Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Structural transformation and household responses to shocks in Uganda

Timothy Wilson

timothy.wilson@vuw.ac.nz

Victoria University of Wellington

Ilan Noy

Victoria University of Wellington

Research Article

Keywords:

Posted Date: November 18th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11279299/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Structural transformation and household responses to shocks in Uganda

Timothy Wilson & Ilan Noy

Abstract

We examine the relationship between structural transformation dynamics at the household level and shock experiences (droughts and floods). We create a panel data-frame that tracks households from the Uganda National Panel Survey (UNPS) from 2001 through to 2020. We identify that droughts/floods are associated with an increase in hardship; the likelihood that a household has enough shoes and clothes for all family members decreases by 3.0 and 2.2 percentage points respectively. We further find that this negative impact is attenuated by structural transformation dynamics. The shock-driven reduction in the likelihood of having enough shoes reduces by 3.1 (p value < 0.1) to 4.6 ($p < 0.05$) percentage points for households who have moved out of subsistence farming status or who generate income outside the family farm. We also find that droughts/floods are associated with an increase in real expenditure of households of 5.3 percent. This increase is also attenuated by household dynamics of structural transformation; they are associated with a 4.5 percent (p value <0.05) to 5.4 percent (p value < 0.01) reduction in the shock-driven expenditure increase. We find suggestive evidence of mechanisms operating through wealth, income, education and neighbourhood connections. We rule out urbanisation as a primary driver.

Funding declaration

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Affiliations:

Timothy Wilson*, Te Herenga Waka, Victoria University of Wellington (PO Box 600, Wellington 6140, New Zealand)

Ilan Noy, Te Herenga Waka, Victoria University of Wellington (PO Box 600, Wellington 6140, New Zealand) & Gran Sasso Science Institute (Viale Francesco Crispi, 7 - 67100 L'Aquila, Italy)

* Corresponding author: timothy.wilson@vuw.ac.nz

Acknowledgements:

This research represents the personal views of the authors and does not necessarily reflect the views or positions of the United Nations or any organization with which the corresponding author is affiliated. The work was undertaken in a personal capacity and is independent of the author's official duties.

Economies transform, and so do their constituent parts. Labour enters, exists, or shifts across. Capital stocks accumulate and decay. Productivity vacillates. A common policy goal in low-income contexts[1] is to shape such transformation so that it is 'structural,' by which it is meant that the economy would transform in ways that generate sustained improvements in economic output. This is usually referred to as structural transformation or structural change.

Structural transformation is an appealing concept for politicians and economists alike. It captures the urgency of raising the incomes of the poorest, while also appealing to the need for improvements in economic functioning. To some, structural transformation emerged as a *necessary* condition for rising out of poverty; Justin Yifu Lin, former Chief Economist and Vice-President of the World Bank writes "all countries that remain poor have failed to achieve structural transformation, that is, they have been unable to diversify away from agriculture and the production of traditional goods into manufacturing and other modern activities" (Lin, 2012 at page 3).

Despite the importance given to structural transformation and the large body of literature on its macro-economic aspects, micro-economic research is sparse. In particular, the implications of structural transformation at the level of the household are relatively under-studied. Meanwhile, new imperatives are constantly competing for policy attention. One of these is in climate change. Economic planning frameworks are now required to simultaneously address the impacts of climate change, while also remaining alert to the need for structural transformation.

Our research examines this intersection. We take a notable feature of household-level structural transformation (household labour allocation and income shifting) and explore its interaction with a notable feature of climate change (more frequent and impactful floods and droughts).

Our focus is Uganda. The Ugandan economy has experienced changes in the rate of structural transformation since its independence, while also experiencing multiple climate hazards, including droughts and floods. We use data from a series of national household surveys from 2001 to 2020 to create a panel dataset with measures for subsistence farming

[1] At the global level, structural transformation is one of the commitments of Member States to enable sustainable development under the 2030 Agenda for Sustainable Development (which sets the Sustainable Development Goals), (UNGA, 2015). At the regional level, the planning frameworks of regional intergovernmental bodies frequently cite the importance of structural transformation. For example, the long-term development framework of the African Union (Agenda 2063) frames itself as "Africa's endogenous plan for structural transformation…" (AUC, 2015 at page 11). At the national level, structural transformation also regularly features in policy frameworks. A recent example (2025) in Uganda occurred when President Museveni welcomed the fact that structural transformation was one of the five priority areas for action under the Awaza Programme of Action for Land-Locked Developing Countries, (Kasooha, 2025).

status, income sources, shock experiences, education status and other household characteristics. We investigate two household dynamics that are commonly associated with structural transformation: households moving out of subsistence farming and households generating income from sources outside the family farm. We explore whether these dynamics influence the household's experience of droughts and floods.

We find that droughts and floods are associated with an increase in hardship faced by households. Specifically, experiencing a drought/flood is significantly associated with a 3.0 percentage point reduction (p value < 0.01) in the likelihood that the household has enough shoes and a 2.2 percentage point reduction (p value < 0.01) in the likelihood that the household has enough clothes. We find that this negative association is reduced for households who have experienced structural transformation dynamics. In other words, structural transformation has an attenuation influence. The shock-driven reduction in the likelihood of having enough shoes reduces by 3.1 (p value < 0.1) to 4.6 (p < 0.05) percentage points for households who have experienced structural transformation dynamics.

We also find that experiencing a drought or a flood is significantly associated with an increase in real expenditure by 5.3 percent (p value < 0.001), consistent with households being forced to buy food and other essential items at elevated prices in the wake of the drought/flood (our inflation deflators are only at the national level). This increase is also attenuated by structural transformation dynamics at the household level; they are associated with a 4.5 percent (p value <0.05) to 5.4 percent (p value < 0.01) reduction in the shock-driven expenditure increase. This finding is consistent for both measures of transformation, suggesting that the result is not driven by how transformation is defined

We explore mechanisms behind this relationship. We find suggestive evidence that wealth, income and education, which are associated with structural transformation, also shape household experience and outcomes of shocks. We also find that structural transformation dynamics are associated with changes in a household's connection to its community that influences selection into shock-coping mechanisms. Finally, we find that urbanisation is not driving our results. This finding is instructive as structural transformation is often incorrectly reduced to a synonym for urbanisation.

Our research contributes to the literature in three primary ways. First, we offer insight into an area that has not yet been explored; how the structural transformation at the household level shapes their experiences of droughts and floods. Second, we expand the literature on Uganda by covering a longer period than previous studies, using the integrated household survey data in a novel way and asking a question that had not yet been asked. We build a

new panel data frame from the Uganda National Panel Survey that covers a longer time period than any previous research and we publish our code to enable other researchers to use this panel data frame. Third, we identify gaps and inaccuracies in the data from the Uganda National Panel Survey. This Survey is part of the Living Standards Measurement Study (LSMS), a flagship initiative of the World bank, which seeks to publish accurate micro-data for research purposes (Grosh & Glewwe, 1995; WB 2026a). By identifying these limitations, we hope to support the objectives of the LSMS.

Section 01 introduces our theoretical framework and the data we use. Section 02 details our methods. Section 03 estimates the impact of droughts/floods on household income, expenditure and hardship indicators. It then explores how these impacts are mediated by structural transformation. Section 04 explores mechanisms. Section 05 examines the robustness of our findings. Section 06 concludes.

01 Context

Structural transformation

Structural transformation or structural change generally refers to the reallocation of economic activity (particularly labour) across sectors from agriculture to manufacturing and services (Herrendorf et. al. 2014). A particular emphasis in the development economics literature is the movement of labour from low productivity sectors (e.g. subsistence agriculture) into high productivity sectors (e.g. services). This is grounded in foundational research on how changes in the structure of an economy, including its labour allocation, can be a source of growth and development (Lewis, 1954; Kuznets 1957; Chenery 1960; Chenery & Taylor 1968).

In such framing, structural transformation is both an explanation and an ideal. It provides an explanation of how economies have grown. For instance, structural transformation has been a major driver of economic growth at the global level since the early 2000s (Martins, 2019). At the same time, it also serves as an ideal; structural transformation is an ideal to pursue for countries for whom sustainable economic growth has so far proved elusive (Kong et. Al. 2024). For instance, the 2030 Agenda for Sustainable Development, which sets the overarching framework for global sustainable development, includes a policy commitment to support least developed countries to embark on structural transformation (UNGA 2015).

In either case, the focus of analysis is generally at the macro economy-wide level. Much attention is paid to decomposing structural transformation over time and its relationship to economic growth, particularly labour productivity growth (e.g de Vries et. al 2015; Martins

2019). Micro-economic analysis, or analysis at the individual or household level is less common. It is often reduced to, or confused with, the considerable research on urbanisation and its economic implications (e.g.Amen 2024;Bryan et. al 2020; Glaeser et. al. 1992; Krugman 1991). This is hardly surprising given that one of the greatest reductions in poverty ever achieved (in China during the last quarter of the 20th century) was associated with high levels of rural to urban migration (Ravallion & Chen, 2007).

Yet urbanisation, structural transformation and poverty reduction are distinct phenomena, even if they are sometimes related (Christiaensen et. al, 2013). For instance, poverty reduction during the 1980s and 1990s in China mainly took place in rural areas, driven by agricultural productivity gains, among other factors. Only from the mid-1990s onwards, was poverty reduction in China predominantly urban, driven by export-led industrialisation (Ravallion & Chen, 2007). Of most relevance for our research, Christiaensen & Kaminski (2015) use a subset of our data and identify that between 2005-2010, 13 percent of the total population in the Uganda Panel Survey moved out of agriculture, yet two thirds of these remained in rural areas. In other words, they structurally transformed, but did not urbanise. The authors also found that labour market participation increased over this period, while the share of household labour time allocated to agriculture decreased. Structural transformation took place, and much of it occurred without households leaving rural areas.

Our analysis zones in on this perspective: we look at how structural transformation plays out at the household level and what implications this has for another overarching dynamic: the increasing frequency of disasters due to climate change.

Structural transformation and climate change

Most research on structural transformation and climate change looks at the impact of the latter on the former. In particular, climate change can impede the structural transformation process through several mechanisms. These include changing the returns from leaving agriculture (Saxena 2024) and disrupting human capital accumulation which is an important enabler for individuals to shift into higher income sectors (Agamile & Lawson, 2021). Conversely, climate shocks can also speed up household transitioning towards non-farm income sources by reducing agricultural productivity (Musungu et. al 2024) or encouraging crop diversification (Antonelli, et. al 2022).

We approach the relationship from the reverse perspective: does structural transformation influence how households experience disasters? We were unable to identify any papers directly addressing this question at the household level. The closest papers examine the question from an economy-wide level, for example, Loayza et. al. (2012) explore how an

economy's sectoral composition can alter the impact of a disaster on the economy's growth. Similarly, Colmer (2021) combines worker, firm and district-level data from India to demonstrate that the ability of non-agricultural sectors to absorb labour can significantly attenuate the impact of temperature-driven agricultural shocks. Yet these papers do not address household-level disaster experience as a function of the transformation itself. We discuss this, and other indirect, but related evidence, more fully in the conceptual framework section below.

Conceptual framework

Returning to our definitions above, structural transformation at the macro-economic level refers to labour moving from low productivity sectors to high productivity sectors. This will have implications at the household level. Our focus is on two specific implications.

First, household labour supply is changing. Household members will be changing their labour allocation from low productivity sectors (often working on the family farm) to higher productivity sectors (often non-farm sectors). We capture this dimension in our empirical strategy by looking at household members job status.

Second, as household labour allocation changes, so does household income sources. Moving into higher productivity sectors is assumed to be associated with higher household income. The UNPS includes a question on whether households report that subsistence farming is their primary source of income. Our empirical strategy exploits variation in this response; as households increasingly report that subsistence farming is no longer their primary source of income they are changing in ways that are consistent with structural transformation.

These two dynamics may have implications for how a household experiences climate shocks, particularly droughts and floods. Appendix Section 01 presents our stylised theoretical framework. It illustrates that households experience shocks in multiple phases, each of which could be affected by structural transformation dynamics. For instance, households living in poverty tend to be more likely to live in areas that have a higher exposure to natural hazards (Rentshcler & Salhab, 2022). In so far as structural transformation reduces poverty, it could therefore reduce exposure to natural hazards and consequent impact of disasters.

On the other hand, structural transformation could increase the impact of a shock if it generates new forms of exposure. Households in Uganda who had non-farm enterprises and wage labour (i.e. structurally transformed) experienced greater losses during COVID-19 lockdowns than farming households (Mahmud & Riley, 2021). Similarly, using a subset of the Uganda National Panel Survey, Sekabira et.al. (2022) find that diversity of crops within a

household's farm leads to better household nutrition outcomes, where-as there is no similar relationship with diversity of crops available in local markets and nutrition outcomes. This suggests that if structural transformation leads to more specialisation and reduces household crop diversity, then nutrition outcomes post shock could be adversely affected. Furthermore, the differential impact of disasters on households is partially influenced by the household asset portfolio at the time of the shock (Quisumbing et.al., 2018). If structural transformation is associated with changes in household asset portfolios, then we can expect it to have an influence on disaster impacts.

Households may employ income and consumption smoothing behaviour to cope with the impacts of a disaster. In Uganda, Asfaw et.al (2015) use data from waves 2009–10 and 2010–11 of the same Uganda Panel Survey to explore this behaviour. If structural transformation dynamics influence household selection into this behaviour, (for example, they increase income, which makes consumption smoothing more affordable), then they are also shaping households' experience of disasters.

Human capital accumulation plays an important role in structural transformation (Martins, 2019a). Meanwhile, the process of accumulating human capital (learning) tends to make future accumulation of capital (more learning) easier (Cunha & Heckman, 2007). Structural transformation dynamics could therefore influence the way in which a household learns from shocks and adapts to be better prepared for future ones.

Finally, as discussed above and explored more fully in Section 05, the relationship between structural transformation and climate shocks may go in both directions. Structural transformation dynamics may shape a household's experience of climate shocks, yet those climate shocks may also shape the household's choices with respect to structural transformation (for example, Antonelli, et. al 2022). In summary, structural transformation dynamics are likely to influence the way in which households experience disasters. However, the direction and nature of this interaction is not clear.

Uganda

The structure of Uganda's economy has changed notably over the last 70 years. The value-added contribution of agriculture to the GDP of Uganda was around 50 percent for most of the 1960s (the earliest that we have reliable data for). It rose to above 70 percent in the mid-1970s and then has gradually declined ever since, overtaken by services and industry as the two largest sectorial contributors to GDP (Mbowa et. al, 2013). Agriculture now contributes less than a quarter of the country's GDP, yet it remains the largest employer. Agriculture employs nearly 70 percent of the work force in Uganda (WB 2025).

Meanwhile, Uganda's population of nearly 50 million people is one of the youngest and fastest growing populations in the world. The average age in Uganda has remained in the mid to late teens since 1995 (NPA, 2022). While the total fertility rate has fallen from 7.1 in 1991 to 4.5 in 2024, it remains one of the highest fertility rates in the world (NPA, 2025). Job creation has not been able to keep pace with new entrants to the labour force, resulting in pervasive unemployment and underemployment (NPA, 2022; NPA 2025).

These dynamics have played out during a period involving multiple hazard events of growing frequency and magnitude. Floods, particularly in low-lying areas, are the most significant risk event in Uganda and affect an estimated 50,000 people annually. Droughts also present a significant risk; between 2004 and 2013, they affected 2.4 million people and caused loss and damage of about 1.2 billion USD, or 7.5 percent of Uganda's GDP in 2010 values (WB 2021). Research, much of it using subsets of the same Uganda National Panel Survey, has identified that shocks in Uganda have had impacts on human capital accumulation (Agamile & Lawson, 2021; Baulia, 2024), income (Björkman-Nyqvist, 2013), within household gender inequality (Björkman-Nyqvist, 2013), energy access and preferences (Oweggi, 2024), and food security and household welfare (Asfaw et.al, 2015; Diwakar & Lacroix (2021). In short, Uganda's population is exposed to several types of shocks, and have been undergoing structural transformation over time. This makes it an ideal setting to investigate the relationship between structural transformation and household experiences of climate shocks.

02 Methods

Data

We use household data from a series of national surveys in Uganda from the period 2001 to 2020. Our primary focus is the Uganda National Panel Survey (UNPS) series, which was started in 2009/10 and builds on the Uganda National Household Survey of 2005/6. The purpose of this series was to produce annual estimates in key policy areas that would enable assessment of national policies and programmes (UBOS, 2012). The series was supported through financial and technical support from the World Bank Living Standards Measurement Study project.

The first wave of the UNPS set out to track the 3,123 households who were originally visited in the Uganda National Household Survey in 2005/06. In that survey, households were also tracked back to the Uganda National household Survey in 2001 with respect to responses on hardship indicators (including whether they had enough clothes and shoes). Going forward,

from 2009/10, household panel surveys were conducted in 2010-11, 2011-12, 2013-14, 2015-16, 2017-18, 2018-19 and 2019-20. We retrieved the microdata from the World Bank Microdata Library for all waves except the wave in 2017-18 (WB 2026).[2]

We employ a variety of tracking methods to link households across all waves with published data. As far as we are aware, this is the first time that households have been successfully tracked across all panels. We detail our approach, assumptions and decisions in Appendix 01: Tracking households across waves.

We locate households within districts. Some districts in Uganda were renamed or merged during our period of analysis, so we mapped all districts back to their parent values as of 2009 to ensure consistency (see Appendix DIS table).

Data limitations

Some households were lost to attrition across waves creating an unbalanced panel. There are gaps in observations for some variables, particularly in respect of the household survey in 2001. We discuss and address these limitations in Section 05 Robustness.

We identified several anomalies or inaccuracies in the published microdata. This microdata was published as part of the World Bank's Living Standards Measurement Study (LSMS). The LSMS aims to publish accurate micro-data that can be used to monitor and research living standards and support policymaking (Grosh & Glewwe, 1995; WB 2026a). In support of this objective, we have documented data anomalies and uncertainties identified in the preparation of our research. Examples of these anomalies include the following. In wave 5 (2015-16), there are multiple variables purporting to represent household IDs. The Basic Information Document (UBOS 2016) does not identify which variable is authoritative, and it is not possible to discern this from the Dynasty ID values. In several waves, survey module data includes information about households who are not included in the household identifier module. In other instances, there are duplicate observations, implausible outliers and inconsistencies, for example, in wave 3 (2011-12), there are 28 households where two people report that they are the head of the household. We publish all identified anomalies and our treatment of them in Appendix Section 02.

Finally, data inconsistencies across survey waves introduces limitations. In particular, the categories of household assets changes across survey waves. To address this, we construct a portfolio of assets for households that only includes assets for which we have consistent

[2] The data for this wave was not published. We contacted the World Bank to request the data and were advised that the Uganda Bureau of Statistics had decided not to publish this data. The Uganda Bureau of Statistics did not respond to our request for the data.

measurement across panels. These include bicycles, furnishings and furniture, jewellery and motorcycles. The full list of the assets included in our portfolio is in Appendix Section 06, Table B. Some assets are excluded because they are not included in all surveys. For instance, land is not included as an asset class in wave 1A (2005/06) but is included in subsequent waves. Meanwhile, computers are only introduced as an option in waves subsequent to wave 1A. We therefore construct our asset variable to only include asset classes that are captured in every wave and are measured consistently.

Descriptive analysis

The average number of children in a household mostly fell during our period of analysis, while education rates, the number of senior citizens (those older than 65 years) and the age of the head of household steadily increased. The number of shocks experienced per household was lower in from 2010/11 until 2015/16, but then increased again in the last two waves. The proportion of households who were headed by a female steadily increased. The proportion of households with at least one person employed outside the family farm fluctuated, ranging from 60.72 percent in 2009-10 to 50.51 percent in 2011-12 (Table 1).

Table 1: Descriptive Statistics

	2005-6	2009-10	2010-11	2011-12	2013-14	2015-16	2018-19	2019-20
Households (n)	3123	2975	2716	2850	3119	3305	3176	3098
Children per household (mean)*	3	3.4	3.28	3.26	3.04	2.45	2.75	2.69
Senior citizens per household (mean)**	0.13	0.17	0.18	0.18	0.17	0.17	0.2	0.22
Median age of household members (median)	19.33	19.05	19.59	19.75	20.39	22.67	22.19	22.95
Household who have at least one person with a formal education (percent)	88.56	89.88	91.06	91.04	92.27	93.43	92.63	94.19
Age of head of household (mean)	41.62	44.95	45.97	46.16	45.4	45.31	47.37	48.1
Household headed by a female (percent)	27.89	28.1	30.41	31.08	31.83	32.76	34.64	35.62
Households with at least one person employed outside the family farm (percent)		60.72	56.59	50.51	54.47	52.67	55.44	57.44
Shocks experienced per household (n)	1.17	0.91	0.59	0.46	0.51	0.32	1.22	1.2

* Children are those are less than 18 years of age
** Senior citizens are defined as those who are more than 65 years of age

Poverty rates rose from 2009/10 to 2010/11 and then fell steadily throughout the rest of our period of analysis. The rise and fall of poverty rates tracked consistently with commensurate changes in household assets and expenditure. The proportion of households where every member had at least two pairs of clothes and one pair of shoes did not track in lock-step with poverty and income dynamics, although both exhibited a general upward trend. In total,

2,612 households in our panel moved out of subsistence farming, while 2,136 households moved into subsistence farming[3] (Table 2).

Table 2: Dynamic descriptive statistics – longitudinal data

	2001	2005-6	2009-10	2010-11	2011-12	2013-14	2015-16	2018-19	2019-20
Poverty and Hardship									
Households living poverty (percent)	-	-	21.77	33.07	30.4	21.37	16.41	19.49	14.28
Households who moved out of poverty since the previous wave (n)	-	-	-	167	343	298	353	247	322
Households who moved into poverty since the previous wave (n)	-	-	-	366	286	169	212	306	163
Households where every member has at least one pair of shoes (percent)	51.75	52.41	52.19	51.6	54.65	61.48	62.51	-	65.39
Households where every member has at least two sets of clothes (percent)	86.77	87.02	83.54	85.37	87.6	93.25	93.31	-	92.63
Income and Wealth									
Household assets value (median)*		121,144	113,354	100,018	108,115	124,415	124,498	120,001	136,351
Household monthly expenditure (median)*	-	-	190,420	149,106	151,666	162,896	181,969	168,704	186,896
Structural Transformation									
Household whose primary income is subsistence farming (percent)	-	46.91	47.3	45.63	51.13	46.63	49.68	46.02	35.63
Households who moved out of subsistence farming since the previous wave (n)	-	-	403	351	243	296	275	484	560
Households who moved into subsistence farming since the previous wave (n)	-	-	323	263	383	236	375	317	239

*Assets do not include land, house, building or enterprise assets. In Ugandan shillings in 2005/6 constant prices

Empirical strategy

We employ multiple methods to explore whether structural transformation at the household level influences household experiences of droughts or floods. Our primary specification is a longitudinal analysis using the panel data to explore whether there is a significant interaction between experiencing a drought/flood and household-level structural transformation dynamics:

[3] While 2,136 households moving into subsistence farming might seem high given it is a period of declining poverty rates, this is partly a function of churn between statuses. Gross flows in/out of subsistence farming were noticeably higher than the net change in each wave. Meanwhile, many households moved back and forth across status. For example, of the 2,136 households who moved into subsistence farming, 54 percent of them had been a subsistence farming household in the past; in other words, they were returning to a prior status rather than entering subsistence farming for the first time. Finally, some inflows may also be caused by floods/droughts pushing the households into subsistence farming, which we discuss more in Section 05 Robustness.

$$\log(y_{it}) = \beta_1 DroughtFlood_{it} + \beta_2 ST_{it} + \beta_3 (DroughtFlood_{it} \; x \; ST_{it}) + \gamma^T X_{it} + \alpha_i + \delta_t + \epsilon_{it} \quad (1)$$

$$H_{it} = \beta_1 DroughtFlood_{it} + \beta_2 ST_{it} + \beta_3 (DroughtFlood_{it} \; x \; ST_{it}) + \alpha_i + \delta_t + \mu_{it} \quad (2)$$

In equation (1), y_{it} represents one of two dependent variables, real household assets and real household expenditure, which we run in separate regressions. In equation (2), H_{it} represents one of two dummy variables measuring hardship. One hardship variable is a dummy that switches on (=1) when every household member has at least two sets of clothes. The other hardship variable is a dummy variable for whether every member of the household has at least one pair of shoes. We refer to these as clothes and shoes hardship indicators respectively, although they are coded to pick up the absence of hardship when the dummy variable switches on. There are missing values for each of these dependent variables, but the proportion of missing values for the hardship indicators is higher because this question was not asked in all surveys (see Appendix Section 6, Table C).

$DroughtFlood_{it}$ is a dummy that switches on (=1) when a household reports that they were impacted by a flood or drought in that wave. It is zero otherwise. There are no missing values.

X_{it} is a column vector of predetermined covariates as control variables that include educational status of household members, number of children in the household (defined as being less than 18 years old) and number of senior citizens (older than 65). We include household and survey wave fixed effects (α_i, δ_t).

ST_{it} is a dummy variable for house i at time t that switches on when a household is considered to have experience dynamics that are consistent with structural transformation. Our coefficient of interest is β_3 which captures the interaction between $DroughtFlood_{it}$ and ST_{it}.

We use two distinct measures for household-level structural transformation dynamics ST_{it} and run separate regressions for each. The first measure is whether a household reports that subsistence farming is its primary source of income. If a household reports that subsistence farming is the primary source of income, then $ST_{it} = 0$ (they have not structurally transformed). If the household reports that some other source of income is their primary source of income, for example, non-agricultural enterprises, then $ST_{it} = 1$. The second measure we use for structural transformation is whether a household reports that at least one of the members of the household above the age of ten report that they have a 'main job' that is something other than 'working on the household farm or with household livestock.' For instance, they may report that their main job is as an employer or working for

someone else. In those cases, $ST_{it} = 1$ (the household has structurally transformed). If the household has no members reporting as such, then $ST_{it} = 0$.[4].

03 Results

We first examine the impact of floods and droughts on households and then investigate whether this impact is influenced by the household structural transformation status.

The impact of floods and droughts

A bivariate comparison identifies that households who experienced floods/droughts have significantly fewer assets and lower monthly expenditure than those who have not. They are less likely to have at least two sets of clothes or at least one pair of shoes for each member of the household. We present these results in full in Section 4 of the Appendix. We also run multivariate two-way fixed effect regression models on our longitudinal data to estimate the impact of floods and droughts. Appendix Section 4 details these methods and presents full results. We find that experiencing a drought or a flood is significantly associated with an increase in real expenditure by 5.3 percent (p value < 0.001). The increase in real expenditure is consistent with households being forced to buy food and other essential items at elevated prices due to the impact of the flood/drought in their region (our inflation deflators are only at the national level, so they cannot account for district-level inflation).

We find that experiencing a drought/flood is consistent with an increase in hardship. It is significantly associated with a 3.0 percentage point reduction in the likelihood that the household has enough shoes (p value < 0.01), and a 2.2 percentage point reduction in the likelihood that the household has enough clothes (p value < 0.01). We are unable to detect significant relationships between experiencing a drought/flood in prior survey waves and current conditions of the household (see results in Appendix Section 4).[5]

The impact of structural transformation on drought / flood experience

A basic bivariate comparison identifies significant differences between structurally transformed households and other households among the population of households who

[4] Other potential measures for structural transformation were also explored but data limitations precluded them. Whether a household had a non-agricultural enterprise, and the proportion of household income that relates to non-agricultural activities, would also have been insightful measures of structural transformation at the household level. However, different reporting practices were used for these variables across survey waves.
[5] This may be due to data limitations; the time between survey waves was inconsistent, and data for wave 6 was unavailable (2017-18).

were affected by a drought or flood. This finding is consistent regardless of the measure used for structural transformation (Table 3).

Table 3: Households affected by a drought or flood

	Other households (n)	Structurally transformed households (n)	Mean of other households	Mean of Structurally transformed households	Difference	P Value of T-Test
Subsistence Farming						
Household assets (in constant 2005 prices)	4,081	2,523	203,505.964	441,016.704	237,510.740	0.000
Households where every member has at least two sets of clothes	3,692	2,300	0.838	0.815	-0.023	0.026
Households where everyone member has at least one pair of shoes	3,690	2,301	0.357	0.503	0.146	0.000
Household monthly expenditure	3,085	1,919	190,925.314	234,966.626	44,041.312	0.000
Household has non-ag. jobs						
Household assets (in constant 2005 prices)	2,734	2,315	188,263.477	437,321.780	249,058.302	0.000
Households where every member has at least two sets of clothes	2,407	2,066	0.846	0.811	-0.036	0.002
Households where everyone member has at least one pair of shoes	2,408	2,066	0.400	0.466	0.066	0.000
Household monthly expenditure	2,625	2,169	183,980.058	244,211.831	60,231.772	0.000

Specifically, households who are no longer subsistence farmers have higher real assets and monthly expenditure, as well as being more likely to have enough shoes for all household members. Similarly, those who have at least one member who has a job outside of the family farm, also have higher assets, income and likelihood of owning enough shoes (Table 3). Conversely, structurally transformed households (by both measures) are less likely to have enough clothes, which is an anomalous finding that we explore more below.

We now turn to our primary specification that estimates the coefficient on the interaction between experiencing a drought flood and structural transformation status. Our results with the strongest statistical significance and economic importance are in respect of real expenditure. Households that have not transformed experience a 7.5 percent (p value <

0.001) to 7.8 percent (p value <0.001) increase in real expenditure when they are affected by a drought/flood, depending on the measure used for structural transformation (Tables 4-5). The interaction on shock impact and transformation is negative and significant. Specifically, household dynamics of structural transformation are associated with a significant reduction in the shock-driven expenditure increase of 4.5 percent (p value <0.05) to 5.4 percent (p value < 0.01) (Tables 4 and 5). Importantly, the size, direction and significance of the finding are broadly consistent across the two measures of transformation, suggesting that our results are not drive by how transformation is defined.

Results are consistent in respect of the household having enough shoes. Experiencing a shock reduces the likelihood that a household has enough shoes by 4.1 percentage points (p value < 0.001) and 4.7 percentage points (p value 0.001) for non-transformed households. The interaction is positive and significant. The shock-driven reduction in likelihood of having enough shoes reduces by 3.1 (p value < 0.1) to 4.6 (p < 0.05) percentage points for transformed households (Tables 4 and 5).

We do not identify statistical significance in the interaction terms when real assets and the likelihood of having enough clothes are regressed. Our models exhibit varying degrees of goodness of fit, ranging from 0.4 percent to 8.6 percent of the within household, within wave variation. The model with the best fit is when jobs outside the family farm is used as the measure for structural transformation. The models with the weakest fit are those whose dependent variable are the likelihood of the household having enough clothes. These models fail to identify statistically significant relationships. This is most likely due to insufficient, intra-household variation of the dependent variable.

In summary, our headline results present a consistent message. Transformation at the household level is associated with a reduction in the extent to which households increase their expenditure when affected by a drought/flood. It also attenuates the negative impact of a drought/flood on one of our hardship indicators (the likelihood that a household will have enough shoes).

Table 4: Longitudinal regressions using subsistence farming as transformation measure - coefficients

	Expenditure (log)			Assets (log)			Clothes			Shoes		
Shock	0.065***	0.078***	0.075***	0.086*	0.098*	0.059	-0.008	-0.008	-0.018+	-0.027***	-0.036***	-0.041***
Transformed	0.013	0.024+	0.040**	-0.006	0.005	0.055	-0.008	-0.008	-0.005	-0.002	-0.010	-0.017
Interaction (Shock & Transformed)		-0.033+	-0.045*		-0.028	-0.006		-0.002	0.002		0.022	0.031+
Expenditure (millions shillings monthly, constant prices)						0.530**			0.028*			0.060**
Assets (millions shillings, constant prices)			0.001						0.000			0.000
Primary education			0.079***			0.270***			-0.010			0.031*
Secondary education			0.143***			0.532***			-0.013			0.068***
Advanced education			0.165***			0.718***			-0.053**			-0.014
Head of HH (age)			0.004**			-0.002			-0.001*			-0.002+
Female head of HH (dummy)			-0.129***			-0.372***			-0.026+			-0.019
Children (n)			0.090***			0.107***			-0.012***			-0.038***
Seniors (n)			-0.032			-0.081			-0.014			-0.029
Num.Obs.	16357	16357	16265	20076	20076	16265	18870	18870	15057	18868	18868	15059
R2 Within	0.004	0.004	0.083	0.000	0.000	0.018	0.000	0.000	0.006	0.001	0.001	0.018
R2 Within Adj.	0.004	0.004	0.082	0.000	0.000	0.017	0.000	0.000	0.004	0.001	0.001	0.017
AIC	23282.9	23280.5	21741.4	86555.9	86557.7	70033.3	10967.8	10969.8	7829.6	21950.8	21949.9	17492.7
BIC	61602.4	61607.7	59971.3	130425.5	130435.2	108263.1	54234.8	54244.6	45226.6	65209.4	65216.3	54890.3
RMSE	0.36	0.36	0.35	1.58	1.58	1.54	0.24	0.24	0.23	0.32	0.32	0.31

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001.
All regressions are two-way fixed effect models, with a log-linear model for expenditure and assets (both in real terms) and a linear probability model for clothes and shoes.
Fixed effects are at the household and survey wave.
'HH' means household.
The dependent variable 'Clothes' is a dummy variable that switches on (=1) when household reports that every member of the household has at least two sets of clothes, (=0) otherwise.
The dependent variable 'shoes' that switches on (=1) when household reports that every member of the household has at least one pair of shoes, (=0) otherwise.
Education variables capture the highest level of education for any individual in the household. They are three dummy variables. The ommitted category is when no one in the household reports that they have a formal education, or they report that they do have a formal education, but they do not know what level it is.
Children (n) captures the number of people in a household who are less than 18 years old.
Seniors (n) captures the number of people in a household who are older than 65 years old.

Table 5: Longitudinal regressions using jobs outside the family farm as transformation measure – coefficients

	Expenditure (log)			Assets (log)			Clothes			Shoes		
Shock	0.062***	0.087***	0.078***	0.040	0.027	0.010	-0.015*	-0.015	-0.016	-0.026**	-0.042**	-0.047***
Transformed	0.084***	0.104***	0.092***	0.157**	0.146**	0.090+	-0.005	-0.005	-0.007	0.005	-0.008	-0.014
Interaction (Shock & Transformed)		-0.054**	-0.054**		0.029	0.027		-0.001	0.001		0.035+	0.046*
Expenditure (millions shillings monthly, constant prices)						0.503**			0.027*			0.056**
Assets (millions shillings, constant prices)			0.001						0.000			0.000
Primary education			0.062***			0.275***			-0.005			0.025+
Secondary education			0.126***			0.531***			-0.008			0.073***
Advanced education			0.127**			0.669***			-0.052*			-0.014
Head of HH (age)			0.005***			0.004			-0.001+			-0.001
Female head of HH (dummy)			-0.136***			-0.306**			-0.022			-0.040*
Children (n)			0.087***			0.093***			-0.011***			-0.039***
Seniors (n)			-0.023			-0.105			-0.012			-0.032
Num.Obs.	15696	15696	15656	16265	16265	15656	15100	15100	14499	15102	15102	14501
R2 Within	0.009	0.010	0.086	0.001	0.001	0.018	0.001	0.001	0.005	0.001	0.001	0.019
R2 Within Adj.	0.009	0.010	0.085	0.001	0.001	0.017	0.000	0.000	0.003	0.001	0.001	0.018
AIC	21953.7	21943.5	20649.8	69280.7	69282.5	66127.6	8076.7	8078.7	7456.4	17939.1	17934.9	16988.9
BIC	59623.6	59621.1	58322.5	107664.5	107674.0	103800.3	45823.1	45832.7	44311.7	55686.1	55689.6	53844.9
RMSE	0.36	0.36	0.34	1.50	1.50	1.46	0.23	0.23	0.22	0.32	0.32	0.31

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001.
All regressions are two-way fixed effect models, with a log-linear model for expenditure and assets (both in real terms) and a linear probability model for clothes and shoes.
Fixed effects are at the household and survey wave.
'HH' means household.
The dependent variable 'Clothes' is a dummy variable that switches on (=1) when household reports that every member of the household has at least two sets of clothes, (=0) otherwise.
The dependent variable 'shoes' that switches on (=1) when household reports that every member of the household has at least one pair of shoes, (=0) otherwise.
Education variables capture the highest level of education for any individual in the household. They are three dummy variables. The ommitted category is when no one in the household reports that they have a formal education, or they report that they do have a formal education, but they do not know what level it is.
Children (n) captures the number of people in a household who are less than 18 years old.
Seniors (n) captures the number of people in a household who are older than 65 years old.

04 Mechanisms

This section explores mechanisms behind our key finding that household dynamics consistent with structural transformation exhibit an attenuation of the impact of climate shocks on real expenditure and hardship. Our primary means of exploring mechanisms is by estimating linear probability models of structural transformation dynamics, using two-way fixed effects;

$$ST_{it} = +\gamma^T X_{it} + \alpha_i + \delta_t + \mu_{it} \quad (3)$$

Where ST_{it} is a dummy variable capturing structural transformation dynamics; when subsistence farming is the structural transformation measure, it switches on (=1) when the household no longer reports that its primary source of income is subsistence farming. When non-agricultural jobs is the structural transformation measure, it switches on (=1) when the household reports that at least one member has a job outside the family farm.

X_{it} is a column vector of household characteristics whose relationship to structural transformation dynamics we are interested to explore in order to uncover potential mechanisms. In addition to the characteristics used above (education status, children, seniors), we add rural status as well as variables pertaining to social connection. These variables come from the UNPS survey question in which households are asked what they did when they last ran out of salt. Households reported that they either borrowed from neighbours, bought salt, did without, or did not use salt.[6]

We create a dummy variable that switches on (=1) when the household reports that they borrowed salt from their neighbour. We consider this to be a proxy for social connection on the assumption that households who are more connected to their neighbours are more likely to borrow salt when they have run out. We create another dummy variable that switches on (=1) when the household went without salt (i.e. they wished to have it but they did not buy it or borrow from their neighbour). The omitted category for both dummy variables is when the household reports that they bought salt. Households who reported that the question was not applicable or that they did not cook or use salt were omitted. We include household and survey wave fixed effects (α_i, δ_t). We present our results in Table 6. The second model (using non-agricultural jobs as the dependent variable) fits the within variation about three times greater than the model using subsistence farming as the proxy for structural transformation.

Table 6: Linear probability model of structural transformation dynamics

	Not subsistence farming	Has non-ag jobs
Borrowed salt (dummy)*	-0.036***	-0.057***
Went without salt (dummy)*	0.027	0.008
Rural (dummy)	-0.063***	-0.017
Expenditure (millions shillings monthly, constant prices)	0.025+	0.047*
Assets (millions shillings, constant prices)	0.000	0.001***
Primary education (dummy)	-0.032*	0.097***
Secondary education (dummy)	-0.021	0.180***
Advanced education (dummy)	-0.008	0.191***

[6] The implied difference between the last two categories is one of preference – some households wished to use salt but when without, while others did not wish to use salt in the first place.

	Not subsistence farming	Has non-ag jobs
Children (n)	-0.003	0.002
Seniors (n)	0.017	-0.009
Head of HH (age)	-0.003***	-0.003***
Female head of HH (dummy)	0.019	-0.017
Num.Obs.	16238	15656
R2 Within	0.006	0.017
R2 Within Adj.	0.005	0.016
AIC	18157.9	17940.5
BIC	56833.6	55934.8
RMSE	0.31	0.31
Std.Errors	by: hhid_panel	by: hhid_panel
FE: hhid_panel	X	X
FE: wave	X	X

* Refers to the question posed to households of what they did when they last ran out of salt. Borrowed salt dummy switches on (=1) when the household borrowed salt from a neighbour. The Went without salt dummy switches on (=1) when the household went without salt. The omitted category are all households who bought salt. Households who reported that the question was not applicable or that they did not cook or use salt were omitted.

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001. Both regressions are two-way fixed effect models, with household and survey wave. 'HH' means household. The dependent variable 'Clothes' is a dummy variable that switches on (=1) when household reports that every member of the household has at least two sets of clothes, (=0) otherwise. The dependent variable 'shoes' that switches on (=1) when household reports that every member of the household has at least one pair of shoes, (=0) otherwise. Education variables capture the highest level of education for any individual in the household. They are three dummy variables. The omitted category is when no one in the household reports that they have a formal education, or they report that they do have a formal education, but they do not know what level it is. Children (n) captures the number of people in a household who are less than 18 years old. Seniors (n) captures the number of people in a household who are older than 65 years old.

Neighbour connections

Social capital and networks play an important role in household preparedness, responses and recovery to shocks (Mawejje & Holden, 2014; Aldrich & Meyer, 2015; Marin et. al., 2015). We find evidence that connections with neighbours may be playing a role in our primary results, although they point in a surprising direction. We identify that households who borrowed salt from their neighbours (rather than buying it) when they last ran out of salt were between 3.6 percentage points (p value <0.001) and 5.7 percentage points (p value <0.001) less likely to have experienced structural transformation (Table 6). We find no significant relationship for households who went without salt rather than buying it.

This suggests that households who have changed in ways consistent with economy-wide structural transformation have weaker social capital ties (by our salt-borrowing measure). The implication is that the mechanism driving the attenuation effect lies elsewhere, and that it is stronger than the decline in social capital associated with structural transformation.

Education

Education is positively associated with improved emergency preparedness and post-disaster outcomes (Lutz et. al. 2014; Hoffman & Muttarak, 2017; Wilson et. al. 2026). We identify a

positive, statistically significant relationship between formal education and structural transformation dynamics when measured by a household having at least one non-agricultural job (Table 6). The strongest association is at the level of advanced education (tertiary degree). Relative to households where no member has any formal education, having a member with an advanced education is associated with a 19 percentage-point higher probability of at least one member holding a job outside the family farm ($p < 0.001$). Educational attainment, associated with structural transformation, is also associated with improved post-disaster outcomes.

However, this finding does not hold when we measure structural transformation dynamics using subsistence farming status. In that case primary education is weakly negatively associated with structural transformation dynamics (coefficient -0.032, p value <0.05), and the other education coefficients are not significant (Table 6). This suggests that education provides only a partial explanation (at best) for our results and may only apply in cases where household members are accessing jobs outside the family farm.

Wealth and income

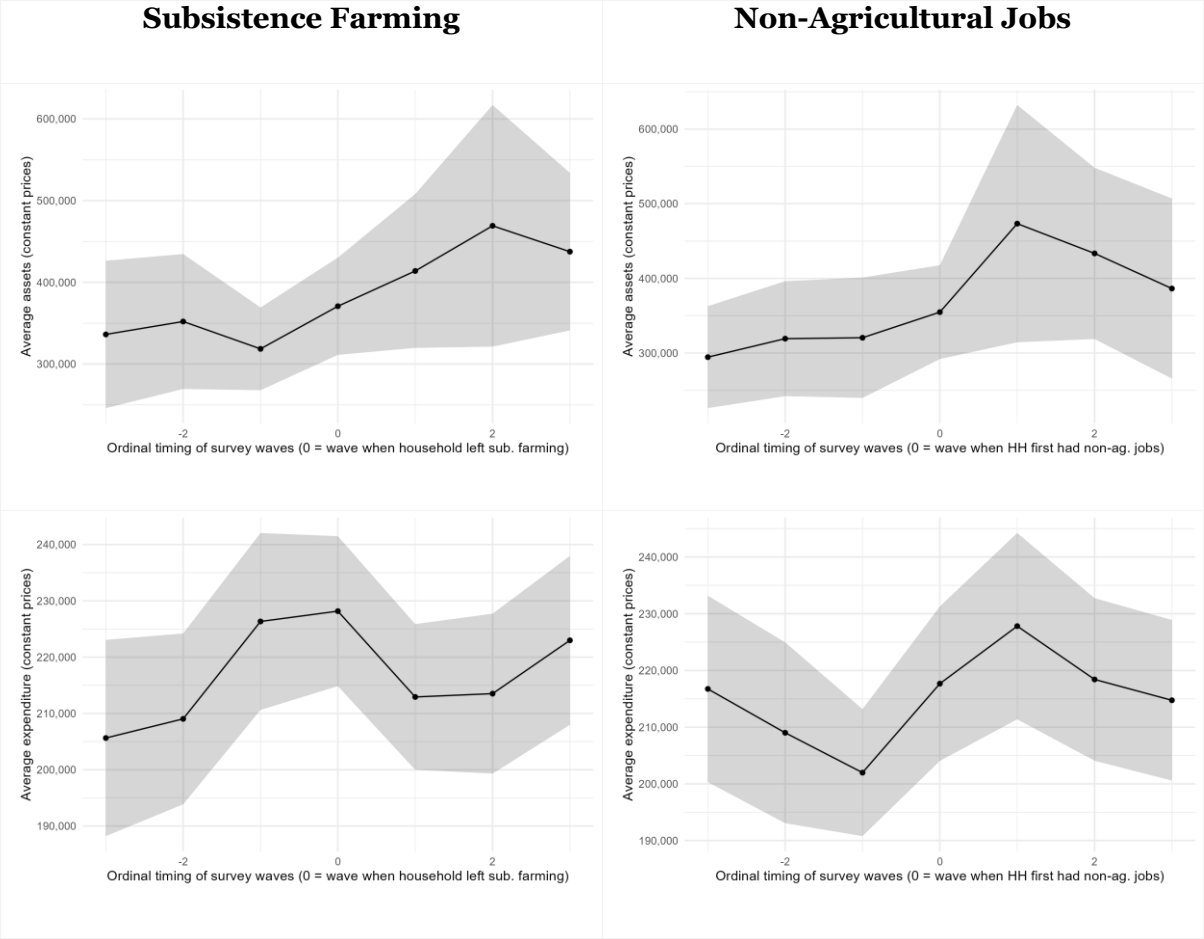
Our linear probability model of structural transformation dynamics also identifies a significant, positive relationship (coefficient .001, p value <0.001) between household asset values and the likelihood that the household moves into having at least one job outside the family farm (Table 6). It identifies a weakly positive relationship between real monthly expenditure and both forms of structural transformation.

Alongside these findings, we know from other research that poverty (in wealth or income) is associated with selection into different disaster coping strategies, many of which are more costly or result in less than optimal post-disaster outcomes (Dercon 2002; Kazianga & Udry 2006; Dinkelman, 2013; Haq, 2015; Janzen & Carter, 2018; Wilson et. al., 2026). Therefore, asset and income dynamics may also be a partial mechanism behind our results; asset accumulation and income growth associated with structural transformation dynamics are also associated with improved household disaster management. These findings are consistent with our earlier bivariate analysis, where we established that among those households affected by shocks, subsistence farming households and those with no non-agricultural jobs tended to have fewer assets and lower monthly expenditures.

We find further supporting evidence in our event study analysis (Figure 1). We compare household asset and monthly expenditure values before and after subsistence farming transitions (left panels) and when household labour supply changes (right panels). We find that households who change in ways consistent with structural transformation tend to

experience increases in real assets and expenditure. This analysis is limited by the fact that we only focus on those households who have been successfully tracked over several waves (at least six). We also only analyse those households who have experienced a structural transformation transition, and our attention is only on the first transition.

Figure 1: Event Study Analysis



Urbanisation

We rule out urbanisation from being a primary mechanism behind our results. If we remove those observations where a household moved from rural to urban locations, we find no change in the results of our primary specifications (we set these results out in full in Tables A and B in Appendix Section 5).

This finding is supported through a closer examination of the data. Of the households who moved out of subsistence farming status, only 4.3 percent of them moved from rural to urban areas. Of the households who moved to a point where at least one of the household members had a job outside of the family farm, only 4.1 percent moved from rural to urban areas (Appendix Section 5). In other words, households changed in ways that were consistent with structural transformation, without moving from rural areas.

That said, the small group of households who did move to urban areas at the same time as their structural transformation change, also experienced a significant increase in expenditure. The most pronounced increase was among households who left subsistence

farming status and moved from rural to urban areas. These households experienced a 62.5 percent increase in expenditure. This compares with a 23.8 increase in expenditure among households who moved out of subsistence farming status without moving to urban areas (Appendix Section 5 Table C). However, households who moved from rural to urban areas are also more likely to have been more difficult to track. Therefore, our results may be biased towards under-estimating the urbanisation association with structural transformation due to attrition.

05 Robustness

Our main specification may suffer from reverse causation when subsistence farming is used as the proxy for structural transformation. A drought/flood might wipe out a household's crops or farm-based income, which would force them to search for other forms of income. In so doing, they would no longer report that subsistence farming is their primary source of income (and therefore be counted as being structurally transformed). Indeed, the closest research to our study also uses household panel data from Uganda to identify that farmers who experience high frequencies of climate shocks are more likely to diversify their crops (Antonelli, et. al 2022).

We address this by re-estimating our primary specification with structural transformation measured at the household's previous survey wave. In other words, structural transformation is measured before the shock takes place. This is a conservative test because the time periods between waves range from one to four years. The test involves measuring true pre-shock status with error. As a result, we can expect the test to bias the interaction result toward zero.

The attenuation of the shock effect on the shoes hardship indicator survives this test with similar magnitude (Appendix Section 06, Tables G and H). The expenditure interaction does not survive this test; the coefficient falls to approximately zero.[7] This could be due to measurement error or reverse causation. We therefore consider the hardship attenuation as our most robust finding and treat the expenditure attenuation as sensitive to timing of the transformation measure.

We test for multicollinearity among the variables used in our primary specification and do not identify concerns (Appendix Section 6 Table F). Panel households were lost to attrition

[7] This occurs for both measures of structural transformation (subsistence farming status and non-agricultural jobs), which is surprising because the reverse causation concerns primarily relate to the former measure. However, the measurement error is likely to be more acute for the latter measure (non-agricultural jobs) because more observations are lost when the lagged measure is used.

across waves. New households were also created when a household split, as well as when one third of the original panel was refreshed in wave 4 (2013-14). In some cases, households appear to have been missed in one wave, but then found in the next wave. These dynamics are summarised in Section 2 of the Appendix (Table B). The result is that our panel is not balanced. Comparing the 1,186 households who were tracked across all eight waves, against the 4,531 households who report fewer than eight longitudinal observations, we find statistically significant differences in means for nearly all variables, except for assets and monthly expenditure (Table D of Appendix Section 6). When we apply the panel weights published by the World Bank, we find an improved balance, although differences remain in household composition and rural status (Table E of Appendix Section 6).

The non-random attrition likely results in our estimates over-representing households that are more stable or have more consistent residential patterns and livelihoods (because such households are easier to track over time). The impact that this bias will have on our estimates is not clear. If households who change in the direction of structural transformation are more mobile, the attrition would bias our coefficients towards zero. In support of this theory, we find that households who earn wages outside the family farm have higher inter-district mobility than those who do not (2.1 percent versus 1.7 percent, p value = 0.046). However, our other measure of structural transformation points in the opposite direction; households who are not in subsistence farming have lower inter-district mobility than those who are (2.2 percent versus 1.6 percent, p value = 0.004).

A full breakdown of each variable and their missing values is reported in Appendix Section 6 Table C. Our data for the waves that occurred between 2005/6 to 2019/20 is largely complete, with two exceptions. The first exception is wave 6. This wave is not published on the World Bank microdata site. We contacted the Living Standards Measurement Survey team of the World Bank and requested the data, but they advised that the Ugandan Bureau of Statistics had declined to publish it. We then requested the data from the Ugandan Bureau of Statistics but did not receive a response.

The second exception relates to a wave conducted in 2001. Microdata for this wave is not publicly available. However, in one household module of the 2005/6 wave, household identifiers and values are published for the 2001 wave. This allows us to track a subsample of households back to 2001 as well. This module covers hardship indicators (whether every member of a household has enough clothes and enough shoes). Therefore, we can obtain a limited glimpse of household hardship indicators back to 2001 for some households, but we have no visibility of other household characteristics for that period (for instance, education status or experience of shocks). We also have a risk of selection bias because households

successfully tracked from 2001 to 2005/6 may be different from others, but the lack of data on other household characteristics means we cannot test for this. Accordingly, we use the 2001 data for descriptive purposes only and omit this wave from our main regression analysis.

06 Conclusion

Structural transformation at the economy level can shape the experience of disasters at the household level. We have found that Ugandan households tended to increase expenditure when affected by a drought/flood and be more likely to experience hardship (measured by not having enough clothes or shoes). In both cases, the effect was attenuated by structural transformation dynamics. Households who had moved out of subsistence farming or who held jobs outside of the family farm experienced a reduction in the impact of the flood/drought on their expenditure and hardship. Our hardship finding is the most robust, where-as our robustness tests identify that our expenditure finding is sensitive to the timing of the structural transformation dynamics.

We find suggestive evidence that at least part of this relationship is coming through the association of income and education with structural transformation. It is not driven by urbanisation. Our finding on urbanisation is instructive as structural transformation is often incorrectly reduced to a synonym for urbanisation. We also find that structural transformation dynamics may influence household experiences of shocks by changing neighbourhood connections.

Our research adds normative strength to the structural transformation agenda. It suggests that structural transformation may come with the added benefit that it improves the ability of households to cope with, and respond to, climate shocks. This is a valuable benefit in a world experiencing more frequent and more severe climate shocks due to anthropogenic climate change.

Our research is limited by data gaps, anomalies and apparent inconsistencies. This is a valuable point to highlight given that the data was funded and published under the World Bank's Living Standards Measurement Survey, which is intended to create high quality data that can be used for research purposes. Our findings would benefit from further research in other economies and countries to explore whether the attenuation effect is also present in those contexts. In addition, it would be helpful to investigate other potential mechanisms behind the structural transformation influence on household experiences of shocks, for example, whether it shapes integration with financial markets, other forms of social capital

and saving/consumption patterns. These lines of inquiry require richer and higher quality data.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this work the primary author used Claude in order to write or review R code and find relevant research papers. After using this tool/service, the primary author reviewed and edited the content as needed and takes full responsibility for the content of the published article.

References

Abunyewah, M., Erdiaw-Kwasie, M. O., Okyere, S. A., Thayaparan, G., Byrne, M., Lassa, J., Zander, K. K., Fatemi, M. N., & Maund, K. (2023) Influence of personal and collective social capital on flood preparedness and community resilience: Evidence from Old Fadama, Ghana, *International Journal of Disaster Risk Reduction*, 94, 103790, https://doi.org/10.1016/j.ijdrr.2023.103790

African Union Commission (AUC). (2015). Agenda 2063: The Africa We Want—Framework Document.

Agamile, P., & Lawson, D. (2021). Rainfall shocks and children's school attendance: Evidence from Uganda. *Oxford Development Studies*, 49(3), 291–309. https://doi.org/10.1080/13600818.2021.1895979

Aldrich, D. P., & Meyer, M. A. (2015). Social capital and community resilience. *American Behavioral Scientist,* 59(2), 254–269. https://doi.org/10.1177/0002764214550299

Aliga, A., Matovu, F., & Wasswa, F. (2023). How do the poor cope with health shocks? Experiences from a cross-sectional study in Uganda. *American Medical Journal*, 16(4), 611–624. https://doi.org/10.21767/AMJ.2022.3935

Amen, H. (2024). How can Uganda harness urbanisation and rural development for economic growth? *Ideas Matter Series,* The International Growth Centre, Retrieved 18 August 2026 from https://www.theigc.org/blogs/ideas-matter/how-can-uganda-harness-urbanisation-and-rural-development-economic-growth

Antonelli, C., Coromaldi, M., & Pallante, G. (2022). Crop and income diversification for rural adaptation: Insights from Ugandan panel data. *Ecological Economics*, 195, 107390. https://doi.org/10.1016/j.ecolecon.2022.107390

Asfaw, S., Piano Mortari, A., Arslan, A., Karfakis, P., & Lipper, L. (2015). Welfare impacts of climate shocks: Evidence from Uganda [Conference paper]. International Conference of Agricultural Economists (ICAE), Milan, Italy

Baulia, S. (2024). Is household shock a boon or bane to the utilisation of preventive healthcare for children? Evidence from Uganda. *Economics and Human Biology*, 52, 101333. https://doi.org/10.1016/j.ehb.2023.101333

Björkman-Nyqvist, M. (2013). Income shocks and gender gaps in education: Evidence from Uganda. *Journal of Development Economics,* 105, 237–253. https://doi.org/10.1016/j.jdeveco.2013.07.013

Bryan, G., Glaser, E., & Tsivanidis, N. (2020) Cities in the Developing World. *Annual Review of Economics,* 12 https://doi.org/10.1146/annurev-economics-080218-030303

Chenery, H. B. (1960). Patterns of industrial growth. *American Economic Review*, 50(4), 624–654

Chenery, H. B., & Taylor, L. (1968). Development patterns: Among countries and over time. *Review of Economics and Statistics*, 50(4), 391–416

Christiaensen, L., De Weerdt, J., & Todo, Y. (2013). Urbanization and poverty reduction: The role of rural diversification and secondary towns. *Agricultural Economics*, 44(4–5), 435–447

Christiaensen, L., & Kaminski, J. (2015), Structural change, economic growth and poverty reduction – Micro-evidence from Uganda, Working Paper Series N° 229 African Development Bank, Abidjan, Côte d'Ivoire

Colmer, J. (2021), Temperature, Labor Reallocation, and Industrial Production: Evidence from India. *American Economic Journal: Applied Economics*. 13(4) 101-124; https://www.jstor.org/stable/27087124

Cunha, F., & Heckman, J. J. (2007). The technology of skill formation. *American Economic Review*, 97(2), 31–47. https://doi.org/10.1257/aer.97.2.31

de Vries, G. J., Timmer, M. P., & de Vries, K. (2015). Structural transformation in Africa: Static gains, dynamic losses. *Journal of Development Studies*, 51(6), 674–688. https://doi.org/10.1080/00220388.2014.997222

Dercon, S. (2002). Income Risk, Coping Strategies, and Safety Nets *The World Bank Research Observer,* 17(2) 141-166

Diwakar, V., & Lacroix, A. (2021). Climate shocks and poverty persistence: Investigating consequences and coping strategies in Niger, Tanzania, and Uganda. *Sustainable Development,* 29(3), 552–570. https://doi.org/10.1002/sd.2200

Dinkelman, T. (2013). *Mitigating Long-run Health Effects of Drought: Evidence from South Africa* (19756)

Glaeser, E. L., Kallal, H. D., Scheinkman, J. A., & Shleifer, A. (1992). Growth in cities. *Journal of Political Economy*, 100(6), 1126–1152

Grosh, M.E. & Glewwe, P. W., (1995) *A guide to living standards measurement study surveys and their data sets (English). Living standards measurement study (LSMS) working paper|no. LSM 120* Washington, D.C. : The World Bank. Retrieved 2 February 2026 from http://documents.worldbank.org/curated/en/270551468764720584

Hallegatte, S., Vogt-Schilb, A., Bangalore, M., & Rozenberg, J. (2017). *Unbreakable: Building the resilience of the poor in the face of natural disasters*. World Bank. http://hdl.handle.net/10986/25335

Haq, R. (2015). Shocks as a Source of Vulnerability: An Empirical Investigation from Pakistan. *Pakistan Development Review*, 54(3).

Herrendorf, B., Rogerson R., & Valentinyi, A. (2014) Chapter 6 - Growth and Structural Transformation, Editor(s): Philippe Aghion, Steven N. Durlauf, *Handbook of Economic Growth,* Elsevier, Volume 2, 2014, Pages 855-941, https://doi.org/10.1016/B978-0-444-53540-5.00006-9

Hoffmann, R., & Muttarak, R. (2017). Learn from the past, prepare for the future: Impacts of education and experience on disaster preparedness in the Philippines and Thailand. *World Development,* 96, 32–51. https://doi.org/10.1016/j.worlddev.2017.02.016

Janzen, S. A., & Carter, M. R. (2018). After the drought: The impact of microinsurance on consumption smoothing and asset protection. *American Journal of Agricultural Economics*, 101(3), 651-671.

Kazianga, H., & Udry, C. (2006). Consumption smoothing? Livestock, insurance and drought in rural Burkina Faso. *Journal of Development Economics*, 79(2), 413–446. https://doi.org/10.1016/j.jdeveco.2006.01.011

Kasooha, I. (2025). President Museveni calls for removal of trade barriers for Developing Landlocked Countries. Office of the Prime Minister (Uganda). https://opm.go.ug/president-museveni-calls-for-removal-of-trade-barriers-for-developing-landlocked-countries/ viewed on 28 February 2026

Kong, L., Sofuoğlu, E., Ishola, B. D., Abbas, S., Guo, Q., & Khudoykulov, K. (2024). Sustainable development through structural transformation: A pathway to economic, social, and environmental progress. *Economic Change and Restructuring*, 57, 27. https://doi.org/10.1007/s10644-024-09583-3

Krugman, P. (1991). Increasing returns and economic geography. *Journal of Political Economy,* 99(3), 483–499

Kuznets, S. (1957). Quantitative aspects of the economic growth of nations: II. Industrial distribution of national product and labor force. *Economic Development and Cultural Change*, 5(4, Supplement), 1–111

Lawson, D., & Kasirye, I. (2013). How the extreme poor cope with crises: Understanding the role of assets and consumption. *Journal of International Development*, 25(8), 1129–1143. https://doi.org/10.1002/jid.2968

Lewis, W. A. (1954). Economic development with unlimited supplies of labour. *The Manchester School*, 22, 139–191. https://doi.org/10.1111/j.1467-9957.1954.tb00021.x

Lin, J. Y. (2012). *New structural economics: A framework for rethinking development and policy*. World Bank. https://doi.org/10.1596/978-0-8213-8955-3

Loayza, N., Olaberria, E., Rigolini, J. & Christiaensen, L., (2012), *World Development* 40(7), 1317-1336; https://doi.org/10.1016/j.worlddev.2012.03.002

Lutz, W., Muttarak, R., & Striessnig, E. (2014). Universal education is key to enhanced climate adaptation. *Science*, 346(6213), 1061–1062. https://doi.org/10.1126/science.1257975

Mahmud, M., & Riley, E. (2021). Household response to an extreme shock: Evidence on the immediate impact of the Covid-19 lockdown on economic outcomes and well-being in rural Uganda. *World Development*, 140, 105318. https://doi.org/10.1016/j.worlddev.2020.105318

Marín, A., Bodin, Ö., Gelcich, S., & Crona, B. (2015). Social capital in post-disaster recovery trajectories: Insights from a longitudinal study of tsunami-impacted small-scale fisher organizations in Chile. *Global Environmental Change*, 35, 450-462. https://doi.org/10.1016/j.gloenvcha.2015.09.020

Martins, P. M. G. (2019). Structural change: Pace, patterns and determinants. *Review of Development Economics* 2018; 00: 1–32. https://doi.org/10.1111/rode.12555

Martins, P. M. G. (2019a) *Structural Change Rediscovered : The Role of Human and Physical Capital*. Research & Policy Briefs 24 Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/266031563538168642

Mawejje, J., & Terje Holden, S. (2014). Social capital, shocks and livestock investments: evidence from Masaka District, Uganda. *International Journal of Development Issues*, 13(2), 98-112. https://doi.org/10.1108/ijdi-12-2013-0092

Mbowa, S., Mayanja, M. L., & Ahaibwe, G. (2013). Why persistent youth unemployment amidst a growing economy in Uganda (EPRC Briefing Paper No. 34). Economic Policy Research Centre

Musungu, A. L., Kubik, Z., & Qaim, M. (2024). Drought shocks and labour reallocation in rural Africa: Evidence from Ethiopia. *European Review of Agricultural Economics*, *51*(4), 1045–1068. https://doi.org/10.1093/erae/jbae020

National Planning Authority of the Government of Uganda (NPA). (2022). Employment and Skills Status Report (ESSR) 2022. Government of Uganda

NPA. (2025). State of Uganda Population Report 2025, Mental health: A silent emergency, Addressing the Psychological Dimensions of Uganda's Demographic Dividend. Government of Uganda.

Nguyễn, L.T., Bostrom, A., Abramson, D. B. & Moy P, (2023) Understanding the role of individual- and community-based resources in disaster preparedness, *International Journal of Disaster Risk Reduction*, 96, 2023, 103882, https://doi.org/10.1016/j.ijdrr.2023.103882

Quisumbing, A. R., Kumar, N., & Behrman, J. A. (2018). Do shocks affect men's and women's assets differently? Evidence from Bangladesh and Uganda. *Development Policy Review*, 36(1), 3–34. https://doi.org/10.1111/dpr.12235

Ravallion, M., & Chen, S. (2007). China's (uneven) progress against poverty. *Journal of Development Economics,* 82(1), 1–42. https://doi.org/10.1016/j.jdeveco.2005.07.003

Rentschler, J., Salhab, M., & Jafino, B. (2022). Flood exposure and poverty in 188 countries. *Nature Communications*, 13, 3527. https://doi.org/10.1038/s41467-022-30727-4

Saxena, R. (2024). Structural transformation and climate change in India (working paper) retried on 16 February 2026 from https://www.colorado.edu/economics/sites/default/files/attached-files/24-05_saxena.pdf

Sekabira, H., Nansubuga, Z., Ddungu, S. P., & Nazziwa, L. (2022). Farm production diversity, household dietary diversity, and nutrition: Evidence from Uganda's national panel survey. *PLOS ONE*, 17(12), e0279358. https://doi.org/10.1371/journal.pone.0279358

Uganda Bureau of Statistics (UBOS). (2012). *The Uganda National Panel Survey (UNPS) 2009/10: Basic information document*. World Bank Microdata Library. Retrieved January 31, 2026, from https://microdata.worldbank.org/index.php/catalog/1001/download/45974

UBOS. (2013). Uganda National Panel Survey 2011/2012 WAVE III REPORT. World Bank Microdata Library. Retrieved January 31, 2026, from https://microdata.worldbank.org/catalog/2059/related-materials

UBOS. (2014). *The Uganda National Panel Survey (UNPS) 2010/11: Basic information document* World Bank Microdata Library. Retrieved January 31, 2026, from https://microdata.worldbank.org/catalog/2166/related-materials

UBOS. (2014 a) *The Uganda National Panel Survey (UNPS) 2013/14: Basic information document* World Bank Microdata Library. Retrieved January 31, 2026, from https://microdata.worldbank.org/catalog/2663/related-materials

UBOS. (2016) *The Uganda National Panel Survey (UNPS) 2015/16: Basic Information Document (BID)* World Bank Microdata Library. Retrieved January 31, 2026, from https://microdata.worldbank.org/catalog/3460/related-materials

UBOS. (2019) *The Uganda National Panel Survey (UNPS) 2018/19: Basic information document (BID)* World Bank Microdata Library. Retrieved January 31, 2026, from https://microdata.worldbank.org/catalog/3795/related-materials

UBOS. (2020) *The Uganda National Panel Survey (UNPS) 2019/2020: Basic information document (BID)* World Bank Microdata Library. Retrieved January 31, 2026, from https://microdata.worldbank.org/catalog/3902/related-materials

United Nations General Assembly (UNGA). (2015). Transforming our world: The 2030 Agenda for Sustainable Development (A/RES/70/1).

https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_RES_70_1_E.pdf

The World Bank (WB). (2021). Climate Risk Profile: Uganda. The World Bank Group

WB. (2025). Uganda Economic Update: Cultivating prosperity through agro-industrialization (Economic Update). World Bank.

WB. (2026). Microdata Library. Retrieved January 31, 2026, from https://microdata.worldbank.org/home

WB. (2026a) The Living Standards Measurement Study (LSMS) The World Bank's Flagship Household Survey Program Website. https://www.worldbank.org/en/programs/lsms Accessed on 2 Febraury 2026

Wilson, T., Noy, I., & Msowoya, C. (2026). Shock responses: Exploring household selection into poverty-reinforcing actions in Malawi. *International Journal of Disaster Risk Reduction*, 138, 106119. https://doi.org/10.1016/j.ijdrr.2026.106119

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Appendix.docx