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# Protection and the Determinants of Household Income in Tanzania 1991-2007

**by**

**Vincent Leyaro and Oliver Morrissey**

**Abstract**

This paper analyses the association between household characteristics – in particular size and location, and for the household head age, sector of employment (and the tariff applicable to that sector) and education - and household income using data from the Tanzania Household Budget Survey for the years 1991/92, 2000/01 and 2007. The static analysis of the determinants of household income is based on the full sample and is complemented by a dynamic analysis using a pseudo-panel (representative households). Larger households have lower income; living in urban areas is associated with income around one quarter higher than rural households; and location in the Coastal zone, which includes Dar es Salaam, increases household income by about 15% compared to the poorest region (Central). Years of education of the household head is associated with higher income: each additional year of education adds about 4.5%. Average incomes of agriculture households are lower than for manufacturing households, but within each broad sector incomes appear to be higher in sub-sectors with higher tariffs. Household income tends to increase in both tariffs and education, but the effect of tariffs diminishes or becomes negative for household heads with secondary education and alters over time. Observing that tariffs offer less protection to the incomes of more educated workers compared to less educated (less skilled) workers is consistent with better educated workers being more productive and therefore in firms, or sectors, better able to compete with imports. Given data limitations it would be incorrect to infer a causal effect of tariffs on household incomes. Nevertheless, the analysis is informative about the effect of the cross-sector pattern of tariff protection on household incomes allowing for other determinants.

**JEL Classification:** D10, H31, O55

**Keywords:** Household Income, Sector Tariffs, Education, Tanzania

**Centre for Research in Economic Development and International Trade, University of Nottingham**

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## Outline



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## 1 Introduction

The prediction that changes in exposure to international trade alter the demand for and returns to factors and the distribution of incomes within a country is one of the accepted tenets of trade theory. In developing countries, where the majority of the population are employed in the informal or household self-employment (business or farm) sectors and devote a substantial amount of time to production for own consumption (Winters, 2002), effects on labour demand and income earning opportunities rather than on relative wages are likely to be the mechanism through which trade affects income distribution and poverty. This is captured in the Stolper-Samuelson theorem, which in its simplest form suggests that trade liberalisation should help the less skilled (the relatively if not absolutely poor), the relatively abundant factor in developing countries, by increasing demand for the products they produce thereby raising their incomes. According to this framework, the poor can gain more from trade openness as it decreases income inequalities. Krueger (1983) and Bhagwati and Srinivasan (2002) argue that, as developing countries are likely to have a comparative advantage in goods made with unskilled labour, tariff reduction should be pro-poor as it raises the wages of unskilled labour in poor (unskilled-labour abundant) countries. Thus, expanding trade opportunities should cut poverty and reduce inequality within poor countries.

According to the comprehensive review by Goldberg and Pavcnik (2007) on the distribution effects of globalization in developing countries, there is no direct evidence on Stolper-Samuelson (SS) effects; evidence suggests that the unskilled in developing countries are generally not better off following more than two decades of trade liberalisation. Distributional change has gone in an opposite direction from that suggested by conventional wisdom, i.e. even in developing countries, the skilled have benefitted more than the unskilled. Faced with this puzzling result, various researchers have challenged the Heckscher-Ohlin (HO) theory, which is the basis of the SS theorem. Researchers have considered various extensions of the HO-SS model to explain income (wage) inequality by suggesting other mechanisms through which trade (openness) affects income distribution (Davis and Mishra, 2007; Easterly, 2007; Prasad *et al*, 2007; Kraay and Dollar, 2004; Sala-i-Martin, 2002). The key question

remains: do tariffs affect household income and are the effects similar across households?

The paper addresses this question for Tanzania, employing three waves of household survey data and applying a pseudo panel technique from repeated cross-sections (RCS) to econometrically estimate the effects of trade barriers (tariffs) and tariff reductions on household income in the 1990s and 2000s. Although the method does not yield precise estimates, as it is not possible to clearly identify the effect of tariffs on household income and tariff changes are not a treatment effect (there is no untreated control group), it does permit an informative analysis of the relationship between household income and household characteristics that may be affected (albeit indirectly) by trade policy. Tanzania is a relevant case study as it is a low income country, with around 45 per cent of the population below the poverty line in the early 1990s, with three rounds of survey data spanning 1991 to 2007 during which the trade regime was reformed.[1]

The cross-sector tariff reductions that occurred during the period are exploited to establish a link between trade policy and household income. Average sector tariffs have fallen from a maximum of 50 per cent in 1991 to 25 per cent in 2000 and 12.5 per cent in 2007 (see Appendix Table A1). Sector average tariffs (at two digit HS code level) are matched to household data by allocating to a household the tariff corresponding to the principal sector of employment of the household head. As the three survey waves do not constitute a panel, the repeated cross-section data is exploited to form a pseudo panel to track a variety of 'representative' households. While there has been substantial work on incomes (and inequality) and descriptive analysis of the characteristics of the poor and changes over time (National Bureau of Statistics, 2002 and 2008; Treichel, 2005), to our knowledge there is no multivariate econometric analysis of the effects of tariffs on household income (measured as consumption expenditure, earnings or wages) in Tanzania.

The empirical literature on the effects of trade policy change on incomes can be categorised into two broad approaches, cross country studies (typically *ex post*

[1] Identifying the effects of trade is confounded as many other reforms were implemented in addition to tariff reductions: price decontrol; rationalization of tariffs and taxes; dismantling of import restrictions (non-tariff barriers); devaluation of the local currency, introducing a market-determined exchange rate and incentives to promote exports; reform of fiscal and monetary policies.

econometric analysis) and country case studies (usually *ex ante* simulation).[2] Most cross-country studies are based on aggregate (macro) data and are limited: problems of data quality; difficulty of distinguishing the effects of trade reforms from other contemporaneous effects and policy changes; and aggregate data do not capture distributional effects. Even if researchers attempt to test for the direct effect of trade on income distribution in aggregate data, there may be significant underlying heterogeneity (Harrison, 2006; Ravallion, 2004). The case studies focus exclusively on the experiences of particular developing countries, often 'predicting' or simulating the likely effects using techniques such as computable general equilibrium (CGE) models (e.g., Hertel and Jeffrey, 2004). Although they can be linked to household data for microsimulation of distribution effects, CGE models have been criticised for using very restrictive assumptions (Kirkpatrick and Scrieciu 2007).

To address limitations of these approaches, researchers have called for the use of micro (highly disaggregated) data, such as at the level of the household or firm, to identify the impact of trade (liberalization) on income (distribution). Micro level data studies are able to allow for (household) heterogeneity, although there are difficulties in addressing endogeneity (even if panel data are available) and disentangling the effects of trade reforms from other contemporaneous policies. Despite the increasing availability of survey data in developing countries, there are few studies examining the effects of trade (policy) on household income (welfare), especially for Africa.[3] To fill this gap, this paper is in the 'micro data' tradition and focuses on the income effect channel.

The remainder of this paper is organized as follows. Section 2 describes the empirical strategy employed in the context of the literature. The data sources and variables are discussed in Section 3, which provides a descriptive analysis. Section 4 presents and discusses the empirical estimates. A concluding discussion is provided in Section 5.

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[2] See Goldberg and Pavcnik (2007), McCullogh *et al* (2002), Harrison (2006), Reimer (2002), Winters (2002) and Winters *et al* (2004).

[3] Studies include Ackah *et al* (2007), Barraud and Calfat (2008), Deaton (1989), Edmonds and Pavcnik (2002), Friedman and Levinsohn (2002), Nicita (2004), Porto (2006), Seshan (2005) and Topalova (2004).

## 2 Empirical Model and Methods

Going beyond the predictions of the SS theorem and macro-based analysis to micro level analysis that allows for heterogeneity is important in understanding the mechanisms through which trade affects earnings of households in low income countries.[4] The effect of trade on incomes of the poor (or poverty) has received less attention than effects on labour (wage) income, and the literature on wage effects is mostly on middle income countries in Asia and Latin America (Goldberg and Pavcnik, 2007). Winters *et al.* (2004) note that trade affects poverty directly through changes in relative prices faced by households as consumers and producers, the market for labour (i.e. employment and wage adjustments) and public spending (as influenced by changes in government revenue). The analysis here only considers the first of these. To estimate the overall impact of trade reforms on household welfare requires assessing the effects of trade reforms on prices, and then the effects of price changes on household welfare. The welfare impacts of changes in the consumer prices of traded and non-traded goods are called *consumption effects*, as analysed in Leyaro *et al* (2010). This paper concentrates on effects on household earnings, the *income effects*, especially labour income for workers with different levels of education (a proxy for skill differences).

In addition to consumption and income effects, there are other effects as increased incomes generate demand for services and non-traded goods (McCulloch *et al* 2002). These spillover effects are difficult to estimate in partial equilibrium and only a few studies have adopted this approach, such as Nicita (2004) for Mexico, Seshan (2005) for Vietnam, Porto (2006) for Argentina. Unlike these studies, the empirical method used in this study is the reduced form specification where the relationship between various household characteristics and household income are examined. We investigate the association of household incomes with tariffs (for the sector in which the household head is employed) and household characteristics, in particular sector of employment and level of education of the household head. To the

[4] The basic intuition behind the SS theorem applied to labour markets is that an increase in the price of a commodity increases the demand for, and hence returns to, the factors used intensively in production. For example an increase in the prices of labour intensive products will increase wage rate. However, the impact on wages is constrained in developing country with surplus labour (underemployment). As surplus labour is a feature of rural areas and informal sectors it is important to consider other sources of income and employment opportunities in addition to wage income.

extent that education is an indication of skills, this allows us to consider the differential effects of tariff changes on skilled and unskilled labour.

Panel data, where the same households are followed in successive surveys, facilitates estimation of parameters capturing the dynamic relationship in a linear dynamic model given as:

$$w_{it} = \alpha w_{it-1} + x'_{it}\beta + \varepsilon_{it} \qquad (1)$$

for $i = 1, \ldots, N$ households (denoting the cross-section dimension) over $t = 1, \ldots, T$ time periods (denoting the time series dimension), where $w_{it}$ is an endogenous variable of interest, $x'_{it}$ is a vector of exogenous explanatory variables (including age, age squared, household size, education, and location variables), $\alpha$ and $\beta$ are unknown parameters to be estimated. The error term has the usual error components structure:

$$\varepsilon_{it} = f_i + v_{it} \qquad (2)$$

where $v_{it}$ is idiosyncratic error term with zero mean and assumed to be uncorrelated over time, and $f_i$ represents a fixed effect. If panel data are available one can estimate $\alpha$ and $\beta$ using GMM estimators by first differencing (1) and then using lagged values of $w_{it-1}$ as instruments.

Suitable data are not available for Tanzania as the household surveys do not have a panel dimension, i.e. different households are surveyed in each wave. Following the seminal work by Deaton (1985) and extensions, one can exploit the repeated cross-section (RCS) data to form a pseudo-panel to group (or aggregate) the individual observations into cohorts comprising households with some similar observed time invariant characteristic(s), such as location or year of birth and sex of household head. Estimating parameters from pseudo panels has spawned a literature. To capture the dynamics, Moffit (1993), Collado (1998), Girma (2000) and McKenzie (2004) predict the lagged dependent variable from an auxiliary regression and use this to estimate the dynamic model. Verbeek and Vella (2005) criticized these estimators where the lagged dependent variable is replaced by a predicted value as inconsistent unless strong, and often unrealistic, conditions are imposed on the

exogenous variables. They proposed that inconsistent results can be overcome by instrumenting other explanatory variables using the standard within estimator applied to a dynamic model in terms of cohort averages rather than individual observations. We consider these issues in our estimation.

We exploit the availability of three rounds of household surveys in Tanzania to construct a pseudo panel and track household cohorts through the three cross-sections. Cohorts are constructed by grouping households based on three characteristics: age of head, gender of head and region in which the household is located. As there are only two values for gender (male or female) and 20 regions, the discretion relates to the span for age of household head. To capture the working population we consider only households with heads between the ages of 18 and 62 initially. As the three surveys are nine and seven years apart, for the first cross-section (1991/92) the sample only includes households whose heads are aged 18 to 62, the second cross-section (2000/01) only includes households with heads aged 27 to 72 (i.e. adding nine years) and the third cross-section (2007) only includes households whose heads are aged 34 to 78 (adding seven years). Thus, most heads of household are in the normal working age span in all surveys and households 'age' over time. We use 5-year bands in defining the generational cohorts resulting in nine birth cohorts; for example, the first age cohort studied was aged 18-22 in 1991/92, 27-31 in 2000/1 and 34-38 in 2007. This gives 360 (9 age x 2 gender x 20 regions) 'representative households' in the pseudo panel (see Appendix Table A12); Ackah *et al* (2007), apply a similar approach to Ghana.

There is a trade-off between the size and number of 'representative households' or cohorts (e.g. male heads of a particular age in Dar-es-Salaam): if the cohort cells contain a large number of households, the number of cohorts (the cross-section dimension of the pseudo-panel) will be small. On the other hand, if we aim for a large cross-section dimension (some of) the cohorts may contain relatively few households (and hence may not be representative of the 'household type'). In fact many of our 360 'representative household' cohorts are quite small; about 25% of the cells, mostly female-headed cohorts in rural locations, comprise 30 or fewer households (Appendix Table A12). On the other hand, as there are three waves of the survey we have a total of 1080 observations in the pseudo-panel, and even using

lagged income the sample size is 720. Thus, even for the pseudo-panel the sample is reasonably large (although we do lose a number of cells than have no households in one of the three surveys).

Given the large proportion of cells of small size, the pseudo-panel may not provide robust estimates and we only use it to complement the analysis using data on all households (although when we want to allow for lagged income, the pseudo-panel is our only option). For consistency, we estimate a 'cohort panel' when using all the households, i.e. for each survey, the households are allocated to the relevant cohort (of the 360) and the data are organized by these cohorts which are tracked over the surveys. Thus, although we do not have a panel of the same households, we have a panel of cohorts of similar households according to the stated criteria (age of head, gender of head and region in which the household is located). Results are reported for both the cohort and pseudo panel where both can be used. We also estimated the models by simply pooling the households and some of these results are reported for comparison.

After matching each household with the relevant sector tariff (i.e. the tariff for the sector in which the head gets the majority of income), we examine how household income (or welfare, measured as real expenditure) relates to trade reforms (as captured by tariffs). The approach is based on modelling the natural logarithm of per adult equivalent consumption expenditure of households, adjusted for variations in prices between localities and over time (using the Fisher index as in Leyaro *et al*, 2010). Household welfare ( $w$ , i.e. real per adult expenditure) is specified as:

$$\ln w_{it} = \alpha + \beta_1 age_{it} + \beta_2 age_{it}^2 + \beta_3 hsize_{it} + \beta_4 educ_{it} + \beta_5 urban_i + \beta_6 ecoz_i + \delta_1 tariff_{jt} + \mu_{it} \quad (3)$$

Subscripts *i* and *t* index households and survey years respectively: *age* is the age of household head at the time of the survey, $age^2$ is squared age, *hsize* is the size of the household, *educ* is education of the household head, *urban* is a 0/1 dummy (1 for households in urban localities and zero otherwise), *ecoz* is four climatic zones

(Central, the default, Coastal, Highlands and Lakes),[5] *tariff* is the average tariff applied to imports of sector *j* in year *t*,[6] and $\mu$ is the error term.

Equation (3) is a linear model that characterises the behaviour for a static model. Although each of the explanatory variables is likely to explain some of the differences in household welfare, it must be recognized that other unmeasured or unobservable differences between households may also matter. Unmeasured or unobservable individual heterogeneity is a problem that faces all survey research. A pooled analysis of the raw household data based on equation (3) will be flawed, in part because such analysis cannot control for unobservables and in part because it assumes that repeated observations on each household are independent. To allow for the household, sector and time heterogeneity, we exploit the organisation into cohorts and equation (3) becomes;

$$\ln w_{it} = \alpha + \beta_1 age_{it} + \beta_2 age_{it}^2 + \beta_3 hsize_{it} + \beta_4 educ_{it} + \beta_5 urban_{it} + \beta_6 ecoz_{it} + \delta_1 tariff_{it} + f_c + \lambda_j + \gamma_t + \varepsilon_{it} \quad (4)$$

Where $f_c$ is the cohort (*c*) fixed effect, $\lambda$ is the fixed effect for the household's sector (*j*) affiliation, $\gamma$ is the year (*t*) fixed effect and ε is the error term. Year fixed effects are included to absorb economy-wide shocks (such as technological change) that may affect welfare while sector dummies control for sector-specific effects, and $f_c$ captures unobserved heterogeneity.[7] Following the pseudo panel data literature, the first extension is to take cohort averages of all variables and estimate (4) based on the cohort means:

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[5] Agricultural productivity and incomes vary across zones. The Central zone is primarily a pastoral system, although legumes, beans and groundnuts are cultivated. The Coastal zone is a fertile area with major food crops (e.g. maize, rice), cash crops (cashew, sugar, coffee and tea), vegetables and fruits. The Highlands zone is also fertile, especially for coffee and tea, and major food crops such as maize and wheat. The Lakes zone is less fertile but has basic food crops such as sorghum and millet, and some livestock.

[6] Although sources of income may offer a better idea of how a given household will be affected by trade liberalization compared to patterns of expenditure (Van de Walle and Cratty, 2003), the data on income by source is not sufficiently consistent (across households) to be used. Therefore we rely on tariffs by sector of employment of head as the proxy. Furthermore, as discussed below, the majority of households are employed in non-traded sectors so there is no tariff to apply.

[7] The presence of *f* and $\lambda$ in the model implies that we need panel data to consistently estimate the parameters in the model, hence our use of the pseudo panel.

$$\ln \overline{w}_{ct} = \alpha + \beta_1 \overline{age}_{ct} + \beta_2 \overline{age}^2_{ct} + \beta_3 \overline{hsize}_{ct} + \beta_4 \overline{educ}_{ct} + \beta_5 \overline{urban}_{ct} + \beta_6 \overline{ecoz}_{ct} + \delta_1 \overline{tariff}_{ct} + \overline{f}_{ct} + \overline{\lambda}_{ct} + \overline{\gamma}_{ct} + \overline{\varepsilon}_{ct} \quad (5)$$

Equation (5) can be estimated via random- or fixed-effects estimators. The random-effects (RE) estimator generates consistent parameter estimates if the individual effects are uncorrelated with the other explanatory variables. The fixed-effects (FE) estimator is also consistent under this assumption, but is less efficient. Under the alternative hypothesis that the individual effects are correlated with other explanatory variables, only the fixed effects estimator is consistent. Though we will use both methods to estimate (5), only random effect results will be reported. As some variables including the dummies are effectively fixed (time invariant), when fixed effects is used these are dropped. Hence, RE is used as a weighted average of fixed and between effects.

The household welfare models (4) and (5) both assume preferences to be time separable. Some recent studies have drawn attention to a class of time non-separable preferences, exhibiting habit formation or persistence. The distinctive characteristic of these models is that current utility depends not only on current consumption but also on a habit stock formed from past consumption (Fuhrer, 2000; Deaton and Grimard, 1992). A dynamic specification could be justified on several grounds. First, households are likely to incur short term costs resulting from trade reforms due to rigidities. It may take time to adjust to any policy shocks such as switching jobs from sectors whose returns are declining to ones where they are rising. In effect, equation (5) may be dynamically misspecified if dynamics really matter. The best solution is to directly model the dynamics; this is very difficult without panel data, but failing to deal with the dynamics can cause serious problems. We employ an alternative dynamic econometric specification, adding the lagged dependent variable ($w_{ct-1}$) to (5).[8] This is estimated for the pseudo-panel (for which we have a lagged income) guided by Moffit (1993), Collado (1998), Girma (2000), McKenzie (2004) and Verbeek and Vella (2005).

[8] A significant coefficient on the lagged dependent variable is evidence that the previous models were mis(under) specified.

Equation (5) imposes a uniform and linear restriction on the parameter $\delta_1$ (and also in the linear dynamic model), the effect of tariff on welfare. The implicit assumption that all households would experience the same effects from tariffs is unlikely. Equation (6) introduces interaction terms to explicitly allow the effect of tariffs on households to differ. We hypothesize that differences can, at least partially, be attributed to different education qualifications and sector of employment of the household head. Equation (4) becomes (with similar addition to the dynamic specification in (5)):

$$\ln w_{it} = \alpha + \beta_1 age_{it} + \beta_2 age_{it}^2 + \beta_3 hsize_{it} + \beta_4 educ_{it} + \beta_5 urban_{it} + \beta_6 ecoz_{it} + \delta_1 tariff_{jt} + \delta_2 tariff_{it} * educ_{it} + \delta_2 tariff_{it} * sctr_{it} + \lambda_j + \gamma_t + \varepsilon_{it} \quad (6)$$

where *educ* is three mutually exclusive educational dummies (primary, secondary and tertiary) denoting the education qualification category of the household head where 'no education' is the omitted category. *Primary* is where the household head has at least primary or below primary, including adult education (i.e. better than no education); *secondary* is household heads with secondary or post-secondary education; and *tertiary* is household heads with graduate level education. The *sctr* dummies for the thirteen traded sectors of household head employment (listed in Table A1) are interacted with tariffs. Households employed in non-traded sectors are assumed to face a zero tariff, so any effects of tariffs can be interpreted relative to such households.[9]

The mediating variable (household head years of education) is transformed by mean centring to create new scales, i.e. by subtracting the sample mean of household head years of education from the value for each household, to give deviation from the mean. We estimate the product term of (6) with the transformed variables such that our coefficient of interest $\delta_1$ can be interpreted as the predicted effect of tariff on income when education is at the sample mean for primary, secondary or tertiary education. This is the marginal impact of tariff on

[9] Topalova (2004:16) argued that all households employed in non-tradable sectors should be assigned a tariff of zero as there are no imports to tax. One could argue for an infinite tariff; as there are no imports there is no competition from imports hence no *downward* pressure on domestic prices that a tariff could offset. It is not obvious how to incorporate an infinite tariff, and the zero tariff implies only that tariff interaction terms are omitted for these households (other characteristics are included).

household income conditional on education qualifications, which can be derived from the untransformed simple interaction effect of (6) as:

$$\partial \ln w_{it} / \partial tariff_{it} = \delta_1 + \delta_2 educ_{it} \quad (7)$$

The coefficient $\delta_2$ on the product term under the transformed model is similar to that on the untransformed model and tests for the presence of interaction effects, implying that the effect of tariff on household income depends on the values of household head years of education and sector of employment. This allows for a number of possibilities but the data are not of sufficient quality to allow these to be clearly distinguished. For example, the effect of tariffs on income may be different across sectors while within sectors the effect of tariff on income may vary by education (or skill) level of the worker. There are simply too few observations of specific household types to address such 'within cohort' variation. Furthermore, the tariff associated with a household is at best an indicator of the relative protection conferred on the main activity from which the household derives a (wage) income. Consequently, as acknowledged, the results are at best indicative.

## 3 Data Description and Discussion

The primary data source is the Tanzania Household Budget Survey (HBS) conducted in 1991/92 (4,823 households), 2000/01 (22,178 households) and 2007 (10,466 households). These are nationally representative surveys conducted by the National Bureau of Statistics with information on: household expenditure, consumption and income; economic activities and source of income; household members' education and health status; ownership of consumer goods and assets; housing structure and building materials; and household access to services and facilities. The surveys provide data at the level of Dar es Salaam (the capital), other urban areas and rural areas. The sampling design for interviewed households was in two stages. Primary sampling units (PSUs), either urban enumeration areas or rural villages, were selected based on the National Master Sample (NMS). Then, households were selected using systematic random sampling from a stratified list of households for each of the sampled PSU. An almost identical questionnaire was administered to each household.

The tariff data is aggregated to the two digit Harmonized System (HS) level for the survey years using both *ad valorem* scheduled (published MFN) and implicit (collected import duty relative to CIF import value) tariffs from the Tanzania Revenue Authority, Customs Department. Given the matching of tariffs at the two digit HS level we have 19 sectors, 13 are in the traded goods sector and six in the non-traded sector. The sample is selected conditional on household head working (and so having a main source of income) and aged between 18 and 78 years; any other households are excluded. Each selected household is mapped to the sector of either main employment or source of income of the household head. This leaves a sample of 4,262 in 1991/92, 18,241 in 2000/01 and 6,534 in 2007.

**Table 1 Summary Statistics on Household Characteristics**

| | *1991/92* | | *2000/01* | | *2007* | |
|---|---|---|---|---|---|---|
| ***Variable*** | ***Mean*** | ***Std. Dev.*** | ***Mean*** | ***Std. Dev.*** | ***Mean*** | ***Std. Dev.*** |
| *Welfare (Tshs)* | 12,393 | 10,081 | 13,024 | 10,692 | 14,351 | 13,410 |
| *Log Welfare* | 9.19 | 0.68 | 9.25 | 0.66 | 9.32 | 0.68 |
| *Age Head* | 39.91 | 10.96 | 42.96 | 12.10 | 49.89 | 11.36 |
| *AgeHead*$^2$ | 1,7123 | 911 | 1,993 | 1,133 | 2,618 | 1,213 |
| *Hh Size* | 5.72 | 3.52 | 5.09 | 3.04 | 5.27 | 3.08 |
| *Years Education* | 5.91 | 4.96 | 10.88 | 0.41 | 11.32 | 7.23 |
| *No Education (%)* | 0.22 | 0.41 | 0.22 | 7.04 | 0.26 | 0.44 |
| *Basic (%)* | 0.70 | 0.46 | 0.68 | 0.42 | 0.64 | 0.48 |
| *Secondary (%)* | 0.05 | 0.22 | 0.06 | 0.47 | 0.06 | 0.23 |
| *Post Secondary (%)* | 0.01 | 0.11 | 0.02 | 0.24 | 0.02 | 0.14 |
| *Tertiary (%)* | 0.01 | 0.11 | 0.02 | 0.13 | 0.02 | 0.14 |
| | *1991-2001* | | *2000-2007* | | *1991-2007* | |
| *Real Welfare Change (%)* | **5.09** | | **10.18** | | **15.79** | |

*Source*: Calculated from Tanzania Household Budget Surveys for 1991/92, 2000/01 and 2007.
*Notes*: The reported figures are weighted using survey weights.

This section describes the data on household head main source of income, economic activities, education and poverty status to illustrate the variation across households and over time. We start by looking at the key household-level variables specified in equation (3): a set of demographic variables that relate to linear and quadratic terms in the age of the head of household to capture possible life cycle effects, educational attainment and household size. Agro-climatic zones are important for households

engaged in agriculture as noted above. Although the skill classification above is based on three education levels we here consider four: Basic Education (equivalent to *primary*); Secondary and Post-Secondary Education (treated separately) and *Tertiary* Education.

The summary statics in Table 1 show that there has been a marginal improvement in almost all of the indicators, particularly education and household welfare. The categories 'no education' and 'basic education' account for almost 90 per cent of all heads in each survey, although there has evidently been a gradual increase over time in years of education and the share of household heads completing education beyond the primary level.

Table 2 classifies households by the main source of income of the household head. The sale of agricultural products – food, cash crops and livestock products - is the main source of cash income for the majority: 67% in 1991/92, 62% in 2000/01 and 55% in 2007. Food crops remain the most important single source, while the importance of cash crops has been falling, from just over a fifth to just over a tenth of households (consistent with evidence of producers shifting out of traditional cash crops in the face of trend declines in real prices; McKay *et al*, 1999). Business income has shown the largest increase, from about 10 per cent in 1991/92 to nearly 20 per cent in 2007. Wages, salaries and casual cash incomes were the main source for about 15% of households in 1991 and 2001 (the shares altered, suggesting shifts between formal and informal employment), rising to 20% in 2007.

**Table 2 Cash Income of Adults by Main Source (% households)**

| Source | 1991/92 | 2000/01 | 2007 |
|---|---|---|---|
| *Sales of food crops* | 41.4 | 40.6 | 39.6 |
| *Sales of livestock & products* | 4.3 | 4.5 | 3.3 |
| *Sales of cash crops* | 21.6 | 17.2 | 12.3 |
| *Business income* | 10.4 | 13.0 | 19.2 |
| *Wages or salaries in cash* | 13.1 | 9.3 | 17.8 |
| *Other casual cash earning* | 2.4 | 6.1 | 2.2 |
| *Cash remittances* | 1.1 | 3.5 | 3.0 |
| *Fishing* | 1.9 | 1.9 | 2.3 |
| *Other* | 3.8 | 3.9 | 0.3 |
| ***Total*** | 100 | 100 | 100 |

*Source*: As for Table 1.

In general, there has been a decline in agriculture as a source of income (mostly due to cash crops) offset by an increasing share of business and employment income. Although a low share, cash remittances have increased in importance, with a comparable decline in 'other' sources. The latter includes gifts received in cash, cash from sale of possessions, withdrawal from savings and loans obtained so may be related to periods of adverse shocks to income. The declining importance of other sources is consistent with general increases in household welfare.

As shown in Table 1, household income increased only modestly in real terms: by five per cent between 1991 and 2001, and by 10 per cent between 2001 and 2007 (thus by 15 per cent between 1991 and 2007). However, this is against the backdrop of large increases in prices of food commodities during the same period (Leyaro *et al* 2010). To explore this further we calculate the real change in income for each source between the survey years using the Fisher index to allow for regional variations in price changes. The calculations in Table 3 apply the Fisher Index within periods to give the first and end year constant prices (showing the real change within the period). For 1991-2001 (and 2001 – 2007), the 1991 (2001) values are deflated by the relevant Fisher Index to be expressed in 2001 (2007) prices for comparison with the 2001 (2007) values. For the period 1991 – 2007, there are two options which yield the same result, either express all incomes in 2001 prices (as in Table 3) or in 2007 prices.

Table 3 reports changes in household real total expenditure across the surveys according to the main source of household income. As sales of food crops are the main income source for the largest number of households (about 40% as shown in Table 2) this is the main contributor to the modest improvement in average household income over the period. Real household income from sales of food crops increased by 5% between 1991 and 2001, by 10% between 2001 and 2007, and thus by 15% over the whole period; this is almost identical to changes in total household welfare (Table 1). Household income derived from certain sources has seen a much higher (above average) increase: sales of livestock and livestock products, business

income, other casual cash earnings and 'other sources'.[10] Table 2 shows that these account for 20-27% of all households. However, income derived from some important sources has declined: sales of cash crops (like coffee, cotton, tea and cashewnuts) and cash remittances (income from fishing was stagnant and wages and salaries increased at a below average rate).

**Table 3 Real Household Income by Main Source of Cash Income in '000 TShs and Percentage Change, 1991-2007**

| | *1991** | *2001* | *% Change* | *2001** | *2007* | *% Change* | *1991** | *2007** | *% Change* |
|---|---|---|---|---|---|---|---|---|---|
| *Sales of food crops* | 9.9 | 10.3 | 5.19 | 19.6 | 21.5 | 9.87 | 9.9 | 11.4 | 15.57 |
| *Sales of livestock ( products)* | 9.1 | 10.1 | 11.49 | 19.1 | 30.6 | 59.92 | 9.1 | 16.2 | 78.28 |
| *Sales of cash crops* | 10.8 | 11.6 | 7.12 | 21.9 | 19.6 | -10.76 | 10.8 | 10.4 | -4.41 |
| *Business income* | 12.7 | 16.3 | 28.72 | 30.8 | 38.3 | 24.15 | 12.7 | 20.3 | 54.80 |
| *Wages or salaries in cash* | 18.5 | 21.5 | 16.27 | 40.7 | 38.9 | -4.27 | 18.5 | 20.6 | 11.31 |
| *Other casual cash earning* | 13.2 | 14.9 | 12.97 | 28.2 | 31.1 | 10.17 | 13.2 | 16.5 | 24.46 |
| *Cash remittances* | 18.9 | 16.0 | -15.70 | 30.3 | 31.0 | 2.49 | 18.9 | 16.4 | -13.60 |
| *Fishing* | 13.2 | 14.9 | 13.05 | 28.3 | 25.1 | -11.35 | 13.2 | 13.3 | 0.22 |
| *Other* | 11.8 | 11.9 | 1.10 | 22.5 | 41.8 | 85.28 | 11.8 | 22.1 | 87.32 |
| ***Average Income Change*** | | | **8.91** | | | **18.39** | | | **28.77** |

*Note*: Income is reported in thousands of Tanzanian Shillings (TShs) adjusted using survey weights. Percentages changes are based on Fisher index: 1991* values are in 2001 prices, 2001* values are in 2007 prices while 2007* values are in 2001 prices.

*Source*: As for Table 1.

**Table 4 Economic Activity of Adults (% households)**

| **Activity** | **1991/92** | **2000/01** | **2007** |
|---|---|---|---|
| *Farming, livestock or fishing* | 72.8 | 63.2 | 57.3 |
| *Employee – government* | 3.4 | 1.9 | 2.7 |
| *Employee – parastatals* | 1.8 | 0.6 | na |
| *Employee – other* | 2.0 | 4.1 | 6.5 |
| *Self-employed with employees* | 4.5 | 1.8 | 1.9 |
| *Self-employed without employees* | 0.3 | 6.1 | 11.6 |
| *Unpaid family helper in business* | 1.8 | 4.1 | 0.8 |
| *Household work* | 3.6 | 8.3 | 7.8 |
| *Student* | 6.3 | 7.6 | 5.8 |
| *Inactive* | 3.5 | 4.6 | 5.5 |
| ***Total*** | 100 | 100 | 100 |

*Source*: As for Table 1.

[10] Of these, however, all but business income have accounted for a declining share of household incomes (Table 2) although clearly important for those households that rely on these sources.

This is consistent with other evidence for Tanzania. Overall (headcount) poverty declined marginally, from 39 per cent in 1991/92 to 36 per cent in 2000/01 and 33 per cent in 2007. Analysis of the household budget surveys indicates increased income inequality in Tanzania (National Bureau of Statistics, 2002; 2008), which explains why poverty has not declined in line with the increase in average incomes. The growth in incomes from food and livestock products and formal and informal (casual cash earnings) business may partly be explained by removal of trade barriers generating increased output of tradables and demand for trade services.

As shown in Table 4, almost two-thirds of the labour force (declining over 1991-2007) are employed in the agriculture and fisheries sector, and most of these live outside Dar es Salaam. Informal sector activities such as self employment, unpaid family business and housewife have been rising, accounting for 20 per cent on average over the period. Government employment, particularly in parastatals, has been falling following structural reforms, privatisation and retrenchment. Economic activities vary by region as well as between urban and rural dwellers. Households in arid and semi-arid areas are largely involved in grazing (hence sales of livestock products), those found by larger rivers, lakes or the ocean are involved in fishing, those found in arable land and valleys are involved in farming, while most people in urban areas are either employed (government or private sector) or engaged in self employment or the informal sector. Those classified as unemployed and inactive has risen from 3.5 per cent in 1991/92 to 5.5 per cent in 2007.

**Table 5 Distribution of Poor Households by Economic Activity and Location**

| ***Activity*** | ***Poor*** | | |
|---|---|---|---|
| | ***1991/92*** | ***2000/01*** | ***2007*** |
| *Farming, livestock or fishing* | 87.4 | 86.6 | 83.3 |
| *Employee – government* | 4.2 | 1.8 | 1.5 |
| *Employee – parastatals* | 1.2 | 0.2 | na |
| *Employee – other* | 2.0 | 3.2 | 4.6 |
| *Self-employed without employees* | 5.1 | 6.0 | 9.9 |
| *Self-employed with employees* | 0.2 | 2.1 | 0.7 |
| ***Location*** | | | |
| *Rural* | 85.3 | 87.8 | 82.8 |
| *Urban* | 14.7 | 12.2 | 17.2 |
| ***All Tanzania*** | **100** | **100** | **100** |

*Source*: As for Table 1.

**Table 6 Distribution of Poor by Main Source of Cash Income (% households)**

| *Source of income* | *Poor* | | |
|---|---|---|---|
| | *1991/92* | *2000/01* | *2007* |
| *Sales of food crops* | 53.7 | 49.6 | 48.3 |
| *Sales of livestock & products* | 4.1 | 7.6 | 3.6 |
| *Sales of cash crops* | 19.6 | 17.5 | 17.9 |
| *Business income* | 8.2 | 9.6 | 14.4 |
| *Wages or salaries in cash* | 6.6 | 3.6 | 9.4 |
| *Other casual cash earning* | 1.7 | 5.8 | 2.0 |
| *Cash remittances* | 0.4 | 1.4 | 3.1 |
| *Fishing* | 0.7 | 1.8 | 1.3 |
| *Other* | 4.4 | 3.2 | 0.0 |
| ***Total*** | **100** | **100** | **100** |

*Source*: As for Table 1.

To the extent that effects of tariffs on household income are conditioned on education and main economic activity of the household head, it may be possible to draw inferences for poverty. As shown in Table 5, the majority of poor households (by activity of head), are engaged in farming, livestock and fishing (declining from 87 to 83 per cent), and in rural areas. Self employed without employees is the other activity with a significant share of poor households (rising from five to ten per cent), accounting for much of the urban poor. A similar pattern is observed for poor households by the main source of income of the head (Table 5.6). Sales of food and cash crops, livestock and fisheries account for about three quarters of households (declining from 78 to 70 per cent). Business, including self-employed and employees, is the main source of income for a relatively high share of poor household heads (increasing from about 15 to about 26 per cent), reflecting the tendency for the non-agriculture poor to be engaged in informal sector activities.

**Table 7 Level of Education by Household Economic Activity, 1991/92**

| | *Education attained* | | | |
|---|---|---|---|---|
| ***Activity*** | ***Primary/No*** | ***Secondary*** | ***Tertiary*** | ***All*** |
| *Farming, livestock or fishing* | 0.99 | 0.01 | 0.00 | 1.0 |
| *Employee – government* | 0.56 | 0.38 | 0.06 | 1.0 |
| *Employee – parastatals* | 0.63 | 0.26 | 0.10 | 1.0 |
| *Employee – other* | 0.85 | 0.12 | 0.03 | 1.0 |
| *Self-employed without employees* | 0.93 | 0.07 | 0.01 | 1.0 |
| *Self-employed with employees* | 0.69 | 0.29 | 0.02 | 1.0 |
| *Others* | 0.48 | 0.52 | 0.00 | 1.0 |

*Notes*: 'Primary/No' is no education up to completed primary, and includes adult education as less than primary. Secondary includes post-secondary.

*Source*: As for Table 1.

**Table 8 Level of Education by Household Source of Income, 1991/92**

| | *Education attained* | | | |
|---|---|---|---|---|
| ***Source of income*** | ***Primary/No*** | ***Secondary*** | ***Tertiary*** | ***All*** |
| *Sales of food crops* | 0.98 | 0.02 | 0.00 | 1.0 |
| *Sales of livestock & products* | 0.96 | 0.04 | 0.00 | 1.0 |
| *Sales of cash crops* | 0.98 | 0.02 | 0.00 | 1.0 |
| *Business income* | 0.92 | 0.07 | 0.01 | 1.0 |
| *Wages or salaries in cash* | 0.63 | 0.31 | 0.06 | 1.0 |
| *Other casual cash earning* | 0.95 | 0.04 | 0.01 | 1.0 |
| *Cash remittances* | 0.95 | 0.02 | 0.03 | 1.0 |
| *Fishing* | 0.99 | 0.00 | 0.01 | 1.0 |
| *Other* | 0.96 | 0.03 | 0.00 | 1.0 |

*Notes*: As for Table 7.
*Source*: As for Table 1.

**Table 9 Household Poverty Status and Location by Level of Education**

| ***Skills/Years*** | ***Not-Poor*** | ***Poor*** | ***Rural*** | ***Urban*** |
|---|---|---|---|---|
| *1991/92* | | | | |
| *Primary/No* | 0.69 | 0.31 | 0.81 | 0.19 |
| *Secondary* | 0.92 | 0.08 | 0.47 | 0.53 |
| *Tertiary* | 0.95 | 0.05 | 0.32 | 0.68 |
| *2000/01* | | | | |
| *Primary/No* | 0.71 | 0.29 | 0.83 | 0.17 |
| *Secondary* | 0.91 | 0.09 | 0.43 | 0.57 |
| *Tertiary* | 0.97 | 0.03 | 0.41 | 0.59 |
| *2007* | | | | |
| *Primary/No* | 0.68 | 0.32 | 0.78 | 0.22 |
| *Secondary* | 0.91 | 0.09 | 0.37 | 0.63 |
| *Tertiary* | 0.93 | 0.07 | 0.30 | 0.70 |

*Notes*: As for Table 7.
*Source*: As for Table 1.

Tables 7 and 8 show the education qualifications (highest educational level attained) of household heads by economic activity and main source of income respectively for the 1991/92 survey (see Appendix Tables A2-A5 for the 2000/01 and 2007 surveys respectively). However defined, almost all agriculture households have only primary education at best (96-99% on different classifications). Education levels are also very low in the informal sector, whether classified as self-employed without employees (93% primary in Table 7) or business/casual cash income (92-95% primary in Table 8). The highest education levels are associated with

government/parastatal employment (38%/26% secondary and 6%/10% tertiary in Table 7), self-employed with employees (29% secondary and 2% tertiary in Table 7), or wages and salaries (31% secondary and 6% tertiary in Table 8).

Table 9 shows that around 30 per cent of the household heads with no more than primary education are poor compared and about 80 per cent are in rural areas. In contrast, only eight per cent of those with secondary and five per cent with tertiary education are poor, and over 50 and 60 per cent respectively are in urban areas. In general, household heads with lower education (primary and below) are most likely to be poor, in rural areas and engaged in farming or other casual (informal) cash earnings. Household heads with above primary education are most likely to be in formal sectors, as government or private sector employees or running a business. As international trade and tariffs will affect sectors in different ways, especially manufacturing (private sector) and agriculture (with difference between food and cash crops), these effects may differ by education levels. Consequently, as effects differ by sector of activity and education, there may be indirect effects on poverty status.

## 4 Econometric Results

Table 10 reports estimates for the cross-section of all households using pooled OLS (POLS) based on equation (3) and cohort panel using Random Effects (RE) based on equation (4).[11] The dependent variable is defined as natural logarithm of per adult equivalent consumption expenditure of the household. Columns 1 and 4 report the results initially without controlling for sector specific effects; the coefficients on tariffs are negative and statistically significant in both cases. By assumption non-traded sector are coded as a zero tariff so incomes in traded sectors appear to be lower *ceteris paribus* (as implied by assuming tariffs were infinite in non-traded sectors). As the coefficient estimates reflect the cross-sector variation in tariffs (relative protection) they should be interpreted as capturing any association at the sector level between tariffs and incomes. This implies that sector differences should be allowed

[11] Recall that the cohort panel uses all households but organized into the relevant cohorts; although RE and FE yield similar results, RE is preferred due to the inclusion of time invariant explanatory variables in most of our specifications.

for, as in the other columns. Note that inferences on the effect of tariff reductions are not warranted as we cannot identify the effect of tariff changes on income for any household and have no 'control group' for which tariffs did not change.

The results in Columns 2 and 5 allow for unobserved sector heterogeneity by including sector dummies for the thirteen traded sectors.[12] The coefficients on *tariff* now have a positive sign and are significant, which suggests that unobserved sector heterogeneity was responsible for the negative estimate and that within traded sectors higher tariffs are associated with higher incomes. As agriculture sectors provide the main income for more than half of households, and average incomes of agriculture households are lower than for manufacturing households, it might be that the tariff captures an agriculture effect. To allow for general sector differences we introduce a dummy *AGR* = 1 if the head of household is in agriculture and zero otherwise (manufacturing) in Columns 3 and 6 in Table 10, with *tariff*AGR* in addition to *tariff*. The coefficient on *tariff* refers to manufactures and remains positive and significant, but agriculture is that coefficient plus the coefficient on *tariff*AGR*, which is negative and significant (but with a much smaller combined coefficient than on *tariff* alone). Most other coefficients are largely unaffected in the alternative specifications.

The effects of protection (the coefficient on *tariff)*, controlling for the sectors of head main source of income, are positive and statically significant, implying that higher protection is associated with higher incomes (i.e. incomes are higher in sectors with higher tariffs, *ceteris paribus*), except for agriculture compared to manufacturing as shown in Columns 3 and 6 (but see further discussion below). As expected from the discussion above, higher education is associated with higher income. The results in Table 10 indicate that this effect is quite linear: compared to no education, primary education is associated with a 20% increase in household income, secondary education around 50%, post-secondary over 60% and tertiary education with a more than 75% increase in income. This is equivalent to an increment of 4.5% for each additional year of education as shown in Appendix Table

[12] These include (listed in Table A1): food crops; livestock and livestock products; cash crops; fishing; food manufactures; dairy, textile; timber and wood; paper, chemicals; other manufactures; sports goods and building materials. These traded sectors account for about half of the households in the surveys according to recorded sector of employment (Table A1a), suggesting some problems with this variable (informal labour appears to be excluded).

A8 (which also shows that only post-primary education is associated with a positive effect on income).[13]

**Table 10 Tariffs and Household Welfare, Linear (Static) Regression**

| | ***POLS*** | ***POLS*** | ***POLS*** | ***RE*** | ***RE*** | ***RE*** |
|---|---|---|---|---|---|---|
| | ***(1)*** | ***(2)*** | ***(3)*** | ***(4)*** | ***(5)*** | ***(6)*** |
| *2000* | -0.006 | 0.039*** | 0.026** | 0.033*** | 0.070*** | 0.057*** |
| | (-0.581) | (3.301) | (2.333) | (2.765) | (5.129) | (4.440) |
| *2007* | 0.081*** | 0.158*** | 0.136*** | 0.079*** | 0.147*** | 0.126*** |
| | (6.555) | (9.759) | (9.323) | (5.065) | (7.801) | (7.227) |
| *AgeHead* | -0.017*** | -0.018*** | -0.018*** | -0.017*** | -0.018*** | -0.018*** |
| | (-7.575) | (-7.895) | (-7.843) | (-5.644) | (-6.127) | (-6.019) |
| *AgeHead*$^2$ | 0.0001*** | 0.0001*** | 0.0001*** | 0.0001*** | 0.0001*** | 0.0001*** |
| | (6.377) | (6.833) | (6.774) | (5.037) | (5.620) | (5.511) |
| *Hhsize* | -0.077*** | -0.078*** | -0.078*** | -0.077*** | -0.077*** | -0.078*** |
| | (-46.773) | (-47.392) | (-47.572) | (-64.823) | (-65.782) | (-65.954) |
| *Urban* | 0.279*** | 0.241*** | 0.242*** | 0.268*** | 0.233*** | 0.234*** |
| | (35.578) | (29.720) | (29.948) | (33.951) | (28.779) | (29.011) |
| *Basic* [a] | 0.215*** | 0.200*** | 0.201*** | 0.209*** | 0.196*** | 0.197*** |
| | (20.600) | (19.220) | (19.341) | (20.056) | (18.898) | (19.033) |
| *Secondary* | 0.553*** | 0.520*** | 0.521*** | 0.531*** | 0.503*** | 0.504*** |
| | (38.488) | (36.161) | (36.298) | (37.475) | (35.543) | (35.694) |
| *Post Secondary* | 0.665*** | 0.625*** | 0.627*** | 0.634*** | 0.599*** | 0.602*** |
| | (35.665) | (33.618) | (33.816) | (32.747) | (31.041) | (31.209) |
| *Tertiary* | 0.846*** | 0.803*** | 0.805*** | 0.812*** | 0.775*** | 0.778*** |
| | (42.977) | (40.861) | (41.023) | (43.589) | (41.669) | (41.882) |
| *Tariff* | -0.161*** | 0.263*** | 0.238*** | -0.135*** | 0.227*** | 0.199*** |
| | (-5.731) | (3.985) | (4.732) | (-4.884) | (3.456) | (4.005) |
| *AGR* | | | -0.191*** | | | -0.174*** |
| | | | (-9.264) | | | (-8.384) |
| *Tariff*AGR* | | | -0.242** | | | -0.210** |
| | | | (-2.567) | | | (-2.250) |
| *Coastal* [a] | 0.164*** | 0.160*** | 0.161*** | 0.144*** | 0.141*** | 0.142*** |
| | (15.178) | (14.818) | (14.894) | (6.137) | (6.133) | (6.197) |
| *Highlands* | 0.046*** | 0.056*** | 0.056*** | 0.052** | 0.063*** | 0.062*** |
| | (4.089) | (5.005) | (4.975) | (2.207) | (2.723) | (2.719) |
| *Lakes* | 0.052*** | 0.051*** | 0.051*** | 0.057** | 0.056** | 0.056** |
| | (4.331) | (4.271) | (4.302) | (2.351) | (2.358) | (2.383) |
| *Constant* | 9.799*** | 9.823*** | 9.843*** | 9.747*** | 9.790*** | 9.801*** |
| | (189.655) | (161.726) | (190.999) | (137.580) | (127.960) | (140.315) |
| *Sector Dummies* | None | All | Non-Agric | None | All | Non-Agric |
| *F-Test* | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| $R^2$ | 0.339 | 0.352 | 0.352 | | | |
| *N* | 28031 | 28031 | 28031 | 28031 | 28031 | 28031 |

*Notes:* POLS is pooled OLS and RE is Random Effects, favoured over FE on the basis of the Hausman test. Figures in parentheses are t-ratios: *** denotes significant at 1 percent level, ** significant at 5 percent and * significant at 10 percent. The F-test supports the hypothesis that all coefficients are jointly significant (i.e. rejects the null that all are zero).

a Omitted categories are no education for education and Central Zone for the agro-climatic zones. Education levels as defined in Table 9.

[13] This matches the years of education in Tanzania, with 7 years of primary, 4 of secondary, 2 post secondary and 3 to 4 of university education, someone with tertiary education would have spent at least 17 years of education, therefore17 x 4.5 = 76.5%.

As commonly observed in the literature, larger households have lower (per adult equivalent) income (income falls by about 7% for each additional family member); living in urban areas is associated with higher income (23-28% higher than rural households). For Tanzania, location in different ecological zones is important (results are relative to the Central zone, the poorest of the ecological regions and primarily pastoral). Being in the Coastal zone, which includes Dar es Salaam (the business capital) but is also a major area for food and cash crop production, increases household income by about 15% (similar to being in urban areas), whereas being in either the Highlands (an area for major food grains, and coffee and tea) or Lakes zones (staple foods and cotton) increases income by around five per cent.

To explore sector-specific effects in more detail we 'saturated' the model with the 13 traded sector dummies and 13 *sector*tariff* (as well as with 13 *sector*education*) interaction terms and report all estimates in Appendix Table A6. Two points are worth emphasizing as we do not want to consider sectors in detail (although all *sector*tariff* interaction terms are negative the effect is this combined with the coefficient on the sector dummy, and just over half of both are significant). First, the negative *tariff*AGR* term seems to be attributable to Livestock and especially (given its importance as a source of income) cash crops (sectors 2 and 3);[14] food crop production, the single largest employment sector, emerges as the 'baseline'. In general, tariffs are lower (Table A1) and incomes are higher for food producers within agriculture, which explains the negative coefficient on *tariff*AGR* in Table 10. Second, when significant the effect for six manufacturing sectors is also negative: one is agriculture-related (dairy), textiles and wood (sectors 7 and 8) are among the main manufacturing sectors, and sectors 11-13 are small in terms of employment. Appendix Table A7 differentiates between broad agriculture and manufacturing

[14] There is an anomaly regarding data on cash crops (sector 3) in the 2000/01 survey as although cash crops appear to be the main source of income for 17% of households (Table 2), only some three per cent of household heads report this as their sector of employment (Table A1b). We are using answers to different questions, one where the head declares their main sector of employment (to match to tariffs) and another giving information on income from different sources (presumably including own production for food). There are a number of possible reasons for a discrepancy, related to the likelihood that households producing cash crops also have other (multiple) sources of income (in particular food crops or off-farm), so they could view these as other sources of employment. Table 3 shows a significant decline in cash crop income so a possibility is that the head engaged in some other activity to earn extra income, although cash crops were still the main source of income (involving other members). We acknowledge this as another limitation of the data (specifically in trying to identify the effect of tariffs).

sectors. The results demonstrate that incomes in agriculture households tend to be lower than for manufacturing households, and overall tariffs tend to be positively associated with income, but within each broad sector tariffs are negatively associated with income. In other words, households employed in manufacturing sectors tend to have higher incomes than households employed in agriculture but within agriculture incomes are lower in sectors with higher tariffs and similarly within manufacturing. These leave the result of a positive coefficient on tariff itself something of a mystery, so we now explore this further. Sector of employment tends to be an important determinant of income, and one possibility is that it is sectors for which the dummy and interaction terms are insignificant (the most important of which, in terms of employment, is manufactured foods, which has relatively high tariffs) account for the positive coefficient on *tariff* itself.

The influence of agriculture sectors against other sectors is apparent. As envisaged, households in agriculture sectors tend to have lower income compared to those employed in manufacturing. Within agriculture, household incomes tend to be higher for producers of cash crops (which face the highest tariffs) up to the early 2000s; by the 2007 survey, incomes were higher for households selling food crops (the lowest tariffs and largest employment share) or livestock products (Table 3). Thus, the results in Table 10 capture cross-sector effects and how these change over time. Furthermore, in general tariffs (and incomes) are higher for manufactured sectors than food crops; this offers an explanation for the finding of a positive significant coefficient on tariffs. The negative interaction between agriculture and tariffs may be because tariffs on cash crops remained relatively high while incomes fell significantly. A similar point may hold within manufacturing, i.e. incomes may have been higher but fell faster or grew slower in sectors with relatively high tariffs. As Tanzania has implemented substantial tariff reductions for the past two decades these distinctions must be considered (and later we estimate a dynamic model): across sectors tariffs may be positively associated with income but this need not hold over time. Indeed, there is some tendency for incomes to have risen faster in sectors with lower tariffs or where tariffs were reduced more. This is a correlation, driven largely by food crops, so no causal inferences can be drawn. The estimation and analysis in the rest of the chapter uses dummies to control for sector heterogeneity, especially the agriculture sector (*tariff***AGR*).

**Table 11 Marginal Impacts of Household Head Education on Income, Cohort Panel Static Regression**

| | ***RE*** ***(1)*** | ***RE*** ***(2)*** | ***RE*** ***(3)*** | ***RE*** ***(4)*** |
|---|---|---|---|---|
| *2000* | 0.048*** | 0.063*** | 0.064*** | 0.062*** |
| | (3.760) | (4.906) | (4.868) | (4.667) |
| *2007* | 0.107*** | 0.141*** | 0.136*** | 0.131*** |
| | (6.110) | (8.020) | (7.609) | (7.255) |
| *AgeHead* | -0.016*** | -0.017*** | -0.015*** | -0.016*** |
| | (-5.516) | (-5.862) | (-4.817) | (-5.363) |
| $AgeHead^2$ | 0.000*** | 0.000*** | 0.000*** | 0.000*** |
| | (5.754) | (4.779) | (3.652) | (3.945) |
| *Hhsize* | -0.078*** | -0.076*** | -0.076*** | -0.076*** |
| | (-66.600) | (-64.241) | (-62.633) | (-62.662) |
| *Urban* | 0.218*** | 0.255*** | 0.271*** | 0.293*** |
| | (27.146) | (31.528) | (32.949) | (35.919) |
| *Tariff* | 0.202*** | 0.189*** | 0.612*** | 0.103** |
| | (4.077) | (3.755) | (8.769) | (2.015) |
| *AGR* | -0.171*** | -0.191*** | -0.232*** | -0.221*** |
| | (-8.287) | (-9.133) | (-10.894) | (-10.350) |
| *Tariff*AGR* | -0.226** | -0.183* | -0.099 | -0.166* |
| | (-2.427) | (-1.936) | (-1.625) | (-1.726) |
| *Education* | 0.047*** | | | |
| | (49.723) | | | |
| *Educ*Tariff* | -0.028*** | | | |
| | (-4.840) | | | |
| *Primary* | | -0.409*** | | |
| | | (-40.479) | | |
| *Primary*Tariff* | | 0.060 | | |
| | | (0.848) | | |
| *Secondary* | | | 0.256*** | |
| | | | (23.870) | |
| *Secondary*Tariff* | | | -0.645*** | |
| | | | (-9.311) | |
| *Tertiary* | | | | 0.505*** |
| | | | | (27.592) |
| *Tertiary*Tariff* | | | | 0.097 |
| | | | | (0.655) |
| *Coastal** | 0.138*** | 0.149*** | 0.152*** | 0.145*** |
| | (5.912) | (6.487) | (6.570) | (6.060) |
| *Highlands* | 0.060** | 0.077*** | 0.082*** | 0.086*** |
| | (2.538) | (3.356) | (3.536) | (3.559) |
| *Lakes* | 0.055** | 0.065*** | 0.069*** | 0.070*** |
| | (2.245) | (2.728) | (2.899) | (2.825) |
| *Constant* | 9.677*** | 10.360*** | 9.931*** | 9.998*** |
| | (138.668) | (147.088) | (140.319) | (139.283) |
| *Sector Dummies* | Non-Agric | Non-Agric | Non-Agric | Non-Agric |
| *F-Test* | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| *N* | 27976 | 28031 | 28031 | 28031 |

*Notes:* As for RE in Table 10; *Education* is measured as number of years but each level of education variable is transformed as indicated in text. Estimates with the education variables but without the education*tariff interactions are in Table A8; the signs and significance of other variables are unaltered and the magnitudes are very similar.

**Table 12 Tariffs, Household Head Education and Income, Psuedo-Panel Static Regression**

| | ***RE*** ***(1)*** | ***RE*** ***(2)*** | ***RE*** ***(3)*** | ***RE*** ***(4)*** |
|---|---|---|---|---|
| *2000* | -0.252** | -0.269** | -0.272*** | -0.229** |
| | (-2.455) | (-2.567) | (-2.579) | (-2.154) |
| *2007* | -0.338** | -0.359** | -0.359** | -0.282* |
| | (-2.219) | (-2.307) | (-2.289) | (-1.787) |
| *AgeHead* | -0.001 | -0.001 | 0.003 | -0.010* |
| | (-0.111) | (-0.193) | (0.560) | (-1.904) |
| *AgeHead²* | 0.0001 | 0.0001 | -0.0001 | 0.0001 |
| | (0.765) | (0.300) | (-0.727) | (1.351) |
| *Hhsize* | -0.093*** | -0.086*** | -0.083*** | -0.082*** |
| | (-15.451) | (-14.058) | (-13.422) | (-13.322) |
| *Urban* | 0.330*** | 0.388*** | 0.409*** | 0.407*** |
| | (7.770) | (9.027) | (9.448) | (9.356) |
| *Tariff* | -0.823** | -0.993** | -0.888** | -0.934** |
| | (-2.154) | (-2.546) | (-2.245) | (-2.360) |
| *Education* | 0.061*** | | | |
| | (6.911) | | | |
| *Educ*Tariff* | -0.014 | | | |
| | (-0.545) | | | |
| *Primary* | | -0.201*** | | |
| | | (-4.421) | | |
| *Primary*Tariff* | | -0.007 | | |
| | | (-0.048) | | |
| *Secondary* | | | 0.017 | |
| | | | (0.447) | |
| *Secondary*Tariff* | | | -0.468*** | |
| | | | (-3.813) | |
| *Tertiary* | | | | 0.351*** |
| | | | | (3.671) |
| *Tertiary*Tariff* | | | | -0.263 |
| | | | | (-0.833) |
| *Coastal** | 0.083** | 0.098*** | 0.097*** | 0.088** |
| | (2.500) | (2.850) | (2.741) | (2.486) |
| *Highlands* | -0.004 | 0.015 | 0.014 | 0.024 |
| | (-0.105) | (0.395) | (0.365) | (0.599) |
| *Lakes* | 0.024 | 0.033 | 0.034 | 0.027 |
| | (0.797) | (1.068) | (1.082) | (0.847) |
| *Constant* | 10.085*** | 11.052*** | 10.782*** | 11.059*** |
| | (31.209) | (26.609) | (26.038) | (26.854) |
| *Sector Dummies* | All sectors | All sectors | All sectors | All sectors |
| *F-Test* | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| *N* | 1000 | 1000 | 1000 | 1000 |

*Notes:* As in Table 10, estimations for the pseudo-panel (*N* less than 1080 because any cells with zero entries in any year are omitted for all years).

Table 11 presents results to explore in more detail the effect of education for the cohort panel RE model (Table A9 provides corresponding POLS estimates, which are similar, and Table A6 provides results for the saturated model with *sector*education* terms). To allow for conditional effects we include interaction terms

for tariffs and household head education (as well as the *AGR* dummy). As mentioned above, we transform the education variable so the coefficient on interaction terms can be interpreted as the marginal impact of tariff on household income for a given level of education (primary, secondary and tertiary). The coefficient on *tariff* controlling for sector effects is positive and significant, as is the coefficient on *Education* (measured as number of years), but the coefficient on the interaction term is negative and statistically significant (Column 1). Household income appears to be increasing in both tariffs (but not in agriculture) and education, but the effect of tariffs diminishes, or becomes negative, as level of education increases. That is, the marginal impact of tariffs on welfare is decreasing in level of education.

Distinguishing the three levels of education shows that those with secondary education seem not to benefit from higher tariffs. When interaction terms between tariffs and each level of education are included separately, only the coefficient on secondary education is statistically significant, and negative (Table 11, Columns 2-4). In this case, the coefficient on the interaction term almost completely offsets that on tariffs; tariffs are not associated with higher income conditional on having secondary education (but having secondary education itself does increase income). There is likely to be a strong association between agriculture households and households with no more than primary education, both of which are associated with lower incomes, whereas household heads with secondary and especially tertiary education are more likely to be employed in manufacturing sectors (Tables 8, A4. and A5). The negative association between tariffs and secondary education is likely to apply within manufacturing. One interpretation is that tariffs tend to protect the incomes of less educated (less skilled) workers more than for more educated workers, consistent with observing that import competition presents a greater challenge to the incomes of relatively less educated (less productive) workers.

**Table 13 Tariffs, Household Head Education and Income, Dynamic Psuedo-Panel Regression**

| | ***RE*** ***(1)*** | ***RE*** ***(2)*** | ***RE*** ***(3)*** | ***RE*** ***(4)*** |
|---|---|---|---|---|
| *2007* | -0.236*** | -0.241*** | -0.253*** | -0.209** |
| | (-2.792) | (-2.755) | (-2.835) | (-2.365) |
| *Lag Welfare* | 0.045 | 0.056* | 0.072** | 0.055* |
| | (1.554) | (1.848) | (2.365) | (1.816) |
| *AgeHead* | 0.009 | 0.011 | 0.006 | -0.000 |
| | (1.134) | (1.273) | (0.711) | (-0.025) |
| *AgeHead²* | -0.0001 | -0.0001 | -0.0001 | -0.0001 |
| | (-0.701) | (-1.213) | (-0.836) | (-0.290) |
| *Hhsize* | -0.099*** | -0.093*** | -0.089*** | -0.084*** |
| | (-13.044) | (-11.988) | (-11.265) | (-10.871) |
| *Urban* | 0.223*** | 0.293*** | 0.345*** | 0.277*** |
| | (3.994) | (5.188) | (6.066) | (4.769) |
| *Tariff* | -1.981*** | -2.081*** | -2.228*** | -2.083*** |
| | (-3.194) | (-3.255) | (-3.414) | (-3.234) |
| *Education* | 0.057*** | | | |
| | (8.970) | | | |
| *Primary* | | -0.193*** | | |
| | | (-6.142) | | |
| *Secondary* | | | 0.104*** | |
| | | | (3.318) | |
| *Tertiary* | | | | 0.317*** |
| | | | | (5.169) |
| *Coastal** | 0.093*** | 0.107*** | 0.107*** | 0.096*** |
| | (2.654) | (2.963) | (2.901) | (2.612) |
| *Highlands* | -0.006 | 0.008 | 0.010 | 0.026 |
| | (-0.149) | (0.187) | (0.217) | (0.588) |
| *Lakes* | 0.049 | 0.059* | 0.060* | 0.056* |
| | (1.618) | (1.876) | (1.876) | (1.779) |
| *Constant* | 9.488*** | 9.749*** | 9.593*** | 9.935*** |
| | (19.829) | (19.784) | (18.977) | (19.975) |
| *Sector Dummies* | All sectors | All sectors | All sectors | All sectors |
| *F-Test* | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| N | 641 | 641 | 641 | 641 |

*Notes:* As in Table 10, estimations for the pseudo-panel (*N* less than 720 because any cells with zero entries in any year are omitted for all years).

Comparable estimates for the pseudo-panel are in Table 12 (and in Tables A10 and A11 excluding interaction terms). Although the size of the estimated coefficients often differs, the sign and significance is generally the same with two major differences. First, the coefficient on *tariff* is negative and significant (although there are sector dummies): for representative households there is a negative association between tariffs and incomes, probably reflecting the predominance of agricultural households (note that the coefficients on *Highlands* and *Lakes* are now

insignificant but that for *Coastal*, the most urban region, is positive and significant). Second, the coefficients on the year dummies are now negative and significant: *ceteris paribus*, incomes of representative households have been declining. Other results are supported: income decreases with household size, is higher in urban locations, and increases with years of education (and the coefficient on *secondary*tariff* is negative and significant). Households with no more than primary education, mostly in agriculture, have lower incomes whereas households with tertiary education have higher incomes; the coefficient on secondary education is insignificant. The latter result seems to be because of the inclusion of the interaction with tariffs, as all education variables are significant with the expected sign in Table A10. These differences should be kept in mind for the dynamic estimates that require the use of the pseudo-panel.

***Dynamic Estimation***

To allow for dynamics in the income equation, we re-estimate including the lagged dependent variable and controlling for sector specific effects. As we are using the pseudo-panel for the three survey rounds (1991/92, 2000/01 and 2007) the lagged dependent variable is the income of the representative household cohort in the preceding survey (so we have two waves for estimation). The results in Table 13 show that the lagged income term is generally significant, albeit weakly so, and positive, suggesting a mild tendency for increasing income inequality. Table 14 reports the comparable results including *education*tariff* interaction terms (and the coefficients on other variables are largely unaffected).

The estimates in Tables 13 and 14 confirm the results of the static model for the pseudo-panel in Table 12; most estimated coefficients have almost the same values with the exception of tariff (which has a much larger negative estimate). The coefficient on *tariff* is negative and significant; given the significant positive coefficients on *urban* and *Coastal* (the most urban region; the coefficient on *Lakes* is weakly significant but *Highlands* remains insignificant), this is likely to reflect the relatively high tariffs on agricultural products (especially cash crops). The coefficient on the 2007 year dummy is negative and significant which is consistent with a decline in cash crop incomes, *ceteris paribus*. There is clear support for the finding that

income increases with years of education in Table 13; the marginal impact of having no more than primary education is actually negative (consistent with these being mostly agriculture households).

**Table 14 Marginal Impact Tariffs and Head Years of Education, Dynamic Psuedo-Panel Regression**

| | ***RE*** ***(1)*** | ***RE*** ***(2)*** | ***RE*** ***(3)*** | ***RE*** ***(4)*** |
|---|---|---|---|---|
| *2007* | -0.225*** | -0.227*** | -0.257*** | -0.204** |
| | (-2.649) | (-2.585) | (-2.901) | (-2.290) |
| *Lag Welfare* | 0.054* | 0.066** | 0.063** | 0.056* |
| | (1.858) | (2.207) | (2.044) | (1.846) |
| *AgeHead* | 0.005 | 0.007 | 0.012 | -0.000 |
| | (0.624) | (0.864) | (1.395) | (-0.044) |
| *AgeHead²* | -0.0001 | -0.0001 | -0.0001 | -0.0001 |
| | (-0.199) | (-0.791) | (-1.490) | (-0.270) |
| *Hhsize* | -0.097*** | -0.092*** | -0.090*** | -0.084*** |
| | (-12.847) | (-11.913) | (-11.397) | (-10.855) |
| *Urban* | 0.222*** | 0.294*** | 0.317*** | 0.277*** |
| | (4.007) | (5.248) | (5.508) | (4.767) |
| *Tariff* | -1.916*** | -2.005*** | -2.003*** | -2.049*** |
| | (-3.073) | (-3.117) | (-3.064) | (-3.134) |
| *Education* | 0.070*** | | | |
| | (6.371) | | | |
| *Educ*Tariff* | -0.093* | | | |
| | (-1.655) | | | |
| *Primary* | | -0.275*** | | |
| | | (-4.593) | | |
| *Primary*Tariff* | | 0.569* | | |
| | | (1.627) | | |
| *Secondary* | | | 0.011 | |
| | | | (0.234) | |
| *Secondary*Tariff* | | | -0.762*** | |
| | | | (-2.801) | |
| *Tertiary* | | | | 0.349*** |
| | | | | (2.911) |
| *Tertiary*Tariff* | | | | -0.210 |
| | | | | (-0.306) |
| *Coastal** | 0.096*** | 0.110*** | 0.105*** | 0.096*** |
| | (2.792) | (3.096) | (2.838) | (2.606) |
| *Highlands* | -0.001 | 0.016 | 0.008 | 0.026 |
| | (-0.013) | (0.362) | (0.176) | (0.575) |
| *Lakes* | 0.050 | 0.061* | 0.062* | 0.056* |
| | (1.641) | (1.952) | (1.934) | (1.749) |
| *Constant* | 9.393*** | 9.726*** | 9.587*** | 9.919*** |
| | (19.608) | (19.544) | (19.073) | (19.916) |
| *Sector Dummies* | All sectors | All sectors | All sectors | All sectors |
| *F-Test* | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| N | 641 | 641 | 641 | 641 |

*Notes:* As in Table 13.

The one difference arises for the interaction terms in Table 14 as now the coefficient on *primary*tariff* is positive and significant, while that on *secondary*tariff* remains negative and significant. This suggests that, controlling for lagged income, the interaction between tariffs and education differs between agriculture and manufacturing. Agriculture households mostly have no more than primary education; given that they have lower incomes, less educated producers of products facing higher tariffs seem to have higher incomes than those producing goods with lower tariffs (this may an effect of fishing, which is a larger share of employment in the second two surveys, see Table A1a). The reverse association with tariffs seems to apply to those with secondary education: *ceteris paribus* higher tariffs are associated with lower incomes.

## 5 Conclusions and Discussion

The principal contribution of this paper is to identify the association between household characteristics – in particular size and location, and for the household head age, sector of employment and education - and household income using data from the Tanzania Household Budget Survey for the years 1991/92, 2000/01 and 2007. A specific aim was to identify the effect of trade policy so the analysis identified households employed in traded sectors to permit addressing the effect of the cross-sector pattern of tariff protection. About half the household heads surveyed, some 14,500 (about 2100, 8750 and 3640 in the respective years), were employed in traded sectors. As the survey data are not a panel, the repeated cross-section for the three rounds of Tanzania Household Budget Survey is exploited to construct a pseudo-panel comprising 360 household cohorts (or representative households) for each survey, defined according to the gender and age of the head and the location of the household. Thus, while the static analysis of the determinants of household income is based on the full sample of households, we are also able to conduct a dynamic analysis using the pseudo-panel to provide a measure of lagged income (for the representative household). The data are quite limited for the purposes of identifying the effects of trade and trade policy on tariffs, as discussed below, so we begin by reviewing the effects of other characteristics.

Descriptive analysis of the survey data in Section 3 suggests modest increases in household income: on average, and for households whose primary source of income is sales of food crops (the main source of income for about 40% of adults in the sample), real income increased by 15% between 1991 and 2007. The largest increases in income were for households earning income from sales of livestock and livestock products (78% increase, but main source for less than 5% of adults), business income (55% increase and this source doubled as a share from ten to 20 per cent of adults) and informal employment (24%, but less than 5% of adults). The largest sector in which household incomes fell, by four per cent overall (but 10% between 2000 and 2007) was cash crop production, the main source of income for over 20% of adults in 1991 but declining to 12% in 2007. This suggests that there are important differences within agriculture, where most households are economically active, and the econometric analysis (Section 4) accounts for sector of employment.

A number of household characteristics are consistent determinants of income (measured as per adult equivalent real household expenditure), with similar effects for estimates using all households and the pseudo-panel. Larger households have lower income (income falls by about 7% for each additional family member); living in urban areas is associated with higher income (around one quarter higher than rural households); and location in the Coastal zone, which includes Dar es Salaam (the business capital) but is also a major area for agriculture, increases household income by about 15% compared to the poorest region (Central). Years of education of the household head is associated with higher income: each additional year of education adds about 4.5%, such that secondary education adds around 50% and tertiary education over 75% to income compared with no education.

As tariffs are only levied on traded goods the sector-tariff analysis refers to households whose head is employed in agriculture or manufacturing, although households employed in non-traded sectors are treated as facing a zero tariff (so some inferences can be drawn). Thus, we consider the effect of the cross-sector pattern of protection (tariffs and changes in tariffs) on cross-sector variation in household incomes. There are a number of limitations in the data for this purpose. First, and of greatest importance, the sector of employment declared by the head may not capture the sectors of activity of the household. Indeed, the distribution of head's

employment across sectors does not tally well with reported sources of income or sectors of activity of adults for the households. This is especially evident for cash crops in 2000/01: fewer than three per cent of heads report this as their sector of employment, but it is declared as the main source of income for 17% of adults. The source of this problem is that households, as a group of adults, may be engaged in many activities; an agriculture household may produce a combination of food, cash crop and livestock products and some members may be engaged in off-farm business or wage employment.

Second, and related, the tariff on a final product may not actually be relevant to a household engaged in that sector, especially for agriculture. This is particularly relevant for cash crops, as farmers typically produce for export in the unprocessed form whereas associated imports, and hence tariffs, have undergone some processing. A tariff on the unprocessed form may be redundant if that is not actually imported (e.g. unroasted coffee beans), whereas a tariff on the processed form (e.g. instant coffee) affects a manufacturing sector (e.g. Tanzanian producers of instant coffee) and not the farmers. Although food crop sales compete with imports in principle, in practice there may be some market segmentation (by quality, variety and even location – with imports mainly in Dar-es-Salaam and local produce in rural markets) and some food is produced for household own-consumption; any effect of tariffs on food producers is at least dampened.

Third, trade and tariffs can affect households in many ways, the important factors being production for export and the extent of competition from imports (and tariffs are only one of the factors affecting domestic prices of import-competing products). In particular, the main factors affecting demand and price for cash crop exports are independent of Tanzanian tariffs, but it is export performance that drives incomes. Furthermore, factors other than tariffs are likely to be the more important determinants of sector performance and incomes; e.g. weather shocks or changes in world (import) prices are important determinants of food crop incomes. The relationship between tariffs and incomes will vary between sectors given the many (unobserved) determinants of sector performance. As these product-specific factors are unobserved the econometric analysis explicitly allows for sector differences

(through the use of sector dummies and interaction terms). Consequently, the results for tariffs must be interpreted with great caution.

The estimated relationship between tariffs and incomes is found to be sensitive to the treatment of sector effects and to the sample used (i.e. all households as against the pseudo-panel of representative households). Overall there appears to be a positive association between sector tariffs and household income, i.e. incomes appear to be higher in sectors with higher tariffs. As agriculture is the main source of income for more than half of households, and average incomes of agriculture households are lower than for manufacturing households, it is especially important to capture any agriculture effect. When this is done (using a dummy $AGR = 1$ if the head of household is in agriculture and zero otherwise) the result suggests a negative effect of tariffs in agriculture (with a much higher value of the positive coefficient for manufactures compared to the negative coefficient for agriculture). However, within agriculture at least, the relationship changes over time; for the reasons mentioned above, this cannot be attributed to an effect of tariffs, especially as a wide range of distortions affected agriculture (Morrissey and Leyaro, 2007). Tariffs have been higher for cash crops than food crops; so too were average incomes in 1991 and 2001, a positive correlation between tariffs and incomes, but by 2007 food crop incomes exceeded those from cash crops (the correlation becomes negative). This is consistent with a long-run tendency for food prices to increase faster than cash crop crises, encouraging substitution into food crops (McKay *et al*, 1999).

In general, household income is increasing in both tariffs and education, and the effect of tariffs diminishes, or becomes negative, as the level of education increases, although the interaction term is only significant, and negative, for secondary education. The marginal impact of tariffs on welfare is decreasing in level of education as those with secondary education seem not to benefit from higher tariffs (having secondary education does increase income). Household heads with secondary and especially tertiary education are more likely to be employed in manufacturing so the negative association between tariffs and secondary education is driven by effects within manufacturing. Observing that tariffs offer less protection to the incomes of more educated workers compared to less educated (less skilled) workers is consistent

with better educated workers being more productive and therefore in firms, or sectors, better able to compete with imports.

Although tariffs may be positively associated with income across sectors (even if this is due to the effect of particular sectors) this need not hold over time. Within agriculture, there is some tendency for incomes to have risen faster in sectors with lower tariffs (food crops) or where tariffs were reduced more (livestock products), such that the correlation between tariffs and incomes was reversed.[15] The static estimates using all households did not capture this change in the correlation over time but the pseudo-panel estimates appear to do so. For the pseudo-panel estimates many factors have the same effects (e.g. household size and location) and the effects for education are similar, but there are important exceptions, notably tariff and the 2007 year dummy which have a negative association with incomes (but were positive for the full household sample). The implication is that controlling for sector effects, education and other household characteristics, and some unobserved tendency for incomes to decline in 2007 given the income of the representative household in the previous survey years, incomes were higher in those sectors with lower tariffs.

There is clearer support for the finding that income increases with years of education in the pseudo-panel: the marginal impact of having no more than primary education (mostly agriculture households) is positive, while that for secondary education remains negative. The latter suggests that, within manufacturing, *ceteris paribus* higher tariffs are associated with lower incomes. Given the same finding for tariffs overall in the pseudo-panel, as noted above, the same seems to be true within agriculture (and can be attributed to cash crops, which had high tariffs but declining income).

For the reasons detailed earlier it would be incorrect to infer a causal effect of tariffs on household incomes. Nevertheless, the analysis is informative about the relationship between the cross-sector pattern of tariff protection (and changes in tariffs) and household incomes. Within agriculture, incomes increased in the sector with the lowest tariffs (food crops) but declined in the sector with the highest tariffs (cash crops) so that the cross-sector correlation between tariffs and incomes switched

[15] The decomposition of manufacturing sectors in the data is insufficient to explore similar effects within manufacturing as many of the specific sectors are relatively small in some years.

from positive to negative. A similar point may hold within manufacturing, i.e. incomes may have been higher but fell faster or grew slower in sectors with relatively high tariffs. As Tanzania implemented substantial tariff reductions in the past two decades the distinction between correlations across sectors and over time is important. However, it is likely that sector performance was determined, in large part if not wholly, by factors other than tariffs.

There is quite consistent evidence that tariffs protect the incomes of less educated (less skilled) workers more than they protect the incomes of more educated workers. This is consistent with observing that import competition (and hence trade liberalisation) presents a greater challenge to the incomes of relatively less educated (less productive) workers. It may be true that at a *global* level trade liberalisation benefits unskilled workers and developing countries, because workers in poorer countries are less skilled than workers in richer countries, but within any country more skilled or educated workers are more likely to benefit. The Stolper-Samuelson theorem suggests that trade liberalisation should help the less skilled (who are likely to be the less educated) and therefore the poor (although not the poorest) in developing countries. There is little empirical evidence to support this, and most evidence suggests that it is only the more skilled workers that benefit from trade liberalisation. However, existing evidence is mostly limited to middle-income developing countries, so we contribute by considering a low-income country. Thus, the Stolper-Samuelson theorem may hold globally by favouring countries whose labour is unskilled relative to the global average. However, within any developing country it may be the less skilled that benefit least (or suffer most) from liberalisation; in any country it is the more productive workers (who are more educated and skilled) that are best able to benefit from international trade opportunities. This is supported by our results for Tanzania: tariffs have tended to protect the incomes of workers, more so for less educated workers so they may lose most from liberalisation. Workers with secondary education seemed to benefit least from tariff protection, so they may benefit more from liberalisation.

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APPENDIX TABLES

## Table A1 Average Tariff Rates by Commodity Groups

| *No.* | *Sectors* | *Scheduled* | | | *Applied* | | |
|---|---|---|---|---|---|---|---|
| | | *1991* | *2000* | *2007* | *1991* | *2000* | *2007* |
| *1* | *Food Crops* | 0.30 | 0.14 | 0.076 | 0.1032 | 0.1588 | 0.0887 |
| *2* | *Livestock* | 0.40 | 0.25 | 0.125 | 0.2258 | 0.1964 | 0.1301 |
| *3* | *Cash crops* | 0.50 | 0.23 | 0.115 | 0.2499 | 0.17644 | 0.2230 |
| *4* | *Fishing* | 0.40 | 0.25 | 0.125 | 0.1588 | 0.0968 | 0.2415 |
| *5* | *Manufactured food* | 0.50 | 0.23 | 0.115 | 0.2281 | 0.2326 | 0.2321 |
| *6* | *Dairy* | 0.40 | 0.24 | 0.122 | 0.2771 | 0.2179 | 0.3026 |
| *7* | *Textile* | 0.50 | 0.23 | 0.115 | 0.1756 | 0.1031 | 0.1662 |
| *8* | *Timber and Wood* | 0.50 | 0.23 | 0.115 | 0.2267 | 0.1655 | 0.1327 |
| *9* | *Paper* | 0.50 | 0.23 | 0.115 | 0.1888 | 0.0818 | 0.0795 |
| *10* | *Chemicals* | 0.50 | 0.23 | 0.115 | 0.0170 | 0.0151 | 0.0300 |
| *11* | *Other Manufacture* | 0.50 | 0.23 | 0.115 | 0.2833 | 0.2224 | 0.2398 |
| *12* | *Sports goods* | 0.50 | 0.23 | 0.115 | 0.2371 | 0.2174 | 0.2331 |
| *13* | *Building materials* | 0.50 | 0.23 | 0.115 | 0.1513 | 0.1546 | 0.1258 |

*Notes:* Tariffs are *ad valorem* as reported in Tariff book (scheduled) or calculated as tariff revenue as a share of import value (applied or implicit). Non-traded sectors (e.g. wholesale and retail, hotels and restaurants, electricity) are omitted on the basis that the tariff is undefined.
*Source:* Tanzania Revenue Authority, Customs Department

## Table A1a Sector Shares for Household Employment - 1991/92, 2000/01 and 2007 Surveys

| **No.** | **Sectors** | **1991/92** | **2000/01** | **2007** |
|---|---|---|---|---|
| 1 | *Food crops* | 21.63 | 20.76 | 26.39 |
| 2 | *Livestock and livestock products* | 2.39 | 1.87 | 2.42 |
| 3 | *Cash crops* | 12.34 | 2.60 | 9.96 |
| 4 | *Fishing* | 1.81 | 4.52 | 3.49 |
| 5 | *Food manufactures* | 4.25 | 8.87 | 0.35 |
| 6 | *Dairy* | 0.31 | 0.04 | 0.67 |
| 7 | *Textile* | 0.82 | 1.99 | 4.01 |
| 8 | *Timber and wood* | 1.29 | 2.92 | 4.06 |
| 9 | *Paper* | 0.66 | 0.10 | 1.41 |
| 10 | *Chemicals* | 0.59 | 1.11 | 0.41 |
| 11 | *Other manufactures* | 1.34 | 0.62 | 0.06 |
| 12 | *Sports goods* | 0.75 | 0.27 | 0.20 |
| 13 | *Building materials* | 1.27 | 2.35 | 2.23 |
| 14 | *All Others (non-traded)* | 50.56 | 51.96 | 44.34 |
| Total | *(Total sample size)* | 100 (4,262) | 100 (18,243) | 100 (6,534) |

*Notes*: Households allocated to sectors as classified in Table A1

**Table A2 Economic Activity and Level of Education, 2000/01**

| | *Education of Household Head* | | | |
|---|---|---|---|---|
| ***Activity*** | ***Primary*** | ***Secondary*** | ***Tertiary*** | ***All*** |
| *Farming, livestock or fishing* | 0.97 | 0.02 | 0.00 | 1.0 |
| *Employee – government* | 0.38 | 0.51 | 0.10 | 1.0 |
| *Employee – parastatals* | 0.52 | 0.33 | 0.15 | 1.0 |
| *Employee – other* | 0.68 | 0.26 | 0.06 | 1.0 |
| *Self-employed with employees* | 0.87 | 0.12 | 0.01 | 1.0 |
| *Self-employed no employees* | 0.83 | 0.15 | 0.02 | 1.0 |
| *Others* | 0.86 | 0.11 | 0.03 | 1.0 |

*Notes:* 'Primary' is no education up to completed primary, and includes adult education as less than primary. Secondary includes post-secondary.
*Source*: Authors' calculation from Tanzania Household Budget Survey for the years 1991/92, 2000/01 and 2007

**Table A3 Economic Activity and Level of Education, 2007**

| | *Education of Household Head* | | | |
|---|---|---|---|---|
| ***Activity*** | ***Primary*** | ***Secondary*** | ***Tertiary*** | ***All*** |
| *Farming, livestock or fishing* | 0.96 | 0.04 | 0.00 | 1.0 |
| *Employee – government* | 0.35 | 0.43 | 0.22 | 1.0 |
| *Employee – parastatals* | na | na | na | na |
| *Employee – other* | 0.60 | 0.24 | 0.15 | 1.0 |
| *Self-employed with employees* | 0.78 | 0.15 | 0.07 | 1.0 |
| *Self-employed no employees* | 0.90 | 0.09 | 0.01 | 1.0 |
| *Others* | 0.80 | 0.16 | 0.03 | 1.0 |

*Notes and Source*: As for Table A2

**Table A4 Source of Income and Level of Education, 2000/01**

| | *Education of Household Head* | | | |
|---|---|---|---|---|
| ***Source of income*** | ***Primary*** | ***Secondary*** | ***Tertiary*** | ***All*** |
| *Sales of food crops* | 0.97 | 0.03 | 0.00 | 1.0 |
| *Sales of livestock & products* | 0.98 | 0.02 | 0.00 | 1.0 |
| *Sales of cash crops* | 0.97 | 0.03 | 0.00 | 1.0 |
| *Business income* | 0.88 | 0.11 | 0.01 | 1.0 |
| *Wages or salaries in cash* | 0.55 | 0.37 | 0.08 | 1.0 |
| *Other casual cash earning* | 0.84 | 0.15 | 0.01 | 1.0 |
| *Cash remittances* | 0.92 | 0.03 | 0.05 | 1.0 |
| *Fishing* | 0.98 | 0.02 | 0.00 | 1.0 |
| *Other* | 0.92 | 0.05 | 0.02 | 1.0 |

*Notes and Source*: As for Table A2

**TableA5 Source of Income and Level of Education, 2007**

| | *Education of Household Head* | | | |
|---|---|---|---|---|
| ***Source of income*** | ***Primary*** | ***Secondary*** | ***Tertiary*** | ***All*** |
| *Sales of food crops* | 0.97 | 0.03 | 0.00 | 1.0 |
| *Sales of livestock & products* | 0.93 | 0.05 | 0.01 | 1.0 |
| *Sales of cash crops* | 0.97 | 0.03 | 0.01 | 1.0 |
| *Business income* | 0.95 | 0.05 | 0.01 | 1.0 |
| *Wages or salaries in cash* | 0.64 | 0.24 | 0.11 | 1.0 |
| *Other casual cash earning* | 0.94 | 0.04 | 0.02 | 1.0 |
| *Cash remittances* | 0.94 | 0.04 | 0.02 | 1.0 |
| *Fishing* | 0.95 | 0.05 | 0.00 | 1.0 |
| *Other* | 0.91 | 0.09 | 0.00 | 1.0 |

*Notes and Source*: As for Table A2

**Table A6 Saturated Model, All Sectors Interacted with Tariffs and Education**

| | ***POLS*** ***(1)*** | ***RE*** ***(2)*** | | ***POLS*** ***(3)*** | ***RE*** ***(4)*** |
|---|---|---|---|---|---|
| *2000* | 0.032*** | 0.063*** | *2000* | 0.034*** | 0.062*** |
| | (2.681) | (4.597) | | (2.865) | (4.544) |
| *2007* | 0.154*** | 0.143*** | *2007* | 0.146*** | 0.134*** |
| | (9.446) | (7.565) | | (9.038) | (7.126) |
| *AgeHead* | -0.018*** | -0.018*** | *AgeHead* | -0.017*** | -0.017*** |
| | (-7.884) | (-6.107) | | (-7.300) | (-5.657) |
| *AgeHead²* | 0.0001*** | 0.0001*** | *AgeHead²* | 0.0001*** | 0.0001*** |
| | (6.811) | (5.588) | | (6.844) | (5.595) |
| *Hhsize* | -0.078*** | -0.077*** | *Hhsize* | -0.078*** | -0.077*** |
| | (-47.505) | (-65.798) | | (-47.494) | (-65.936) |
| *Urban* | 0.240*** | 0.233*** | *Urban* | 0.229*** | 0.221*** |
| | (29.675) | (28.742) | | (28.173) | (27.249) |
| *Basic** | 0.200*** | 0.196*** | *Basic** | 0.036** | 0.040** |
| | (19.267) | (18.965) | | (2.287) | (2.561) |
| *Secondary* | 0.520*** | 0.503*** | *Secondary* | 0.167*** | 0.165*** |
| | (36.199) | (35.610) | | (5.954) | (6.071) |
| *Post Secondary* | 0.624*** | 0.599*** | *Post Secondary* | 0.194*** | 0.187*** |
| | (33.622) | (31.055) | | (5.624) | (5.492) |
| *Tertiary* | 0.802*** | 0.776*** | *Tertiary* | 0.244*** | 0.241*** |
| | (40.875) | (41.712) | | (5.740) | (5.922) |
| *Tariff* | 0.712** | 0.760*** | *Tariff* | 0.285*** | 0.244*** |
| | (2.415) | (2.705) | | (4.329) | (3.724) |
| *SCTR*1 | 0.118* | 0.134* | *SCTR*1 | -0.254*** | -0.249*** |
| | (1.675) | (1.919) | | (-7.362) | (-7.400) |
| *SCTR*2 | -0.088 | -0.054 | *SCTR*2 | -0.455*** | -0.431*** |
| | (-1.226) | (-0.757) | | (-14.597) | (-14.153) |
| *SCTR*3 | 0.163* | 0.168* | *SCTR*3 | -0.302*** | -0.306*** |
| | (1.812) | (1.892) | | (-6.513) | (-6.783) |
| *SCTR*4 | -0.135* | -0.070 | *SCTR*4 | -0.389*** | -0.372*** |
| | (-1.781) | (-0.933) | | (-9.960) | (-10.043) |
| *SCTR*5 | -0.133 | -0.084 | *SCTR*5 | -0.385*** | -0.351*** |
| | (-1.527) | (-0.985) | | (-9.357) | (-8.849) |
| *SCTR*6 | 0.117 | 0.102 | *SCTR*6 | -0.291*** | -0.278*** |
| | (1.363) | (1.197) | | (-7.870) | (-7.655) |
| *SCTR*7 | 0.398*** | 0.413*** | *SCTR*7 | -0.305** | -0.324** |
| | (3.334) | (2.877) | | (-2.431) | (-2.270) |
| *SCTR*8 | 0.192** | 0.202** | *SCTR*8 | -0.172*** | -0.170*** |
| | (2.200) | (2.267) | | (-2.747) | (-2.993) |
| *SCTR*9 | -0.076 | -0.027 | *SCTR*9 | -0.476*** | -0.451*** |
| | (-0.901) | (-0.318) | | (-10.822) | (-9.918) |
| *SCTR*10 | 0.201* | 0.234** | *SCTR*10 | -0.436*** | -0.400*** |
| | (1.689) | (2.106) | | (-5.015) | (-4.601) |
| *SCTR*11 | 0.207 | 0.225* | *SCTR*11 | -0.253*** | -0.240*** |
| | (1.339) | (1.727) | | (-2.900) | (-3.036) |
| *SCTR*12 | 0.427*** | 0.411*** | *SCTR*12 | -0.304** | -0.278*** |
| | (2.693) | (2.896) | | (-2.477) | (-2.659) |
| *SCTR*13 | 0.211 | 0.219 | *SCTR*13 | -0.163 | -0.155 |
| | (1.315) | (1.409) | | (-1.157) | (-1.285) |
| ***Tariff*SCTR1*** | 0.000 | 0.000 | ***Educn* SCTR1*** | 0.034*** | 0.032*** |
| | . | . | | (14.507) | (14.382) |

| | | | | | |
|---|---|---|---|---|---|
| ***Tariff*SCTR2*** | -0.660** | -0.720** | ***Educn* SCTR2*** | 0.025*** | 0.025*** |
| | (-2.189) | (-2.494) | | (8.959) | (9.034) |
| ***Tariff*SCTR3*** | -0.830** | -0.871** | ***Educn* SCTR3*** | 0.034*** | 0.035*** |
| | (-2.384) | (-2.574) | | (5.752) | (5.858) |
| ***Tariff*SCTR4*** | -0.062 | -0.243 | ***Educn* SCTR4*** | 0.033*** | 0.034*** |
| | (-0.202) | (-0.831) | | (7.937) | (8.426) |
| ***Tariff*SCTR5*** | -0.044 | -0.157 | ***Educn* SCTR5*** | 0.031*** | 0.029*** |
| | (-0.120) | (-0.462) | | (6.522) | (6.302) |
| ***Tariff*SCTR6*** | -0.814** | -0.714** | ***Educn* SCTR6*** | 0.022*** | 0.023*** |
| | (-2.406) | (-2.171) | | (5.548) | (6.056) |
| ***Tariff*SCTR7*** | -1.502*** | -1.491*** | ***Educn* SCTR7*** | 0.043*** | 0.047*** |
| | (-3.368) | (-2.720) | | (3.388) | (3.501) |
| ***Tariff*SCTR8*** | -0.312 | -0.370 | ***Educn* SCTR8*** | 0.035*** | 0.034*** |
| | (-0.851) | (-1.006) | | (5.369) | (5.992) |
| ***Tariff*SCTR9*** | -0.287 | -0.409 | ***Educn* SCTR9*** | 0.044*** | 0.044*** |
| | (-0.821) | (-1.171) | | (9.099) | (8.415) |
| ***Tariff*SCTR10*** | -0.801 | -0.914** | ***Educn* SCTR10*** | 0.062*** | 0.057*** |
| | (-1.604) | (-2.112) | | (5.473) | (5.835) |
| ***Tariff*SCTR11*** | -1.027* | -1.033** | ***Educn* SCTR11*** | 0.025*** | 0.026*** |
| | (-1.704) | (-2.121) | | (3.051) | (3.469) |
| ***Tariff*SCTR12*** | -1.077** | -1.059** | ***Educn* SCTR12*** | 0.049*** | 0.045*** |
| | (-2.098) | (-2.357) | | (3.593) | (4.186) |
| ***Tariff*SCTR13*** | -0.910* | -0.987** | ***Educn* SCTR13*** | 0.013 | 0.011 |
| | (-1.952) | (-2.149) | | (0.722) | (0.810) |
| | 0.159*** | 0.141*** | | 0.159*** | 0.141*** |
| *Coastal** | (14.745) | (6.285) | *Coastal** | (14.826) | (6.186) |
| | 0.055*** | 0.062*** | | 0.055*** | 0.063*** |
| *Highlands* | (4.883) | (2.741) | *Highlands* | (4.927) | (2.727) |
| | 0.049*** | 0.055** | | 0.052*** | 0.056** |
| *Lakes* | (4.084) | (2.362) | *Lakes* | (4.360) | (2.379) |
| | 9.725*** | 9.669*** | | 10.002*** | 9.966*** |
| *Constant* | (109.785) | (97.074) | *Constant* | (160.418) | (129.170) |
| *F-Test* | 0.000 | 0.000 | *F-Test* | 0.000 | 0.000 |
| $R^2$ | 0.354 | | $R^2$ | 0.359 | |
| *N* | 28031 | 28031 | *N* | 27976 | 27976 |

*Notes:* As for RE in Table 10

## Table A7 Distinguishing Agriculture and Manufacturing Effects

| | ***POLS*** ***(1)*** | ***RE*** ***(2)*** |
|---|---|---|
| *2000* | 0.035*** | 0.065*** |
| | (2.967) | (4.824) |
| *2007* | 0.153*** | 0.142*** |
| | (9.389) | (7.543) |
| *AgeHead* | -0.018*** | -0.018*** |
| | (-7.894) | (-6.162) |
| *AgeHead*$^2$ | 0.000*** | 0.000*** |
| | (6.820) | (5.642) |
| *Hhsize* | -0.078*** | -0.077*** |
| | (-47.471) | (-65.811) |
| *Urban* | 0.241*** | 0.233*** |
| | (29.755) | (28.813) |
| *Basic** | 0.200*** | 0.196*** |
| | (19.255) | (18.967) |
| *Secondary* | 0.520*** | 0.503*** |
| | (36.198) | (35.627) |
| *Post Secondary* | 0.625*** | 0.600*** |
| | (33.630) | (31.095) |
| *Tertiary* | 0.803*** | 0.776*** |
| | (40.867) | (41.731) |
| *Tariff* | 0.520*** | 0.432*** |
| | (6.106) | (5.183) |
| *AGR* | -0.132*** | -0.130*** |
| | (-3.942) | (-3.890) |
| *Tariff*AGR* | -0.470*** | -0.391*** |
| | (-4.364) | (-3.698) |
| *MANF* | 0.131** | 0.161** |
| | (2.008) | (2.021) |
| *Tariff*MANF* | -0.483*** | -0.359*** |
| | (-3.877) | (-2.926) |
| *Coastal** | 0.160*** | 0.141*** |
| | (14.799) | (6.312) |
| *Highlands* | 0.056*** | 0.062*** |
| | (4.989) | (2.776) |
| *Lakes* | 0.049*** | 0.055** |
| | (4.123) | (2.367) |
| *Constant* | 9.767*** | 9.746*** |
| | (157.765) | (127.043) |
| *Sector Dummies* | All | All |
| *F-Test* | 0.0000 | 0.0000 |
| $R^2$ | 0.353 | |
| *N* | 28031 | 28031 |

*Notes:* As for RE in Table 10

**Table A8 Tariffs and Head Years of Education, Cohort Panel Static Regression**

| | ***RE*** ***(1)*** | ***RE*** ***(2)*** | ***RE*** ***(3)*** | ***RE*** ***(4)*** |
|---|---|---|---|---|
| *2000* | 0.043*** | 0.063*** | 0.071*** | 0.062*** |
| | (3.346) | (4.867) | (5.430) | (4.703) |
| *2007* | 0.100*** | 0.141*** | 0.143*** | 0.132*** |
| | (5.715) | (7.994) | (7.972) | (7.254) |
| *AgeHead* | -0.015*** | -0.017*** | -0.015*** | -0.016*** |
| | (-5.045) | (-5.850) | (-4.854) | (-5.349) |
| *AgeHead²* | 0.000*** | 0.000*** | 0.000*** | 0.000*** |
| | (5.322) | (4.767) | (3.692) | (3.937) |
| *Hhsize* | -0.078*** | -0.076*** | -0.076*** | -0.076*** |
| | (-66.607) | (-64.250) | (-62.413) | (-62.669) |
| *Urban* | 0.217*** | 0.254*** | 0.275*** | 0.293*** |
| | (26.951) | (31.518) | (33.431) | (35.935) |
| *Tariff* | 0.220*** | 0.193*** | 0.171*** | 0.102** |
| | (4.440) | (3.836) | (3.334) | (1.997) |
| *AGR* | -0.178*** | -0.192*** | -0.226*** | -0.220*** |
| | (-8.629) | (-9.186) | (-10.582) | (-10.338) |
| *Tariff*AGR* | -0.192** | -0.178* | -0.151* | -0.168* |
| | (-2.068) | (-1.886) | (-1.664) | (-1.751) |
| *Education* | 0.045*** | | | |
| | (55.303) | | | |
| *Primary* | | -0.405*** | | |
| | | (-46.034) | | |
| *Secondary* | | | 0.299*** | |
| | | | (30.734) | |
| *Tertiary* | | | | 0.510*** |
| | | | | (30.984) |
| *Coastal** | 0.138*** | 0.149*** | 0.151*** | 0.145*** |
| | (5.871) | (6.491) | (6.551) | (5.988) |
| *Highlands* | 0.059** | 0.077*** | 0.083*** | 0.086*** |
| | (2.500) | (3.355) | (3.572) | (3.521) |
| *Lakes* | 0.054** | 0.065*** | 0.069*** | 0.070*** |
| | (2.233) | (2.729) | (2.900) | (2.795) |
| *Constant* | 9.667*** | 10.357*** | 9.913*** | 9.997*** |
| | (138.387) | (147.243) | (140.087) | (138.729) |
| *Sector Dummies* | Non-Agric | Non-Agric | Non-Agric | Non-Agric |
| *F-Test* | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| *N* | 27976 | 28031 | 28031 | 28031 |

*Notes:* As in Table 10

Comment: In the table households are in three groups: those with no more than primary education (includes adult education) can be thought of as unskilled; those with secondary and post-secondary education can be thought of as semi-skilled; and those with tertiary education can be thought of as skilled. A low level of education (primary) is negative and statistically significant, implying it is associated with low income. Higher education, secondary and above, is positive and significant, implying association with higher income. This is consistent with the observation that income increases with skill level.

**Table A9 Marginal Impacts of Tariffs and Head Years of Education, Pooled Cross-section Static Regression**

| | ***POLS*** ***(1)*** | ***POLS*** ***(2)*** | ***POLS*** ***(3)*** | ***POLS*** ***(4)*** |
|---|---|---|---|---|
| *2000* | 0.021* | 0.025** | 0.018 | 0.019* |
| | (1.847) | (2.223) | (1.588) | (1.680) |
| *2007* | 0.119*** | 0.142*** | 0.132*** | 0.129*** |
| | (8.168) | (9.643) | (8.815) | (8.681) |
| *AgeHead* | -0.016*** | -0.017*** | -0.012*** | -0.014*** |
| | (-7.067) | (-7.144) | (-5.177) | (-5.984) |
| *AgeHead²* | 0.000*** | 0.000*** | 0.000*** | 0.000*** |
| | (6.992) | (5.451) | (3.451) | (3.855) |
| *Hhsize* | -0.079*** | -0.076*** | -0.075*** | -0.075*** |
| | (-47.832) | (-47.429) | (-46.961) | (-46.805) |
| *Urban* | 0.226*** | 0.264*** | 0.284*** | 0.305*** |
| | (28.090) | (32.684) | (34.688) | (37.168) |
| *Tariff* | 0.237*** | 0.228*** | 0.660*** | 0.142*** |
| | (4.745) | (4.486) | (8.707) | (2.772) |
| *AGR* | -0.188*** | -0.208*** | -0.252*** | -0.242*** |
| | (-9.102) | (-10.029) | (-12.008) | (-11.481) |
| *Tariff*AGR* | -0.256*** | -0.230** | -0.150* | -0.215** |
| | (-2.715) | (-2.430) | (-1.678) | (-2.252) |
| *Education* | 0.049*** | | | |
| | (50.285) | | | |
| *Education*Tariff* | -0.032*** | | | |
| | (-5.569) | | | |
| *Primary* | | -0.433*** | | |
| | | (-42.156) | | |
| *Primary*Tariff* | | 0.088 | | |
| | | (1.168) | | |
| *Secondary* | | | 0.274*** | |
| | | | (25.494) | |
| *Secondary*Tariff* | | | -0.661*** | |
| | | | (-8.478) | |
| *Tertiary* | | | | 0.537*** |
| | | | | (27.965) |
| *Tertiary*Tariff* | | | | 0.038 |
| | | | | (0.241) |
| *Coastal** | 0.155*** | 0.172*** | 0.180*** | 0.171*** |
| | (14.472) | (15.840) | (16.231) | (15.290) |
| *Highlands* | 0.051*** | 0.070*** | 0.075*** | 0.081*** |
| | (4.576) | (6.185) | (6.526) | (7.007) |
| *Lakes* | 0.049*** | 0.059*** | 0.064*** | 0.065*** |
| | (4.167) | (4.895) | (5.219) | (5.261) |
| *Constant* | 9.697*** | 10.408*** | 9.931*** | 10.004*** |
| | (191.134) | (199.470) | (190.662) | (191.102) |
| *Sector Dummies* | Non-Agric | Non-Agric | Non-Agric | Non-Agric |
| *F-Test* | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| $R^2$ | 0.359 | 0.337 | 0.310 | 0.308 |
| *N* | 27976 | 28031 | 28031 | 28031 |

*Notes:* As in Table 10

## Table A10 Tariffs and Determinants of Household Welfare, Psuedo-Panel Static Regression

| | ***RE*** ***(1)*** | ***RE*** ***(2)*** | ***RE*** ***(3)*** | ***RE*** ***(4)*** | ***RE*** ***(1)*** |
|---|---|---|---|---|---|
| *2000* | -0.189* | -0.258** | -0.210** | -0.244** | -0.239** |
| | (-1.913) | (-2.488) | (-2.097) | (-2.347) | (-2.334) |
| *2007* | -0.207 | -0.317** | -0.241 | -0.294* | -0.286* |
| | (-1.421) | (-2.057) | (-1.627) | (-1.905) | (-1.881) |
| *AgeHead* | -0.001 | -0.003 | -0.003 | -0.001 | -0.001 |
| | (-0.237) | (-0.480) | (-0.464) | (-0.246) | (-0.268) |
| *AgeHead²* | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| | (0.466) | (0.719) | (0.676) | (0.499) | (0.517) |
| *Hhsize* | -0.087*** | -0.087*** | -0.086*** | -0.088*** | -0.088*** |
| | (-14.659) | (-14.540) | (-14.427) | (-14.762) | (-14.767) |
| *Urban* | 0.360*** | 0.353*** | 0.350*** | 0.361*** | 0.360*** |
| | (8.536) | (8.278) | (8.218) | (8.516) | (8.540) |
| *Basic* | 0.223*** | 0.211*** | 0.223*** | 0.211*** | 0.211*** |
| | (4.541) | (4.279) | (4.558) | (4.256) | (4.267) |
| *Secondary* | 0.387*** | 0.383*** | 0.393*** | 0.377*** | 0.378*** |
| | (7.045) | (6.980) | (7.177) | (6.833) | (6.856) |
| *Tertiary* | 0.604*** | 0.598*** | 0.603*** | 0.598*** | 0.600*** |
| | (8.337) | (8.302) | (8.382) | (8.253) | (8.291) |
| *Tariff* | -0.615* | -0.861** | -0.684* | -0.823** | -0.806** |
| | (-1.680) | (-2.233) | (-1.832) | (-2.129) | (-2.116) |
| *Coastal** | 0.097*** | 0.096*** | 0.100*** | 0.093*** | 0.094*** |
| | (2.894) | (2.862) | (2.997) | (2.777) | (2.806) |
| *Highlands* | 0.025 | 0.021 | 0.023 | 0.024 | 0.024 |
| | (0.651) | (0.564) | (0.608) | (0.637) | (0.637) |
| *Lakes* | 0.041 | 0.039 | 0.040 | 0.041 | 0.042 |
| | (1.341) | (1.280) | (1.321) | (1.327) | (1.387) |
| *Constant* | 9.544*** | 10.640*** | 9.607*** | 9.676*** | 9.670*** |
| | (43.805) | (26.349) | (43.825) | (41.343) | (42.294) |
| *Sector Dummies* | No Sectors | All Sectors | Non-Agric Sectors | Agric Sectors Only | Food Crop Only |
| *F-Test* | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| *N* | 1000 | 1000 | 1000 | 1000 | 1000 |

*Notes:* As in Table 10, estimations for the pseudo-panel (*N* is less than 1080 because any cells with zero entries in any year are omitted for all years).

**Table A11 Tariffs, Household Head Education and Income, Psuedo-Panel Static Regression**

| | ***RE*** ***(1)*** | ***RE*** ***(2)*** | ***RE*** ***(3)*** | ***RE*** ***(4)*** |
|---|---|---|---|---|
| *2000* | -0.250** | -0.269** | -0.277*** | -0.222** |
| | (-2.445) | (-2.572) | (-2.608) | (-2.101) |
| *2007* | -0.335** | -0.359** | -0.371** | -0.272* |
| | (-2.207) | (-2.312) | (-2.350) | (-1.731) |
| *AgeHead* | 0.001 | -0.001 | -0.005 | -0.010* |
| | (0.139) | (-0.232) | (-0.940) | (-1.843) |
| *AgeHead²* | 0.000 | 0.000 | 0.000 | 0.000 |
| | (0.581) | (0.350) | (0.723) | (1.289) |
| *Hhsize* | -0.093*** | -0.086*** | -0.085*** | -0.082*** |
| | (-15.444) | (-14.141) | (-13.656) | (-13.324) |
| *Urban* | 0.331*** | 0.388*** | 0.430*** | 0.408*** |
| | (7.781) | (9.033) | (9.966) | (9.390) |
| *Tariff* | -0.817** | -0.994** | -1.083*** | -0.908** |
| | (-2.140) | (-2.551) | (-2.744) | (-2.301) |
| *Education* | 0.057*** | | | |
| | (10.464) | | | |
| *Primary* | | -0.202*** | | |
| | | (-7.328) | | |
| *Secondary* | | | 0.118*** | |
| | | | (4.307) | |
| *Tertiary* | | | | 0.285*** |
| | | | | (5.295) |
| *Coastal** | 0.083** | 0.098*** | 0.105*** | 0.089** |
| | (2.492) | (2.841) | (2.951) | (2.511) |
| *Highlands* | -0.005 | 0.015 | 0.015 | 0.024 |
| | (-0.123) | (0.383) | (0.384) | (0.609) |
| *Lakes* | 0.024 | 0.033 | 0.032 | 0.028 |
| | (0.809) | (1.059) | (1.014) | (0.894) |
| *Constant* | 10.064*** | 11.057*** | 10.991*** | 11.038*** |
| | (31.416) | (27.228) | (26.595) | (26.861) |
| *Sector Dummies* | All sectors | All sectors | All sectors | All sectors |
| *F-Test* | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| *N* | 1000 | 1000 | 1000 | 1000 |

*Notes:* As in Table A10.

## Table A12: Cohort Definition, 5-year Age Bands

| Cohort ID | Region of Domicile | Age in 1991/92 | Age in 2000/01 | Age in 20007 | Sex Head | Mean Cell Size |
|---|---|---|---|---|---|---|
| 1 | Dodoma | 18-22 | 27-31 | 34-38 | Male | 148 |
| 2 | Dodoma | 23-27 | 32-36 | 39-43 | Male | 172 |
| 3 | Dodoma | 28-32 | 37-41 | 44-48 | Male | 160 |
| 4 | Dodoma | 33-37 | 42-46 | 49-53 | Male | 50 |
| 5 | Dodoma | 38-42 | 47-51 | 54-58 | Male | 126 |
| 6 | Dodoma | 43-47 | 52-56 | 59-63 | Male | 96 |
| 7 | Dodoma | 48-52 | 57-61 | 64-68 | Male | 74 |
| 8 | Dodoma | 53-57 | 62-66 | 69-73 | Male | 57 |
| 9 | Dodoma | 58-62 | 67-71 | 74-78 | Male | 40 |
| 10 | Dodoma | 18-22 | 27-31 | 34-38 | Female | 54 |
| 11 | Dodoma | 23-27 | 32-36 | 39-43 | Female | 59 |
| 12 | Dodoma | 28-32 | 37-41 | 44-48 | Female | 55 |
| 13 | Dodoma | 33-37 | 42-46 | 49-53 | Female | 50 |
| 14 | Dodoma | 38-42 | 47-51 | 54-58 | Female | 42 |
| 15 | Dodoma | 43-47 | 52-56 | 59-63 | Female | 28 |
| 16 | Dodoma | 48-52 | 57-61 | 64-68 | Female | 30 |
| 17 | Dodoma | 53-57 | 62-66 | 69-73 | Female | 19 |
| 18 | Dodoma | 58-62 | 67-71 | 74-78 | Female | 14 |
| 19 | Arusha | 18-22 | 27-31 | 34-38 | Male | 226 |
| 20 | Arusha | 23-27 | 32-36 | 39-43 | Male | 239 |
| 21 | Arusha | 28-32 | 37-41 | 44-48 | Male | 206 |
| 22 | Arusha | 33-37 | 42-46 | 49-53 | Male | 182 |
| 23 | Arusha | 38-42 | 47-51 | 54-58 | Male | 139 |
| 24 | Arusha | 43-47 | 52-56 | 59-63 | Male | 77 |
| 25 | Arusha | 48-52 | 57-61 | 64-68 | Male | 46 |
| 26 | Arusha | 53-57 | 62-66 | 69-73 | Male | 39 |
| 27 | Arusha | 58-62 | 67-71 | 74-78 | Male | 41 |
| 28 | Arusha | 18-22 | 27-31 | 34-38 | Female | 61 |
| 29 | Arusha | 23-27 | 32-36 | 39-43 | Female | 59 |
| 30 | Arusha | 28-32 | 37-41 | 44-48 | Female | 60 |
| 31 | Arusha | 33-37 | 42-46 | 49-53 | Female | 32 |
| 32 | Arusha | 38-42 | 47-51 | 54-58 | Female | 35 |
| 33 | Arusha | 43-47 | 52-56 | 59-63 | Female | 22 |
| 34 | Arusha | 48-52 | 57-61 | 64-68 | Female | 13 |
| 35 | Arusha | 53-57 | 62-66 | 69-73 | Female | 11 |
| 36 | Arusha | 58-62 | 67-71 | 74-78 | Female | 8 |
| 37 | Kilimanjaro | 18-22 | 27-31 | 34-38 | Male | 108 |
| 38 | Kilimanjaro | 23-27 | 32-36 | 39-43 | Male | 143 |
| 39 | Kilimanjaro | 28-32 | 37-41 | 44-48 | Male | 177 |
| 40 | Kilimanjaro | 33-37 | 42-46 | 49-53 | Male | 149 |
| 41 | Kilimanjaro | 38-42 | 47-51 | 54-58 | Male | 138 |
| 42 | Kilimanjaro | 43-47 | 52-56 | 59-63 | Male | 92 |
| 43 | Kilimanjaro | 48-52 | 57-61 | 64-68 | Male | 72 |
| 44 | Kilimanjaro | 53-57 | 62-66 | 69-73 | Male | 50 |
| 45 | Kilimanjaro | 58-62 | 67-71 | 74-78 | Male | 48 |
| 46 | Kilimanjaro | 18-22 | 27-31 | 34-38 | Female | 55 |
| 47 | Kilimanjaro | 23-27 | 32-36 | 39-43 | Female | 59 |
| 48 | Kilimanjaro | 28-32 | 37-41 | 44-48 | Female | 67 |
| 49 | Kilimanjaro | 33-37 | 42-46 | 49-53 | Female | 52 |
| 50 | Kilimanjaro | 38-42 | 47-51 | 54-58 | Female | 31 |
| 51 | Kilimanjaro | 43-47 | 52-56 | 59-63 | Female | 28 |
| 52 | Kilimanjaro | 48-52 | 57-61 | 64-68 | Female | 17 |
| 53 | Kilimanjaro | 53-57 | 62-66 | 69-73 | Female | 10 |
| 54 | Kilimanjaro | 58-62 | 67-71 | 74-78 | Female | 14 |
| 55 | Tanga | 18-22 | 27-31 | 34-38 | Male | 148 |
| 56 | Tanga | 23-27 | 32-36 | 39-43 | Male | 173 |
| 57 | Tanga | 28-32 | 37-41 | 44-48 | Male | 207 |
| 58 | Tanga | 33-37 | 42-46 | 49-53 | Male | 145 |
| 59 | Tanga | 38-42 | 47-51 | 54-58 | Male | 144 |
| 60 | Tanga | 43-47 | 52-56 | 59-63 | Male | 88 |
| 61 | Tanga | 48-52 | 57-61 | 64-68 | Male | 73 |
| 62 | Tanga | 53-57 | 62-66 | 69-73 | Male | 64 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 63 | Tanga | 58-62 | 67-71 | 74-78 | Male | 62 |
| 64 | Tanga | 18-22 | 27-31 | 34-38 | Female | 43 |
| 65 | Tanga | 23-27 | 32-36 | 39-43 | Female | 53 |
| 66 | Tanga | 28-32 | 37-41 | 44-48 | Female | 42 |
| 67 | Tanga | 33-37 | 42-46 | 49-53 | Female | 57 |
| 68 | Tanga | 38-42 | 47-51 | 54-58 | Female | 57 |
| 69 | Tanga | 43-47 | 52-56 | 59-63 | Female | 27 |
| 70 | Tanga | 48-52 | 57-61 | 64-68 | Female | 22 |
| 71 | Tanga | 53-57 | 62-66 | 69-73 | Female | 19 |
| 72 | Tanga | 58-62 | 67-71 | 74-78 | Female | 5 |
| 73 | Morogoro | 18-22 | 27-31 | 34-38 | Male | 178 |
| 74 | Morogoro | 23-27 | 32-36 | 39-43 | Male | 210 |
| 75 | Morogoro | 28-32 | 37-41 | 44-48 | Male | 183 |
| 76 | Morogoro | 33-37 | 42-46 | 49-53 | Male | 174 |
| 77 | Morogoro | 38-42 | 47-51 | 54-58 | Male | 129 |
| 78 | Morogoro | 43-47 | 52-56 | 59-63 | Male | 103 |
| 79 | Morogoro | 48-52 | 57-61 | 64-68 | Male | 71 |
| 80 | Morogoro | 53-57 | 62-66 | 69-73 | Male | 48 |
| 81 | Morogoro | 58-62 | 67-71 | 74-78 | Male | 42 |
| 82 | Morogoro | 18-22 | 27-31 | 34-38 | Female | 41 |
| 83 | Morogoro | 23-27 | 32-36 | 39-43 | Female | 34 |
| 84 | Morogoro | 28-32 | 37-41 | 44-48 | Female | 51 |
| 85 | Morogoro | 33-37 | 42-46 | 49-53 | Female | 34 |
| 86 | Morogoro | 38-42 | 47-51 | 54-58 | Female | 39 |
| 87 | Morogoro | 43-47 | 52-56 | 59-63 | Female | 24 |
| 88 | Morogoro | 48-52 | 57-61 | 64-68 | Female | 24 |
| 89 | Morogoro | 53-57 | 62-66 | 69-73 | Female | 21 |
| 90 | Morogoro | 58-62 | 67-71 | 74-78 | Female | 11 |
| 91 | Pwani | 18-22 | 27-31 | 34-38 | Male | 117 |
| 92 | Pwani | 23-27 | 32-36 | 39-43 | Male | 127 |
| 93 | Pwani | 28-32 | 37-41 | 44-48 | Male | 124 |
| 94 | Pwani | 33-37 | 42-46 | 49-53 | Male | 104 |
| 95 | Pwani | 38-42 | 47-51 | 54-58 | Male | 108 |
| 96 | Pwani | 43-47 | 52-56 | 59-63 | Male | 65 |
| 97 | Pwani | 48-52 | 57-61 | 64-68 | Male | 66 |
| 98 | Pwani | 53-57 | 62-66 | 69-73 | Male | 53 |
| 99 | Pwani | 58-62 | 67-71 | 74-78 | Male | 33 |
| 100 | Pwani | 18-22 | 27-31 | 34-38 | Female | 37 |
| 101 | Pwani | 23-27 | 32-36 | 39-43 | Female | 28 |
| 102 | Pwani | 28-32 | 37-41 | 44-48 | Female | 34 |
| 103 | Pwani | 33-37 | 42-46 | 49-53 | Female | 36 |
| 104 | Pwani | 38-42 | 47-51 | 54-58 | Female | 21 |
| 105 | Pwani | 43-47 | 52-56 | 59-63 | Female | 26 |
| 106 | Pwani | 48-52 | 57-61 | 64-68 | Female | 18 |
| 107 | Pwani | 53-57 | 62-66 | 69-73 | Female | 27 |
| 108 | Pwani | 58-62 | 67-71 | 74-78 | Female | 14 |
| 109 | Dar es salaam | 18-22 | 27-31 | 34-38 | Male | 581 |
| 110 | Dar es salaam | 23-27 | 32-36 | 39-43 | Male | 469 |
| 111 | Dar es salaam | 28-32 | 37-41 | 44-48 | Male | 471 |
| 112 | Dar es salaam | 33-37 | 42-46 | 49-53 | Male | 515 |
| 113 | Dar es salaam | 38-42 | 47-51 | 54-58 | Male | 484 |
| 114 | Dar es salaam | 43-47 | 52-56 | 59-63 | Male | 289 |
| 115 | Dar es salaam | 48-52 | 57-61 | 64-68 | Male | 169 |
| 116 | Dar es salaam | 53-57 | 62-66 | 69-73 | Male | 211 |
| 117 | Dar es salaam | 58-62 | 67-71 | 74-78 | Male | 62 |
| 118 | Dar es salaam | 18-22 | 27-31 | 34-38 | Female | 132 |
| 119 | Dar es salaam | 23-27 | 32-36 | 39-43 | Female | 104 |
| 120 | Dar es salaam | 28-32 | 37-41 | 44-48 | Female | 120 |
| 121 | Dar es salaam | 33-37 | 42-46 | 49-53 | Female | 99 |
| 122 | Dar es salaam | 38-42 | 47-51 | 54-58 | Female | 74 |
| 123 | Dar es salaam | 43-47 | 52-56 | 59-63 | Female | 40 |
| 124 | Dar es salaam | 48-52 | 57-61 | 64-68 | Female | 9 |
| 125 | Dar es salaam | 53-57 | 62-66 | 69-73 | Female | 14 |
| 126 | Dar es salaam | 58-62 | 67-71 | 74-78 | Female | 11 |
| 127 | Lindi | 18-22 | 27-31 | 34-38 | Male | 139 |
| 128 | Lindi | 23-27 | 32-36 | 39-43 | Male | 144 |
| 129 | Lindi | 28-32 | 37-41 | 44-48 | Male | 130 |
| 130 | Lindi | 33-37 | 42-46 | 49-53 | Male | 96 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 131 | Lindi | 38-42 | 47-51 | 54-58 | Male | 90 |
| 132 | Lindi | 43-47 | 52-56 | 59-63 | Male | 76 |
| 133 | Lindi | 48-52 | 57-61 | 64-68 | Male | 51 |
| 134 | Lindi | 53-57 | 62-66 | 69-73 | Male | 39 |
| 135 | Lindi | 58-62 | 67-71 | 74-78 | Male | 33 |
| 136 | Lindi | 18-22 | 27-31 | 34-38 | Female | 49 |
| 137 | Lindi | 23-27 | 32-36 | 39-43 | Female | 35 |
| 138 | Lindi | 28-32 | 37-41 | 44-48 | Female | 34 |
| 139 | Lindi | 33-37 | 42-46 | 49-53 | Female | 33 |
| 140 | Lindi | 38-42 | 47-51 | 54-58 | Female | 27 |
| 141 | Lindi | 43-47 | 52-56 | 59-63 | Female | 26 |
| 142 | Lindi | 48-52 | 57-61 | 64-68 | Female | 23 |
| 143 | Lindi | 53-57 | 62-66 | 69-73 | Female | 18 |
| 144 | Lindi | 58-62 | 67-71 | 74-78 | Female | 14 |
| 145 | Mtwara | 18-22 | 27-31 | 34-38 | Male | 141 |
| 146 | Mtwara | 23-27 | 32-36 | 39-43 | Male | 163 |
| 147 | Mtwara | 28-32 | 37-41 | 44-48 | Male | 186 |
| 148 | Mtwara | 33-37 | 42-46 | 49-53 | Male | 126 |
| 149 | Mtwara | 38-42 | 47-51 | 54-58 | Male | 125 |
| 150 | Mtwara | 43-47 | 52-56 | 59-63 | Male | 96 |
| 151 | Mtwara | 48-52 | 57-61 | 64-68 | Male | 77 |
| 152 | Mtwara | 53-57 | 62-66 | 69-73 | Male | 48 |
| 153 | Mtwara | 58-62 | 67-71 | 74-78 | Male | 41 |
| 154 | Mtwara | 18-22 | 27-31 | 34-38 | Female | 36 |
| 155 | Mtwara | 23-27 | 32-36 | 39-43 | Female | 35 |
| 156 | Mtwara | 28-32 | 37-41 | 44-48 | Female | 41 |
| 157 | Mtwara | 33-37 | 42-46 | 49-53 | Female | 29 |
| 158 | Mtwara | 38-42 | 47-51 | 54-58 | Female | 38 |
| 159 | Mtwara | 43-47 | 52-56 | 59-63 | Female | 27 |
| 160 | Mtwara | 48-52 | 57-61 | 64-68 | Female | 15 |
| 161 | Mtwara | 53-57 | 62-66 | 69-73 | Female | 15 |
| 162 | Mtwara | 58-62 | 67-71 | 74-78 | Female | 9 |
| 163 | Ruvuma | 18-22 | 27-31 | 34-38 | Male | 147 |
| 164 | Ruvuma | 23-27 | 32-36 | 39-43 | Male | 157 |
| 165 | Ruvuma | 28-32 | 37-41 | 44-48 | Male | 168 |
| 166 | Ruvuma | 33-37 | 42-46 | 49-53 | Male | 116 |
| 167 | Ruvuma | 38-42 | 47-51 | 54-58 | Male | 118 |
| 168 | Ruvuma | 43-47 | 52-56 | 59-63 | Male | 68 |
| 169 | Ruvuma | 48-52 | 57-61 | 64-68 | Male | 65 |
| 170 | Ruvuma | 53-57 | 62-66 | 69-73 | Male | 45 |
| 171 | Ruvuma | 58-62 | 67-71 | 74-78 | Male | 28 |
| 172 | Ruvuma | 18-22 | 27-31 | 34-38 | Female | 39 |
| 173 | Ruvuma | 23-27 | 32-36 | 39-43 | Female | 37 |
| 174 | Ruvuma | 28-32 | 37-41 | 44-48 | Female | 35 |
| 175 | Ruvuma | 33-37 | 42-46 | 49-53 | Female | 30 |
| 176 | Ruvuma | 38-42 | 47-51 | 54-58 | Female | 23 |
| 177 | Ruvuma | 43-47 | 52-56 | 59-63 | Female | 17 |
| 178 | Ruvuma | 48-52 | 57-61 | 64-68 | Female | 13 |
| 179 | Ruvuma | 53-57 | 62-66 | 69-73 | Female | 8 |
| 180 | Ruvuma | 58-62 | 67-71 | 74-78 | Female | 4 |
| 181 | Iringa | 18-22 | 27-31 | 34-38 | Male | 127 |
| 182 | Iringa | 23-27 | 32-36 | 39-43 | Male | 186 |
| 183 | Iringa | 28-32 | 37-41 | 44-48 | Male | 188 |
| 184 | Iringa | 33-37 | 42-46 | 49-53 | Male | 115 |
| 185 | Iringa | 38-42 | 47-51 | 54-58 | Male | 109 |
| 186 | Iringa | 43-47 | 52-56 | 59-63 | Male | 82 |
| 187 | Iringa | 48-52 | 57-61 | 64-68 | Male | 59 |
| 188 | Iringa | 53-57 | 62-66 | 69-73 | Male | 38 |
| 189 | Iringa | 58-62 | 67-71 | 74-78 | Male | 26 |
| 190 | Iringa | 18-22 | 27-31 | 34-38 | Female | 81 |
| 191 | Iringa | 23-27 | 32-36 | 39-43 | Female | 81 |
| 192 | Iringa | 28-32 | 37-41 | 44-48 | Female | 52 |
| 193 | Iringa | 33-37 | 42-46 | 49-53 | Female | 44 |
| 194 | Iringa | 38-42 | 47-51 | 54-58 | Female | 37 |
| 195 | Iringa | 43-47 | 52-56 | 59-63 | Female | 26 |
| 196 | Iringa | 48-52 | 57-61 | 64-68 | Female | 23 |
| 197 | Iringa | 53-57 | 62-66 | 69-73 | Female | 23 |
| 198 | Iringa | 58-62 | 67-71 | 74-78 | Female | 20 |

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|---|---|---|---|---|---|---|
| 199 | Mbeya | 18-22 | 27-31 | 34-38 | Male | 178 |
| 200 | Mbeya | 23-27 | 32-36 | 39-43 | Male | 201 |
| 201 | Mbeya | 28-32 | 37-41 | 44-48 | Male | 200 |
| 202 | Mbeya | 33-37 | 42-46 | 49-53 | Male | 131 |
| 203 | Mbeya | 38-42 | 47-51 | 54-58 | Male | 107 |
| 204 | Mbeya | 43-47 | 52-56 | 59-63 | Male | 72 |
| 205 | Mbeya | 48-52 | 57-61 | 64-68 | Male | 67 |
| 206 | Mbeya | 53-57 | 62-66 | 69-73 | Male | 54 |
| 207 | Mbeya | 58-62 | 67-71 | 74-78 | Male | 42 |
| 208 | Mbeya | 18-22 | 27-31 | 34-38 | Female | 53 |
| 209 | Mbeya | 23-27 | 32-36 | 39-43 | Female | 53 |
| 210 | Mbeya | 28-32 | 37-41 | 44-48 | Female | 41 |
| 211 | Mbeya | 33-37 | 42-46 | 49-53 | Female | 53 |
| 212 | Mbeya | 38-42 | 47-51 | 54-58 | Female | 47 |
| 213 | Mbeya | 43-47 | 52-56 | 59-63 | Female | 37 |
| 214 | Mbeya | 48-52 | 57-61 | 64-68 | Female | 26 |
| 215 | Mbeya | 53-57 | 62-66 | 69-73 | Female | 23 |
| 216 | Mbeya | 58-62 | 67-71 | 74-78 | Female | 16 |
| 217 | Singida | 18-22 | 27-31 | 34-38 | Male | 114 |
| 218 | Singida | 23-27 | 32-36 | 39-43 | Male | 133 |
| 219 | Singida | 28-32 | 37-41 | 44-48 | Male | 115 |
| 220 | Singida | 33-37 | 42-46 | 49-53 | Male | 99 |
| 221 | Singida | 38-42 | 47-51 | 54-58 | Male | 99 |
| 222 | Singida | 43-47 | 52-56 | 59-63 | Male | 83 |
| 223 | Singida | 48-52 | 57-61 | 64-68 | Male | 59 |
| 224 | Singida | 53-57 | 62-66 | 69-73 | Male | 55 |
| 225 | Singida | 58-62 | 67-71 | 74-78 | Male | 35 |
| 226 | Singida | 18-22 | 27-31 | 34-38 | Female | 39 |
| 227 | Singida | 23-27 | 32-36 | 39-43 | Female | 36 |
| 228 | Singida | 28-32 | 37-41 | 44-48 | Female | 53 |
| 229 | Singida | 33-37 | 42-46 | 49-53 | Female | 56 |
| 230 | Singida | 38-42 | 47-51 | 54-58 | Female | 39 |
| 231 | Singida | 43-47 | 52-56 | 59-63 | Female | 28 |
| 232 | Singida | 48-52 | 57-61 | 64-68 | Female | 30 |
| 233 | Singida | 53-57 | 62-66 | 69-73 | Female | 17 |
| 234 | Singida | 58-62 | 67-71 | 74-78 | Female | 17 |
| 235 | Tabora | 18-22 | 27-31 | 34-38 | Male | 181 |
| 236 | Tabora | 23-27 | 32-36 | 39-43 | Male | 186 |
| 237 | Tabora | 28-32 | 37-41 | 44-48 | Male | 159 |
| 238 | Tabora | 33-37 | 42-46 | 49-53 | Male | 108 |
| 239 | Tabora | 38-42 | 47-51 | 54-58 | Male | 106 |
| 240 | Tabora | 43-47 | 52-56 | 59-63 | Male | 87 |
| 241 | Tabora | 48-52 | 57-61 | 64-68 | Male | 74 |
| 242 | Tabora | 53-57 | 62-66 | 69-73 | Male | 47 |
| 243 | Tabora | 58-62 | 67-71 | 74-78 | Male | 29 |
| 244 | Tabora | 18-22 | 27-31 | 34-38 | Female | 56 |
| 245 | Tabora | 23-27 | 32-36 | 39-43 | Female | 39 |
| 246 | Tabora | 28-32 | 37-41 | 44-48 | Female | 31 |
| 247 | Tabora | 33-37 | 42-46 | 49-53 | Female | 36 |
| 248 | Tabora | 38-42 | 47-51 | 54-58 | Female | 36 |
| 249 | Tabora | 43-47 | 52-56 | 59-63 | Female | 20 |
| 250 | Tabora | 48-52 | 57-61 | 64-68 | Female | 19 |
| 251 | Tabora | 53-57 | 62-66 | 69-73 | Female | 14 |
| 252 | Tabora | 58-62 | 67-71 | 74-78 | Female | 9 |
| 253 | Rukwa | 18-22 | 27-31 | 34-38 | Male | 169 |
| 254 | Rukwa | 23-27 | 32-36 | 39-43 | Male | 156 |
| 255 | Rukwa | 28-32 | 37-41 | 44-48 | Male | 144 |
| 256 | Rukwa | 33-37 | 42-46 | 49-53 | Male | 121 |
| 257 | Rukwa | 38-42 | 47-51 | 54-58 | Male | 93 |
| 258 | Rukwa | 43-47 | 52-56 | 59-63 | Male | 72 |
| 259 | Rukwa | 48-52 | 57-61 | 64-68 | Male | 37 |
| 260 | Rukwa | 53-57 | 62-66 | 69-73 | Male | 30 |
| 261 | Rukwa | 58-62 | 67-71 | 74-78 | Male | 22 |
| 262 | Rukwa | 18-22 | 27-31 | 34-38 | Female | 24 |
| 263 | Rukwa | 23-27 | 32-36 | 39-43 | Female | 31 |
| 264 | Rukwa | 28-32 | 37-41 | 44-48 | Female | 30 |
| 265 | Rukwa | 33-37 | 42-46 | 49-53 | Female | 23 |
| 266 | Rukwa | 38-42 | 47-51 | 54-58 | Female | 25 |

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| 267 | Rukwa | 43-47 | 52-56 | 59-63 | Female | 14 |
| 268 | Rukwa | 48-52 | 57-61 | 64-68 | Female | 15 |
| 269 | Rukwa | 53-57 | 62-66 | 69-73 | Female | 5 |
| 270 | Kigoma | 58-62 | 67-71 | 74-78 | Female | 12 |
| 271 | Kigoma | 18-22 | 27-31 | 34-38 | Male | 154 |
| 272 | Kigoma | 23-27 | 32-36 | 39-43 | Male | 163 |
| 273 | Kigoma | 28-32 | 37-41 | 44-48 | Male | 181 |
| 274 | Kigoma | 33-37 | 42-46 | 49-53 | Male | 126 |
| 275 | Kigoma | 38-42 | 47-51 | 54-58 | Male | 100 |
| 276 | Kigoma | 43-47 | 52-56 | 59-63 | Male | 79 |
| 277 | Kigoma | 48-52 | 57-61 | 64-68 | Male | 49 |
| 278 | Kigoma | 53-57 | 62-66 | 69-73 | Male | 36 |
| 279 | Kigoma | 58-62 | 67-71 | 74-78 | Male | 34 |
| 280 | Kigoma | 18-22 | 27-31 | 34-38 | Female | 27 |
| 281 | Kigoma | 23-27 | 32-36 | 39-43 | Female | 33 |
| 282 | Kigoma | 28-32 | 37-41 | 44-48 | Female | 38 |
| 283 | Kigoma | 33-37 | 42-46 | 49-53 | Female | 24 |
| 284 | Kigoma | 38-42 | 47-51 | 54-58 | Female | 32 |
| 285 | Kigoma | 43-47 | 52-56 | 59-63 | Female | 13 |
| 286 | Kigoma | 48-52 | 57-61 | 64-68 | Female | 20 |
| 287 | Kigoma | 53-57 | 62-66 | 69-73 | Female | 9 |
| 288 | Kigoma | 58-62 | 67-71 | 74-78 | Female | 10 |
| 289 | Shinyanga | 18-22 | 27-31 | 34-38 | Male | 172 |
| 290 | Shinyanga | 23-27 | 32-36 | 39-43 | Male | 200 |
| 291 | Shinyanga | 28-32 | 37-41 | 44-48 | Male | 185 |
| 292 | Shinyanga | 33-37 | 42-46 | 49-53 | Male | 147 |
| 293 | Shinyanga | 38-42 | 47-51 | 54-58 | Male | 165 |
| 294 | Shinyanga | 43-47 | 52-56 | 59-63 | Male | 95 |
| 295 | Shinyanga | 48-52 | 57-61 | 64-68 | Male | 74 |
| 296 | Shinyanga | 53-57 | 62-66 | 69-73 | Male | 43 |
| 297 | Shinyanga | 58-62 | 67-71 | 74-78 | Male | 39 |
| 298 | Shinyanga | 18-22 | 27-31 | 34-38 | Female | 33 |
| 299 | Shinyanga | 23-27 | 32-36 | 39-43 | Female | 52 |
| 300 | Shinyanga | 28-32 | 37-41 | 44-48 | Female | 42 |
| 301 | Shinyanga | 33-37 | 42-46 | 49-53 | Female | 30 |
| 302 | Shinyanga | 38-42 | 47-51 | 54-58 | Female | 37 |
| 303 | Shinyanga | 43-47 | 52-56 | 59-63 | Female | 35 |
| 304 | Shinyanga | 48-52 | 57-61 | 64-68 | Female | 18 |
| 305 | Shinyanga | 53-57 | 62-66 | 69-73 | Female | 14 |
| 306 | Shinyanga | 58-62 | 67-71 | 74-78 | Female | 7 |
| 307 | Kagera | 18-22 | 27-31 | 34-38 | Male | 166 |
| 308 | Kagera | 23-27 | 32-36 | 39-43 | Male | 155 |
| 309 | Kagera | 28-32 | 37-41 | 44-48 | Male | 178 |
| 310 | Kagera | 33-37 | 42-46 | 49-53 | Male | 137 |
| 311 | Kagera | 38-42 | 47-51 | 54-58 | Male | 122 |
| 312 | Kagera | 43-47 | 52-56 | 59-63 | Male | 65 |
| 313 | Kagera | 48-52 | 57-61 | 64-68 | Male | 49 |
| 314 | Kagera | 53-57 | 62-66 | 69-73 | Male | 52 |
| 315 | Kagera | 58-62 | 67-71 | 74-78 | Male | 59 |
| 316 | Kagera | 18-22 | 27-31 | 34-38 | Female | 29 |
| 317 | Kagera | 23-27 | 32-36 | 39-43 | Female | 30 |
| 318 | Kagera | 28-32 | 37-41 | 44-48 | Female | 44 |
| 319 | Kagera | 33-37 | 42-46 | 49-53 | Female | 36 |
| 320 | Kagera | 38-42 | 47-51 | 54-58 | Female | 32 |
| 321 | Kagera | 43-47 | 52-56 | 59-63 | Female | 35 |
| 322 | Kagera | 48-52 | 57-61 | 64-68 | Female | 24 |
| 323 | Kagera | 53-57 | 62-66 | 69-73 | Female | 21 |
| 324 | Kagera | 58-62 | 67-71 | 74-78 | Female | 15 |
| 325 | Mwanza | 18-22 | 27-31 | 34-38 | Male | 201 |
| 326 | Mwanza | 23-27 | 32-36 | 39-43 | Male | 204 |
| 327 | Mwanza | 28-32 | 37-41 | 44-48 | Male | 221 |
| 328 | Mwanza | 33-37 | 42-46 | 49-53 | Male | 179 |
| 329 | Mwanza | 38-42 | 47-51 | 54-58 | Male | 142 |
| 330 | Mwanza | 43-47 | 52-56 | 59-63 | Male | 116 |
| 331 | Mwanza | 48-52 | 57-61 | 64-68 | Male | 77 |
| 332 | Mwanza | 53-57 | 62-66 | 69-73 | Male | 68 |
| 333 | Mwanza | 58-62 | 67-71 | 74-78 | Male | 46 |
| 334 | Mwanza | 18-22 | 27-31 | 34-38 | Female | 41 |

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| 335 | Mwanza | 23-27 | 32-36 | 39-43 | Female | 39 |
| 336 | Mwanza | 28-32 | 37-41 | 44-48 | Female | 78 |
| 337 | Mwanza | 33-37 | 42-46 | 49-53 | Female | 44 |
| 338 | Mwanza | 38-42 | 47-51 | 54-58 | Female | 29 |
| 339 | Mwanza | 43-47 | 52-56 | 59-63 | Female | 34 |
| 340 | Mwanza | 48-52 | 57-61 | 64-68 | Female | 17 |
| 341 | Mwanza | 53-57 | 62-66 | 69-73 | Female | 21 |
| 342 | Mwanza | 58-62 | 67-71 | 74-78 | Female | 13 |
| 343 | Mara | 18-22 | 27-31 | 34-38 | Male | 127 |
| 344 | Mara | 23-27 | 32-36 | 39-43 | Male | 168 |
| 345 | Mara | 28-32 | 37-41 | 44-48 | Male | 180 |
| 346 | Mara | 33-37 | 42-46 | 49-53 | Male | 143 |
| 347 | Mara | 38-42 | 47-51 | 54-58 | Male | 103 |
| 348 | Mara | 43-47 | 52-56 | 59-63 | Male | 84 |
| 349 | Mara | 48-52 | 57-61 | 64-68 | Male | 52 |
| 350 | Mara | 53-57 | 62-66 | 69-73 | Male | 44 |
| 351 | Mara | 58-62 | 67-71 | 74-78 | Male | 35 |
| 352 | Mara | 18-22 | 27-31 | 34-38 | Female | 36 |
| 353 | Mara | 23-27 | 32-36 | 39-43 | Female | 41 |
| 354 | Mara | 28-32 | 37-41 | 44-48 | Female | 56 |
| 355 | Mara | 33-37 | 42-46 | 49-53 | Female | 53 |
| 356 | Mara | 38-42 | 47-51 | 54-58 | Female | 41 |
| 357 | Mara | 43-47 | 52-56 | 59-63 | Female | 34 |
| 358 | Mara | 48-52 | 57-61 | 64-68 | Female | 25 |
| 359 | Mara | 53-57 | 62-66 | 69-73 | Female | 17 |
| 360 | Mara | 58-62 | 67-71 | 74-78 | Female | 15 |

*Note:* Cohorts are defined for 5 year age bands, 20 regions and 2 genders; mean cell size is the average over the three surveys.