode characteristics, both coefficients of interest (on risk and cost) increase in magnitude compared to columns 1 and 3. The perceived amenities are jointly significant in all specifications, justifying their inclusion.

Failing to account for transport mode attributes leads us to underestimate the VSL. The estimated VSL accounting for the detailed transport controls are shown at the bottom of Columns 2 and 4. The estimated VSL for Africans rises to US$778,492 (statistically different from zero at 95% confidence), while non-Africans have an average VSL of US$2,960,968 (although zero is again contained in the 95% confidence interval). Column 5 shows the results for the pooled sample, formally testing for the equality of the coefficient estimates across Africans and non-Africans. Differences between African and non-African travelers are driven by the coefficient on the total cost of the trip, with Africans less likely to choose the more expensive options.

A key assumption of our model is that travelers are well informed about accident risk. Results from our survey indicate that travelers are aware of the broad ranking of safety (i.e., the helicopter is riskiest, but many think the ferry is relatively safer than it is, etc.). Another way to assess the role of information is to test whether the estimated VSL differs for those travelers who are likely to be objectively better informed about travel risks. As one approach, it is reasonable to assume that Sierra Leonean travelers are generally more knowledgeable about the relevant risks than foreigners: all of the accidents were widely reported in the local media and the issue was even commented upon by the President.[20] At the same time, Sierra Leonean airport travelers exhibit similar observable characteristics to the other African travelers in terms of education and earnings. If it were indeed the case that foreigners were less informed than locals about accident risk, this would be reflected in their choices, and thus they should exhibit a different VSL.

Appendix Table A.2 reports the model's results only for the Sierra Leonean subsample, and compares them to the results for other Africans, both with and without controls for the perceived quality of transport mode attributes. The coefficients associated with the probability of completing the trip and cost are not statistically different between these two groups, which is consistent with the assumption that information regarding fatality risk was broadly similar in the two groups. Along the same lines, first-time travelers to or from Lungi airport could conceivably be less knowledgeable about the relevant risks than more seasoned travelers. When we carry out the analogous estimation excluding all reported trips by first-time Lungi travelers, all the main patterns described above are unchanged (see Appendix Table A.3), again suggesting that poor information about risks is not the key driver of the estimates.

5.2. Mixed Logit Results

We next present estimates using our preferred mixed logit model in Table 5, under the assumption that the coefficients associated with the probability of completing the trip and the total transportation cost both follow a triangular distribution. In all regressions, we also control for the perceived quality of the different attributes for each mode of transport, as above, and assume that tastes over these qualities are fixed for tractability.

The mixed logit model leads to higher mean estimates of the coefficients associated with both the probability of completing the trip and its opportunity cost, both for Africans and non-Africans. The implied average VSL for African travelers is now US$577,129, while for non-Africans it is US$923,928. Both estimates are significantly different from zero, but not statistically significantly different from each other. For the case of the non-African travelers, the difference between the estimated mean VSL with the conditional logit and the one obtained here is mostly driven by a difference in the coefficients associated with the cost of the trip, which becomes larger in the mixed

[20] See: www.statehouse.gov.sl/index.php/investment-guide/498-president-koroma-receives-togolese-delegation-.

logit estimation (Column 2 of Table 5).[21] We are able to generate the distribution of the VSL across individuals using the mixed logit model, and the distributions for both Africans and non-Africans are displayed in Figure 5. There is considerable overlap between the two distributions, but the non-African distribution lies to the right of the distribution for African travelers; the next sub-section explores this difference further.

Policy analysts frequently apply VSL estimates from one setting to different regions or different points in time, where average income levels may differ, and to do so they often employ estimates of the income elasticity of the VSL (see Hammitt and Robinson 2011). Currently, there is debate over the empirical income elasticity of the VSL, with estimates ranging between 0.4 and 1.7. For example, the contingent valuation studies reviewed in Viscusi and Adly (2003) typically estimate elasticities less than one, ranging between 0.4-0.6. Many longitudinal studies estimate an elasticity greater than one: Costa and Khan (2004) estimate an elasticity ranging between 1.5 and 1.7, and Hall and Jones (2007) argue for an elasticity of 1.2. In Table 6 we estimate of the income elasticity of the VSL in our data by regressing the log of the VSL (generated at the individual level in the mixed logit model) on the log of the individual hourly wage rate.[22] In our sample, we estimate an elasticity of 1.77, with very similar estimates for Africans and non-Africans. This lies at the upper end of the range of existing estimates, and implies that the VSL increases rapidly with rising individual income.

5.3. What explains differences between Africans and non-Africans?

Although there are no statistically significant differences in mean VSL estimates across Africans and non-Africans in our sample of airport travelers, the mean estimate for non-Africans is roughly twice as large as that for Africans, and this gap merits further explanation. Three leading hypothesis in the literature could potentially account for the lower estimates among Africans. First, people with a shorter remaining life span might rationally invest less in marginal reductions in mortality risk (Oster 2009). Second, in the African context it has sometimes been argued (mainly by non-economists) that there is considerable cultural "acceptance" of morbidity and mortality

[21] We also estimated models in which we assumed that the random coefficients are distributed normally. The median implied VSL values are similar to those reported in Table 5 for both Africans and non-Africans (not shown), but the mixed logit estimates are less precisely estimated using normal mixing distributions.
[22] The relatively few travelers (approximately 6%) who report zero wage earnings are dropped from this analysis.

risk, which itself may be an expression of pervasive fatalism (Fortes and Horton 1983; Caldwell 2000; Meyer-Weitz 2005). Third, it has been hypothesized that expenditures in life-prolonging technologies are highly sensitive to income (Hall and Jones 2007), and thus poorer individuals will have a far lower VSL. We next present evidence that casts some doubt on the first two hypotheses (and several other potential explanations), and provide suggestive evidence that income differences are a more likely explanation for the patterns in the data.

To start, the different choices made by Africans and non-Africans do not seem to arise from differential perceptions regarding the amenity value of the modes of transport, which are similar (Figure 6, Panel A). However, there are substantial differences in the wages of the two groups, with non-Africans earning considerably more (Panel B). Africans and non-Africans also expect to live for roughly the same number of additional years, with nearly identical distributions (Panel C), suggesting that individual life expectancy is unlikely to be a key driver.[23] Finally, and consistent with previous evidence, Africans in our sample express significantly more fatalistic views than the non-Africans (Panel D).

We next examine the extent to which these variables can account for differences between Africans and non-Africans in our data. As a benchmark, Column 1 in Table 7 reproduces the regression from Column 5 in Table 4, which shows that Africans are no more sensitive to differences in fatality risk but do appear to be more sensitive to total trip cost (including the opportunity cost of time). Column 2 augments the specification by controlling for interactions with individual level observable characteristics, including gender, age, education, having children, exposure to armed conflict, and whether the respondent can swim (which might be relevant for assessing risk when taking the sea transport modes). These controls are included as interaction terms with the probability of completing the trip and the total trip cost (with all variables de-meaned in the interaction terms). Note that the introduction of these variables in the regression does not alter either the statistical significance or magnitude of the interaction between the African indicator variable and trip cost (or the other coefficients of interest).

In Columns 3, 4, and 5 of Table 7, we progressively include further interactions with the characteristics presented in Panels B, C, and D of Figure 6. Finally, in column 6 we include the

[23] The question asked respondents whether they expected to be alive at a certain age, and we increased the age in 5 year increments until the respondent answered in the negative.

full set of interactions jointly and this yields the most convincing set of findings. The coefficient estimate on the interaction between cost and the individual wage is robustly large, negative and significant at 99% confidence. Including this Cost x Wage term also reduces the magnitude and statistical significance of the Cost x African coefficient estimate by 90 percent, and thus appears to account for the bulk of the difference in VSL estimates between Africans and non-Africans.

6. Summary and Discussion

This paper exploits an unusual transportation setting to provide revealed preference estimates of the value of statistical life (VSL). We observe the trade-offs individuals are willing to make between mortality risk and travel costs among those traveling to and from the international airport in Sierra Leone among multiple transport options with different characteristics. The study setting and data allows us to partially overcome some typical problems faced in VSL estimation. While differences between Africans and non-Africans are not statistically significant, we find that African travelers appear somewhat less willing to pay for reduced mortality risk, with an average VSL of US$577,000 compared to US$924,000 for the non-African travelers. We show suggestive evidence that this difference can be largely accounted for by differences in the average job earnings between the two groups.

The value of a statistical life is a key public policy parameter frequently used to evaluate the cost effectiveness of infrastructure and environmental projects that affect mortality risk. The VSL estimates in this paper are thus potentially of great interest in Sub-Saharan Africa, which is currently one of the world's fastest growing regions and is experiencing a boom in large-scale infrastructure projects (World Bank 2013). However, until now there have been few credible revealed preferences VSL estimates in Africa (or other low income regions).

The VSL estimates we generate may be directly applicable in evaluating potential infrastructure projects in Sierra Leone itself. To illustrate one such project, on July 2nd 2013, Sierra Leone President Ernest Bai Koroma met with China's president and vice-president to discuss three large infrastructure projects to be potentially financed with Chinese investment.[24] Importantly, one of the projects under discussion was the construction of an entirely new international airport, which would be located closer to the capital of Freetown, allowing travelers to drive to the capital by

[24] See http://news.sl/drwebsite/publish/article_200523131.shtml

road and thus avoid the harrowing journey that is the backdrop of the current study. The initial estimated cost of the potential project is said to be approximately US$300 million. Using this rough cost estimate, our own VSL estimates for African airport travelers, and making some conservative assumptions regarding the reduction in mortality risk generated by eliminating the Lungi-Freetown trip, we are able to provide a back-of-the-envelope calculation regarding some of the social benefits generated by the proposed project.

We first assume that the ground transportation will only be as safe as the safest existing transport mode, namely the water taxi, at 2.55 fatalities per 100,000 passenger trips. Road travel is likely to be considerably safer, but this is a conservative starting point. Given that the actual weighted mortality risk is 3.90 fatalities per 100,000 passenger trips (taking appropriate averages in Table 1), this implies a reduction in mortality risk of approximately a third, or 1.35 per 100,000 passenger trips.

Lungi International Airport's passenger traffic is currently roughly 14,000 passengers per week.[25] We assume that passenger traffic to the new airport (if and when constructed) will remain constant at this level, which means that the total yearly passenger traffic in the new airport would be approximately 700,000 passengers per year. This again appears very conservative given the rapid increase in total population and in business travel to Sierra Leone in recent years.

Using these two assumptions, the new airport would save approximately 1.35/100,000 x 700,000 passengers = 9.45 lives per year. Using the estimated VSL for Africans air travelers, this implies a social benefit of US$5.5 million per year. If the government or social planner discounts at 10% per year, the net present value of this benefit is approximately US$60 million. While this figure does not fully "pay for" the initial US$300 million cost estimate, it goes a long way towards justifying such an expense despite being driven by conservative assumptions on the reduction in accident risk and future air travel, and of course it does not account for all of the other intended benefits of a new airport in terms of international trade and economic growth. This rough calculation illustrates how useful a more empirically grounded VSL estimate can be as an input into public policy decisions in African and other low income settings. Finally, it is worth noting

[25] The approximate number of passengers per week was obtained for July 2013 by collecting data on all flights arriving and departing from the airport in a given week, assuming nearly full flights (95% of capacity), and accounting for the passenger capacity of each aircraft.

that, given Africa's rapid current economic growth rates, our finding of a large positive income elasticity implies that value of life estimates are likely to risk rapidly in the coming years, and this too is a trend that will be useful to factor into public policy analyses there.

References

Ashenfelter, Orley (2006). "Measuring the Value of a Statistical Life: Problems and Prospectus". *Economic Journal*, 116(510): 10-23.

Ashenfelter, Orley and Michael Greenstone (2004a). "Estimating the Value of a Statistical Life: The Importance of Omitted Variables and Publication Bias". *American Economic Review*, 94(2): 454-460.

Ashenfelter, Orley and Michael Greenstone (2004b). "Using Mandated Speed Limits to Measure the Value of a Statistical Life". *Journal of Political Economy,* 112(1): 226-267.

Ashraf, Nava, Erica Field and Jean Lee (2010). "Household Bargaining and Excess Fertility: An Experimental Study in Zambia". *BREAD Working Paper* No. 187.

Bascom, W. R. (1951). "Social Status, Wealth and Individual Differences Among the Yoruba". *American Anthropologist,* 53: 490–505.

Caldwell, J. C. (2000). "Rethinking the African AIDS epidemic". *Population and Development Review*, 26: 117–13.

Cohen, J., and P. Dupas (2010), "Free Distribution or Cost-Sharing? Evidence from a Randomized Malaria Prevention Experiment". *Quarterly Journal of Economics*, 125(1): 1-45.

Costa, D.L., and M.E. Kahn. 2004. "Changes in the Value of Life, 1940-1980." *Journal of Risk and Uncertainty*. 29(2), 159-180

Deaton, Angus, Jane Fortson, and Robert Totora (2009), "Life (Evaluation), HIV/AIDS, and Death in Africa", *NBER Working Paper 14637*.

DellaVigna, Stefano and Ulrike Malmendier (2006). “Paying to Not go to the Gym”, *American Economic Review*, 96: 694-719.

Dupas, P. (2011), “Health Behavior in Developing Countries”, *Annual Review of Economics,* 3.

Fortes, M. and Horton, R. (1983). “Oedipus and Job in West African Religion”, Cambridge: Cambridge University Press.

Greenstone, Michael, Stephen P. Ryan, and Michael Yankovich (2012). “The Value of a Statistical Life: Evidence from Military Retention Incentives and Occupation-Specific Mortality Hazards”, MIT Working Paper

Greenstone, Michael, and B. Kelsey Jack (2013). “Envirodevonomics: A Research Agenda for a Young Field”, NBER Working Paper No. 19426.

Hall, Robert, and Charles Jones (2007), “The Value of Life and the Rise in Health Spending”, *Quarterly Journal of Economics*, 122(1): 39-72.

Hammitt, James K. and Robinson, Lisa A. (2011) "The Income Elasticity of the Value per Statistical Life: Transferring Estimates between High and Low Income Populations," *Journal of Benefit-Cost Analysis*, 2 (1): Article 1.

Iliffe, John (1995). *Africans: the history of a continent*. Cambridge University Press.

Kremer, Michael and Edward Miguel (2007). “The Illusion of Sustainability”, *Quarterly Journal of Economics*, 122(3): 1007-1065.

Kremer, Michael, Jessica Leino, Edward Miguel, and Alix Peterson Zwane (2011), “Spring Cleaning: Rural Water Impacts, Valuation, and Property Rights Institutions”, *Quarterly Journal of Economics*, 126(1), 145–205.

Lavetti Kurt (2011), “Dynamic Labor Supply with a Deadly Catch”, Cornell Working Paper.

Lee, J. and L. Taylor (2012). “Randomized Safety Inspections and Risk Exposure on the Job: Quasi-experimental Estimates of the Value of a Statistical Life”, GSU Working Paper.

Liu, Jin Tan, J.K. Hammitt, and Jin Long Liu (1997). “Estimated Hedonic Wage Function and Value of a statistical life in a Developing Country,” Economics Letters, 57 (3): 353-358.

Madajewicz, M., A, A. van Geen, J. Graziano, I. Hussein, H. Momotaj, R. Sylvi, and H. Ahsan (2007). “Can information alone change behavior? Response to arsenic contamination of groundwater in Bangladesh.” *Journal of Development Economics*, 84 (2): 731.754.

McFadden, Daniel (1974), “Conditional logit analysis of qualitative choice behavior”, in P. Zarembka, ed., Frontiers in Econometrics, Academic Press, New York, pp. 105-142.

McFadden, Daniel and Kenneth Train (2000), “Mixed MNL models for discrete response”. *Journal of Applied Econometrics*, 15(5): 447–470

Meyer-Weitz, A. (2005). “Understanding fatalism in HIV/AIDS protection: The individual in dialogue with contextual factors”. *African Journal of AIDS Research*, 4(2): 75–82

Oster, E. (2009). “HIV and Sexual Behavior Change: Why not Africa?”. Mimeo, Univ. of Chicago.

Shanmugan, K. R. (2001). “Self Selection Bias in the Estimates of Compensating Differentials for Job Risks in India,” *Journal of Risk and Uncertainty*, 22 (3): 263-275.

Tarozzi, Alessandro, Aprajit Mahajan, Brian Blackburn, Dan Kopf, Lakshmi Krishnan and Joanne Yoong (2013). Micro-loans, bednets and malaria: Evidence from a randomized controlled trial in Orissa (India), *UPF Working Paper.*

Train, K. (2003). *Discrete Choice Methods with Simulation*. Cambridge Univ. Press: Cambridge.

Viscusi, Kip, and Joseph Aldy (2003). “The Value of a Statistical Life: A Critical Review of Market Estimates throughout the World”. *Journal of Risk and Uncertainty*, 27 (1): 5–76.

Viscusi, W. Kip (2010) “The Heterogeneity of the Value of Statistical Life: Introduction and Overview”, *Journal of Risk and Uncertainty*, 40: 1-13.

World Bank (2011). *World Development Indicators*. Washington DC.

World Bank (2013). “Africa’s Pulse”, Volume 7, April, 2013. Washington, DC.

Figure 1: Map of the Study Setting, Lungi International Airport and Freetown, Sierra Leone

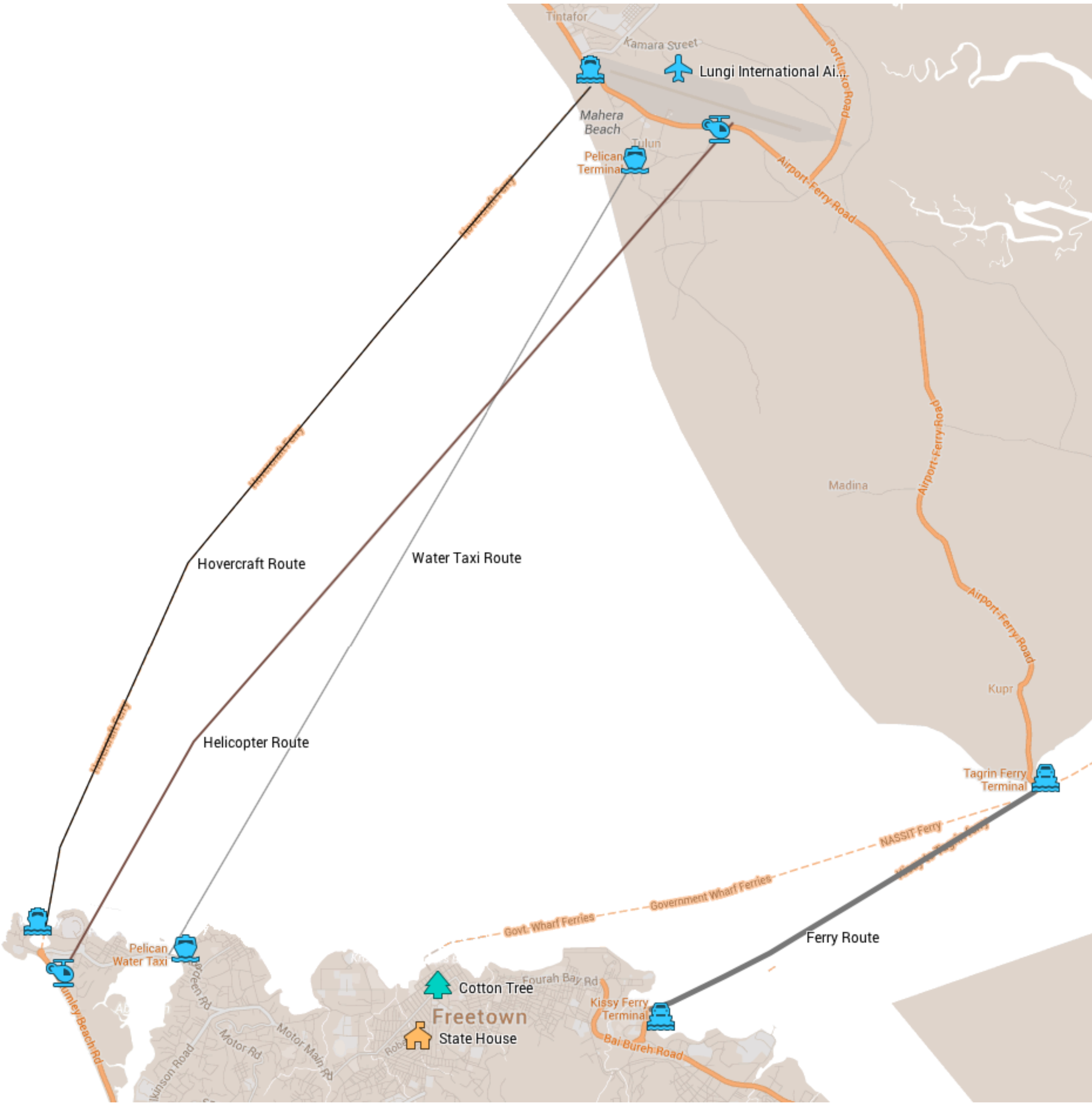
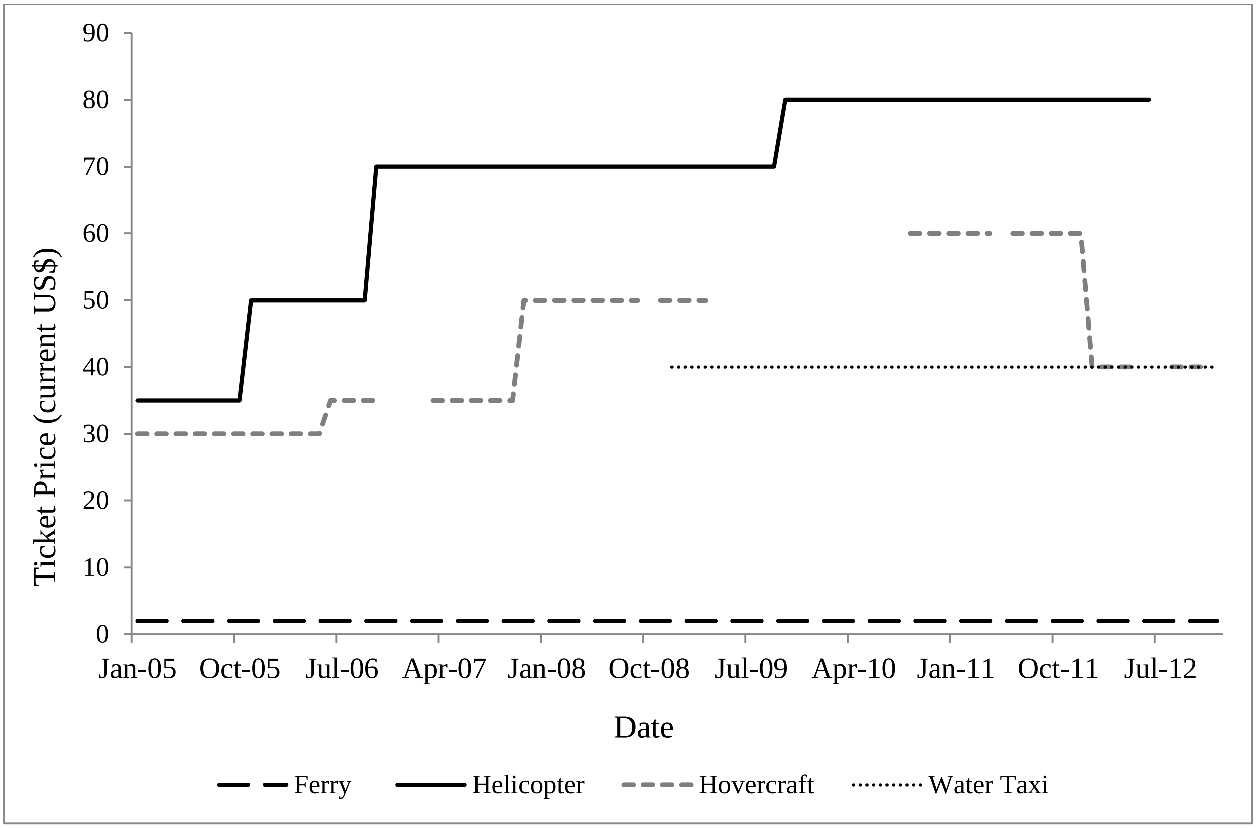
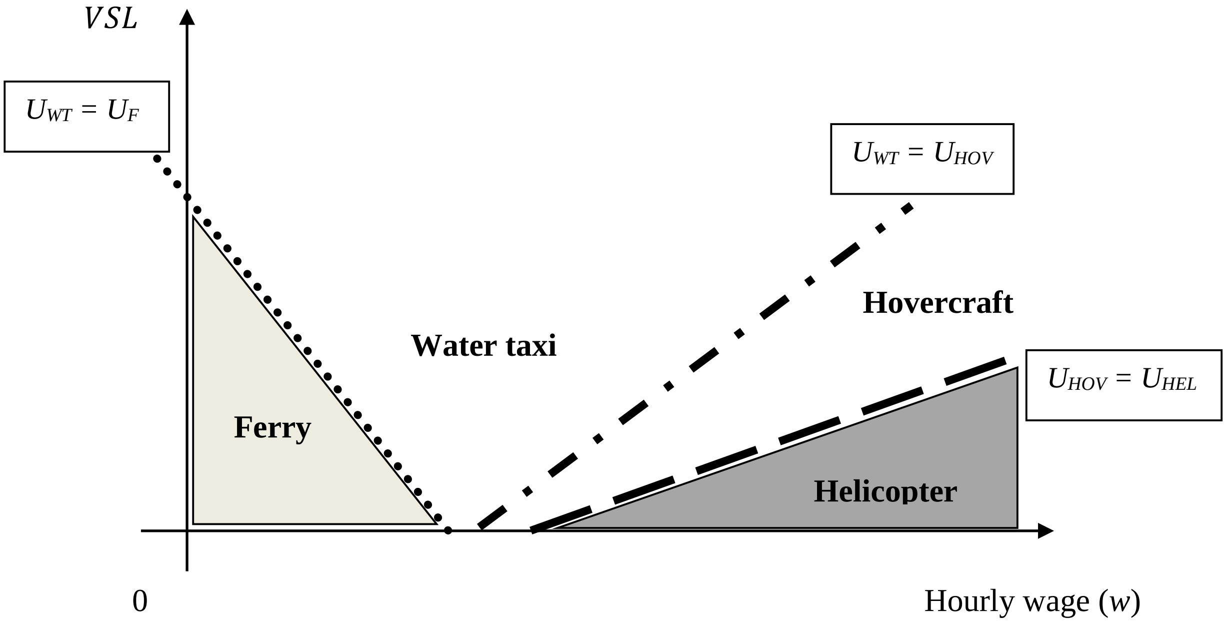


Figure 2: Operation and pricing for the modes of transport



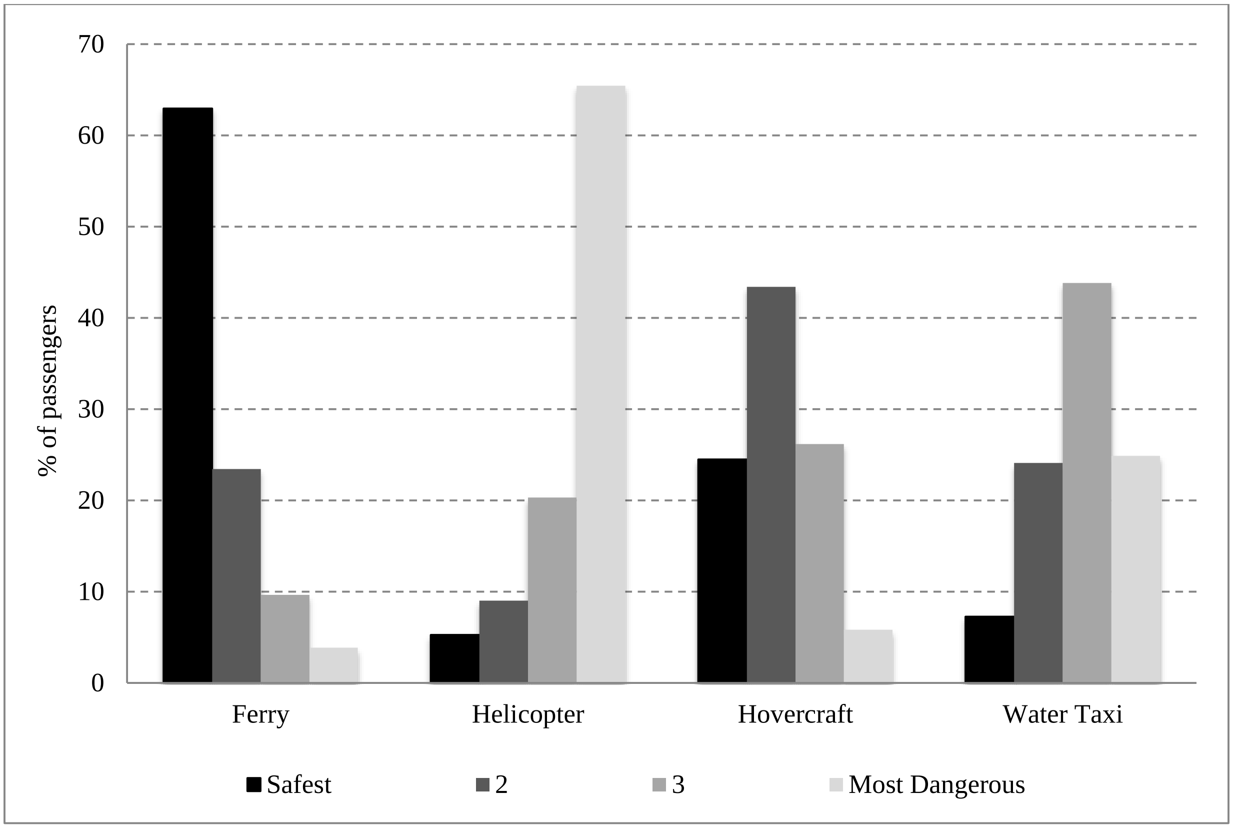
Notes: data collected by the authors through interviews with managers of the different modes of transport. The helicopter operated between March 2002 and June 2012; the Water Taxi has been operating since December 2008; the Ferry has been operating continuously; the Hovercraft started operations in December, 2004, and has reported interruptions between: (i) October 2006 and February 2007, (ii) October 2008; (iii) Between April 2009 and July 2010; (iv) May 2011; (v) June and July 2012.

Figure 3: Transport choice as a function of wages (w) and value of life (VSL)



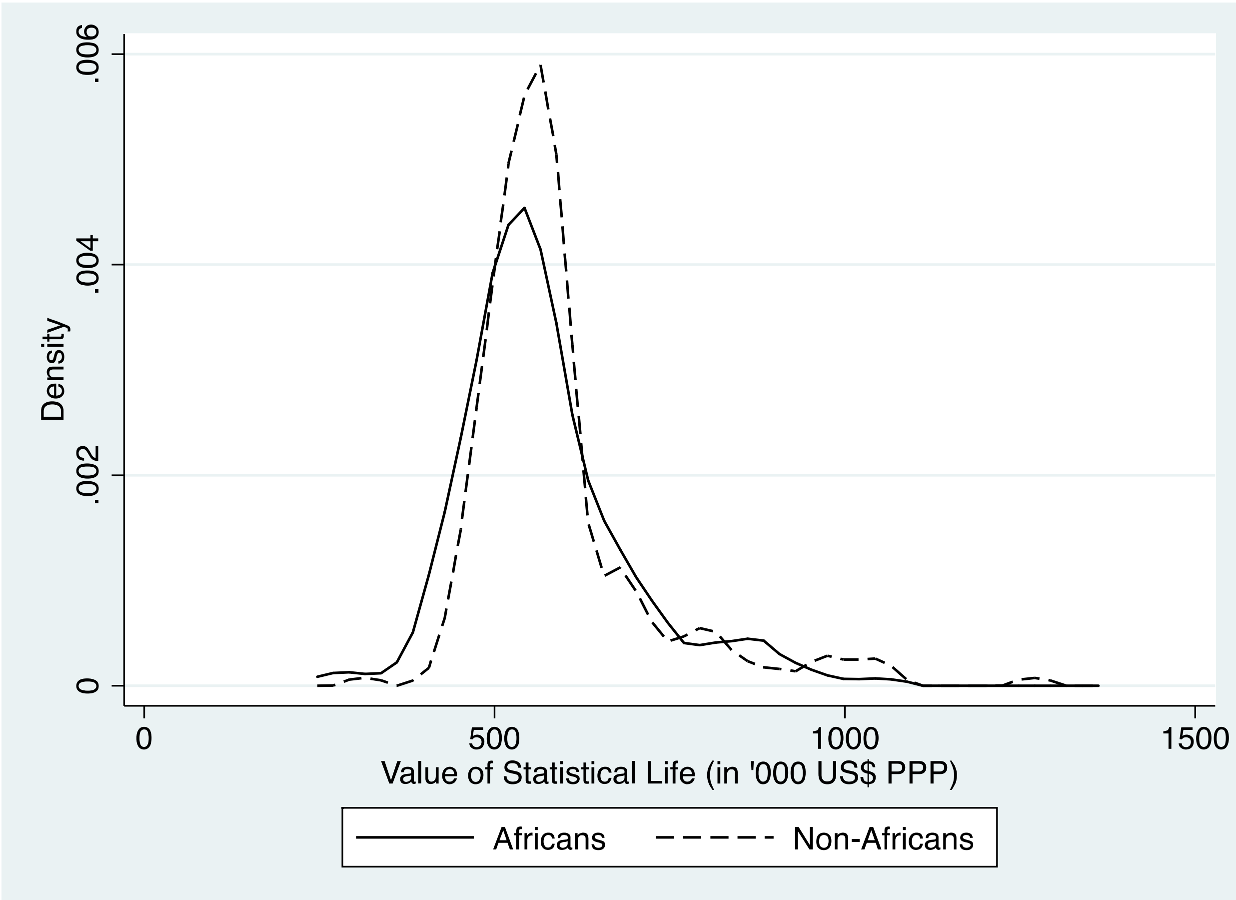
Notes: Each line represents the locus of VSL–Wage for which an individual is indifferent between two transportation options. The loci in the figure are computed using the observed historical mortality risk, average historical transportation cost, and trip duration for each of the modes of transport. The transport names indicate regions of the parameter space where that mode is chosen, i.e., the shaded region in the bottom left of the figure (near the origin) is where the ferry would be preferred in expectation, etc. In the figure, the abbreviation "WT" denotes water taxi, "F" denotes the ferry, "HOV" denotes hovercraft, and "HEL" denotes the helicopter.

Figure 4: Perceived Transportation Risk Rankings



Source: Transportation Choice Survey 2012. Each respondent was asked: "When travelling by road, air or water there are chances that an accident happens, and someone dies in the accident. Even though the chances that a fatal accident occurs are small, some modes of transport are safer than others. Moreover, these risks can change depending on the weather conditions (or the seasons). In terms of the chances of having a fatal accident on a day like today (in the rainy season, between May and September), that is, the chances that the mode of transport taken crashes, and a person like you dies in the crash: How would you rank the transport modes, from the safest to the most dangerous one?" The figure portrays the results from this question. The same question was asked for the dry season, and the results are very similar.

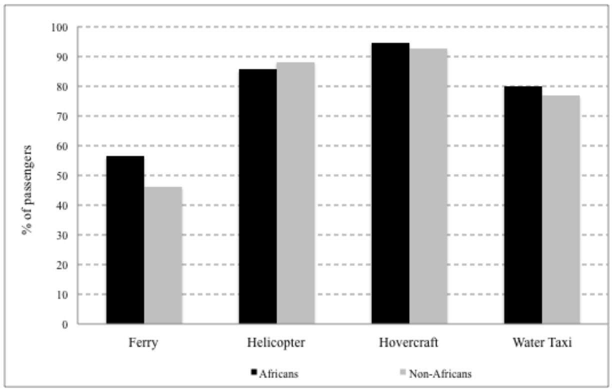
Figure 5: Distribution of individual VSL estimates, mixed logit estimates with triangular distributions



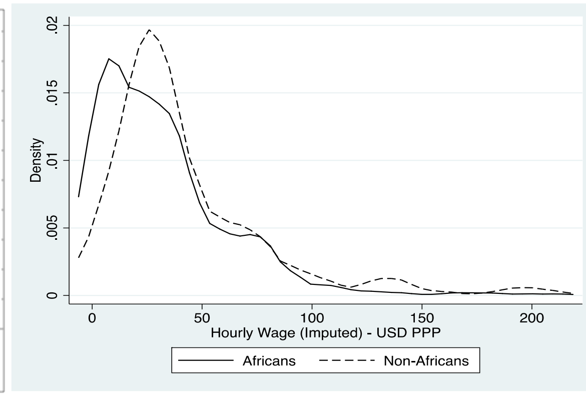
Notes: Kernel density estimates of individual VSL estimates from the mixed logit model in Column 3 of Table 5. The random coefficients associated with the probability of completing a trip and the cost of the trip are assumed to have a triangular distribution. For presentation purposes, this figure trims the top 1% of the distribution.

Figure 6: Observable Differences between African Travelers and non-African Travelers

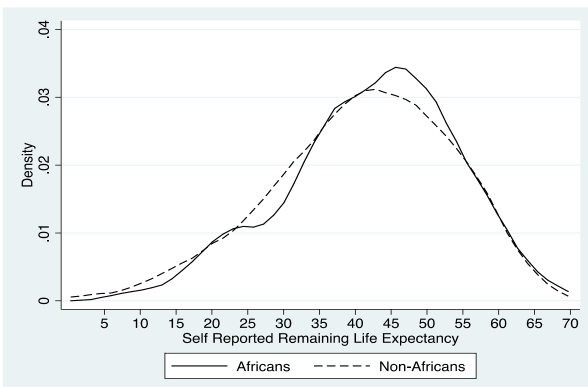
Panel A: Overall Quality: Good or Excellent



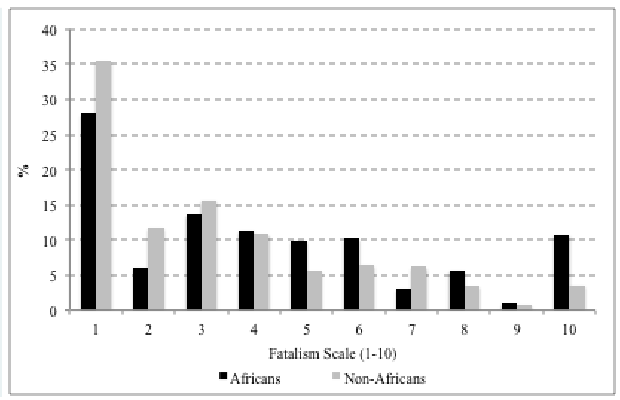
Panel B: Hourly Wage



Panel C: Remaining Life Expectancy



Panel D: Fatalism (Scale 1-10)



Notes: Panel A reports the percentage of Non-Africans and Africans who rank the overall quality of each of the modes of transport as “Good” or “Excellent”.
Panel B shows the kernel density estimates of the self-reported hourly wage for Africans and non-Africans.
Panel C presents the kernel density estimates for the self-reported remaining life expectancy for the two groups; the variable is the difference between self-reported age until the age at which the respondent reports to expect to live.
Panel D portrays the frequency of responses to a fatalism question for Non-Africans and Africans. Each respondent was asked the following question: “Some people feel they have completely free choice and control over their lives, while other people feel that what they have no real effect on what happens to them. Please use this scale where 1 means "no choice at all" and 10 means "a great deal of choice" to indicate how much freedom of choice and control you feel you have over the way your life turns out”. This scale was then inverted so that 10 denotes “no choice at all” to capture fatalism.

Table 1: Transportation Options, Descriptive Statistics and Accident Risk

	Mode of Transportation				
	Ferry	Water taxi	Hovercraft	Helicopter	Road
Panel A: Average passenger traffic					
# of trips per week	74	50	22	32	
# of passengers per week (when operating)	4440	1100	1826	640	
% of sample trips choosing this mode	56.7%	25.3%	16.0%	2.0%	-
Panel B: Costs					
Ticket cost in US$ (c_j)	0.5-2	35-40	35-50	70-80	N/A
Transit time in minutes (to/from Freetown dock/helipad)	70	35	28	12	240 +
Waiting time in minutes (avg.)	30	0	0	0	
Total travel time in minutes (t_j)	100.0	35.0	28	12.0	
Panel C: Accident risk (per 100,000 passenger-trips)					
Probability of fatal accident (p_j)	4.43	2.55	3.88	18.41	N/A
Probability of any accident	10.02	7.19	75.72	17.96	N/A
Panel D: Travel amenities (average, scale 1 to 5)					
Comfort of the seats	3.20	3.94	4.30	3.94	N/A
Less Noisy	2.21	3.99	4.19	4.09	N/A
Less Crowded	1.98	4.16	4.27	4.28	N/A
Convenient location	2.59	4.00	3.87	3.98	N/A
Quality of the clientele	3.33	4.27	4.37	4.39	N/A

Sources: Information on fatal accidents was obtained by a comprehensive search of Sierra Leone and international newspapers during the period January 2005 through June 2012, the UN engineering department in Freetown, as well as several news sources. Information on the monetary cost and travel time were obtained during fieldwork in August 2012. The probability of an accident is computed as the ratio of the total number of accidents observed during the reference period, divided by the number of trips made by transport during the same period, taking into account the breaks in service for each mode of transport. Similarly, the probability of a fatal accident is computed as the ratio of the number of fatalities observed during the reference period, divided by the estimated number of passengers that made a trip during the same period. Information on choices was collected in the 2012 Sierra Leone Survey on Transportation Choices. To get information about the average time of the trip, the researchers did each trip from the airport to Freetown multiple times.

Table 2: Accidents on Freetown-Lungi transportation modes, January 2005 – September 2012

Mode of Transportation	Date	Deaths
Ferry	Mar. 12, 2006	120
	Aug. 2, 2007	158
	Sept. 9, 2009	120
Water taxi	Feb. 27, 2009	5
Hovercraft	May 5, 2006	6
	Aug. 18, 2006	11
	Nov. 13, 2007	0
	May 23, 2008	0
	May 19, 2011	0
Helicopter	June 3, 2007	19
	Oct. 18, 2007	22

Notes: Information on fatal accidents was obtained by a comprehensive search of Sierra Leone and international newspapers during the period January 2005 through September 2012, the U.N. Engineering Department database in Freetown, and interviews with the management of each of the modes of transport.

Table 3: Respondent descriptive statistics

	Africans (N=336)		Non-Africans (N=225)		Full sample (N=561)	
	Mean	s.d.	Mean	s.d.	Mean	s.d.
Panel A: Transportation Choices						
Transport taken: Ferry	0.67	0.47	0.36	0.48	0.57	0.50
Transport taken: Water Taxi	0.20	0.40	0.36	0.48	0.25	0.43
Transport taken: Hovercraft	0.11	0.32	0.25	0.43	0.16	0.37
Transport taken: Helicopter	0.02	0.13	0.03	0.16	0.02	0.14
Panel B: Respondent Characteristics and Attitudes						
Gender (1=Male)	0.78	0.42	0.76	0.43	0.77	0.42
Age	39.87	10.91	41.17	11.97	40.34	11.30
Educational level: less than completed university	0.23	0.42	0.13	0.34	0.19	0.40
Educational level: complete university or more	0.77	0.42	0.87	0.34	0.81	0.40
Personally affected by civil conflict (Yes=1)	0.58	0.49	0.15	0.36	0.43	0.50
Have children? (1=Yes)	0.81	0.39	0.69	0.46	0.77	0.42
Knows how to swim?	0.36	0.48	0.74	0.44	0.50	0.50
Nationality: Sierra Leonean	0.58	0.50	0.00	0.00	0.37	0.48
Hourly wage (PPP) - Measured	25.68	28.08	50.77	56.98	34.38	42.18
Hourly wage (PPP) - Imputed	29.05	27.65	47.60	51.35	35.64	38.80
Self-reported belief of remaining life expectancy	42.75	11.89	39.77	12.26	41.69	12.10
Self-reported fatalism (scale 1 to 10)	4.21	3.05	3.27	2.57	3.87	2.92

Notes: “Africans” includes Sierra Leoneans. Panel A shows statistics for all trips recorded in the dataset (1793 overall, 1083 Africans, 710 Non-Africans). Panel B shows descriptive statistics at the individual traveler level (N shown in the table header). All statistics are weighted to represent the observed proportions of the population taking each mode of transport. The PPP exchange rates come from the World Bank's World Development Indicators. The conversion to PPP uses the country of residence of the respondent. Wage imputations are based on three education categories (high school or less, some or completed university, and post graduate), region of residence (African / non-African), and job status (Government, international organization or private business outside Sierra Leone; Local NGO, local business, academic/research/education; Student/Unemployed). 447 out of 561 respondents reported their wages (270 of 337 Africans, and 177 of 225 Non-Africans).

Table 4: Transportation Choices and the Value of a Statistical Life – conditional logit estimates

	(1)	(2)	(3)	(4)	(5)
	Africans		Non-Africans		All
Prob. of completing the trip ($1-p_j$)	6.668	8.996	10.408	10.524	11.876
	(1.371)***	(1.741)***	(1.952)***	(2.202)***	(2.444)***
Total transportation cost ($Cost_{ij}$)	-0.021	-0.012	-0.004	-0.004	-0.002
	(0.002)***	(0.003)***	(0.005)	(0.004)	(0.003)
($1-p_j$) * African					-3.921
					(2.820)
$Cost_{ij}$ * African					-0.013
					(0.004)***
Ranking: Comfort of the seats		-0.351		1.075	0.116
		(0.519)		(0.626)*	(0.402)
Ranking: Less Noisy		0.310		-0.408	-0.010
		(0.616)		(0.712)	(0.457)
Ranking: Less Crowded		-1.285		-0.430	-0.806
		(0.477)***		(0.696)	(0.395)**
Ranking: Convenient location		-0.981		0.256	-0.409
		(0.431)**		(0.509)	(0.334)
Ranking: Quality of the Clientele		0.152		-0.298	-0.103
		(0.582)		(0.673)	(0.429)
Observations (respondent-alternative options)	3,281	3,281	2,124	2,124	5,405
Number of trips	1083	1083	710	710	1793
Number of decision makers	336	336	225	225	561
Log-Likelihood	-997.15	-941.28	-616.02	-609.84	-1,573.87
Mean Value of a Statistical Life (in '000 US$ PPP)	319.985	778.492	2,586.708	2,960.968	-
2.5% percentile	155.781	235.181	-3,658.309	-4,674.640	-
97.5% percentile	484.189	1321.803	8,831.725	10,596.570	-

Notes: The data are from a survey applied to travelers in August-September 2012. The probability of completing the trip is defined as the one minus the probability of being in an accident and dying (x1000). Each observation in is a unique traveler-transportation mode pair in the current choice. The dependent variable is an indicator equaling 1 if the traveler chose the transportation mode represented in the traveler-transportation mode pair. In every choice situation, we consider only the transportation modes available (i.e., the hovercraft or the helicopter are unavailable in certain months), and limit the sample to trips that took place in January 2005 of later. All regressions are weighed to be representative to the actual share of travelers taking each individual mode of transport. Standard errors below each point estimate are clustered at the level of the individual decision-maker, significantly different than zero at 90% (*), 95% (**), 99% (***) confidence. The VSL is the ratio of the coefficient estimates on the probability of completing the trip term over the total cost term, and its standard error is estimated using the delta method.

Table 5: Transportation Choices and the Value of a Statistical Life – mixed logit estimates with triangular distributions

	(1) Africans	(2) Non-Africans	(3) All
Prob. of completing the trip ($1-p_j$)	10.209	10.572	10.155
	(2.182)***	(2.311)***	(1.595)***
Total transportation cost ($Cost_{ij}$)	-0.020	-0.012	-0.019
	(0.003)***	(0.003)***	(0.002)***
Controls for perceived qualities of modes of transp.	Yes	Yes	Yes
Observations (respondent-alternative options)	3292	2124	5,416
Number of trips	1083	710	1793
Number of decision makers	336	225	561
Log-Likelihood	-855.262	-679.567	-1556.953
Mean Value of a statistical life (in ‘000 US$ PPP)	577.260	923.928	597.749
2.5% percentile	397.616	685.191	418.572
97.5% percentile	1,142.138	1,263.699	1,046.118

Notes: The data are from a survey administered to travelers in August-September 2012. The probability of completing the trip is defined as the one minus the probability of being in an accident and dying (x1000). Each observation in is a unique traveler-transportation mode pair in the current choice. The dependent variable is an indicator equaling 1 if the traveler chose the transportation mode represented in the traveler-transportation mode pair. In every choice situation, we consider only the transportation modes available (i.e., the hovercraft or the hovercraft are unavailable in certain months), and limit the sample to trips that took place in January 2005 of later. In all regressions we control for passenger’s perceived ranking on: comfort of the seats, less noisy, less crowded, convenient location, and the quality of the clientele. All regressions are weighed to be representative to the actual share of travelers taking each individual mode of transport. Standard errors below each point estimate are clustered at the level of the individual decision-maker, significantly different than zero at 90% (*), 95% (**), 99% (***) confidence. The VSL is the ratio of the individual level coefficients on the probability of completing the trip term over the total cost term.

Table 6: Income Elasticity of the Value of a Statistical Life, using individual mixed logit VSL estimates and self-reported wages

	(1)	(2)	(3)
	Africans	Non-Africans	All
Log($Wage_i$)	1.827	1.703	1.770
	(0.033)***	(0.027)***	(0.022)***
Observations	312	218	530
R^2	0.91	0.95	0.92

Notes: The dependent variable is Log(VSL_i) for each individual i as generated in the mixed logit model (in Table 5, Column 3). The constant term is omitted from the regression. Individuals without self-reported wages or earnings are omitted from the analysis here. Significantly different than zero at 90% (*), 95% (**), 99% (***) confidence.

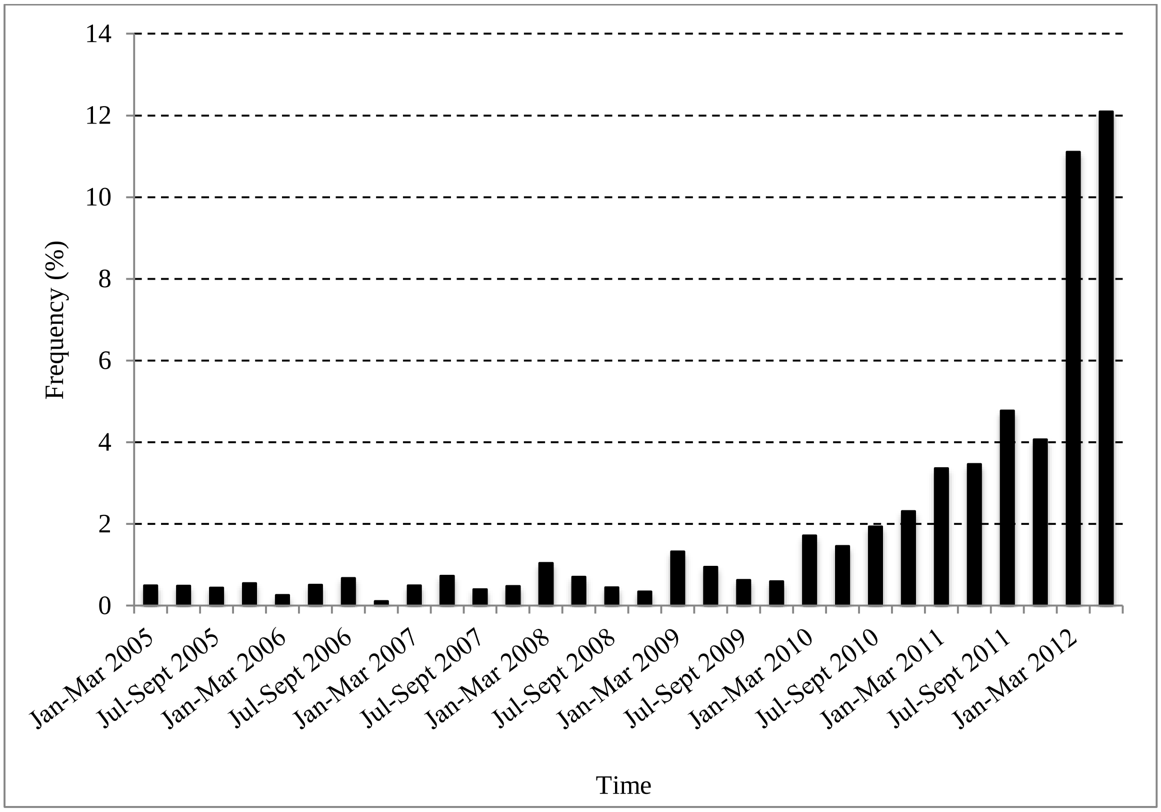
Table 7: Heterogeneity in VSL estimates (conditional logit estimates), full sample

	(1)	(2)	(3)	(4)	(5)	(6)
Prob. of completing the trip ($1-p_i$)	11.876	13.322	13.276	13.134	11.804	11.825
	(2.444)***	(2.543)***	(2.555)***	(2.584)***	(2.983)***	(3.027)***
Total transportation cost ($Cost_{ij}$)	-0.002	-0.003	-0.003	-0.005	-0.012	-0.013
	(0.003)	(0.003)	(0.003)	(0.003)*	(0.003)***	(0.003)***
($1-p_j$) * African	-3.921	-4.416	-4.331	-4.393	-3.283	-3.386
	(2.820)	(3.197)	(3.238)	(3.255)	(3.537)	(3.542)
$Cost_{ij}$ * African	-0.013	-0.011	-0.010	-0.009	-0.001	-0.001
	(0.004)***	(0.004)**	(0.004)**	(0.004)**	(0.004)	(0.004)
($1-p_j$) * Remaining life exp. (/10)			-0.622			-0.603
			(2.419)			(2.745)
$Cost_{ij}$ * Remaining life exp. (/10)			-0.001			0.001
			(0.004)			(0.004)
($1-p_j$) * Fatalism				-0.196		-0.043
				(0.488)		(0.521)
$Cost_{ij}$ * Fatalism				-0.001		-0.001
				(0.001)**		(0.001)
($1-p_j$) * Wage (/100)					1.969	1.940
					(2.364)	(2.523)
$Cost_{ij}$ * Wage (/100)					0.008	0.007
					(0.002)***	(0.002)***
Controls Included:						
Perceived quality of the modes	Yes	Yes	Yes	Yes	Yes	Yes
Interactions with observables	No	Yes	Yes	Yes	Yes	Yes
Observations	5,405	5,405	5,405	5,405	5,405	5,405
Number of trips	1793	1793	1793	1793	1793	1793
Number of decision makers	561	561	561	561	561	561
Log-Likelihood	-1,573.87	-1,561.37	-1,561.19	-1,554.11	-1,541.79	-1,539.19

Notes: The data are from a survey applied to travelers in August-September 2012. The probability of completing the trip is defined as the one minus the probability of being in an accident and dying (x1000). Each observation in is a unique traveler-transportation mode pair in the current choice. The dependent variable is an indicator equaling 1 if the traveler chose the transportation mode represented in the traveler-transportation mode pair. In every choice situation, we consider only the transportation modes available (i.e., the hovercraft or helicopter are unavailable in certain months), and limit the sample to trips that took place in January 2005 of later. All regressions control for observed ranking of the quality of the mode of transport (Comfort, Noise, Crowdedness, Convenience of location, and quality of the clientele). Columns 2-6 also include interactions between the probability of completing the trip and cost of the trip and observable individual characteristics such as age, gender, university degree, has children, has been affected by conflict, and knows how to swim (not shown). All terms in the interactions are de-meaned. All regressions are weighed to be representative to the actual share of travelers taking each individual mode of transport. Standard errors below each point estimate are clustered at the level of the individual decision-maker, significantly different than zero at 90% (*), 95% (**), 99% (***) confidence. The VSL is the ratio of the coefficient estimates on the probability of completing the trip term over the total cost term, and its standard error is estimated using the delta method.

SUPPLEMENTARY APPENDIX (NOT INTENDED FOR PUBLICATION)

Figure A.1: Timing of trips in the dataset (by quarter)



Notes: The figure shows the histogram (in %) of the timing of all trips in the dataset. Data is grouped by quarter (three month interval). The quarter when the data was collected (Jul-Sept 2012) is not presented; 41.7% of reported trips took place during that quarter. That quarter is excluded because its inclusion in the figure makes it difficult to visually interpret the remaining data.

Table A.1: Descriptive Statistics, by mode of transportation

	Ferry		Water Taxi		Hovercraft	
	Mean	s.d.	Mean	s.d.	Mean	s.d.
Panel A: Reasons for choosing this mode						
Safer	0.84	0.37	0.43	0.50	0.80	0.40
Cheaper	0.65	0.48	0.03	0.17	0.02	0.12
Faster	0.02	0.15	0.85	0.35	0.73	0.45
More Comfortable	0.53	0.50	0.49	0.50	0.71	0.46
Panel B: Respondent Characteristics and Attitudes						
Gender (1=Male)	0.78	0.42	0.72	0.45	0.78	0.42
Age	39.76	10.71	41.31	10.56	41.02	12.80
Educational level: less than completed university	0.21	0.41	0.10	0.31	0.20	0.40
Educational level: complete university or more	0.79	0.41	0.90	0.31	0.80	0.40
Personally affected by civil conflict (Yes=1)	0.55	0.50	0.30	0.46	0.23	0.43
Have children? (1=Yes)	0.81	0.39	0.69	0.46	0.71	0.46
Knows how to swim?	0.45	0.50	0.58	0.49	0.54	0.50
Nationality: Sierra Leonean	0.47	0.50	0.25	0.43	0.23	0.42
Hourly wage (PPP)	29.59	42.85	43.43	39.79	40.26	40.68
Hourly wage (PPP) - Imputed	31.32	39.90	43.37	36.33	40.57	36.71
Self-reported belief of remaing life expectancy	82.27	4.86	81.75	5.11	81.68	6.88
Self-reported fatalism (scale 1 to 10)	42.50	11.63	40.44	10.90	40.66	13.52

Notes: In this table, each observation represents a single passenger observation. All statistics are weighted to represent the true proportions of the population taking each mode of transport. The PPP exchange rates used correspond to 2011 (2012 are still not available), from the World Bank's World Development Indicators. The conversion to PPP uses the country of residence of the respondent. Wage imputations are based on three education categories (high school or less, some or completed university, and post graduate), region of residence (African / non-African), and job status (Government, international organization or private business outside Sierra Leone; Local NGO, local business, academic/research/education; Student/Unemployed). 447 out of 562 respondents reported their wages (270 of 337 Africans, 177 of 225 Non-Africans).

Table A.2: Transportation Choices and the Value of a Statistical Life in Africa, conditional logit estimates

	(1)	(2)	(3)	(4)	(5)
	Africans, not Sierra Leoneans		Sierra Leoneans		All Africans
Prob. of completing the trip (1-p_j)	6.917	10.102	6.394	8.263	10.093
	(2.359)***	(2.647)***	(1.628)***	(2.156)***	(2.996)***
Total transportation cost ($Cost_{ij}$)	-0.019	-0.011	-0.022	-0.012	-0.009
	(0.003)***	(0.004)***	(0.003)***	(0.004)***	(0.003)***
(1-p_j) * Sierra Leonean					-2.030
					(3.532)
$Cost_{ij}$ * Sierra Leonean					-0.004
					(0.004)
Ranking: Comfort of the seats		-1.128		0.308	-0.346
		(0.716)		(0.729)	(0.518)
Ranking: Noise level		1.261		-0.573	0.315
		(0.929)		(0.812)	(0.611)
Ranking: Crowdedness		-1.530		-0.958	-1.269
		(0.683)**		(0.660)	(0.471)***
Ranking: Convenient location		-0.560		-1.280	-0.999
		(0.694)		(0.558)**	(0.430)**
Ranking: Quality of the Clientele		-0.411		0.425	0.126
		(0.659)		(0.949)	(0.587)
Observations (respondent-alternative options)	1,502	1,502	1,779	1,779	3,281
Number of trips	508	508	575	575	1083
Number of decision makers	150	150	186	186	336
Log-Likelihood	-461.35	-435.03	-534.54	-498.76	-939.92
Mean Value of a statistical life (in '000 US$ PPP)	373.236	895.981	285.474	703.423	-
2.5% percentile	47.171	-35.220	105.271	54.953	-
97.5% percentile	699.300	1827.184	465.676	1,351.892	-

Notes: The data are from a survey applied to travelers in August-September 2012. The probability of completing the trip is defined as the one minus the probability of being in an accident and dying (x1000). Each observation in is a unique traveler-transportation mode pair in the current choice. The dependent variable is an indicator equaling 1 if the traveler chose the transportation mode represented in the traveler-transportation mode pair. In every choice situation, we consider only the transportation modes available (i.e., the hovercraft or the helicopter are sometimes unavailable), and limit the sample to trips that took place in January 2005 of later. All regressions are weighed to be representative to the actual share of travelers taking each individual mode of transport. Standard errors below each point estimate are clustered at the level of the individual decision-maker, significantly different than zero at 90% (*), 95% (**), 99% (***) confidence. The VSL is the ratio of the coefficient estimates on the probability of completing the trip term over the total cost term, and its standard error is estimated using the delta method.

Table A.3: Transportation Choices and the Value of a Statistical Life in Africa, conditional logit estimates excluding the respondent's first trip made

	(1)	(2)	(3)	(4)	(5)
	Africans		Non-Africans		All
Prob. of completing the trip (1-p_j)	5.562	7.659	8.513	8.650	9.557
	(1.466)***	(1.806)***	(2.042)***	(2.212)***	(2.369)***
Total transportation cost ($Cost_{ij}$)	-0.021	-0.012	-0.004	-0.003	-0.002
	(0.002)***	(0.003)***	(0.005)	(0.004)	(0.003)
(1-p_j) * African					-2.815
					(2.814)
$Cost_{ij}$ * African					-0.013
					(0.004)***
Ranking: Comfort of the seats		-0.602		0.976	-0.049
		(0.530)		(0.604)	(0.404)
Ranking: Less Noisy		0.579		-0.209	0.200
		(0.617)		(0.722)	(0.463)
Ranking: Less Crowded		-1.344		-0.658	-0.896
		(0.477)***		(0.698)	(0.400)**
Ranking: Convenient location		-1.161		0.209	-0.524
		(0.421)***		(0.497)	(0.326)
Ranking: Quality of the Clientele		0.347		-0.159	0.039
		(0.564)		(0.676)	(0.423)
Observations (respondent-alternative options)	2,609	2,609	1,813	1,813	4,422
Number of trips	876	876	613	613	1489
Number of decision makers	335	335	225	225	560
Log-Likelihood	-807.60	-760.51	-534.36	-528.92	-1,308.08
Mean Value of a Statistical Life (in '000 US$ PPP)	267.179	641.666	2,249.418	2,687.532	-
2.5% percentile	99.863	155.453	-4,041.621	-4,901.442	-
97.5% percentile	434.495	1,127.87	8,540.456	10,276.51	-

Notes: The data are from a survey applied to travelers in August-September 2012. The probability of completing the trip is defined as the one minus the probability of being in an accident and dying (x1000). Each observation in is a unique traveler-transportation mode pair in the current choice. We exclude from the regression the first trip each passenger made. The dependent variable is an indicator equaling 1 if the traveler chose the transportation mode represented in the traveler-transportation mode pair. In every choice situation, we consider only the transportation modes available (i.e., the hovercraft or the helicopter are unavailable in certain months), and limit the sample to trips that took place in January 2005 of later. All regressions are weighed to be representative to the actual share of travelers taking each individual mode of transport. Standard errors below each point estimate are clustered at the level of the individual decision-maker, significantly different than zero at 90% (*), 95% (**), 99% (***) confidence. The VSL is the ratio of the coefficient estimates on the probability of completing the trip term over the total cost term, and its standard error is estimated using the delta method.