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Is household income diversification a means of survival or a means of accumulation? Panel data evidence from Tanzania.

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Abstract

What drives income diversification among rural households in developing countries? A large literature has examined whether household income diversification is a means of survival or a means of accumulation, which has so far remained inconclusive. This paper attempts to evaluate which explanation of household income diversification – diversification as survival or diversification as accumulation – stands up to empirical scrutiny. We use household panel data from Tanzania of approximately 800 households for four years and use fixed and random effects models to sweep out unobserved households' attitudes to risk that may be correlated with household income diversification behaviour. We also use instrumental variable methods to address the possibility of reverse causality and that the household's income status may be endogenous to its diversification behaviour. Our results suggest that the 'diversification as accumulation' motive of household income diversification seems to have stronger empirical validity in the Tanzanian context.

Keywords: Income Diversification; Tanzania, Panel Data.

JEL Classification: D12, R20, O5.

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1. Introduction

One of the most established characteristics of rural households in developing countries is that they obtain their incomes from many different sources (Reardon 1997, Davis et al. 2010). Household income diversification is the norm in rural societies, and specialisation in a single activity is the exception. A large literature has examined the determinants of household income diversification in developing economies (see Ellis 1998, 2000a and 2000b, and Barrett et al. 2001a). This literature has identified a variety of factors that may explain income diversification such as risk reduction strategies, responses to household shocks, and asset accumulation strategies that originate from movement into nonfarm activities and migration to cities. Most of these factors can be broadly classified into two fundamental causes of household income diversification– one takes household income diversification to be a consequence of push factors while the other views the latter as driven by pull factors. Among the push factors, household income diversification could be due to "risk reduction, response to diminishing factor returns in any given use, such as family labour supply in the presence of land constraints driven by population pressure and fragmented landholdings, reaction to crisis and liquidity constraints, high transactions costs that induce households to self-provision in several goods and services, etc." (Barrett et al, 2001a, pp. 315-316). Pull factors could include the "realization of strategic complementarities between activities such as crop-livestock integration" or "local engines of growth such as commercial agriculture or proximity to an urban area (that) create opportunities for income diversification in productivity and expenditure-linkage activities" (ibid, pp. 316). Therefore, one set of causes of household income diversification see the latter as a matter of necessity and survival, where diversification is born out of desperation, and driven primarily by the household's poverty status (Ellis 1998). The other set of causes of household income diversification see the latter "as a matter of choice and opportunity, involving proactive household strategies for improving living standards" (Ibid., pp. 7).

In this paper, we examine the determinants of income diversification for a panel of rural households in Tanzania for the period 1991-1994. We look at what characterises the behaviour of our panel of households – whether survival or accumulation motives drive household diversification patterns. One strong implication of the 'diversification as survival' view is that the expected relationship between household income diversification and the household's income will be negative – poor households will be likely to diversify more than richer households. In the 'diversification as accumulation' view, it will be exactly the opposite. Under this view, the expected relationship between household diversification and household income will be positive – richer households will be more likely to diversify more. If assets were used as a measure of poverty status instead of income, a similar set of predictions will be expected – asset poor households will be expected to diversify their incomes more if survival was the key determinant of income diversification. In this case, there will be a negative relationship between

diversification and the value of asset holdings of the household. On the other hand, if the motive for diversification was accumulation, asset rich households will be more likely to diversify their incomes. In this case, there will be a positive relationship between diversification and the value of asset holdings of the household.

Whether household income diversification is a matter of necessity or choice is a matter of considerable policy importance. If rural households diversify out of necessity, and it is the poorest households that are most likely to diversify their incomes, policies which facilitate the movement of members of poor households out of high risk and low return agricultural activities into non farm wage employment, and self-employment (in start-up businesses, for example) along with easier access to urban and semi-urban jobs, are of paramount importance. On the other hand, if income diversification is a matter of choice, mostly undertaken by richer households who have the necessary level of income and assets to make the transition into non-farm activities where there are high entry costs, it may be more important from a policy point of view to stress public investments in agricultural activities such as roads, electricity and agricultural extension services, along with the removal of impediments to engaging in high value agricultural activities such as producing horticultural and other non-traditional products for export markets. In this case, greater emphasis on fostering the growth of incomes in agriculture, especially among poorer households, so that they can generate the necessary capital to move out of agriculture at a later stage, may well be the desired policy objective.

Previous empirical research using household survey data on the determinants of household income diversification has found both 'diversification as survival' and 'diversification as accumulation' motives to be prevalent in the actual behaviour of rural households in Sub-Saharan Africa and Asia (Ellis 2000b). There have been, however, two important limitations of previous empirical work on the determinants of household income diversification. Firstly, most studies that use household survey data tend to examine the determinants of household income diversification at a point in time (that is, use cross-sectional data). However, the use of cross-sectional data in establishing the causes of household income diversification will not be able to disentangle innate household characteristics that are unobservable to the econometrician such as the household's attitude to risk. Attitudes towards risk may explain household income diversification independent of 'push' and 'pull' factors. The observed correlation between income diversification and these 'push' and 'pull' factors may be simply due to an omitted variable – the degree of risk aversion of members of the household.

Omitted variable bias due to the lack of incorporation of the household's unobserved attitude to risk in the econometric analysis of the determinants of household income diversification plagues both the 'diversification as survival' and 'diversification as accumulation' accounts of household income diversification. Thus, in the 'diversification as survival' view, where households are both income and asset poor, a household's preference to minimise fluctuations in expected incomes

may explain why they prefer not to 'put their eggs in one basket', especially where different income streams have low covariate risks (Ellis 2000b). In this case, the different diversification strategies followed by two households may be explained by the different degrees of risk aversion between these two households, rather than their poverty status. Similarly, for households who use diversification as a means of further accumulation, one household may be more willing to invest in risky but high return assets such as livestock, than another for the same endowments of financial and human capital, if the former household has a higher appetite for risk. Here again, attitudes towards risk may explain different diversification outcomes, for the same level of income/assets between households (Dercon 1996, Dercon 2002). This suggests that empirical analysis of income diversification must disentangle household innate characteristics such as attitudes to risk from other household, community and macro variables that may impact on household income diversification to precisely identify the determinants of the latter.

The second limitation of previous empirical research is that it is difficult to establish causality in the relationship that has been found between the household's income and/or asset status and its income diversification behaviour. For example, using a Q-squared methodology combining a 10 year panel data with qualitative life-histories for Tanzania, De Weerdt (2010) finds that households who have moved out of poverty were those who diversified their farming activities, growing food crops for their own consumption, cash crops for sale and keeping livestock. This finding of a positive correlation between diversification into commercial agriculture and livestock and household income status has been seen in earlier studies on income diversification in Sub-Saharan Africa (such as Dercon and Krishnan 1996). However, it is not clear whether such an observed positive relationship between diversification away from food crops and movement out of poverty is due to income diversification being causal to the income status of the household, or whether household's income/asset status is itself causal to its diversification behaviour.

The problem of disentangling causality from correlation bedevils both the 'diversification as survival' and 'diversification as accumulation' views of household income diversification. Thus, in the 'diversification as survival' view, the negative relationship between household income and diversification may be due to the fact that when poor households engage in income smoothing via seasonal migration or by engaging in wage employment for other households as a means to smoothen their consumption, the low incomes they obtain from these activities may explain why they remain in poverty. Similarly, in the 'diversification as accumulation' view, the ability of some households to enter into high value activities such as cattle rearing or to obtain remittances as a source of income by sending educated members of the household to the city to work may explain why under this perspective, there may be a positive relationship between household income diversification and household income.

This paper attempts to address the two limitations in the empirical literature on determinants of household income diversification discussed above and by doing so, systematically evaluate which account of household income diversification – diversification as survival or diversification as accumulation – stands up to empirical scrutiny. By using household panel data from Tanzania of 800 households for four years and fixed and random effects methods, we are able to sweep out unobserved households' attitudes to risk that may be correlated with household income diversification behaviour. We also use instrumental variable methods to address the reverse causality issue and test for the causal role that income may play in diversification outcomes. Since current income can be a weak proxy for permanent income, especially for rural households, we also look at the relationship between household's asset status and diversification patterns. The overall finding of the paper is that there is a robust positive relationship between diversification and household income/asset status, controlling for household fixed/random effects and the possible endogeneity of income and assets along with other household and village level determinants of income and asset diversification which have been identified in the literature. Thus, our results suggest that the 'diversification as accumulation' motive of household income diversification seems to have stronger empirical validity, at least in the Tanzanian context.

Tanzania is a particularly appropriate for an empirical analysis of the determinants of household income diversification. Earlier studies have noted the phenomenon of 'deagrarianization' in the Sub-Saharan African context in general, and the Tanzanian context in specific, where there has been a greater share of household income is being derived from non-agricultural rural employment (Bryceson 1999). Previous studies have also noted that the phenomenon of income diversification is prevalent for rural households at all levels of income in Tanzania (Dercon and Krishnan 1996, Ellis and Mdoe 2003). Furthermore, the availability of panel data on income and its correlates for a large number of rural households in the Kagera region of Tanzania for 1991-1994 allows us to examine the determinants of household income diversification in a more systematic manner than is possible for most other developing countries.

The rest of the paper is in five sections. In the next section, we discuss how we measure income diversification and describe the conceptual basis of the two perspectives on the causes of diversification. Section 3 discusses the empirical strategy, the econometric methodology and data to be used in the empirical analysis. Section 4 presents patterns of income diversification evident in the data and other relevant descriptive statistics. Section 5 presents the results of the empirical analysis. Section 6 concludes..

2. Household Income Diversification: Measures and Determinants

Household income diversification has been measured in various ways in the empirical literature. In this section, we begin by describing our proposed measure of household income diversification, which we will use in the empirical analysis. We then discuss the conceptual basis of the two explanations on the causal origins of income diversification and summarise the findings of previous research on the determinants of household income diversification in the developing country context.

Measuring Household Income Diversification

Many studies of household income diversification view the latter as a move away by rural households from growing crops (that is, being pure cultivators) to off-farm or nonfarm labour, rearing livestock or migration of some members of the household to cities. In these studies, diversification is measured using discrete indicator variables for different types of income portfolios that may exist among households (e.g. an income portfolio with no diversification – pure cultivators - will get a value of one, a mixed income portfolio with both cultivation and livestock rearing will get a value of two, a mixed income portfolio of both farming and non-farming income will get a value of three, and so on).1 Other studies measure income diversification as the proportion of income derived from non-farm sources (Reardon et al. 1992, Davis et al. 2010). While the move from farm activities to non-farm activities will be clearly beneficial to the household in most contexts, measuring diversification as a transition to more rewarding sources of income or a move away from subsistence agriculture is problematic. Firstly, it becomes a tautological matter that diversification is associated with accumulation if the former is measured as a movement from less productive to more productive sources of income. Secondly, it is not obvious why a household that derives, say, 75 per cent of its income from one source of income should be seen as being more diversified than another household which may derive equal shares of income from different sources of income. For this reason, the use of indicator variables to denote the degree of diversification in different income portfolios is problematic – the construction of such indicator variables is sensitive to the assumptions made about the precise thresholds of income shares used to assign different households to different income portfolio categories.

We,choose to use a Herfindahl index of household income concentration, where the index is constructed as the sum of squares of the shares of different income groups in the household income basket.2 As we are aware from the applications of this index in the industrial

[1] For example, see Dercon and Krishnan (1996) and Abulai and CroleRees (2001).

[2] See Anderson and Deshingkar (2005) for an application of this measure to household income diversification.

organisation literature, a smaller value of the index implies a higher degree of income diversification (Carlton and Perloff 1994). Our measure is more appropriate in the context of our paper as it makes no assumption that a higher degree of diversification is necessarily related to greater household engagement in more remunerative nonfarm activities (so by construction, the use of our measure in the empirical analysis does not lead to the result that the higher values of our measure implies greater income accumulation). Our measure also does not necessitate the need for arbitrary assignment of households to different income diversification categories (Ellis 2000b).3

Why do Households Diversify?

Perhaps the most important characteristic of household income in rural areas of low income developing countries is their extreme variability. Weather variation, the incidence of disease, pests and fire, and random shifts in international crop prices cause farm incomes to fluctuate unpredictably in these countries. In the face of large shocks to their income, there are three ways in which poor rural households may attempt to smooth out their consumption. The first of these is the pooling of risk by which households within a village, kinship group or social network may share each other's risk through institutional arrangements which lead to the efficient allocation of risk. If such arrangements work well and if shocks or adverse events are idiosyncratic, peculiar to the household, then for any particular household, its consumption would track the aggregate consumption of the village, kinship group or social network and not be affected by the household's income. In this case, there would be little incentive for the household to diversify risks by diversifying the sources of its income. While several empirical studies have documented the existence of risk-pooling mechanisms at the village level (such as Platteau and Abraham, 1987, and Townsend, 1994, for southern India, and Udry, 1994, for northern Nigeria), these studies also show that full risk-pooling is rarely observed, particularly among the poorer households. Thus, informal insurance mechanisms that exist among members of the village, kinship group or social network will not enable all households to insulate consumption from income fluctuations. This would particularly be true if fluctuations in household income are more due to aggregate village-level factors than due to household-specific factors.

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[3] The logic of this income diversification index is broadly similar to those of the income diversification indices used by Davis et al (2010) which have been constructed at the country level, but unlike these indices, it allows us to measure diversification at the level of the household, which is our unit of analysis, as opposed to the country level.

A second way in which rural households may attempt to insulate consumption from large unpredictable movements in their incomes is to smoothen consumption over time using saving and credit transactions. Households will save in the face of positive shocks to their income, which are expected to be transitory, and dis-save (or borrow) in the face of negative shocks to income. By doing so, they will attempt to keep consumption unchanged. While there is a good deal of evidence that households engage in a substantial degree of intertemporal consumption smoothing using saving and credit transactions (Besley 1995, Deaton 1992), there are strong reasons to believe rural households in developing countries do not have access to credit markets that allow them to insulate consumption completely from income shocks. If credit markets are not perfect, some rural households will be constrained in their ability to borrow when faced with a large transitory fall in their incomes, leaving these households unable to cope with income variability.

Both risk-pooling and the use of saving and credit institutions may be seen as ex post means of smoothening consumption. However, if these ex post mechanisms fail (or more importantly, if households anticipate that these ex post mechanisms will fail), then the preferred strategy for the household is to smoothen consumption ex ante by reducing income fluctuations (Morduch 1995 refers to this as income smoothing). While households may smoothen income by favouring variability-reducing inputs and production techniques and shifting production into more conservative but less profitable modes (Binswanger and Rozenzweig 1993), perhaps the most common method of income smoothing that they choose is to diversify the sources of their income. Thus, income diversification may be seen as an outcome of risk-averse households' strategy to minimise the variance of their income by achieving an income portfolio with low covariate risk among its components (Alderman and Paxson 1992, Reardon 1992, Reardon et al. 1992, 1997, Ellis 2000a). Since poorer households tend to be more risk averse (given the widely held belief that risk aversion tends to decrease in income and wealth), have fewer assets which can be sold to smoothen consumption, and have less access to credit facilities or formal and informal insurance mechanisms, the poor will be more likely to diversify ex ante as a coping response to shocks (Dercon 2002, Barrett et al. 2001a). This theoretical implication of the incomplete markets approach to rural household behaviour underpins the diversification as survival perspective in the literature on household income diversification. Under this approach, income diversification is mostly undertaken by poor households as a mechanism to smoothen consumption in the face of high income volatility and out of sheer desperation.

Several studies find evidence to support the hypothesis that diversification is driven by income variability linked to survival concerns. Reardon et al. (1992) find that harvest shortfalls and terms of trade movements drive diversification using four years of household data from Burkina Faso. Using household data for rural districts in Nepal, Menon (2009) finds that when the head of the household is in agriculture, other members of the household are less likely to choose agriculture in districts where rainfall is more uncertain. A similar finding is obtained for Mexico

by Eakin (2005). Anderson and Deshingkar (2005) find that households with lower asset holdings have more diversified income portfolios using data from six villages in Andhra Pradesh, India (though they also find greater diversification among households with asset holdings over a certain level, implying that there is an U shaped relationship between asset holdings and diversification).

An alternate explanation of household income diversification is based on the assumption of economies of scope in production, along with entry barriers to high return economic activities. Economies of scope exist when the same inputs generate greater per unit profits when spread across multiple outputs than when dedicated to any one output (Barrett et al. 2001a). Unlike the presence of economies of scale, which tend to favour specialisation in one activity, economies of scope tend to favour diversification as a means of profit maximisation. While most empirical studies on Africa or Asia find little evidence of economies of scale beyond a very small farm size, it is likely that diversification across different types of crops (cash crops versus food crops, for example) or across different types of activities (farming in combination with livestock rearing or remittances derived from the migration of some members of the household to cities, for example) can lead to significant income enhancement for the household (Ibid.). However, entry into many activities both within and outside agriculture needs initial capital or access to land. Both agricultural and non agricultural thresholds are evident in most rural economies, where richer households are able to make investment outlays to meet fixed costs in the purchase of cattle and agricultural implements, the setting up a non-farm enterprise or the education of their children for the skilled labour market while poorer households are unable to do so (Barrett and Swallow 2005). Diversification in this case would be mostly driven by accumulation motives, and is mostly confined to richer households. There is strong evidence that income diversification has acted as a means of accumulation in Sub-Saharan Africa, with households with larger holdings of land or access to capital more able to move into high return activities such as livestock rearing or non-farm employment (Dercon 1998, Block and Webb 2001, Abulai and CroleRees 2001, Barrett et al. 2001b, De Weerdt 2010).

It is clear from the discussion above that there are strong theoretical arguments on the causal origins of income diversification, both for the diversification as survival and diversification as accumulation hypotheses. Furthermore, the findings of previous studies remain inconclusive. In addition, as we have argued previously, the robustness of the findings of earlier empirical research has been hindered by a lack of adequate attention to problems of omitted variable bias to due to households' attitudes to risk and reverse causality from diversification to income or wealth status of the household. In the next section, we set out our empirical strategy, and show how we will test for the necessity versus choice explanations for household income diversification. We will elaborate on how we will attempt to address the limitations in the previous literature on household income diversification.

3. Empirical Strategy, Econometric Methodology and Data

In this section, we present the empirical specification used in the regressions, discuss the econometric methodology and describe the data.

Empirical Specification

Our interest centers around the effect of household income on the Herfindahl index of household income concentration. We estimate regressions of the following generic form:

$$S_{ivt} = \alpha + + \rho Y_{it} + \sum_k \gamma_k R_{vt} + \sum_k \beta_k X_{it} + d_t + u_i + e_{it} \qquad (1)$$

Where i designates the household, v designates village in which the household resides, t designates time, S is the Herfindahl index of household concentration (larger values implies more income concentration), Y is the logarithm of household income, and Rvt and Xit¬ are vectors of standard control variables at the village and household level respectively. The error terms dt and ui capture the time-invariant and household-invariant components of the error term, while eit is the white noise component of the error term. The year effects dt have been included to capture year-specific national level shocks, such as weather shocks, oil price shocks, and other macroeconomic shocks that may affect diversification behaviour for all households in a given year. The household specific effects ui capture unobserved household characteristics that are time-invariant and most importantly, from our perspective, unobserved household attitudes to risk.

One important consideration is whether household current income, Yit, is a reasonable proxy for household welfare status. While income is a direct measure of welfare, current income may not be correlated strongly with permanent income, especially when weather shocks have a significant effect on year to year variations in income in rural areas. Arguably, permanent income is the explanatory variable of interest, as household would base their diversification strategies on permanent income, rather than transitory income. In this case, assets offer a store of wealth that is more closely related to permanent income. Common to several previous studies on household diversification behaviour, we experiment with household asset holdings as a measure of household permanent income and re-estimate equation (1) with assets as the key explanatory variable of interest, in place of current income (see Dercon 1998).

To measure household asset holdings, we construct an index of assets, using the principal component approach to the measurement of assets proposed by Filmer and Pritchett (2001). We use the first principal component for a set of variables that capture the household's asset holdings – the first principal component of this set of variables captures the largest amount of information that is common to these variables, and provides a measure of the asset richness of the household. The advantage of this approach is that it does not have to make arbitrary assumptions of weighting multiple assets to obtain a single value of asset holdings, nor does it require information on prices for each asset that a household may own (and where in many

prices do not exist or where a monetary valuation of the asset is not appropriate). The set of variables that we use to obtain the asset index are the quality of the roof, the number of rooms in the household dwelling, the type of fuel used for cooking, the availability or non-availability of indoor water and toilets, and ownership of assets such as a radio, a bicycle, a car, a motorcycle, a TV, a fridge, and a sewing machine (these are similar to the set of assets used in Filmer and Pritchett 2001).

As indicated earlier, a negative sign of the income/assets variable indicates that the diversification as accumulation hypothesis holds and a positive sign of the income/diversification variable if the diversification as survival hypothesis holds. Given the plausible assumption that income portfolios of the richest and poorest strata of the population may be more diversified than those of the middle-income strata (Anderson and Deshingkar, 2005), we also tested the hypothesis that the relationship between income concentration and incomes/assets may be characterised by an inverted U-shape pattern. However, this hypothesis was not supported by our data.

Our control variables at the village level are a set of dummy variables which capture whether the village has access to any formal or informal credit institutions (Credit) is electrified (Electricity), has access to a post office and telecommunications (Post and Telephone) and has access to a motorable road (Motoroad). The presence of the infrastructural variables – electricity, post office and telecommunications, and access to motorable roads - could have a negative effect on household income concentration – as households in villages which have these infrastructural facilities would be more able to diversify nonfarm employment opportunities or migrate to cities (with the presence of motorable roads). With respect to credit facilities, the effect of this variable on household income concentration would be positive or negative, depending on whether household income diversification is driven by survival or accumulation concerns. If income diversification is driven by survival concerns, then greater access to credit will enable poor households to smoothen consumption inter-temporally, rather than by diversifying their income portfolios. In this case, the relationship between access to credit facilities in the village and household income concentration will be positive. On the other hand, if income diversification is mostly a means of accumulation, access to credit will provide households with an easier route into non farm activities or livestock rearing, which have high entry costs. In this case, the relationship between access to credit facilities in the village and household income concentration will be negative.

Our control variables at the household level are standard demographic variables such as age and gender of the head of household, the proportion of members of the household who are dependents, and the size of the household. Previous research has found that male headed households or households with more children are associated with more diversified income portfolios (Dercon and Krishnan 1996).With respect to the size of the household, we expect that

larger households are more likely to follow diversified income strategies, given that there are more individuals in the household.

Econometric Methodology

We use an Instrumental Variables (IV) method of estimation along with household fixed effects and year effects. The use of the IV method addresses the problem of reverse causality discussed previously – that household income is itself determined by the household's diversification strategy, rather than the other way around. The use of household fixed effects nets out unobserved household attitudes to risk, which as we have argued previously, may explain household diversification behaviour, independent of income.

Our data set provides a large number of variables that are exogenous in the household income regression and could serve as credible instruments. There is no credible econometric way of assuring the quality of our instruments, as most tests for endogeneity available in the literature assume ex ante that the instrument chosen is at least conceptually appropriate. We experimented with instrumentation (without simultaneously correcting for fixed or random effects) and our final set of instruments passed the Sargan overidentification test. The set of instruments that we finally selected includes different types of village level shocks (e.g. refugee inflow, epidemic or natural disaster), the rainfall variability in the district over the preceding year, the education of the head of household and an indicator of whether a working member of the household died during the preceding year. These variables impact on diversification via their effects on income and not directly, and satisfy the exclusion criteria of being included as instruments.

We also include random effects instead of fixed effects in several of the estimates as robustness checks. Given the short time variation in our panel, and the large cross-sectional dimension, random effects estimation may be more efficient than fixed effects, and we experiment with both random and fixed effects in the estimation of equation (1).

Data

We use data from the Kagera Health and Development Survey (KHDS), a longitudinal household survey, conducted in the Kagera region of Tanzania from 1991 to 1994. This region of approximately 1.9 million people is located on the western shore of Lake Victoria, bordering Uganda to the north and Rwanda and Burundi to the West. The population is overwhelmingly rural and mainly engaged in the production of bananas and coffee to the north and rain-fed annual crops (maize, sorghum and cotton) in the south. The KHDS interviewed more than 800 households from 51 communities in all five districts of Kagera- Bukoba, Karagwe, Muleba, Buharamu and Ngara. The households were interviewed in 6-7 month intervals for up to four survey periods. Of the total 816 households initially selected, a total of 757 completed all four

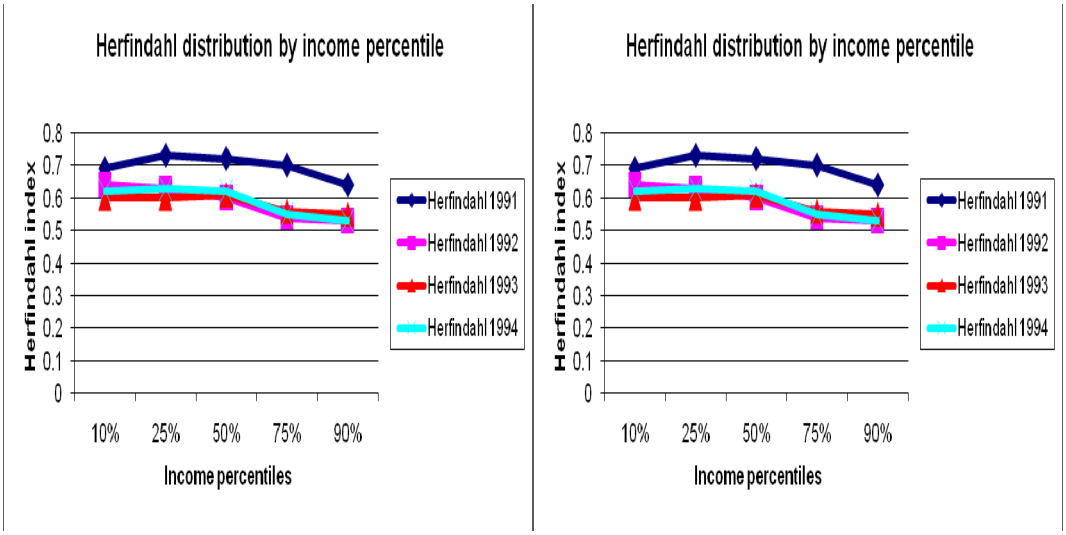
rounds of the survey. The household questionnaire is based on the World Bank's Living Standards Measurement Survey, and thus assures representativeness, richness and high quality of the data collected. Its advantage is that it is fully longitudinal .

Our income diversification index is based on five different broad categories of income: income from agricultural production, income from non-farm employment, income from non-farm businesses or self-employment, income from rents and income from remittances. This set of income categories is fairly representative of categories used in the literature (e.g. Davis et al, 2010). We also tried including crop and livestock incomes as two separate categories, but this did not change our Herfindahl index measure. Hence, we included these two types of income as a combined category. Ideally, we would have also distinguished between agricultural activities on one's own farm and agricultural activities on somebody else's farm, but our data did not allow this distinction. We did not include public transfers in our index due to their small size and inherent endogeneity (poorer households will be expected to receive greater transfers from the state than richer households).

4. Patterns of Income Diversification

We begin with a plot of the household diversification index in each year against the income percentiles of households in the first year of our panel, 1991 in Figure 1 to see whether there is a relationship between level of income and income diversification. We observe that despite occasional non-linearities, the general pattern is one of a negative relationship between our measure of income concentration and the level of income. The same pattern is observed when we use the asset index in place of income. This grants some preliminary support to the 'diversification as a means of accumulation' hypothesis. Figure 1 also indicates that the level of income concentration was higher in 1991 than the level of concentration across all income groups during the rest of the period. In our empirical analysis we attempt controlling for various types of year specific shocks that may influence diversification behaviour on a year to year basis.

Figure 1 Income diversification by income and wealth percentiles



It would be interesting to find out whether specialization in a certain activity, e.g. non-farm employment, provides better opportunities for households to diversify their incomes. Hence, in Figure 2 we plot the time distribution of the Herfindahl indices of households whose main source of income in 1991 was each one of the five income categories that we used for our Herfindahl index construction. As in Davis et al (2010), we define as main income category an income category that represents at least 75% of the total income. We observe that irrespective of the starting position, all households became more diversified over time. In general, the households whose main source of income was non-agricultural salaried employment were characterised by greater income concentration throughout the period. Households whose main source of income was agricultural production were most diversified in 1991 and 1992, but decreased their diversification in 1993 and 1994.

Figure 2: Income diversification by main source of income

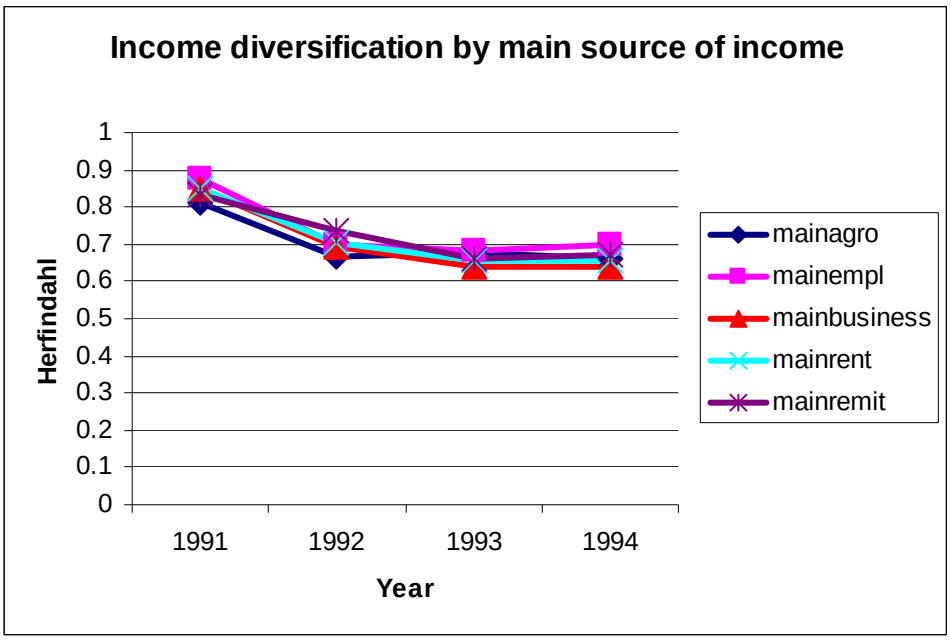
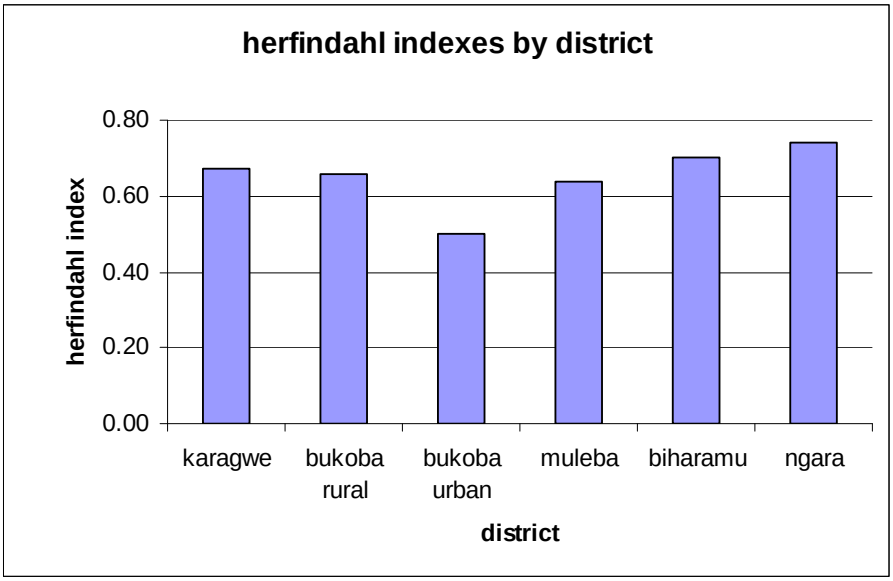


Figure 3 highlights the differences in Herfindahl indices across the 5 different regions surveyed, where Bukoba is split into two parts- Bukoba rural and Bukoba urban. We do not observe large differences in diversification across the regions, except that, as expected, households living in the urban part of Bukoba enjoy a slightly higher income diversification. To make sure that our results are not driven by these geographical differences, we estimated our equations for the sample excluding the Bukoba urban region, but did not find significant difference in our results. Furthermore, controlling for district fixed effects did not affect our results significantly.

Figure 3: Income diversification by region



Finally, in Figure 4 we try to find out whether there are scale effects in the pattern of households income diversification in that larger households find it easier to diversify their incomes. We do find confirmation of this hypothesis. The Herfindahl index of households with only one or two family members is approximately 0.69, while the Herfindahl index of households with more than ten members is less than 0.6.

Figure 4: Income diversification by household size

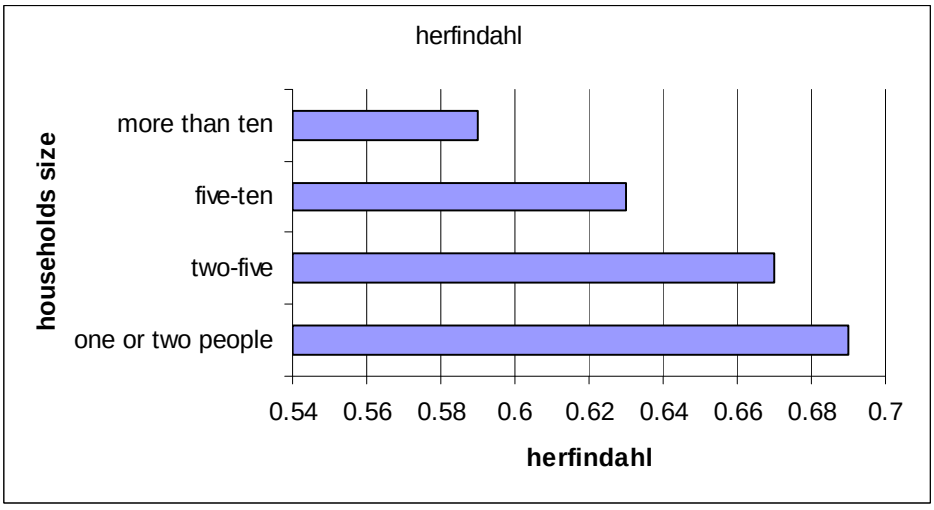


Table 1 explores the variation of Herfindahl indexes by key demographic characteristics of the household and infrastructural characteristics of the geographical cluster . The gender of the head of household does not induce significant differences in income diversification and neither does the age of the head of household. Similarly, the proportion of young age and old age dependents in the family- where dependents are those in ages of less than 15 and ages of more than 60- does not seem to affect the income diversification of households significantly, except that households without any dependents have more concentrated incomes than households with at least some dependents. This could be due to the need to find better diversification strategies to ensure the survival of dependent members of the family, but could also capture to some extent the scale effect of being able to use child and old age labour in income accumulation. To disentangle these two different effects, we control for both the dependency ratio and the household size in our empirical specification.

Table 1: Patterns of Income Diversification with Various Household Characteristics

	Mean Herfindahl	Standard deviation	Number of observations
Gender			
Female	0.6361	0.1916	437
Male	0.6329	0.1975	1916
Dependents as proportion of household size			
0	0.6674	0.2024	120
0-50%	0.6290	0.1970	797
>50%	0.6333	0.1948	1134
Age of the head of household			
Less than 20	0.6295	0.2122	31
20-50	0.6409	0.2006	1015
>= 50	0.6264	0.1911	1005
Credit availability			
Not available	0.6528	0.1963	939
Available	0.6109	0.1938	1112
Motoroad availability			
Not available	0.7090	0.1988	84
Available	0.6304	0.1955	1967
Access to electricity			
Not available	0.6526	0.1927	1510
Available	0.5805	0.1962	541
Availability of post and telephone			
Not available	0.6392	0.1948	1833
Available	0.5867	0.2019	218

Finally, when looking at the infrastructural impacts on household income diversification, we see that the availability of credit, access to electricity, the availability of post and telephone and the availability of motor roads have a positive impact on diversification. The observation that better infrastructure, especially in the form of ability to obtain credit, eases the diversification

constraints is one of the most common findings in the literature on income diversification (e.g. Menon, 2009). Our basic descriptive statistics also indicate that the incomes of households are not highly diversified (Table 2). The mean of our Herfindahl index variable is approximately 0.65. The mean age of head of household is 49, less than a third of the household heads are female, approximately half of the average household members are dependents and the households are relatively large, with a mean of more than 6 family members.

Table 2: Descriptive Statistics

Variable	Mean	Standard deviation	Minimum	Maximum	Number of observations
Herfindahl index of income concentration	0.6488	0.1959	0.2208	1	2051
Log household income	11.6472	0.95832	8.1842	16.3041	2051
Asset index	5.3567	2.5515	0.9720	25.2385	2051
Age of head of household	49.2826	17.1781	3	98	2051
Female head	0.2736	0.4459	0	1	2051
Proportion dependents	0.5497	0.2293	0	1	2051
Household size	6.6951	3.5459	1	36	2051
Credit dummy	0.4663	0.4989	0	1	2051
Post and telephone dummy	0.0983	0.2978	0	1	2051
Motoroad dummy	0.9230	0.2666	0	1	2051
Electricity	0.2288	0.4201	0	1	2051
Rainfall variance	99.5921	22.8859	63.4482	119.2974	2051
Education of head	0.0551	0.2282	0	1	2051
Disaster	0.6490	0.4774	0	1	2051
Death in family	1.7499	0.4332	1	2	2051

5. Regression Results

In Table 3, we present our estimates of equation (1), where the key explanatory variable is (log of) household income. In Cols. (1) and (2), we present simple Ordinary Least Squares (OLS) estimates of equation (1), with only household level controls., and with year effects included, first using fixed effects and then random effects. In Cols. (3) and (4), we present the estimates of equation (1), using the Instrumental Variable (IV) method of estimation with only household level controls but without year effects (and with fixed and random effects). In Cols. (5) and (6), we include year effects. In Cols. (7) an (8), we include access to credit. In Cols. (9) and (10), we estimate the full specification, which includes all village level controls. Our results are fairly consistent across the different specifications. We observe a strong negative impact of the income variable on the degree of concentration, with the value of the income coefficient varying from 0.0097 in the non-instrumented case with random effects and -0.0696 after instrumentation, random effects and controlling for different types of additional effects. The income variable is statistically significant in all the estimates, except for the OLS case with fixed effects. More importantly, the coefficient on the income variable is statistically significant at the 1 per cent level, in the full specification when all the controls have been added, whether using fixed or random effects (Cols. (9) and (10)). There is persuasive support for the hypothesis that income diversification in rural Tanzania is used as a means of accumulation and not as a means of mere survival.

Table 3: Impact of Household Income on Diversification

Columns	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
Variables	**FE**	**RE**	**FE+IV**	**RE+IV**	**FE+IV**	**RE+IV**	**FE+IV**	**RE+IV**	**FE+IV**	**RE+IV**
Constant	0.8018***	0.8180***	1.1750***	1.4915***	1.5315***	1.6823***	1.5299***	1.6767***	1.5243***	1.4977***
	(0.0913)	(0.0656)	(0.2036)	(0.1384)	(0.1977)	(0.1354)	(0.1977)	(0.1354)	(0.1994)	(0.1407)
Log. household income	-0.0044	-0.0097*	-0.0370**	-0.0683***	-0.0741***	-0.0907***	-0.0734***	-0.0894***	-0.0681***	-0.0696***
	(0.0077)	(0.0055)	(0.0169)	(0.0116)	(0.0166)	(0.0114)	(0.0166)	(0.0114)	(0.0170)	(0.0119)
Head age	0.0006*	-0.0000	-0.0004	-0.0000	-0.0007**	-0.0002	-0.0007**	-0.0002	-0.0007**	-0.0002
	(0.0003)	(0.0003)	(0.0003)	(0.0000)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0002)
Female head	-0.0339**	-0.0184*	-0.0173	-0.0048	-0.0306**	-0.0126	-0.0299**	-0.0118	-0.0297**	-0.0084
	(0.0142)	(0.0104)	(0.0147)	(0.0106)	(0.0141)	(0.0103)	(0.0141)	(0.0103)	(0.0141)	(0.0103)
Proportion dependents	0.0580**	0.0596***	0.0126	0.0267	0.0533*	0.0526**	0.0532*	0.0521**	0.0549*	0.0505**
	(0.0283)	(0.0208)	(0.0289)	(0.0209)	(0.0280)	(0.0204)	(0.0280)	(0.0204)	(0.0280)	(0.0203)
Household size	-0.0075***	-0.0050***	-0.0116***	-0.0074***	-0.0064***	-0.0035***	-0.0064***	-0.0036***	-0.0064***	-0.0034***
	(0.0018)	(0.0014)	(0.0016)	(0.0012)	(0.0016)	(0.0013)	(0.0016)	(0.0013)	(0.0016)	(0.0012)
Credit	--	--	---	--	--	--	-0.0108	-0.0163*	-0.0105	-0.0133
							(0.0122)	(0.0087)	(0.0123)	(0.0090)
Electricity	--	--	--	--	--	--	--	--	-0.0008	-0.0411***

									(0.0162)	(0.0099)
Post and telephone	--	--	--	--	--	--	--	--	0.0008 (0.0265)	-0.0239* (0.0140)
Motoroad	--	--	--	--	--	--	--	--	-0.0613** (0.0283)	-0.0478** (0.0210)
Year effects	Yes***	Yes***	No	No	Yes***	Yes***	Yes***	Yes***	Yes***	Yes***
Rsq	0.0710	0.0747	0.0350	0.0350	0.0954	0.1014	0.0967	0.1030	0.0998	0.1157
N obs	2051	2051	2051	2051	2051	2051	2051	2051	2051	2051

Notes: The figures in brackets are standard errors. *** , ** and * indicate significance at the 1%, 5% and 10% level, respectively. FE: Fixed Effects; RE: Random Effects; IV: Instrumental Variable method.

Whenever significant, all of our infrastructural variables are negative, indicating that households are able to diversify and hence increase their ability to accumulate, when such infrastructural facilities are present. Access to motorable roads, in particular, is important for household diversification strategies – the coefficient on this variable is negative and significant for both the fixed and random effects cases. Access to credit has a negative effect on household income concentration, supporting the finding that income diversification is mostly driven by accumulation motives – however, it is significant only in the random effects case, and when all other village level controls are not included.

The rest of our controls have the expected signs. We find confirmation of the scale effect that household size has on diversification, which we noted in our descriptive analysis. We also find that a large dependency ratio has a positive impact on concentration – households with a large number of children or dependent households are less likely to diversify. Finally, the impact of the age and gender of the head of household on concentration is in general not significant at conventional levels – though female headed households and older households tend to have more diversified income portfolios.

We next re-estimate equation (1) replacing household income with the asset index. The results are presented in Table 4. We follow the same structure in presenting the results as in Table 3. In Cols. (1) and (2), we present simple Ordinary Least Squares (OLS) estimates of equation (1), with only household level controls., and with year effects included, first using fixed effects and then random effects. In Cols. (3) and (4), we present the results using the Instrumental Variable method of estimation with household level controls but without year effects (but with fixed and random effects). In Cols. (5) and (6), we include year effects. In Cols. (7) an (8), we include access to credit. In Cols. (9) and (10), we include all controls, including village level controls. The results are remarkably similar to those obtained in Table 3. Strikingly, the coefficient on the asset index is negative and significant across all estimates (and in most cases, at the 1 per cent level), whether OLS or IV, and whether fixed or random effects are included. The results indicate that asset rich households are the most likely to diversify. We also obtain very similar findings on the other variables – access to credit along with access to infrastructural variables – electricity, post and telephone and motorable roads - are more likely to lead to greater diversification among households. The results are particularly strong for the random effects case. With respect to the household controls, female headed households are more likely to have more diversified portfolios, and households with a greater proportion of dependents have less diversified portfolios.

6. Conclusions

Most rural households in developing countries, and especially in Sub-Saharan Africa, have highly diversified portfolios. While several studies have examined the determinants of household income diversification in developing economies, the causes for household income diversification remain unclear. In particular, it remains an empirical issue whether household income diversification is a consequence of 'push' or 'pull' factors. In this paper, we examine the determinants of income diversification for a panel of rural households in Tanzania for the period 1991-1994. We test for which motive for income diversification characterises the behaviour of our panel of households – whether survival or accumulation motives drive household diversification patterns. In our empirical strategy, we pay careful attention to concerns relating to possible reverse causality from diversification to income and omitted variable bias originating from unobserved household attitudes to risk.

Using Instrumental Variable estimation methods and household fixed/random effects, along with a range of household and village level controls, we find unequivocal evidence that the diversification behaviour of households in rural Tanzania are driven by accumulation motives rather than by survival concerns. This result holds true whether we use current income or asset holdings as a measure of the household's long-run income status. Our results suggest that it is only richer households that have been able to take advantages offered by a diversified income portfolio.

Our results call into question the pessimistic view of African agriculture that has shaped the academic discourse and policy discussions on household income diversification in recent years (for example, see Bryceson 2005). In contrast to the widely held belief that household income diversification is a symptom of African depeasantisation and of a failing agricultural sector, our paper suggests that household income diversification may well be out of choice, and not necessity, as richer rural households use the capital that they have generated out of agriculture to move into profitable non-agricultural activities. However, our paper also suggests that asset and poverty traps may develop among those rural households who are not able to make the transition in their income portfolios into such activities. In this case, specific policy measures may be needed to allow rural poor households to generate agricultural income to make the transition to diversified portfolios, including public investment in infrastructure and easier access to rural financial institutions and rural markets.

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