

Effects of poverty on fragility: A micro-level analysis in Kenya

Sindu Kebede¹, Ghassan Baliki², and Evans Ngenoh³

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¹Sindu Kebede (PhD)

Humboldt University of Berlin

Post-doctoral researcher, HORTINLEA Project

Faculty of Life Sciences

Invalidenstr. 42, 10115 Berlin, Germany

Tel: +49-30-2093-46345

Fax: +49-30-2093-6236

Email: kebedesw@agrar.hu-berlin.de

²Ghassan Baliki (PhD)

International Security and Development Center (ISDC), Senior Researcher

Leibniz-Institut für Gemüse-und Zierpflanzenbau (IGZ), Research Associate

Auguststr. 89, 11017 Berlin, Germany

Email: baliki@isdc.org

³Evans Ngenoh (Doctoral Candidate)

Humboldt University of Berlin (HORTINLEA) and Egerton University

Doctoral Candidate

P.O. Box 536, 20115 Egerton, Kenya

Tel: +254 721 538378

Email: ken.ngenoh@gmail.com

Abstract

The relationship between fragility and poverty remains unexplored due to a number of factors and its associated complexities. First, the concept of fragility and its measures have overlooked heterogeneity at the micro level while focusing on fragility at the macro or state level. Second, due to plausible endogeneity in the relationship between fragility and poverty, as well as the lack of viable and strong instruments, it remains difficult to draw causality pathways. In view of this, this study contributes to the fragility-poverty literature by taking a micro-level approach, proposing individual-level measure of fragility namely the fragility exposure index. This index measures individuals' perceptions and experiences of fragility based on three dimensions namely economic inclusion, social cohesion, and human security. This allows us to test the effect of poverty on the levels of fragility. We use a three-year panel dataset, HORTINLEA household survey conducted in rural and peri-urban areas of Kenya. This made it possible to address the potential endogeneity of poverty by using a shock related variable as an instrument, namely lagged sum of climatic shocks faced by households in the 12 months prior to the survey. Furthermore, the relevant assumption of the exclusion restriction about the instrumental variable approach was appropriately made and acknowledged. The findings suggest that higher poverty rates increase perceptions and experiences of fragility at the micro-level. This strong association holds for different specifications, but more significant results are found using instrumental variable estimation approach. From the three dimensions of fragility, economic inclusion shows significance and strong relationship to poverty while human security shows strong and significance association to poverty only in the IV-2SLS estimation. As such, our finding ascertains two outcomes: on the one hand, use of instrumental variable approach is a viable option to identify the link between poverty and fragility, on the other hand, there is indeed a strong and significant association between poverty and fragility, whereby better-off households (in terms of less poverty) are less likely to be fragile.

Key Words: Poverty, fragility, micro-analysis, Kenya, Instrument variable

1. Introduction

To date, the debate on fragility has been mainly focused on the role of the state, state collapse and state failure (Milliken, 2003; Goldstone et al., 2004; Binzel and Brueck, 2009; Anderson et al., 2007; Ghani and Lockhart, 2008). In general terms, a country is fragile when it has unstable or underperforming institutions, and these are not only government institutions but also include social networks, business-elite partnerships, and even civil society as a whole (Burt et al., 2014). Weak institutions contribute to poor health and education, decreased government transparency, increased government corruption, poor infrastructure, and inefficient economic management (Tanzi and Davoodi, 2002; Rodrik 2007; Acemoglu and Robinson 2012). Weak political institutions, economic decline, poverty, and violent conflict have been cited as a set of common and interrelated factors that affect, either in causing or sustaining fragility (Mbabazi et al., 2002; Vallings and Torres, 2005; Burt et al., 2014). The 2011 World Development Report states that ‘People in fragile and conflict-affected states are more than twice as likely to be undernourished as those in other developing countries, more than three times as likely to be unable to send their children to school, twice as likely to see their children die before age five, and more than twice as likely to lack clean water’ (World Development Report, 2011).

The relationship between weak institutions and economic development has received continued focus in the social science research in the past two decades. While there is a consensus that strong states and institutions are important for fostering economic growth, the mechanisms are not yet well-articulated and understood (North, 2007). On the one hand, weak and fragile institutions are considered a hindrance to economic performance (Acemoglu et al., 2005), while on the other hand, poorly performing economies are more prone to fall into the fragility or conflict trap. This is evident where fragility of the low-income rural population becomes a major constraint to poverty-alleviation strategies. For example, in 2012, about 76 percent (677 million) of people in extreme poverty (below the \$1.90 a day poverty line), were living in countries that were either politically fragile, environmentally vulnerable or both (Von Grebmer et al., 2014). Given the current conditions and trends of fragility, the absolute number of people living under \$1.25 a day in fragile states are expected to rise from 200 million in 2010 to 231 million in 2030 (Burt et al., 2014). This is partly linked to the incentive governing the behavior of a social group (political class) in the manipulation of available natural resources either through ethnic composition or colonial heritage especially in fragile states with weak institutions (Shepherd et al., 2013).

Yet, to date most of the empirical work that studies the relationship between fragility and weak institution on one hand, and poverty and economic development on the other hand focuses on the macro or country level. This complex bidirectional relationship between institutional fragility and economic development in general, and poverty in particular, requires further in-depth exploration at the micro-level to disentangle its underlying mechanisms, which remains a major research gap. This paper, builds on prior work which aims to measure fragility at the individual level (Baliki, et al, 2017)¹, to study the impact of poverty on the micro- experiences and -perceptions of fragility. In order to achieve this objective, we use a household-level fragility exposure index and assess its link to household-level poverty measures in rural Kenya.

Kenya provides an interesting case to test our hypothesis on the micro-level impact of poverty on fragility. After the post-election violence that took place in 2007, Kenya has been classified by a number of indices as a fragile state, and since then the country has remained in the high-risk group of fragility. Moreover, areas that are prone to conflict and are exposed to extreme stresses (such as climate-related shocks) have a higher tendency of having a poverty incidence of over 80 percent which are much higher than the aggregate national poverty incidence of 45 percent (KNBS, 2013). For this, we use data set from the HORTINLEA panel survey conducted in 2014, 2015 and 2016. We implement an instrumental variable approach to overcome endogeneity issues given that fragility can drive poverty and vice-versa. Consequently, exposure to prior climatic stresses is used as an instrument for poverty in the analysis. The findings suggest that higher poverty rates and lower consumption expenditure increase perceptions and experiences of fragility at the micro-level.

The paper is structured as follows. The next section provides a literature review on the relationship between poverty, conflict, and fragility at both the macro and micro levels outlining the research gaps. Section three describes the conceptual framework and section four summarizes the country background. Data, measures of poverty and fragility, and descriptive are presented in section five. The econometric approach is outlined in section six and the findings in section seven. Last section concludes.

¹ The work of Baliki et al. (2017) is an AERC commissioned research work under the ‘Growth in Fragile and Post-Conflict States in Africa – collaborative research project’. The research paper is now *AERC Working Paper and IZA Discussion paper No. 11188*. (See reference for details).

2. Literature Review and Research Gap

While the literature on conflict and poverty is growing from both macro and micro perspectives, less work has been devoted to studying fragility and poverty. Studies on fragility remain mainly conceptual in nature, focusing on definitions and characterizations of fragile states (Ikpe, 2007; Zoellick, 2008; Ncube and Jones, 2013). Most of the few existing empirical studies focus on understanding fragility as a state concept and assess its link to aid effectiveness, economic growth/poverty using either a macro perspective or multi-country analysis (Torres and Anderson, 2004; Vallings and Moreno-Torres, 2005; Burt, et al, 2014). For instance, Torres and Anderson (2004) study the challenges state fragility impose on development and poverty reduction. Adopting the definition of state fragility as ‘difficult environment’, they assess how these environments make development aid effectiveness challenging. In another instance, Burt et al. (2014) study poverty reduction in fragile states using alternative scenarios to forecast attainable poverty reduction rates in 2030 given different levels of inequality; improved institutions; and improved security in fragile states. They find that the most reasonably attainable poverty rate in fragile states is 24 % in 2030.

Micro-level studies on fragility and its link to poverty is, however, absent. This is mainly because there are no proper indices that capture exposure to fragility at household or individual levels. A recent study by Baliki et al (2017) proposes and tests various modules of exposure to fragility at the individual level, including both perceptions and experiences of fragility on various domains namely: human security, economic inclusion, and social cohesion. The paper argues that regardless if a state is considered fragile or not, different individuals or groups experience fragility differently, and a micro-level measure of fragility is vital to better understand its underlying mechanisms.

In addition to the scarce work on fragility and poverty, two important strands of literature are significant to this debate. The first set of literature studies the relationship between poverty and conflict (Blomberg et al., 2006; Braithwaite et al., 2016; Miguel et al., 2004; Tollefsen, 2017). The common ground of this work, and its relationship to fragility, is mainly methodological, where the application of instrumental variable approaches are crucial to understand the causal links of this relationship. For instance, the study by Braithwaite et al. (2016) provides a multi-country level evidence on the causal link between poverty and conflict. By using a robust instrument (a time-varying measure of international inequality) to tackle the endogeneity

problem, they conclude that the impact of poverty on conflict appears to be causal. In similar vein, Miguel et al. (2004) use rainfall variation as an instrumental variable for economic growth in 41 African countries during 1981-99. They find that growth is strongly and negatively related to civil conflict, where a negative growth shock of five percentage points increases the likelihood of conflict by one-half the following year. Bloomberg et al. (2006) also provide a similar finding where lower growth raises the likelihood of conflict and in turn conflict lowers economic growth using panel data for over 152 countries from 1950-2000. A recent study by Tollefsen (2017) uses georeferenced survey data from the Pan-African Afro-barometer survey for 4008 subnational districts across 35 Africa States. He finds that areas with high levels of poverty are more likely to experience conflict. He further disentangles the underlying mechanism of the link between poverty and conflict through interaction models, and finds that poverty is more likely to exacerbate violence if an area's local institutions are weak or when impoverishment overlaps with group grievances against the government. This highlights the importance of studying fragility in order to provide evidence on the linkage from poverty to civil conflict.

In addition to the macro-level evidence on poverty and conflict, recent evidence is slowly evolving that focuses on studying the relationship between conflict and poverty at the household level (Justino, 2009; Lemus, 2013; Justino et al., 2013). For instance, Lemus (2013) provides evidence from Columbia on the effect of conflict on poverty. The study uses multidimensional poverty index as measure of poverty and government deterrence as an instrument variable for conflict and lagged effect of conflict. The paper finds that the incidence of conflict significantly increases rural poverty and the lagged effect of conflict on poverty lasts for at least 3 years, while decreasing over time. Similarly, Justino et al. (2013) assess the poverty impact of violent events that affected Rwanda in the 1990s. They find that households whose house was destroyed or who lost land ran a higher risk of falling into poverty.

The second significant work that relates to our study is the literature on winning hearts and minds. This strand of literature mainly focuses on how governments sway voters support through the provision of services. A number of studies look on how the provision of public services or employment programs affects people's perceptions, attitudes, and trust in political institutions (Berman et al, 2008, Blattman, et al, 2016). Development programs are found to positively affect people's welfare, which in turn improves their attitudes towards the government, and, as a consequence, reduces violence. This suggests that there is an important link between economic well-being and poverty on one hand, and institutions on the other hand, which requires further

exploration to tease out how poverty attributes to political grievances and institutional fragility from the micro-perspective.

In summary, there are three important aspects of the literature that are significant to this work. First, despite the growth in the fragility literature, most of the work either remains conceptual in nature or empirically focused on the macro-level; and only a few attempts to measure fragility at the micro- or individual-level. Second, apart from the studies that look at winning hearts and minds, there is particularly no quantitative evidence that links how poverty and fragility interplay at the micro-level, and what are the mechanisms through which the causality from poverty to fragility manifests itself. Third, there is bulk of evidence on measuring exposure to conflict at the micro-level, and how this affects poverty levels and vice-versa. Most of this work attempts to use instrumental variables (mainly weather shocks) to disentangle the causal pathways. Given the closeness in the issues of identification between fragility and conflict, it would be vital to apply an instrumental variable approach to overcome endogeneity problems when determining the causal linkage from poverty to fragility.

3. Conceptual Framework

The main objective of this paper is to study how individual's poverty levels affect their exposure and experiences of fragility. In other words, are poor households more likely to perceive and experience fragility than non-poor households? In order to empirically answer this research question, it is imperative to shed light on the pathways through which fragility and poverty can and do interlink. For this purpose, we produced a simple conceptual framework to capture these interlinkages as shown in figure 1. In the first instance, building on the concepts and definitions of fragility, weak institutions decrease government's ability to provide equal opportunities to its citizens, decrease provision of services and public goods, and increase government corruption, poor infrastructure and inefficient economic management (Tanzi and Davoodi; 2002; Rodrik 2007; Acemoglu and Robinson 2012). These factors in hand hinder vulnerable individuals to escape the poverty trap, lowering individuals' consumption expenditure, and increasing their food insecurity. In the second instance, high poverty levels are likely to cause fragility, manifested in increased individual grievances, crime, and violence, and diminished trust in government and political institutions. Hence, fragility worsens where there is a combination of increased poverty or economic decline with pre-existing presence of weak institutions that cannot meet the very real grievances caused by, for instance, inequitable distribution of resources or unequal access to formal institutions (Hausken and Ncube, 2013). This negative

cyclical dynamic between poverty and fragility can be closely linked to studies which show that once a country experiences violent conflict, it faces a reversal of economic development, which in turn increases the likelihood of further conflict (Braithwaite et al., 2016).

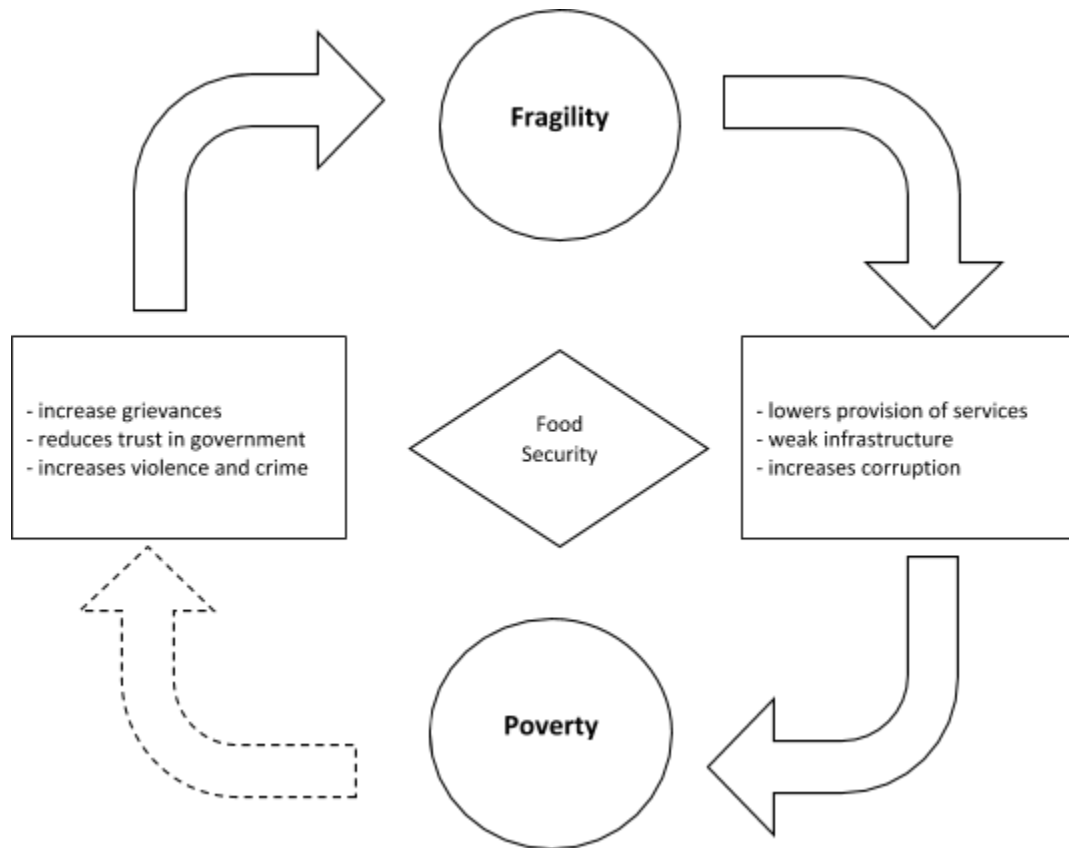


Figure 1. A simplified link between fragility and poverty and its underlying mechanisms

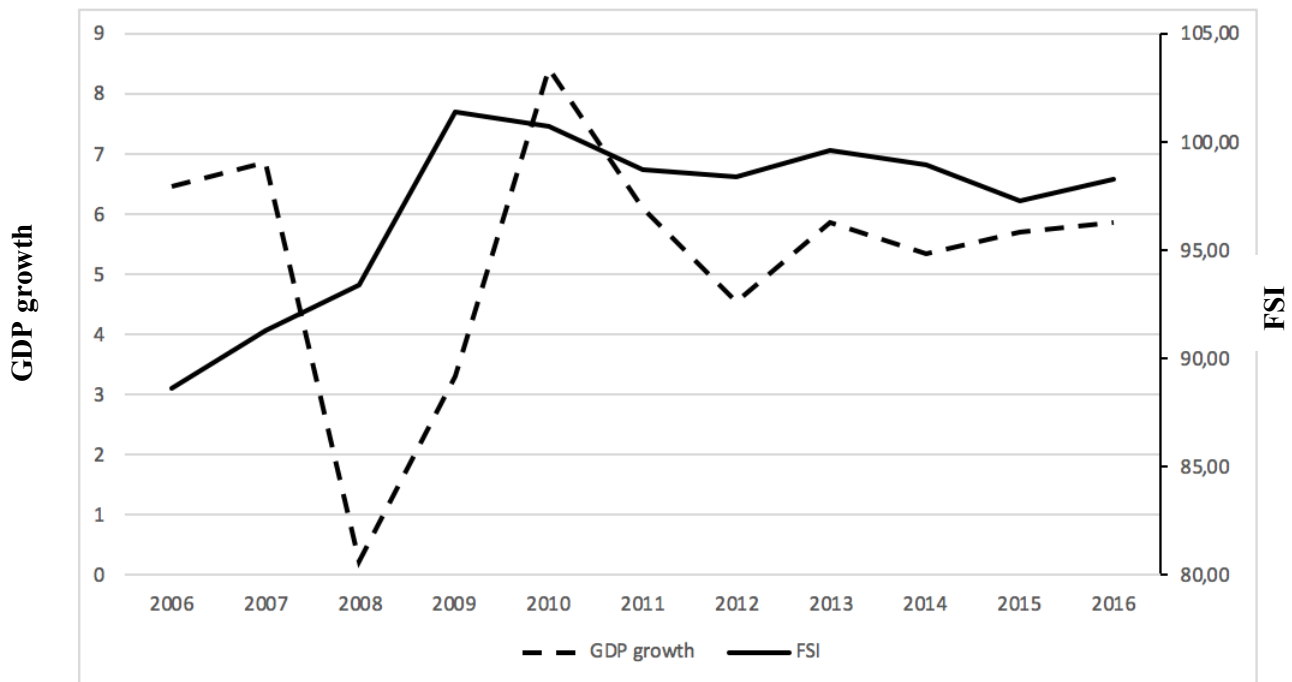
For this study, we will focus on the left-part of this relationship, examining how higher poverty rates contribute to increasing fragility. At the individual level, it is difficult to differentiate clearly what drives and what constitutes fragility as such. Given that we are only able to measure how people experience and perceive fragility at the micro-level, we will aim to develop a holistic and multidimensional measure of exposure to fragility which constitutes most of the driving factors that impact fragility level at the individual level (a detailed description of these indicators is presented in section 5.2).

4. Country Background

Kenya is an ethnically, culturally, and economically diverse country. After the post-election violence that took place in 2007, Kenya has been classified by a number of indices as a fragile state, and since then the country has remained in the high-risk group of fragility. For example,

based on the 2017 Fragile State Index (FSI), Kenya lies in the 30 most fragile states. In the aftermath of the contested 2007 election and violence, the FSI of Kenya increased rapidly to a peak level registered in the past decade (figure 2). Consequently, Kenya has undergone a number of legislative and constitutional reforms, which mainly reduced the power of the president, enhanced the role of parliament and citizens, and created an independent judiciary. Most notably the reforms provided a very ambitious decentralization process which aimed to transfer important governance decision-making to sub-national legislative units. This gives counties full autonomy to address local needs in provision of services (World Bank, 2012). However, these constitutional reforms coupled with impressive economic growth were not sufficient to significantly improve Kenya's fragility situation.

Figure 2. Relationship between FSI and GDP Growth, Kenya (2006-2016)



Source: GDP Growth, Annual numbers from World Bank (2018). Fragility State Index (FSI), yearly indicators from the Fund for peace (2018), the higher the FSI, the higher the fragility level.

Kenya has been facing an uphill task towards poverty alleviation, perhaps due to the level of vulnerability of its populations. Although the country has achieved remarkable economic performance in the past decade, extreme poverty has not been eliminated, and inequality has not only persisted but deepened in various subnational levels (UNESCO, 2010; Von Grebmer et al., 2016). Yet, Kenyans living in different regions as well as those living in the same region have

completely different welfare levels and access to services. For instance, the northern Kenya area is prone to drought, flooding, and conflicts and therefore, food insecurity and malnutrition are prevalent, as are insecurity and displacement; livelihoods are fragile and access to services in such regions are poor (Swithern, 2014). Furthermore, lack of access to essential social services like education, water and sanitation, leads to continued poverty and vulnerability of the population. Hence, the counties that are prone to conflict and are exposed to extreme stresses (such as climate-related shocks) have a higher tendency of having a poverty incidence of over 80 percent which are much higher than the aggregate national poverty incidence of 45 percent (KNBS, 2013). At the same time, these counties have the highest risk ratings (fragile) of all counties in Kenya. The same trends are also witnessed between rural, peri-urban, and urban areas where fragility in terms of access to services varies extensively (Baliki et al., 2017). For example, individuals in urban areas have about two times more access to improved water and sanitation services than their rural counterparts. They also have 10 times more electricity coverage than rural areas (KNBS, 2013). Given this background, Kenya provides an interesting case study to test our hypothesis on the micro-level impact of poverty on fragility.

5. Data and Measures

5.1 Data: HORTINLEA survey

We use the HORTINLEA² panel survey collected in rural and peri-urban areas of Kenya. Data collection under the HORTINLEA survey started in September 2014 and continued in 2015 and 2016 in a total of three waves. The fragility module was introduced to the survey questionnaire in the latest wave (i.e. 2016). Even though the main focus of the survey is on agricultural and horticultural production, it contains comprehensive socio-economic information on households and individuals, and their welfare status, which augment the fragility module (Kebede et al., 2016).

Households for the survey were selected using a multistage sampling approach. Given the agricultural nature of the survey, a purposive sampling technique was used to select the counties within rural and peri-urban strata. These included Kisii (200 households) and Kakamega (200 households) in rural; Nakuru (150 households) and Kiambu (150 households) in peri-urban

² The HORTINLEA household survey is conducted by Humboldt University of Berlin in collaboration with Egerton University and Leibniz University of Hannover. The data collection is funded as part of the initiative for global food security (GlobE) of the German Federal Ministry of Education and Research and the German Federal Ministry for Economic Cooperation and Development.

areas. Selection of the sub-counties and divisions was based on information from the respective district agricultural offices. From each division, locations/wards were randomly selected, and households within locations were in turn randomly selected with a total sample size (N) of 700 households. Even though the HORTINLEA household survey is not representative at the national level, it provides a comprehensive overview of households engaged in small-scale agricultural production in rural and peri-urban areas. Given the randomized sampling method and the relatively large sample size in each county, results of analysis on the survey data can be generalized to agricultural producers in rural and peri-urban areas in Kenya. Therefore, information contained in the survey both in terms of household-level fragility and poverty are crucial to tackling the proposed research questions. To our knowledge, there are no comprehensive datasets that provide such detailed information on the fragility-poverty nexus at the micro-level, which is further developed and explained in the next section.

5.2 Multi-dimensional Measures

5.2.1. Fragility measures at the micro-level

We argue that fragility can be traced to the household/individual-level by accounting for households'/individuals' exposure to various manifestations of its impacts. In particular, our micro-level approach to fragility focuses on the importance of how different individuals experience and perceive various manifestations of fragility. We measure fragility in the context of state functions and institutional capacities at the micro-level. Therefore, the study focuses on measuring fragility through trust in institutions, perception of legitimacy and fears, as well as experiences of corruption, and access to public services.

Building on the work of Baliki et al. (2017), we generate a multidimensional index, the Fragility Exposure Index (FEI), which is based on three separate domains: human security; economic inclusion; and social cohesion³. “Human Security” focuses on individual protection but is considered more broadly than simply individuals being protected from physical violence. “Economic Inclusion” focuses on the provision of opportunity and ability for all people to take an equal share in economic opportunity. For example, it includes uneven access to public services or the experience of corruption. “Social Cohesion” is based around an idea that members of communities have the opportunity to cooperate within and across groups. In this

³ See the work of Baliki et al (2017) for detailed explanation of the construction of Fragility Exposure Index (FEI) and the respective indicators included within each domain.

regard, social cohesion reflects participation in communities and trust in government and other institutions (both formal and informal).

The Fragility Exposure Index (FEI) for individual i in time t is then specified as:

$$FEI_{it} = 100 \times Norm(D_{it})$$

$$D_{it} = Norm\left(\sum_{j=1}^N X_{ijt}\right) + Norm\left(\sum_{j=1}^M Y_{ijt}\right) + Norm\left(\sum_{j=1}^O Z_{ijt}\right) \quad (1)$$

Where X_{ijt} , Y_{ijt} , and Z_{ijt} represent the three domains: human security, economic inclusion, and social cohesion, respectively. Each sub-indicator within the following domains is normalized to take a value between 0 and 1 as follows:

$$X_{ijt} = Norm(x_{ijt}) = \frac{x_{ijt} - \min(x_{jt})}{\max(x_{jt}) - \min(x_{jt})}$$

Where i , j and t denote the individual, sub-indicator, and time period (e.g., year), respectively. For each domain the total number of the normalized sub-indicators is added up to develop an equally weighted domain index. In the final step, as shown in equation (1), each domain is then normalized in order to provide equal weights between these domains for the generation of the FEI. Using equation (1), we are able to classify individual experiences of or exposure to fragility into one index which takes a value between 0 and 1 for each individual. A value of zero (0) means not fragile and 1 being fully fragile.

For this study, we utilize the same dataset used by Baliki et al (2017). Hence, we are able to construct the same FEI for the sample, which facilitates the analysis on one hand, and reduces costs of including a fragility module in a new questionnaire. The fragility module in the HORTINLEA dataset covers information of both experiences and perceptions of fragility. In brief, it includes: fear and satisfaction on a range of security, economic, and social aspects; trust and perceptions of effectiveness of formal and informal institutions; community involvement and experiences of corruption; among other indicators. Detailed information on the FEI module can be accessed in Baliki et al (2017).

5.2.2 Poverty measures at the micro-level

We use household consumption aggregate to assess the poverty situation of sampled households in rural and peri-urban areas of Kenya. The consumption aggregate is constructed following the guidelines provided in Deaton and Zaidi (2002). The consumption aggregate consists of two broad components namely: food and non-food consumption. The food consumption component is calculated based on recall information over a one-week period on the quantities consumed of about 95 food items. The major groups of these food items include cereals; roots and tubers; pulses; meat; other animal products; exotic vegetables; indigenous vegetables; fish; dairy products and eggs; fruits; beverage and drinking; seasonings; and sugar and candy. The food consumption aggregate is constructed using four sources namely: a) food consumed from purchases; b) food consumed from gifts or free of charge; c) food consumed from own production; and d) food consumed from storage (own stock). In addition, the survey collected information on the unit prices for the purchase of food items in the past one week from the respondents. In addition to this, a price questionnaire was administered simultaneously with the household survey to capture per unit prices of all items included in the survey questionnaire from the nearby local market where the interviewed households would normally purchase these items.

There are two main issues related to food consumption aggregation: a) correctly converting the various unit references in which food items were reported into a metric unit; and b) accurately valuing food consumption from various sources. We tackled the first issue by using a table to convert the different measurement units into a standard metric unit, namely kilograms. For the second challenge, we used a data set of median food item price per kilograms that are representative of those faced locally by each household. We acknowledge the limitation here that food prices vary not only across different counties but also within counties depending on whether the market is in rural, urban or peri-urban location. However, we try to minimize this error of variability of food prices by matching the food price reported by each household with the median food item price.

The second main component of consumption aggregate is the non-food consumption expenditure. The HORTINLEA survey collected household expenditure information on about 24 regular non-food items during the past one month. The section also allows respondents to report expenditures of items spent on a yearly basis. These are later converted into monthly quantities. In addition, non-food items received as a gift or free of charge during the past 4 weeks are also captured. The non-food items included personal care, medical care, education

costs, transport, communication, clothing, donations, and domestic utensils. Following previous practices in consumption aggregation in developing countries, we do not include health expenditures in the non-food consumption expenditures due to heterogeneity in responses in terms of these expenditures (see Dercon et al., 2009 for details).

We then added the food and non-food consumption expenditure valued in KSHS to obtain the total consumption expenditure per household. In order to obtain a measure of individual well-being, we use two options. Either we deflate the total consumption expenditure by household size or by equivalence scales. Even though, deflating it by household size is the simplest way, it will underestimate the welfare of people who live in households composed of a high fraction of children. This is because children, up to a certain age, consume less than adults (KNBS, 2007). The second option of using equivalence scales gives a better individual estimate as it weighs the different individual age groups differently. Following (KNBS, 2007), we use the following equivalence scales: age groups 0-4 are weighted by 0.24; children aged 5-14 are weighted by 0.65; and all individuals aged 15 years and above are weighted by unity. In the analysis, we use total consumption expenditure per adult equivalence as a measure of poverty.

5.3 Descriptive results

The Fragility Exposure Index (FEI) takes a value between 0 and 1 for each individual where a value of zero (0) means not fragile and one (1) being fully fragile. First, let us see the relationship between ‘perception’ and ‘experience/manifestation’ components of the fragility exposure index of Kenya. Figure 3 plots the distribution of the FEI separating the sub-indicators capturing perceptions of fragility versus experiences of it. The same is applied to each of the respective domains. Figure 3a shows the distribution of the total fragility index separated by perceptions and experiences sub-indicators. One clearly sees that Kenyans are more fragile in terms of perceptions (mean of 55.7) than in terms of actual experiences (mean of 47.5). The differences are highly significant with a p-value < 0.001 . This holds true for the Human Security domain (Figure 3b) and the Social Cohesion domain (Figure 3d). However, the reverse is true for the Economic inclusion domain.

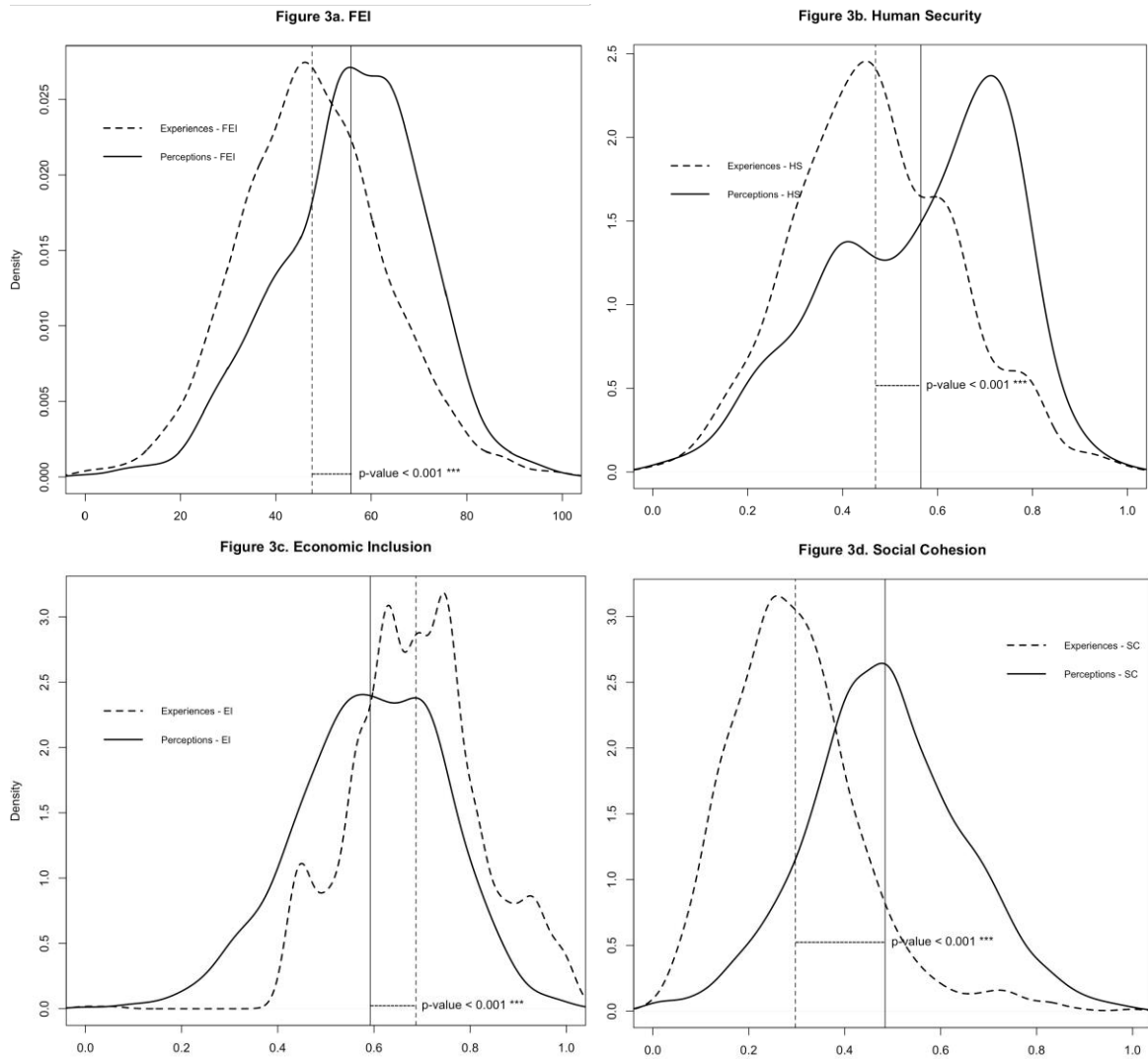


Figure 3. Differences between experiences and perceptions of the Fragility Exposure Index and its Domains - Kenya

The mean FEI is 0.51 (figure 4 and table 1) and more interesting features develop as we decompose FEI into the three domains. Individuals are more likely, on average, to experience fragility via human security and economic inclusion, with mean values of 0.53 and 0.56 respectively, compared to social cohesion, which has mean values of 0.36. Second, the median is very close to that of the mean for each of the domains in general and particularly for the economic inclusion and social cohesion domains, suggesting that outliers have negligible effects on our comparisons.

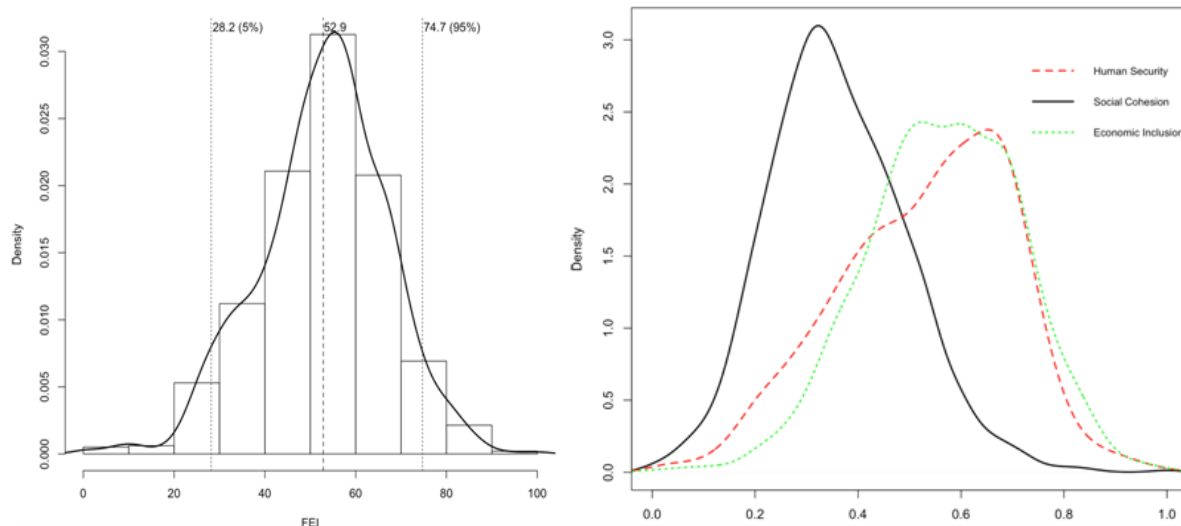


Figure 4. Distribution of the Domains of Fragility Exposure Index – Kenya. A value of zero (0) means not fragile and 1(100) being fully fragile.

Regarding our poverty measure, total consumption expenditure per adult equivalent has a mean value of 58.92 per month (table 1). Comparing the consumption expenditure for each household against a benchmark value, namely poverty line provides an interesting feature. The poverty line is calculated based on a nationally representative survey namely the Kenya Integrated Household Budget survey conducted in 2005/06. Consequently, the Kenya National Bureau of Statistics (KNBS) calculated the 2005 rural poverty line as Kshs 1,562 per month (KNBS, 2007). We inflated this figure by annual inflation and converted to a 2016 rural poverty line in USD using real exchange rate. We find the rural poverty line of USD 36.11 per month. Hence, we use this rural poverty line to identify which household is poor and non-poor. We note a limitation that, given our sample is both from rural and peri-urban locations, it would have been ideal to use either a poverty line specific to rural and peri-urban locations or even better a county-level poverty line. However, to the best of our knowledge, we could not find a county-specific poverty line calculated based on a representative survey neither do we find a poverty line specific for peri-urban locations in Kenya. Therefore, we had to opt to use the rural poverty line as a benchmark, this would also make sense since majority of the surveyed households are from rural locations. For the econometric analysis, we use total consumption expenditure per adult equivalent as a continuous variable, hence we avoid the bias of using rural poverty line as a benchmark.

We find that percentage of households below poverty line remained the same over time, about 34% of the sample below the poverty line. We further assess the correlation of fragility

exposure index (FEI) with poverty situation of households as shown in table A1 in the annex. Since we calculate FEI for the 2016 survey only, we tabulate this index across the poverty situation of households in 2014, 2015 and 2016. We find a significant difference of fragility index between the poor and non-poor households when both are measured in the same year namely FEI 2016 with poverty in 2016. This is especially significant for the FEI, the human security dimension as well as the economic inclusion dimension of fragility. It shows us that poor households have higher fragility index compared to their non-poor counterparts significant at 5% level. The fact that strong significance difference in fragility is observed for poor and non-poor households only in current years, compared to lagged poverty levels, shows that present level of poverty and vulnerability are more important to fragility instead of past levels of poverty.

Our sample is dominated by male headed and married households in more than 80% of the sample with the average age of household head being 53 years. The average household has 6 members with the head having 8-9 years of schooling. Most households own agricultural land where the average land size is about 0.86 hectares. A limited proportion of our sample households have access to agricultural services such as credit and use of irrigation. For instance, only about 23% have access to credit and only 27% of households use irrigation for agricultural production. Nevertheless, our agricultural sample households produce a variety of crops, up to 7 types of agricultural crops.

Table 1. Descriptive statistics

	Mean	Std dev.	Obs.
Panel A: Measures of Fragility			
Fragility Exposure Index _2016	0.515	0.14	674
Human security _2016	0.525	0.17	674
Economic inclusion _2016	0.559	0.15	674
Social cohesion _2016	0.339	0.12	674
Panel B: Measures of poverty			
Consumption exp. per adult equivalent, per month(USD in ppp) _2016	58.92	85.614	671
Poverty head count, % of poor _2016	34.42	0.4754	671
Poverty head count, % of poor _2015	34.42	0.4754	671
Poverty head count, % of poor _2014	35.46	0.4787	671
Panel C: Channels of link			
Household dietary diversity scale _2016 (HDDS)	9,2	1,28	674
Household Crop diversity _2016	7,43	2,43	674
Food consumption scale, 2016 (FCS)	81,41	12,26	668
Panel d: Household characteristics			
Household size _2016	6,11	2,37	674
Male headed households _2016	0,81	0,38	674
Age of household head, 2016	52,70	12,61	674
Married household head, 2016	0,84	0,35	674
Education level of household head _2014	9,48	4,70	674
land size, in hectare _2016	0,86	1,15	674
Household owns farm _2016	0,96	0,18	674
Household participates in markets _2016	0,68	0,46	674
Household has access to credit _2016	0,23	0,42	674
Household has access to irrigation _2016	0,27	0,44	674
Household lives in Kisii	0,29	0,45	674
Household lives in Kakamega	0,27	0,44	674
Household lives in Nakuru	0,21	0,41	674
Household lives in Kiambu	0,21	0,40	674
Panel e: Instrument variables: Climatic Shocks			
Households affected by drought _2014, %	17.95	0,384	674
Household affected by drought _2015, %	44.80	0,497	674
Household affected by water shortage _2014, %	9.79	0.297	674
Household affected by water shortage _2015, %	21.36	0.410	674
Household affected by flood _2014, %	2.07	0.142	674
Household affected by flood _2015, %	5.34	0.225	674
Household affected by heavy rain _2014, %	18.8	0.391	674
Household affected by heavy rain _2015, %	25.5	0.436	674
Household affected by land slide _2014, %	2.07	0.142	674
Household affected by land slide _2015, %	4.89	0.215	674
Household affected by storm _2014, %	5.04	0.219	674
Household affected by storm _2015, %	5.04	0.219	674

6. Identification Strategy

We implement multivariate regression estimations to tease the impact of poverty on fragility. Based on the proposed conceptual framework, fragility and poverty have a ‘reciprocal’ relationship. This creates a challenge in quantitative analysis to clearly unravel the effect of one on the other. The endogeneity between poverty and fragility is evident as exposure to fragility

might also impact levels of poverty. To overcome this challenge, and following works of Braithwaite et al., (2016) and Lemus, (2013), we use an instrumental variable approach.

We use exogenous variations in climatic shocks as instrumental variable for poverty to estimate its impact on fragility. In this case, the exclusion restriction assumed that the use of the climatic shocks as an instrumental variable for poverty is independent of the FEI (outcome variable), given the covariates used in the estimation. Exogenous climatic shocks offers a plausible instruments for poverty, particularly that our sample is drawn from small-holder farmers who rely on agriculture as the main source of livelihood. Hence, our econometric identification strategy permits focusing on short-term fluctuations in poverty due to climatic shocks that impact fragility at the household level. We undertook various tests to identify a viable instrument for poverty from the available set of shocks in the HORTINLEA survey. We found that sum of prior climatic shocks is the closest instrument for poverty. Households are requested to report on the question: “Was your household affected by the following event [...] in the past year?” In the survey, climatic shocks include: drought, water shortage, flood, heavy rain, landslide and storm. Given that our sample is mainly agricultural households, majority of the households reported to have faced such shocks. For instance, 18% of the respondents reported to have faced drought in 2014 and this figure increased to 44.7% in 2015. We use sum of climatic shocks faced by households in the past two years i.e. for 2014 and 2015. We claim that climatic shocks have a direct effect on poverty especially given that our sample households are agricultural households whose livelihood is based on rain-fed agriculture. Therefore, climatic shocks can only affect fragility through poverty. We perform appropriate over identification tests on the assumptions that the excluded instruments are distributed independently of the error process, and they are sufficiently correlated with the included endogenous regressors.

The IV-2SLS estimation framework focuses principally on level of fragility, measured via perceptions and trust of institutions, as well as fears of insecurity for an individual i in time t . Exogenous shock variations is captured by cumulative exposure of households to climatic shocks in the previous two years $\sum_{t-2}^{t-1} CS_i$ and is used to instrument for poverty levels P_{it} at time t in the first stage of the estimation. In addition, we include household characteristics x_{it} as well county dummy variable in the estimation to control for county level effects.

$$P_{it} = \alpha_0 + \alpha_1 x_{it} + \alpha_2 x_{it-1} + \alpha_3 \sum_{t-2}^{t-1} CS_i + \varepsilon_{it} \dots\dots (2)$$

The second-stage equation will then estimate the impact of poverty on fragility as shown in equation (3). The fragility variable is only captured in year 2016.

$$FEI_{it} = \beta_0 + \beta_1 x_{it} + \beta_2 x_{it-1} + \beta_3 P_{it} + \gamma_{it} \dots\dots (3)$$

7. Results and discussion

The empirical investigation aims to identify the effect of poverty on fragility. However, there is endogeneity between fragility and poverty of households. In order to go around the issue of endogeneity, we opted for the use of instrumental variable estimation strategy where we took the sum of climatic shocks (namely drought, water shortage, flood, heavy rain, landslide and storm) faced by households in 2014, 2015, and 2016 as viable instruments for poverty measure in 2016. Since we measure poverty by consumption expenditure of a household, we claim that those households who faced higher sum of climatic shocks in 2014, 2015, and 2016 have lower consumption expenditure on average in the year 2016 (our poverty measure). This is tested by a simple OLS regression as shown in table 2, where we find a strong relationship between lagged sum of climatic shocks and total consumption per adult equivalent of a household in 2016. As the result shows, consumption expenditure in 2016 has significant relation to sum of climate shocks in 2014 and 2015. However, this does not rule out contemporaneous effect of shocks on consumption, as shown by the significant effect of sum of climatic shocks in all past years on consumption in 2016 (although with slightly lower coefficient). However, when we use only sum of climatic shocks in 2016 as an explanatory variable, we do not find significant effect on consumption expenditure of 2016. Therefore, the effect of climatic shocks on consumption is strong when we assess rather the cumulative effect of shocks.

Table 2. Consumption expenditure and instrument variable (OLS regression results)

	Consumption exp. in log_2016	Consumption exp. in log_2016	Consumption exp. in log_2016	Consumption exp. in log_2016
Sum of climatic shocks_2014 & 2015	-0.0696*** (0.0184)	-0.0593*** (0.0177)	-0.0474*** (0.0169)	-0.0413** (0.0169)
Sum of climatic shocks_2014, 2015 & 2016	-0.0601*** (0.0171)			
Sum of climatic shocks_2016	-0.0397 (0.0418)			
HH size_2016		-0.106*** (0.0132)	-0.102*** (0.0132)	-0.0943*** (0.0139)
HH head is Male_2016		0.0763 (0.0935)	0.0296 (0.0908)	0.0155 (0.0923)
Age of HH head in log_2016		-0.188* (0.0979)	-0.226** (0.105)	-0.229** (0.103)
Married HH Head_2016		0.0692 (0.0931)	0.0911 (0.0923)	0.112 (0.0910)
HH head years of education in log_2016		0.0266 (0.0400)	0.0144 (0.0401)	-0.00138 (0.0407)
Land Size in log_2016			0.0637* (0.0330)	0.0696** (0.0326)
HHs owns farm land_2016			0.0308 (0.125)	0.0382 (0.126)
HHs sells products in markets_2016			0.0966* (0.0534)	0.113** (0.0542)
HHs has access to Credit_2016			0.172** (0.0739)	0.164** (0.0732)
HHS uses irrigation_2016			0.252*** (0.0649)	0.206*** (0.0745)
County Controls	No	No	No	Yes
Observations	674	622	622	622
R-squared	0.017	0.136	0.185	0.190

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Dependent variable is Total consumption expenditure per adult equivalent in logarithm in 2016. It is calculated per month in USD.

Guided by the results from table 2, we can now use lagged sum of climatic shocks as instrument variable in the IV-2SLS estimation model. Empirical findings of both OLS and instrumental variable 2SLS approach are presented in table 3. The findings show that poverty, as measured by real consumption expenditure per adult equivalent is strongly and negatively correlated with exposure to fragility. This result is consistent while using OLS regressions but we find more significant and strong coefficient results with instrument variable regression controlling for socio-economic characteristics of households and County controls. From the socio-economic characteristics of households, we find that higher household size decreases exposure to fragility significant at 1% level in the IV-2SLS equations. This could be because higher size could serve as a buffer against exposure to fragility. Similarly, households with better educated heads have lower exposure to fragility, although marginally significant.

Table 3. Consumption expenditure and Fragility Exposure Index (FEI)

	OLS	OLS	OLS	OLS	IV-2SLS	IV-2SLS	IV-2SLS	IV-2SLS
VARIABLES	FEI16	FEI16	FEI16	FEI16	FEI16	FEI16	FEI16	FEI16
Consumption exp. in log_2016	-0.021***	-0.022**	-0.019*	-0.018*	-0.186**	-0.210**	-0.241**	-0.247**
	(0.008)	(0.009)	(0.010)	(0.010)	(0.073)	(0.088)	(0.114)	(0.124)
HH size_2016		-0.002	-0.002	-0.003		-0.022**	-0.025**	-0.025**
		(0.003)	(0.003)	(0.003)		(0.010)	(0.012)	(0.012)
HH head is Male_2016		-0.010	-0.007	-0.011		0.015	0.009	0.005
		(0.020)	(0.020)	(0.020)		(0.027)	(0.028)	(0.028)
Age of HH head in log_2016		-0.003	-0.009	-0.008		-0.018	-0.039	-0.045
		(0.024)	(0.025)	(0.025)		(0.031)	(0.037)	(0.040)
Married HH		-0.012	-0.015	-0.015		-0.014	-0.007	-0.002
		(0.022)	(0.023)	(0.022)		(0.028)	(0.031)	(0.031)
HH head years of education in log_2016		-0.018*	-0.019*	-0.017		-0.006	-0.007	-0.009
		(0.011)	(0.011)	(0.011)		(0.015)	(0.017)	(0.017)
Land Size in log_2016			0.004	0.002			0.018*	0.018
			(0.005)	(0.005)			(0.011)	(0.012)
HHs sells products in markets_2016			-0.018	-0.017			0.013	0.017
			(0.013)	(0.013)			(0.024)	(0.026)
HHs has access to Credit_2016			-0.017	-0.014			0.021	0.023
			(0.013)	(0.014)			(0.030)	(0.030)
HHS uses irrigation_2016			-0.008	0.003			0.050	0.052
			(0.013)	(0.014)			(0.034)	(0.034)
County Controls	No	No	No	Yes	No	No	No	Yes
F-Stat					14.31	15.86	11.16	8.88
R-squared	0.01	0.02	0.03	0.04				
Observations	674	623	623	623	674	623	623	623

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Dependent variable FEI16 is fragility exposure index calculated at household level for the year 2016. Total consumption expenditure per adult equivalent in logarithm in 2016. It is calculated per month in USD. Instrument variables: Lagged sum of climate shocks.

We run both OLS and IV-2SLS regression models taking the three major dimensions of fragility as dependent variables (table 4). For the human security dimension, we find that IV-2SLS estimation results show a significant and negative correlation between fragility and consumption expenditure while OLS shows only marginal level of significance and it loses significance when controlling for more socio-economic and county fixed effects. For the dimension of economic inclusion, we find strong association between poverty and fragility measured in economic inclusion. This association is strong and significant throughout the different specifications,

controlling for socio-economic characteristics of households and county fixed effects. However, still we find more level of significance and higher coefficient estimates while using IV-2SLS estimation procedure. This means that economic exclusion creates injustice and unfair treatment, which can provide a pretext for recourse to violence. Ensuring that all individuals, groups, and communities have equal access to economic development and other opportunities is imperative to reducing fragility. In this respect, there is a need for programs that focus on the economy and on building inclusive and accountable institutions; and creation of opportunities through reforms on private sector development and the modernization of various sectorial systems is viable option. For the social cohesion dimension of fragility, we find weak significance level in both OLS and IV-2SLS estimation. In both cases, we find that fragility measured in social cohesion is negatively, but weakly associated with consumption expenditure.

Table 4. Consumption expenditure and Dimensions of Fragility Exposure Index (FEI)

	OLS	OLS	OLS	OLS	IV-2SLS	IV-2SLS	IV-2SLS	IV-2SLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Human Security								
Consumption exp. in log_2016	-0.012** (0.009)	-0.018* (0.010)	-0.017 (0.011)	-0.017 (0.011)	-0.230*** (0.084)	-0.234** (0.096)	-0.273** (0.125)	-0.294** (0.141)
Economic Inclusion								
Consumption exp. in log_2016	-0.022** (0.009)	-0.023** (0.010)	-0.021* (0.011)	-0.020* (0.011)	-0.184** (0.078)	-0.235** (0.101)	-0.276** (0.131)	-0.279** (0.142)
Social Cohesion								
Consumption exp. in log_2016	-0.010 (0.007)	-0.013* (0.008)	-0.008 (0.008)	-0.008 (0.008)	-0.044 (0.057)	-0.049 (0.068)	-0.046 (0.083)	-0.036 (0.091)
Observations	674	623	623	623	674	623	623	623

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Total consumption expenditure per adult equivalent in logarithm in 2016. It is calculated per month in USD.

Controls (1) and (5): None

Controls (2) and (6): HH size, Gender, Age, Marital Status, Education

Controls (3) and (7): HH size, Gender, Age, Marital Status, Education, Market, Credit, Irrigation

Controls (4) and (8): HH size, Gender, Age, Marital Status, Education, Market, Credit, Irrigation, country controls

In general, we can summarize the findings of the econometric results that there exists a strong and negative association between fragility as measured by FEI and poverty as measured by consumption expenditure per adult equivalent. This means, when the consumption expenditure of households increases (therefore, when households are less poor), they are less likely to be exposed to fragility. This strong and negative association holds for different specifications, but more significant results are found using Instrumental variable estimation approach. From the three dimensions of fragility, economic inclusion shows significance and strong relationship to consumption expenditure while using both OLS and IV-2SLS. However, only IV-2SLS gives strong and significance association of consumption expenditure with human security. As such, our finding ascertains two outcomes: on the one hand, use of instrumental variable approach is a viable option to identify the link between poverty and fragility, on the other hand, there is indeed a strong and significant association between poverty and fragility, whereby better-off households (in terms of less poverty) are less likely to be fragile.

We further explored the channels of linking poverty to fragility. Following the conceptual framework (figure 1), we identified suitable variables that could link poverty to fragility. For this we used IV-2SLS to estimate the effect of food security measured by household dietary diversity score (HDDS), crop diversity, and food consumption score (FCS) calculated from households using HORTINLEA survey. Household dietary diversity score (HDDS) is the count of food groups consumed by a household in the past one week. This is captured by households reporting during the HORTINLEA Survey. Eleven food groups are included namely staples; roots and tubers; pulses, seeds and nuts; fruits; vegetables; fish; meat; eggs; dairy (milk only); oil; and sugar. Dietary diversity is especially a good predictor of child nutrition as it captures the quality of diet regarding micro-nutrients (Arimond and Ruel, 2004). Crop diversity shows the number of agricultural crops cultivated by the household on their farm. Food consumption score (FCS) is a composite score based on dietary diversity, food frequency and relative nutritional importance of different food groups (WFP, 2006). From the HORTINLEA survey, we use the food groups as: staples; pulses; fruits; vegetables; animal protein (including fish, meat, and eggs); dairy (milk only); oil; and sugar. Summary statistics of HDDS, crop diversity and FCS are presented in panel (C) of table 1.

We find that two of the food security indicator variables namely HDDS and FCS are positively and significantly (at 5% level) associated with consumption expenditure of households (a measure of poverty) as shown in table 5. Therefore, the hypothesis that food security could be one of the channel where poor households are exposed to fragility is verified within our sample of households from Kenya. Households who are poor are more likely to be food insecure (either in terms of diversity of diet or food consumption score) which also makes them fragile in the various dimensions measured. Insecurity from non-food dimensions of welfare could also be the channel where poverty and fragility are interlinked. This could be through lack of provision of public services and effective institutions, to mention just a few. However, due to data limitation, we could not test this channel.

Table 5. Channels of linking poverty to Fragility

	IV-2SLS	IV-2SLS	IV-2SLS
	HDDS_2016	CROP Diversity_2016	FCS_2016
Sum of climatic shocks_2014 & 2015	-0.104**	-0.027	-0.761**
	(0.035)	(0.071)	(0.323)
County Fixed Effects	Yes	Yes	Yes
Socio-economic controls	Yes	Yes	Yes
Observations	674	674	668
R-squared	0.204	0.139	0.254

Note: HDDS: Household dietary diversity score (1 being the lowest diversity, with a maximum of 11, for Samples in HORTINLEA survey 2016. CROPDIV: diversity of crops grown on farm survey round 2016; FCS: food consumption score for different food groups, here the average is used from the 2016 survey round. Socio-economic controls included are: HH size, Gender, Age, Marital Status, Education, Market, Credit, Irrigation, country controls

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

8. Conclusion

The relationship between fragility and poverty remains unexplored due to a number of factors. First, the concept of fragility and consequently its measures have ignored the within-country variations and the heterogeneity at the micro- and individual-level. Second, due to plausible endogeneity in the relationship between fragility and poverty, as well as the lack of viable and strong instruments, it remains difficult to draw causality pathways. This study contributes to the fragility-poverty literature by taking a micro-level approach, proposing a measure of fragility (the fragility exposure index), which measures individuals' perceptions and experiences of fragility. This allows us to test the effect of poverty on the levels of fragility by addressing the potential endogeneity of poverty by using a shock related variable, namely sum of prior climatic shocks.

We use the HORTINLEA survey conducted in rural and peri-urban areas of Kenya which focused on farm households that are agricultural and horticultural producers. Even if the survey was conducted every year since 2014 to 2016; the fragility module is introduced in the latest round of the survey, i.e. 2016. The data set we used is unique in a way as it allowed us to combine individual/household level fragility measures with household-level poverty resulting in a micro-level analysis.

The econometric results show that there exists a strong and negative association between fragility as measured by Fragility Exposure Index (FEI) and poverty as measured by consumption expenditure per adult equivalent. This means, when the consumption expenditure of households increases (therefore, when households are less poor), they are less likely to be exposed to fragility. This strong and negative association holds for different specifications, but

more significant results are found using Instrumental variable estimation approach. From the three dimensions of fragility, economic inclusion shows significance and strong relationship to poverty while using both OLS and IV-2SLS. However, only IV-2SLS gives strong and significance association of poverty with human security. As such, our finding ascertains two outcomes: on the one hand, use of instrumental variable approach is a viable option to identify the link between poverty and fragility, on the other hand, there is indeed a strong and significant association between poverty and fragility, whereby better-off households (in terms of less poverty) are less likely to be fragile.

Indeed, a nationally representative panel household survey would provide a generalizable conclusion. In our case, the fragility module was introduced into the survey only in the final survey round, therefore, it was not possible to use a panel econometric approach. This is something to be picked by future research on the topic.

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Annex

Table A1. Correlation between Fragility and Poverty.

		2016			2015			2014		
		Poor	Non-poor	t-test	Poor	Non-poor	t-test	Poor	Non-poor	t-test
	FEI	0.53	0.50	0.0237	0.52	0.51	0.4004	0.52	0.51	0.5055
	Human security	0.54	0.51	0.0444	0.53	0.52	0.3083	0.53	0.52	0.4416
2016	Economic inclusion	0.57	0.54	0.0135	0.56	0.55	0.5362	0.56	0.55	0.2186
	Social cohesion	0.34	0.33	0.590	0.34	0.33	0.8455	0.33	0.34	0.4875

Source: Authors' computation from HORTINLEA panel survey

Table A2. Households affected by Climatic Shocks (2014-2016), Percentage

	2014	2015	2016
Drought affected hhs	0.181 (0.385)	0.442 (0.497)	0.401 (0.491)
Shortage of water affected hhs	0.081 (0.273)	0.210 (0.407)	0.079 (0.270)
Flood affected hhs	0.025 (0.157)	0.052 (0.223)	0.012 (0.108)
Unusually heavy rain affected hhs	0.225 (0.418)	0.265 (0.442)	0.130 (0.336)
Land Slide/erosion affected hhs	0.023 (0.149)	0.050 (0.217)	0.007 (0.085)
Storm affected hhs	0.050 (0.219)	0.050 (0.217)	0.047 (0.211)
Observations	1232	706	685

Mean coefficients; SD in parentheses, HORTINLEA survey (2014-2016)