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Valuing Changes in Time Use in Low and Middle-Income Countries

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Executive Summary

Valuing changes in time use, particularly travel times, is often a critical parameter in the economic evaluation of development programs in low- and middle-income countries. Standard economic guidance suggests that when increases in travel time displace time on the job for salaried workers, these changes should be valued at the cost to employers (pre-tax and including benefits and indirect supervision costs). When time changes occur in a household's activities outside of salaried employment, however, the value may be more uncertain, particularly if travel time displaces time spent in leisure or on other unpaid household work. Despite a robust empirical literature in industrialized countries using nonmarket valuation techniques, there are relatively few studies examining the value of travel time in these settings. We review the ten existing studies that value changes in time use in low and middle-income countries. There is some support for a rule that is commonly used in industrialized countries of valuing travel time at 50% of after-tax wages, though in fact none of the ten studies referenced whether wages or income were pre- or post-tax. We then describe a benefit transfer approach to estimating the value of time changes in low and middle-income countries and describe possible sources of wage data. We then describe a stated preference approach that can be used to estimate the value of time for a specific development project (i.e., an estimate for a specific local context where households time use patterns will be affected by a development project).

The paper closes with our recommendations on what a benefit-cost analyst should do if one of the outcomes of a development project being appraised in a low or middle-income country is a change in households' time use patterns. Specifically, we recommend using the after-tax (take-home) wage rate in the local policy site as the value of time if the analyst believes that the majority of time changes resulting from the development project are being devoted to income-generating activities outside the formal sector. If a salaried worker can devote additional time to tasks for her employer, the value of time should be the before-tax wage rate plus benefits. If most of the time savings do **not** seem to be reallocated to income-generating activities, then the analyst should value time at 50% of the after-tax wage, and conduct a sensitivity analysis valuing time between 25% and 75% of that wage. If this parameter affects the overall recommendation on the project, the analyst should consider generating site-specific travel time values with primary research, perhaps by implementing the stated preference approach we describe. Primary research may also be warranted if the distributional impacts of the project on time use are of particular concern, since the analyst will want to learn about heterogeneity in how the local population values time use changes.

1. Introduction[1]

One important outcome of some development projects in low and middle-income countries is that households may no longer need to spend as much time to accomplish a specific activity, and can thus devote these "time savings" to other welfare-enhancing activities. For example, a health clinic may be located closer to a household's community, and thus members of the household will have to spend less time traveling to receive both routine and emergency health services. An improved water source may be located closer to a household, and thus women and children who collect water will need to spend less time to collect a given quantity of water. In both examples, households experience reductions in *travel* times. Households may choose to spend these travel time savings on other pursuits, such as leisure or paid labor, or they may in fact use the travel time savings to travel more frequently (i.e. visit the health clinic more often or to collect more water).

Changes in households' time allocation also can be negative (a cost to the household). For example, a side effect of a health or development policy or project may be that households have to spend more time on a specific activity, and thus incur a welfare loss. For example, a road project may displace some households, forcing them to relocate farther away from their work or school. As a consequence, they may spend more time commuting. In this case the change in time allocation would decrease individuals' well-being and should be counted as a cost of the policy intervention.

Having a health clinic or an improved water source closer to one's home is an economic benefit, and a common approach to measuring the magnitude of this benefit is to multiply the amount of time "saved" in the activity by a monetary value per time unit (shadow value of time). The purpose of this methods paper is to summarize the literature on the monetary value of time in developing countries and to offer recommendations to analysts who are conducting benefit-cost analyses in low and middle-income countries about what methods they can use to estimate the value of time. If conducting primary research on the value of changes in time use is not feasible or warranted, we suggest a parameter value they might use in a benefit-cost analysis instead.

This parameter value is commonly referred to in various literatures as either the "value of time" (VOT), "value of travel time" (VTT), or "value of travel time savings" (VTTS). These names imply that there is a single value for an individual or household that characterizes their opportunity cost of travel time. It is more accurate, however, to refer to the value of time saved in specific activities like collecting water or traveling to health clinics. Comparing VTT estimates across these sectors implies that marginal utility of time spent sitting in traffic, walking to a vaccination clinic, or collecting water from a source outside the home, are similar. This seems implausible, and researchers in the transportation and recreational demand sectors have long recognized that different values should be used, for example, for time spent in free-flow traffic

[1] Acknowledgments: We thank Ani Deolalikar, Lisa Robinson, Dean Jamison, and James Hammitt for helpful comments and suggestions on an earlier draft.

vs. congested traffic. Therefore, one should not expect VTT estimates to be easily transferable from one sector to another. Furthermore, these values are likely to vary among individuals even for the same activities. For example, one person may find waiting in line to be vaccinated drudgery while another enjoys the time socializing with community members. Since the marginal utility of waiting varies between individuals, so too should their value of changes in the queuing time (these might occur, for example, by adding vaccination staff and lowering wait times).

When time changes occur in the activities of employees, there is a consensus among economists working in industrialized countries that before-tax market wage data should be used to estimate the value of time, including benefits and indirect costs of employee supervision (Robinson et al 2017; Baxter, Robinson, and Hammitt, 2017).[2] This conclusion would hold in developing countries if the development project affected the time use of salaried employees on the job who paid taxes and receive benefits.

However, it is more common in developing countries than in industrialized countries for people to be working outside the formal sector and not be paying taxes. In developing countries many people, especially women, do not have jobs in the formal sector. Changes in their time allocation occur in the informal economy and the home, and valuing these changes in time allocation requires nonmarket valuation approaches. When time changes occur in a household's activities outside of salaried employment, the value may be more uncertain. Economists in industrialized countries often use the after-tax wage rate of the individual(s) affected to approximate this value (Baxter, Robinson, and Hammitt, 2017). This conclusion holds if the individual has the opportunity to tradeoff (exchange) time in nonmarket activities with activities in the formal sector.

In both industrialized and developing countries, individuals who save time in household or informal activities may have opportunities to reallocate time savings to activities that generate income. But for a variety of reasons, this may not be the case. For example, a project or policy intervention may reduce or increase an individual's commuting time without affecting the

[2] As background for this paper, we reviewed all eight of the guidance documents reviewed in the Robinson et al (2017) Scoping Study (see pages 37-38). In four cases, the guidance documents did not make recommendations on how to value time (Commonwealth of Australia 2006, Treasury Board of Canada 2007, US EPA 2010, European Commission 2015). Of these, some did not discuss valuing time at all (Canada and EU) while others discussed travel cost methods and valuations broadly without making specific recommendations (EPA (pages 7.24 – 7.28) and Australia pages 122-123). Two documents recommended valuing time lost at work at the employers' labor costs (pre-tax wages plus benefits) and time lost from private time or leisure at 100% of post-tax wages (US HHS 2016 (pages 26-32), Norwegian Ministry of Finance 2012 (pages 41-48). Both the UK and France recommend using specific values (in pounds and euros) for time savings in BCAs of transport policies (HM Treasury 2011 (pages 59-60) and French Policy and Planning Commission 2013 (pages 33-35)). In France, these values are differentiated between urban and inter-urban transport, trip purpose, distance, mode (bus/train/auto), and activity (walking, waiting, transferring). Interestingly, three of these four documents that do make recommendations cite general economic theory rather than empirical work to support these rules around valuing changes in non-work and/or leisure time. The French and UK guidance document cite no empirical studies; US HHS (2016) refer readers to the Boardman (2011) text and a US Department of Transportation report for further information.

amount of time the individual is required to spend at a salaried job. However, individuals may impute a value to time savings even in the absence of income-generation opportunities, but this may not be equal to the after-tax wage rate. And even if income-generating activities are available, individuals may decide to devote time savings to other nonmarket activities such as childcare or leisure, and it is an empirical question what economic value individuals assign to time savings devoted to activities that do not directly generate additional monetary income.

Nonmarket valuation approaches are also required to estimate the value of time in both industrialized countries and developing countries when policy interventions affect time use patterns outside an employee's normal work day. Just as in developing countries, many people in industrialized countries work at home or outside the formal sector. However, in developing countries nonmarket valuation techniques play a larger role in estimates of the value of changes in time use because few people are employed in the formal sector.

Economists in industrialized countries have thus used nonmarket valuation methods (both revealed and stated preference techniques) to estimate the value of time changes that do not occur under an employer's watch. Economists have interpreted the results of this research in industrialized countries to suggest that a reasonable estimate of the value of travel time savings would be 50% of an individual's after-tax wages (Boardman et al 2011, von Wartburg and Waters (2004)). These authors also recommend valuing travel time savings from walking at double this amount (100% of wages), and waiting at 125% of wages. But there has been little discussion in the development economics literature as to whether these conclusions are applicable in developing countries.

This paper is organized in five sections. The next, second section reviews the literature on the value of changes in time use in low and middle-income countries. In the third section, we describe a benefit transfer approach to estimating the value of time changes in low and middle-income countries. The fourth section describes a stated preference approach that can be used to estimate the value of time for a specific development project (i.e., an estimate for a specific local context where households time use patterns will be affected by a development project). In the fifth section, we present our recommendations on what a benefit-cost analyst should do if one of the outcomes of a development project being appraised in a low or middle-income country is a change in households' time use patterns.

2. Literature Review

There are relatively few empirical studies of the value of time savings in low and middle-income countries. Table 1 present a summary of ten papers that we reviewed. As shown, this literature is quite recent. All but two of these studies have been published in the last 10 years. Five of the studies are from countries in Africa (3 of these from Kenya), four from Asia (2 of these are from China), and one from Latin America (Costa Rica). Five of the studies used revealed preference methods, three used stated preference methods, and two used both. Four of the studies report VTT estimates for the transport sector (value of time spent commuting), and four report

estimates for the water supply sector (value of time spent collecting water). There is one study for the health sector and one for the labor sector. Five of the studies were conducted in large urban areas, four in rural areas, and one in a small town.

We follow the convention in the transportation and recreation demand literatures, and report VTT estimates as a fraction of hourly wage rates if authors report this. As we discuss below, this wage rate could be directly observed through surveys or from secondary data, and calculated either as the hourly wage (for hourly workers) or imputed based on annual income and an assumption about the number of working hours per year. Another common approach is to report VTT estimates as a fraction of local unskilled wage rates. Unfortunately, none of the ten studies distinguishes between before- and after-tax wages. It seems most likely to us that in most cases what was observed was after-tax wages because the informal economy is larger in these settings and fewer workers would be earning taxable wages.

In the transportation sector, Dissanayake & Morikawa (2002) and Walker (2010) estimated VTTs by examining actual mode (bus, car, train) choices in a revealed preference, nested logit framework. Dissanayake & Morikawa (2002) report a mean VTT of 27 baht per hour in Bangkok in 1995. The authors do not report results as a fraction of wages or income. Walker (2010) report a range of VTT in Chengdu, China of 51- 86% of the city-wide average hourly wages.

Liu (2007) used both actual mode choice and data from stated preference questions to rank-order respondents' transportation choices. VTT estimates averaged 64% of in-sample wage rates for in-vehicle time and 82% of wages for out-of-vehicle time.

Alpizar and Carlsson (2003) used a repeated discrete choice approach, asking car commuters in San Jose, Costa Rica to make several hypothetical choices between continuing to commute by car or switching to a public bus. The authors model these data using a random-parameters logit framework, and find mean values of VTT of 40-50% of the sample's hourly wages, with higher willingness-to-pay for reductions in travel times by bus than by car.

Jeuland et al. (2010) applied the travel cost method to individuals' decisions to travel and queue to receive free cholera vaccines in Beira, Mozambique. Using a count model of visits from surveyed households throughout the city, and survey data on the pecuniary cost of travel (i.e bus fares) and respondents' total travel times, , they estimated respondents' VTT as 18-46% of the median hourly wage.

Larson (2015) use a contingent behavior approach and asked respondents in rural Botswana to make a series of choices among hypothetical jobs in community-based natural resource programs. Each choice task offered a respondent different job offers that differed by type of activity, daily wage, and days of month to be worked. The author used a flexible model of labor decisions in which the shadow value of time varies with a number of economic variables rather than implying a single, constant value of time. The author used the model results to estimate the minimum wage they would accept for each job type.

Whittington et al. (1990) used two revealed preference methods to estimate the VTT spent collecting water from outside the home in a small market town (Ukunda) in eastern Kenya. Both methods relied on actual water source decisions. The first approach bounded VTTs by exploiting differences in collection times (including walking, waiting and filling containers) and prevailing prices paid between free open wells, water kiosks, and water vendors who would deliver water to the house, along with times needed to collect water from each of these. The second used a multinomial logit discrete choice framework. Both approaches used data from 69 households and found that the VTT was approximately 100% of unskilled wages.

Asthana (1997) analyzed water source choice decisions of 490 households in rural India using a discrete choice model. The author estimated the VTT to be approximately 35% of the unskilled wage rate.

Kremer et al. (2011) examined individuals' decisions to travel to springs that had been randomly-selected for protection from water quality contamination in rural Kenya. Actual water source choices, as well as stated rankings of sources, were modeled with a random parameters logit framework. The authors' main research objective was to estimate how households valued improvements in water quality. To estimate the value of time spent collecting water, however, the authors used stated preference data from a double-bounded, dichotomous choice contingent valuation task. In the first step of the valuation task, respondents were asked how much their household would be willing to pay to "keep their spring'' protected. In the second step, respondents were asked how many minutes their household would be willing to walk to obtain water from a protected spring. For the 104 respondents with responses to both questions, the authors divided the willingness to walk by the willingness to pay to derive the VTT. Their estimate has a mean of US$0.09 per 8-hr day, or only 7% of unskilled or casual labor wage rates.[3]

Cook et al (2016) also used stated preference data to estimate the value of time spent collecting water in rural Kenya, but their approach differs from Kremer et al. (2011). Their valuation task explicitly presents respondents with the tradeoff between time and money, rather than relying on the ratio of two separate valuation exercises. This approach also allowed Cook et al. (2016) to model responses in a richer random-parameters logit framework and to report individual-level VTT estimates. Also, in the Kremer et al. (2011) study, the average self-reported one-way walking time in their site was only 9 minutes so that time spent collecting water may have been less salient to respondents than in the study site in Cook et al (2016), where average one-way walk times were 22 minutes.

[3] Kremer et al. (2011) observed only bounded values of time and money and assigned individual values based on the median of a normal distribution fit to the data (see footnote 18, pg. 185 of their paper). The underlying individual-level estimates are not reported or explored (only the summary statistics of the distribution of VTT are reported). To produce VTT estimates for the remainder of their sample, the paper mentions (p. 185) a regression of these VTT estimates on education, number of children and asset ownership, but the results from this regression are not discussed or presented in the paper or in either of the two supplementary appendices.

Cook et al. found that there was considerable heterogeneity in the value of time savings among their sample households. A latent class modeling approach revealed four categories of respondents. About a third of sample respondents valued the time savings quite highly – at 140% of the prevailing unskilled wage rates. For these households, time savings were clearly valuable, either because they could be reallocated to income-generating activities, or because the household valued the fact that more time could be spent on other non-income generating activities, such as leisure or childcare. However, 18 percent of their sample households place essentially zero monetary value on time savings from having water closer to their home. The remaining half of respondents (in two latent classes) valued time at roughly 25% of unskilled wages.

Cook et al.'s results are consistent with two quite different hypotheses about the value of time spent collecting water. First, water sector professionals have often speculated that women enjoy walking to collect water from outside the home because it gives them an opportunity to socialize with other women, and they enjoy getting out of the house. Although it is true that in both instances, women do collect water outside the home, a zero value of time savings could suggest that some water carriers may not mind collecting water outside the home. [Another explanation of a zero value of time savings is that these households have few employment opportunities and are severely cash-constrained.]

This policy context also raises the issue of whose time is being saved: water collection is sometimes done by children (Sorenson et al 2011), as are other types of resource collection. The opportunity cost of time for children may be reduced educational attainment rather than lost wages. Valuing time at a fraction of the unskilled wage rate may be an underestimate of the discounted stream of higher future earnings from improved investment in the child's human capital if households did not understand the ultimate consequences of assigning work to children. Despite anecdotal evidence that this be true in many areas with poor access to water supply, there are currently few high-quality studies linking resource collection and educational attainment. One exception is Nauges and Strand (2017), who find that reducing Ghanian girls' water collection times in half is associated with increasing school attendance by 7%. It is also plausible, however, that reducing collection times may have a more important impact on educational attainment through increased time spent at night doing homework, or having more energy during the school day. Many parents may accurately judge the tradeoff between assigning their child to work that they would either need to do themselves (at an economic cost) or hire outside help. If so, the fundamental link typically assumed between a child's opportunity cost and the adult wage rate remains.

In summary, despite our warning above not to compare VTT estimates across sectors, there is a surprising consistency in the VTT results in many of the studies summarized in Table 1. Eight of the ten studies report mean VTT estimates that fall in the range of 25-75% of some measure of household income or wage rate. Only Kremer et al. (2011) report a mean VTT close to zero. And only Whittington et al. (1990) report a mean VTT close to the market wage rate of unskilled labor. There also appears to be no systematic differences in VTT estimates derived from stated versus revealed preference methods.

Recall that Boardman et al. (2011) also recommend using higher opportunity costs for time spent waiting or walking, reflecting the higher disutility most people assign to spending time in those activities. Although it seems likely that an aversion to waiting is universal in human nature, it is also plausible that households in some countries and cultures are more accustomed to waiting than the industrialized-country populations studied in most empirical applications. This would imply that households in developing countries place a lower premium on reductions in waiting times than those in industrialized countries, though they may still value reductions in wait times more than reductions in travel time.

Unfortunately, none of the studies from low and middle-income countries reviewed above addressed this issue, so our recommendation for now is to value changes in time spent waiting at the same rate as time spent travelling. Similarly, there is currently no evidence on whether these populations value reductions in time spent traveling by motorized transport differently than time spent walking. In fact, most of the studies reviewed either involved household members walking (i.e. to collect water) or choosing among only motorized transport options. Only Jeuland et al (2011) observed households making decisions about whether to walk to a vaccination site or take public transport site, but their data do not allow the estimation of differential VTTs by mode. In the absence of empirical evidence, we again recommend valuing walking time the same as time traveling by other modes.

3. Benefit Transfer Approach

The simplest approach to estimating the value of changes in time use in low and middle-income countries is to assume that the average value of time of households affected by the health or development project being appraised is some fixed percentage of the average household's wage rate. This "benefit transfer" approach effectively takes research findings from one location (the "study site") and assumes that they will be applicable in another location (the "policy site"). This is in fact the most common approach in industrialized countries when the policy intervention affects households' time use outside of their normal work day (i.e., "on their own time").

In light of the findings from the admittedly limited literature on the value of time from developing countries reviewed in the previous section of this paper, we believe that the advice of Boardman et al (2011) from industrialized countries is likely to be a good starting point for valuing changes in time use in developing countries. In other words, as a first approximation, in developing countries, households' changes in time use outside of the formal sector can be estimated at 50% of the average after-tax wage rate. There is, however, an added complication in the application of this benefit transfer approach in developing countries, i.e., what is the after-tax wage rate in the policy site?

In industrialized countries, analysts can generally obtain sufficiently accurate data on local after-tax wage rates from government statistics. Although local wage or income data from representative national surveys are becoming more accessible in many low and middle-income

countries, they remain scarce in many locations. Analysts in developing countries may need to conduct some primary research on local after-tax wage rates in order to implement this benefit transfer approach. It is important to emphasize that the recommendation to value changes in time use at 50% of the after-tax wage rate does not mean that the analyst can substitute a conversion of annual (national) GDP per capita into an hourly estimate for the household's after-tax wage rate, however convenient this substitution may seem. National GDP per capita (converted to $ per hour) is unlikely to be a close approximation of the average after-tax household wage rate in a specific location.

To obtain the average household after-tax wage rate, the analyst has three main options when secondary data are not available. First, the analyst can try to obtain self-reported household wages from a household survey like the Living Standards Measurement Survey (in many but not all surveys the LSMS asked about taxes paid or withheld (i.e Uganda 2011 or Tanzania 2010) so after-tax wages can be computed). Second, the analyst can collect self-reported income and convert this to an after-tax wage rate. Third, the analyst can gather information on the wage rate of unskilled labor in the policy site, and assume that this is opportunity cost of labor to the average household.[4]

Because the available literature from developing countries is too thin to say much about the value of time changes in different activities (e.g. collecting water from outside the home or commuting to work), we do not recommend the use of different percentages of after-tax wages for different activities. Instead we suggest that the analyst undertake a sensitivity analysis to determine whether the results of the benefit-cost analysis of the development project change for value of time changes between 25% to 75% of the after-tax wage rate.

We note that this benefit transfer approach does not capture the possibility of heterogeneity in the value of changes in time use among households affected by the health or development project. In other words, an estimate of the total benefits of time savings based on this benefit transfer approach will not reveal the distribution of benefits among different household groups. As a result, this benefit transfer approach may limit the analyst's ability to conduct a careful examination of the distributional consequences of the development project.

[4] When demand for labor is very low, e.g. during periods when little labor is needed in agriculture, it is not clear that even if the analyst had a wage rate, that it would be the right opportunity cost to use. For example, an individual might have a skilled job that pays 100 Ksh/hr, but the job is only available 8 hours per week. She cannot increase hours worked and earn 100 Ksh/hr if more time becomes available. If time "savings" are negative, then 100 Ksh/hr might be the appropriate shadow price because she would need to cut back on hours worked. But where households cannot increase labor supply even if they want to do so, the local market is not in equilibrium. Although one could in theory weight the opportunity cost of time by the probability of employment, we know of no empirical applications attempting this. Using the unskilled wage rate seems more conservative and is plausibly a better estimate of the opportunity cost of time if at the margin someone with a little additional time available could find some work on activities requiring only unskilled labor.

4. Stated Preference Approach to Estimating the Value of Changes in Time Use: Primary Research

If an analyst wishes to estimate households' value of time use changes in a specific local context, rather than use a benefit transfer approach, there are two primary options. The first is to rely on a revealed preference approach that uses households' actual decisions that involve trade-offs between time and money[5]. As discussed in Section 2, these have most commonly involved transportation mode choices, although Jeuland et al (2010) used a revealed preference approach for the decision to travel to be vaccinated. The main concern with this approach is its applicability in rural areas of low-income countries. Unless by chance a natural experiment occurs (like the mass vaccination in Jeuland et al 2010), transportation mode choices for most households may be too limited for the analyst to infer values of time from those decisions. In some settings, one might be able to gather data on households who choose to walk versus take an informal taxi or motorbike. However, unless one gathers information on repeated choices from each respondent (e.g. panel data), it will be difficult to estimate anything except a population-level average value of travel time. If individual-level estimates are desirable, for example in distributional analyses, then a stated preference approach generally will be preferable and cost less to implement.

Although a stated preference approach for estimating the opportunity cost of time has been used in a large number of studies in industrialized countries, particularly in transportation, we focus here on the recent approach in Cook et al (2016) since it was tailored for low- and middle-income countries.[6] The basic tradeoff of time and money was framed in terms of water collection decisions. Respondents were first asked about the characteristics of the sources they currently use. They were then asked to imagine that two new *hypothetical* water source alternatives were available to them. They were told to assume that the characteristics of these new sources were very good (i.e. excellent and safe for drinking, open at convenient times), so that respondents could focus on changes in the two attributes that varied between the two hypothetical sources: 1) the price charged per jerrican, and 2) the time it would take to collect water from the source (including time waiting and filling the container). In in-person interviews, the enumerator showed the respondent a printed choice task card (Figure 1) and explained the attributes associated with each hypothetical new water point, and asked if the respondent had any questions. Respondents were then asked which of the three sources (their current main source and the two hypothetical sources) they would most and least prefer to use. The most and least-preferred data were used to construct a complete ranking of the two hypothetical choices and the respondent's current primary source, which allowed the authors to estimate

[5] We recommend Haab and McConnell's 2002 text on nonmarket valuation methods for a detailed introduction to these methods.

[6] Readers interested more broadly in stated preference methods should consult the recently-updated guidance on conducting SP studies (Johnston et al 2017).

logit models that included all three options as well as models that only compared the choice between the two hypothetical sources.[7]

Figure 1. Hypothetical choice task in Cook et al (2016)

	New water point A	**New water point B**	**Your current source**
Total time to walk to source, wait, fill container and return home	**10 minutes**	**5 minutes**	(Time and cost as reported by respondent)
Cost per 20L jerrican	**1 Ksh** per 20L jerrican	**0.25 Ksh** per 20L jerrican	

Although one could have each respondent complete only one such task, it is most common to have them complete a series of choice tasks, creating a panel of hypothetical choices that can then be used to model heterogeneity in values and estimate individual-level coefficients. The process of constructing these choice tasks is not simple, and is the domain of experimental design (see Hensher, Rose and Greene 2015, Chapter 6 for an introduction). In the case of Cook et al (2016), the experiment was based on a "full factorial" design of two attributes (per jerrycan price and roundtrip time), each of which had three levels. Choice tasks where either hypothetical alternative dominated the other on both time and cost were eliminated, leaving nine choice tasks. These were then divided into three blocks with three choice tasks each. Respondents were randomly assigned to blocks, and task order within the block was randomized. In addition to the three tasks from the block, all respondents were presented with a task that included one source with the lowest time and lowest price and another source with the middle time and middle price. Because one of the two hypothetical sources dominated the other in both time and price, this task served as a simple check of respondents' comprehension of the choice experiment.

An analyst could easily adapt this overall choice experiment structure to the most salient time-money tradeoff in their "policy site." The water collection decision is likely to be relevant in many rural areas of low-income countries, especially in areas where respondents are familiar with paying per-trip or per-bucket fees. A similar tradeoff that is common in many rural areas is the decision to purchase charcoal versus spend time collecting firewood. In urban areas or in middle-income countries, one could often use repeated hypothetical choice tasks around

[7] This latter approach is important since the current water source may have unobserved attributes that provide utility or disutility, and respondents may anchor on their current status quo. Although one typically models such situations by including an alternate-specific constant (ASC), it can be useful to "strip out" that unobserved utility by focusing on just the hypothetical alternatives to focus only on the marginal utility of time versus the marginal utility of money. Note, however, that this latter model would likely do a poor job of predicting outcomes or choices.

transportation decisions. For more information on conducting high-quality stated preference studies in low-income settings, interested readers might consult Whittington (2002) for discussions of scenario design, enumerator training and supervision, and study administration.

5. Recommendations

Perhaps surprisingly, we find that economists' standard advice for valuing changes in time use outside of the formal sector in industrialized countries (i.e., use 50% of the household's after-tax wage rate) seems to be applicable as well in low and middle-income countries. At the same time, a simple stated preference approach is now available for estimating the value of time changes specific to a "policy site." This stated preference approach for valuing time changes has been tested in a developing country context (rural Kenya), and we believe that the results are encouraging.

We recommend that an analyst who is conducting a benefit-cost analysis of a development project in a developing country that results in significant changes in households' time use first investigate to see if the majority of time changes are being devoted to income generating activities outside the formal sector. If this is the case, then one should use the average household after-tax (i.e. take home) wage rate as the value of time. Time saved on the job such that a worker can devote the additional time to other tasks for her employer should be valued at the before-tax wage rate plus benefits, although we suspect this situation will be less common in the types of policy initiatives envisioned for this guidance note.

If most of the time savings do not seem to be reallocated to income-generating activities, then the analyst should test whether an assumption of the value of time between 25% and 75% of the average after-tax wage rate in the policy site affects the outcome of the appraisal. If values of time within this range do not affect the recommendation on the project, then primary research on the value of time in the policy site is probably not warranted.

If the recommendation on the project (policy intervention) does change depending on the percentage of the after-tax household wage rate (between 25% and 75%), then the analyst should consider carefully the option of conducting primary research to estimate the monetary value households in the policy site impute to time changes. The stated preference approach described in section 4 will likely be the main option that analyst have at their disposal to conduct such primary research.

There is one important caveat to this recommendation. If the distributional consequences of the policy intervention (e.g., the distribution of project benefits and costs on the poor or on women) are a central focus of the project, then primary research on the value of time changes may be justified even if the recommendation on the project does not change depending on the percentage of the after-tax household wage rate. The benefit transfer approach will not reveal the heterogeneity among households in the policy site regarding their value of time. If understanding this heterogeneity among households is important to the analyst and her client,

then there is little choice but to conduct primary research on the value of time changes in the policy site.

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Table 1 – A Summary of the Literature on Estimates of the Value of Travel Time (VTT) in Low and Middle-Income Countries

Author(s)	Sector	Country	Location	Valuation Method	Date of Fieldwork	Sample Size	Results	Comments
Whittington et. al. 1990	Water supply	Kenya	Ukunda (small market town)	Revealed preference (actual water source choices, MNL)	1986	69	"Bounding" results (p273-274) imply VTT ~100% imputed wages; RUM results imply VTT ~125% of local unskilled wages	
Asthana (1997)	Water supply	India	Rural	Revealed Preferences (Actual water source choices, probit)	?	245	VTT - 35% of the unskilled wage rate (as fixed by Labor Commission)	Little information on survey effort or sample frame
Dissanayake & Morikawa, (2002)	Transport	Thailand	Bangkok	Revealed Preference (Actual mode choice, nested logit)	1995	1,205	mean VTT of 27 Thai baht/hr, but no description of average wage rates in sample. Cost parameter expressed as fraction of income.	First level of nested model is ownership of car or motorcycle; lower level models mode choice. Two-commuter households only.
Alpizar & Carlsson (2003)	Transport	Costa Rica	San Jose	Stated Preference (Repeated discrete choice, MNL and RPL)	2000	602	mean values of VTT of 40-50% of the sample's average hourly wages, but sensitive to econometric specification	Frame limited to current car owners
Liu (2007)	Transport	China	Shanghai	Revealed & Stated preference (Actual mode choice &	2001	100 (useable sample of 91)	VTT estimates averaged 64% of in-sample wage rates for in-vehicle time and 82% of wages	No information on sampling strategy or representativeness

				contingent valuation)			for out-of-vehicle time	
Walker et al. (2010)	Transport	China	Chengdu	Revealed Preference (Actual mode choice, latent class)	2005	532 commute trip choices from 1,001 sampled households	Average VTT 7.8 – 12.9 yuan per hour, 51- 86% of city-wide average income	
Jeuland et al. (2010)	Health	Mozambique	Beira	Revealed preference (Travel Cost)	2005	1300	valued travel time at 18-46% of the median hourly wage in sample	Household travel cost model of decision to participate in a vaccine trial; did not distinguish between utility of traveling and queuing
Kremer et al. (2011)	Water supply	Kenya	Rural	Stated preference (double-bounded, dichotomous choice contingent valuation)	2005	104	$0.09 per 8-hr day; 7% of unskilled or casual labor wage rate	Willingness to pay for protected springs asked as separate exercise from "willingness to walk". VTT as ratio of these two (n=104); estimate reported is for an out of sample prediction to other study participants
Larson (2015)	Labor market choices	Botswana	Rural	Stated preference (contingent behavior)	2007	499 households in 13 villages	VTT varies by job characteristics but average BWP 8-12 per day for men, 17-21 for women.	Willingness to accept wildlife conservation jobs; job type, daily wage, number of days worked per month, and job duration varied. Model allowing VTT to vary with money income, time available, wage offered and days

								worked fit data better than constant VTT parameter
Cook et al. (2016)	Water supply	Kenya	Rural (Meru)	Stated preference (Discrete choice experiment, RPL and latent class)	2013	387 in four "sublocations"	50% of the household's wage rate but heterogeneity	Among households without private piped connections