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Education and the Vulnerability to Food Inadequacy in Timor-Leste

RAGHBENDRA JHA & TU DANG

ABSTRACT *This paper adopts a simple empirical approach to estimate vulnerability to food inadequacy using cross-section data from the 2001 Timor-Leste Living Standard Measurement Survey. This measurement is based on the assumption that households are exposed to the same kind of shock. It is found that the distribution of vulnerability to food inadequacy to the education of household head is more significant than that to observed food poverty. The results support the argument that senior primary and tertiary education can help reduce the food risk that households face, in particular the risk that a household is undernourished. Thus, in Timor-Leste public spending on these forms of education can provide a form of support that favours the poor.*

JEL Classification: C21, C23, I32, O57

1. Introduction

While there is considerable evidence linking inadequate education to poverty, it is somewhat surprising that so little work has been done on the impact of education on under-nutrition (i.e. food poverty), despite the obvious importance of such research. The Timor-Leste Living Standard Measurement Survey (TLSS) of 2001 provides a unique source to fill this lacuna in the case of Timor-Leste (World Bank, 2001). Before 1999, education in Timor-Leste was quite underdeveloped. Following the vote for independence in a referendum in August 1999, about 95% of the schools in Timor-Leste were burned down by pro-Indonesia militia and about 20% of primary school teachers and 80% of secondary school teachers left the country. However, within 18 months of such widespread destruction, the school system had largely been rebuilt (Wu, 2003).

In this paper, our primary goal is to understand whether and how education can play a role in reducing vulnerability to food poverty in Timor-Leste, a country whose poverty and vulnerability experiences have barely been studied. Here, we conceive of food consumption as a measure of economic well-being to allow for the concern that total

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consumption may rise above the poverty threshold in the short term owing to sporadic purchase of durables or other lumpy goods (Luttmer, 2002).¹ Several papers on the analysis of vulnerability have emphasized the importance of asset ownership in reducing such vulnerability (e.g. Jha *et al.*, 2010), but, to the best of our knowledge, there have been no analyses of the impact of education expenditure on vulnerability to food poverty, in particular for Timor-Leste. From a policy perspective, this is a crucially important issue because whereas the pattern of asset ownership is typically slow to change, education expenditures can change more quickly. This paper addresses this important issue.

Traditionally, anti-poverty policy has been concerned only with bringing the poor above the poverty line. However, economists have long realized that if individuals are risk averse, a household's sense of well-being depends not only on its average income or expenditures, but also on the risks it faces and its ability to deal with these risks. A household or individual with adequate food today can become food-inadequate in the future because of shocks such as disease, job loss or natural disasters. Food security is a concern especially in Timor-Leste because food availability is aligned with the harvest cycle (World Bank, 2003a). In this country, "major urban centers typically have access to just enough food all throughout the year, while other parts of the country face greater fluctuation in food availability, and experience food shortage about twice as often as food excess" (World Bank, 2003a, p. 95). Thus, the second goal of this paper is to extend the notion of food poverty to include vulnerability to food inadequacy, and consider the role of education in reducing that vulnerability. According to Holzmann & Jørgensen (2001), poverty and vulnerability are closely related concepts owing to two established facts: the poor are typically most exposed to diverse risks; and the poor have the fewest instruments to deal with these risks.

Conceptually, studies differ in their definitions of vulnerability, partly owing to the limitations of data. In this paper, following Chaudhuri *et al.* (2002), we define vulnerability to food inadequacy as the probability that a household will not have enough food in the future.² Ideally, with a panel data of sufficient length we could directly estimate the probability distribution of the household's food consumption. However, panel data are typically not available, especially in developing countries such as Timor-Leste. In practice, cross-sectional data can be used to estimate the inter-temporal variance by assuming homoscedasticity (Gibson & Rozelle, 2003) or allowing heteroscedasticity with the variance depending on some observable household characteristics, such as mean of household consumption (Chaudhuri *et al.*, 2002).

The Chaudhuri *et al.* (2002) method is based on the assumption that idiosyncratic shocks to consumption are identical *over time* for each household, ruling out the possibility that most parts of Timor-Leste face particularly large fluctuations in food availability. This paper relaxes this assumption by calibrating the food consumption for each month over the year by using information from a subjective answer. This helps us to estimate the standard error over time and compute the vulnerability for each household. Thus, this paper pursues three objectives. First, it examines food poverty in Timor-Leste and demonstrates the relationship between food poverty and education. Next, it identifies the determinants of both food poverty and vulnerability to food inadequacy. Finally, it helps us understand the role education policies could play in overcoming food poverty in Timor-Leste.

The paper is structured as follows. Section 2 discusses the data and measurement of food poverty. Section 3 briefly reviews the recent situation in relation to poverty and education in Timor-Leste. Section 4 discusses determinants of food poverty in Timor-

Leste. Section 5 analysis vulnerability to food inadequacy and Section 6 concludes the paper. To the best of our knowledge, this is the first analysis of the role of education in reducing food poverty and vulnerability to food inadequacy in Timor-Leste.

2. Data and Measurements of Food Poverty

Data used in this paper come from the TLSS, which was conducted between August and November 2001. This survey was designed to assess the extent, nature and causes of poverty. It assembles information on household demographics, housing and assets, household expenditures and some components of income, agriculture, labour market data, basic health and education, subjective perceptions of poverty and social capital.

The TLSS has a sample size of 1800 households from 100 *sucos* (villages), or about 1% of the total number of households in Timor-Leste. It covers three areas: major urban centres (Dili and Baucau), other urban centres and rural areas. Within rural areas it covers three broad geographic regions (west, centre and east). To ensure that each analytical domain contained a sufficient number of households, the sample was stratified to 450 households in the major urban centres (378 in Dili and 72 in Bacau), 252 households in the other urban centres and 1098 households in rural areas.

The sampling of households in each stratum followed a three-stage procedure. In the first stage, a certain number of *sucos* were selected with probability proportional to size: four in urban Baucau, 14 in other urban centres and 61 in rural areas. In the second stage, three *aldeias* (loosely, localities) in each *suco* were selected, again with probability proportional to size. In the third stage, six households were selected in each *aldeia* with equal probability. This implies that the sample is approximately self-weighted within the stratum³ (World Bank, 2005).

The poverty line is provided by the survey and is defined as monthly *real* per capita expenditure of 154 374.1 rupiah. This poverty line consists of two elements: the food and non-food components. The food component requires setting of minimum food-energy requirements. The survey followed common practice in East Asia and used 2100 calories per person per day as the basic nutritional requirement. The survey identified the food bundle that yields this level of nutrition by examining the prevailing consumption patterns. Following standard convention, the survey excluded alcoholic drinks, tobacco and betel, and residual subcategories (“other”). For poverty lines, the survey generated a lower national monthly per capita poverty line of US\$14.41 and a higher national poverty line of US\$15.43. The food share accounts for 75% of total expenditure in the case of the lower poverty line and 70% in the case of the upper poverty line. In this paper, we use the upper poverty line. Correspondingly, food expenditure at this poverty line is US\$10.8 per month per person. With this poverty line, we estimate that 32.5% of the population is poor and that 32.1% of the population is undernourished.⁴

3. Food Poverty and Education in Timor-Leste

On 19 October 1999, Indonesia’s parliament voted to confirm the results of the referendum in Timor-Leste of 30 August 1999, which rejected autonomy under Indonesia and favoured independence. With about a million people, the country is one of the world’s poorest nations. In 2004, life expectancy was 61 years and the adult literacy rate was only 50.1%. Population growth recently has been a high 3.2% per year (Table 1).

Table 1. Timor-Leste's data profile

	2000	2005	2007	2008
<i>Population and area</i>				
Population, total (millions)	0.82	0.99	1.06	1.10
Population growth (annual %)	0.5	4.2	3.4	3.2
Surface area (square km) (thousands)	14.9	14.9	14.9	14.9
Agricultural land (% of land area)	22.7	22.9	..	..
Poverty headcount ratio (% of population)*	32.5	..	..	..
GNI per capita, Atlas method (current US\$)	..	740	1520	2460
GNI per capita, PPP (current international \$)	790	1490	3110	4690
<i>People</i>				
Life expectancy at birth, total (years)	56	60	61	61
Fertility rate, total (births per woman)	7.0	6.7	6.5	..
Mortality rate, under 5 years (per 1000)	129	105	97	..
Primary completion rate, total (% of relevant age group)	..	..	69	..
<i>Economy</i>				
GDP (current US\$) (billions)	0.32	0.33	0.40	0.50
GDP growth (annual %)	13.7	6.2	7.8	13.2
Inflation, GDP deflator (annual %)	3.0	1.0	12.9	10.7
ODA and official aid (current US\$) (millions)	231	185	278	..

Note: GNI, Gross National Income; PPP, Purchasing Power Parity; ODA, Overseas Development Assistance.

*Our estimation from 2001 TLSS.

Source: World Development Indicators database, September 2009.

Although Timor-Leste enjoyed high rates of economic growth of about 10% per year in the aftermath of independence, this growth was mainly concentrated in oil exports, public expenditure and aid. Table 2 shows that, following the 1999 referendum, public expenditure grew rapidly from 39% in 2000 to 57% of non-oil GDP in 2001 and remained high for the following years. Table 2 also notes that donor programmes supported about 70% of total public expenditures and, in fact, non-oil GDP growth was driven by donor programmes (World Bank, 2003a). The cut in aid after 2002 was followed by a significant contraction in growth. The increase in the rate of poverty between 2001 and 2004 was, in turn, a consequence of poor growth performance.

Based on our estimation from the TLSS, 33.1% of Timor-Leste's rural population and 28.6% of the urban population live in a household in which the real value of food consumption per capita is below the food poverty line.⁵ Table 3 illustrates that the differences in regional food poverty rates are not particularly significant, except that

Table 2. Public expenditure in non-oil GDP in Timor-Leste, 2000–05

	2000	2001	2002	2003	2004	2005
Capital (% of non-oil GDP)	9	16	22	18	15	15
Public expenditures (% of non-oil GDP)	39	57	65	71	70	68
Donor programmes:						
•millions of US\$	79	148	181	170	165	154
•% of public expenditures	68.1	75.9	78.4	70.5	69.6	66.4
•% change		87.3	22.3	– 6.1	– 2.9	– 6.7

Source: IMF Country Report No. 07/86.

Table 3. Food poverty in Timor-Leste in 2001 by region

	Headcount index		Contribution to total	
	Index	Standard error	%	Standard error
Dili/Baucau	29.2	2.3	9.7	0.3
Other urban	28.0	2.9	9.1	0.3
Rural centre	36.0	2.2	41.4	2.2
Rural east	26.8	2.4	19.1	1.8
Rural west	34.8	3.2	20.7	2.0
Urban	28.6	1.8	18.8	0.4
Rural	33.1	1.5	81.2	0.4

Note: Results are corrected for the effect of stratification and sampling weights.

Source: 2001 TLSS.

the food poverty rate in rural areas is slightly higher than that in urban areas. However, as the rural population accounts for 79% of the nation’s population, the rural poor account for 81.2% of Timor-Leste’s poor, making it clear that food poverty in Timor-Leste is predominantly a rural problem.

Timor-Leste faces not only food inadequacy but also vulnerability to food inadequacy, i.e. a high risk of food inadequacy. Figure 1 illustrates the large fluctuations in food availability in Timor-Leste throughout a year. As a result, at the national level, on average, for 3.6 months of a year the population does not have adequate food (Table 4). In contrast to food poverty rates, the differences between rural and urban areas in the number of months during which food inadequacy is experienced are significant. For example, on average, households in Dili/Baucau experienced 1.8 months a year with food inadequacy, compared with roughly 4 months in rural areas. This again raises concerns about the food insecurity to which the population is exposed.

Figure 1. Food inadequacy by month.

Source: 2001 TLSS.

Table 4. Vulnerability to food inadequacy by region

	Less than adequate (No. of months)	Just adequate (No. of months)	More than adequate (No. of months)
Dili/Baucau	1.8 (0.05)	9.7 (0.06)	0.4 (0.03)
Other urban	3.7 (0.04)	5.8 (0.07)	2.6 (0.06)
Rural centre	3.7 (0.03)	6.1 (0.05)	2.1 (0.04)
Rural east	4.2 (0.05)	6.8 (0.06)	1.0 (0.05)
Rural west	3.9 (0.05)	6.0 (0.06)	2.1 (0.06)
National	3.6 (0.02)	6.7 (0.03)	1.7 (0.02)

Notes: Standards errors in parentheses. Results are corrected for the effect of stratification and sampling weights.

Source: 2001 TLSS.

Figure 2. Ever attended school by age and region.

Source: 2001 TLSS.

Inadequate education may be one of the proximate causes of food poverty in the rural sector. To illustrate the link between education and poverty, Figure 2 shows that the adult rural population has significantly lower schooling attendance than the urban population. About 50% of the rural population who are in the 19–29 years age group and 40% of those who are 30 and above have never attended school, in comparison with Dilli/Baucau and the other urban areas, where 82 and 61%, of the population attended school, respectively.

4. Determinants of Food Poverty in Timor-Leste

4.1 Model Specification

A wide range of variables measuring the potential determinants of food poverty in Timor-Leste is available from the TLSS. The selection of variables included in the model is guided by the World Bank (2003a, b). These variables can be grouped into the following categories:

- *Regions*: indicator variables for Dili/Baucau, other urban, rural centre, rural east.
- *Household demographics*: household size (number of household members), household size squared, number of members under 60 years.
- *Head characteristics*: age, age squared, gender, education, occupation.
- *Assets*: landholding and savings.
- *Housing*: house ownership; availability of (i) safe drinking water, (ii) electricity; number of years lived in the dwelling, distance to the centre.
- *Access*: distance to *aldeia* centre.

Table 5 provides some descriptive statistics on these variables.

Table 5. Descriptive statistics for the model of food consumption ($N = 1800$)

	Mean	SD	Min	Max
Log of real per capita monthly food expenditure	0.077	0.044	0	0.147
<i>Region</i>				
Dili/Baucau	0.250	0.433	0	1
Other urban	0.140	0.347	0	1
Rural center	0.280	0.449	0	1
Rural east	0.190	0.392	0	1
<i>Demographics</i>				
Household size	5.063	2.513	1	19
Household size squared	31.945	31.981	1	361
Number of persons under age 6	5.063	2.513	1	19
<i>Head</i>				
Male	0.359	0	1	0.359
Age (years)	13.860	16	99	13.860
Age square	1346.731	256	9801	1346.731
<i>Head's education</i>				
Upper primary	0.353	0	1	0.353
Junior primary	0.271	0	1	0.271
Senior primary	0.332	0	1	0.332
University/academia	0.156	0	1	0.156
Real per capita monthly expenditure on education (1000 rupiahs)	1.692925	6.925874	0	139.6407
<i>Head's occupation</i>				
House worker	0.166	0	1	0.166
Farmer	0.471	0	1	0.471
Non-farm worker	0.124	0	1	0.124
Trader	0.205	0	1	0.205
Teacher/civil servant	0.230	0	1	0.230
<i>Housing</i>				
Dwelling is owned by household head	0.302	1	2	0.302
Number of years living in the dwelling	8.111	0	80.16666	8.111
Kilometres to <i>aldeia</i> center	5.428	0	50	5.428
Safe drinking water (tap or bottled)	0.481	0	1	0.481
Electricity is main source of lighting	0.478	0	1	0.478
<i>Assets</i>				
Holding land (hectares)	3.032	0	100	3.032
Savings (1000US\$)	2.644	0	100.2	2.644

4.2 Results from the Food Consumption Estimation

The results of the basic model of food consumption estimated using ordinary least squares (OLS) are reported in Table 6, column 1. In general, the model performs well. The goodness-of-fit measure, R^2 , is 0.33, sufficiently high for models using cross-sectional data. In addition, many of the coefficients of control variables have the expected sign and are statistically significant. For example, the results show that large household size significantly

Table 6. Estimates of log real per capita food consumption

Variables	Log of real per capita monthly food expenditure		
	(1)	(2)	(3)
Idiosyncratic shock	— —	— —	0.147*** (0.027)
<i>Region</i>			
Dili/Baucau	0.002 (0.056)	0.011 (0.055)	0.009 (0.055)
Other urban	0.006 (0.041)	0.007 (0.041)	0.017 (0.040)
Rural centre	0.076** (0.037)	0.076** (0.038)	0.097*** (0.037)
Rural east	0.085* (0.043)	0.085** (0.043)	0.105** (0.043)
<i>Demographics</i>			
Household size	−0.312*** (0.021)	−0.316*** (0.021)	−0.311*** (0.020)
Household size squared	0.016*** (0.002)	0.016*** (0.002)	0.016*** (0.002)
Number of persons under age 6	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
<i>Head</i>			
Male	0.108*** (0.040)	0.130*** (0.039)	0.081** (0.040)
Age (years)	0.018*** (0.006)	0.014** (0.006)	0.017*** (0.006)
Age square	−0.000*** (0.000)	−0.000*** (0.000)	−0.000*** (0.000)
<i>Head's education</i>			
Upper primary	0.056 (0.043)	— —	0.035 (0.042)
Junior primary	0.074 (0.054)	— —	0.056 (0.055)
Senior primary	0.138*** (0.052)	— —	0.119** (0.050)
University/academia	0.272*** (0.104)	— —	0.228** (0.103)
Real pc monthly expenditure on education (1000 rupiahs)	— —	0.004* (0.002)	— —
<i>Head's occupation</i>			
House worker	−0.232** (0.094)	−0.241** (0.094)	−0.220** (0.092)

Table 6. Continued

Variables	Log of real per capita monthly food expenditure		
	(1)	(2)	(3)
Farmer	-0.116*** (0.043)	-0.132*** (0.043)	-0.108** (0.042)
Non-farm worker	-0.045 (0.115)	-0.054 (0.117)	-0.061 (0.119)
Trader	0.155** (0.061)	0.155** (0.062)	0.143** (0.060)
Teacher/civil servant	0.036 (0.070)	0.109 (0.069)	0.005 (0.069)
<i>Housing</i>			
Dwelling is owned by household head	-0.054 (0.045)	-0.036 (0.044)	-0.050 (0.045)
Number of years living in the dwelling	0.006*** (0.002)	0.005*** (0.002)	0.005*** (0.002)
Kilometres to <i>aldeia</i> centre	0.009*** (0.002)	0.009*** (0.002)	0.010*** (0.002)
Safe drinking water (tap or bottled)	-0.014 (0.028)	-0.008 (0.028)	-0.017 (0.027)
Electricity is main source of lighting	0.158*** (0.039)	0.175*** (0.039)	0.138*** (0.039)
<i>Assets</i>			
Holding land (hectares)	0.029** (0.013)	0.029** (0.014)	0.029** (0.013)
Savings (1000US\$)	0.013 (0.011)	0.013 (0.012)	0.010 (0.011)
Constant	12.428*** (0.163)	12.549*** (0.153)	12.546*** (0.160)
Observations	1800	1800	1800
R-squared	0.327	0.324	0.339

Notes: Standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

reduces expectation of food consumption per capita. It is well known that families with many children are, on average, poorer, *ceteris paribus*.⁶ However, this negative effect weakens with household size because the coefficient on (average) household size squared is positive and significant. We also find both age and gender of the household head to be associated with expected food consumption: consumption per capita is higher for households with older males as heads. The occupation of the head also has an effect on the food consumption level: consumption is lower for households with heads who are working as house workers or farmers, but higher for households with heads who are working as traders.

As expected, possession of assets is positively associated with the level of food consumption. It can be seen from Table 6 that the fact of landownership significantly increases the household's expectation of food consumption. However, we did not find any significant evidence that having savings is associated with the mean of future consumption. After controlling for the region, demographic, education, occupation,

Figure 3. Scatter plot of expenditure on food and education.

housing and assets factors, the dummies for education of household head have positive coefficients, of which the dummies for senior primary and university/academia-level education have significant effects. This implies that there are significant gains in food consumption from senior primary and tertiary education of the household head.

4.3 Robustness Check

One potential problem with estimating Equation (5) is that the dummies measuring the educational qualification of household heads could be endogenous. It is possible that the households who spend more on food also have more opportunity to obtain higher education. To address this problem we can use an instrumental variable, which is correlated to education indicators but independent of food consumption. The variable used in this paper is the household’s monthly real expenditure on education, also available in the survey. Figure 3 shows that there is no evidence of a correlation between expenditure on food and education. The results show that households with higher expenditure on education have higher food consumption per capita (Table 6, column 2). The results once again support our hypothesis that improving education will raise food consumption.⁷

5. Vulnerability to Food Inadequacy in Timor-Leste

5.1 Empirical Strategy towards Measuring Vulnerability

We define vulnerability to food inadequacy as the risk that a household (or individual), if currently having enough food, will have inadequate food in the future, or, if currently

having inadequate food, will fall deeper into under-nutrition. Thus, vulnerability to food inadequacy of household (or individual) i at time t is defined by

$$VEP_t^i = \Pr(c_{t+1}^i \leq z), \quad (1)$$

where c_{t+1}^i is the per capita food consumption of household i at time $t+1$ and z is the per capita food requirement defined as the food poverty line.

If we assume a stationary environment where the probability of possible future food consumption outcomes remains the same across time, the vulnerability (to food poverty) of household i can be defined as

$$VEP^i = \Pr(c^i \leq z), \quad (2)$$

which is independent of time t , or

$$VEP^i = \int_0^z f_i(c_i) dc_i, \quad (3)$$

where f_i is the probability density function of c_i . A household is then considered vulnerable to food poverty if its VEP exceeds some threshold. Chaudhuri *et al.* (2002) consider two vulnerability thresholds. The first is the observed current poverty rate in the population. The alternative threshold is 0.5. This threshold indicates that a household whose vulnerability level exceeds 50% is more likely than not to end up being poor and can thus be considered to be vulnerable (to poverty). In this paper, we take the threshold probability level that defines a household vulnerable to poverty to be 0.5. This threshold has the advantage⁸ that if a household is just at the poverty line and expects a mean zero shock, it has vulnerability to poverty of 0.5 (Pritchett *et al.*, 2000).

To derive exact results, some parametric assumptions are needed concerning the distribution of consumption. An assumption that has proved to be a good approximation in a wide variety of settings is that consumption follows a lognormal distribution (see Gibson & Rozelle, 2003; Glewwe, 2007):

$$\ln c \sim N(\xi, \sigma^2). \quad (4)$$

Hence, the entire distribution of consumption of household i is captured by the mean ξ and (inter-temporal) variance σ^2 . Thus, vulnerability of household i is then estimated by

$$VEP^i = \Phi\left(\frac{\ln z - \xi_i}{\sigma_i}\right), \quad (5)$$

with Φ as the cumulative lognormal distribution function. Ideally, with panel data of sufficient length we can directly estimate the mean and variance of a household's food consumption.

In practice, cross-sectional data can also be used to estimate the conditional mean and the inter-temporal variance by assuming homoscedasticity (Gibson & Rozelle, 2003).

However, the homoscedasticity assumption rules out the possibility that different households face different volatilities of consumption. Hence, Chaudhuri *et al.* (2002) allowed heteroscedasticity and the variance to depend on some observable household characteristics, such as conditional mean. The resulting estimation is based on the assumption that idiosyncratic shocks to consumption are identical *over time* for each household. The assumption seems quite restrictive, especially as most parts of Timor-Leste face large fluctuations in food availability (World Bank, 2003b).

In this paper, we take into account the information about a household's capacity to keep food consumption constant over the year reported in the survey in a section on subjective well-being. In the survey, households are interviewed on whether they have enough food, not enough food, or more than enough food in the current month (corresponding to the consumption used in the above models) and the past 12 months.⁹ We assume that the subjective well-being answer can be a proxy for idiosyncratic shocks to a household's food consumption. More specifically, the shock will take the value zero if the answer is "enough", s if the answer is "more than enough" and $-s$ if the answer is "not enough". Here, we assume that these shocks are identical for all households, so there is no subscript i below s . The model for food consumption is then specified to include the "shock" variable (Table 6, column 3). Subsequently, consumption can be predicted for each month of the year to obtain series of monthly food consumption over the year for each household. From these series we estimate inter-temporal standard error of monthly food consumption σ_i for household i in Equation (5).

5.2 A Profile of Vulnerability to Food Inadequacy in Timor-Leste

Based on the estimation results for mean (Table 6, column 1) and the above estimated standard error we can compute the level of vulnerability to food inadequacy for each household. A household is then considered vulnerable to food poverty if its vulnerability level exceeds some threshold; in our case this is, following Chaudhuri (2003) and Chaudhuri *et al.* (2002), 0.5. We then conducted a vulnerability profile for Timor-Leste, focusing on the distribution of vulnerability by education of household head.

First, Table 7 presents vulnerability to food inadequacy by region. The distribution of households who are vulnerable to food adequacy across the regions is approximately the

Table 7. Vulnerability to food inadequacy by region

	Headcount index		Contribution to total	
	Index	Standard error	%	Standard error
Dili/Baucau	13.2	1.7	6.5	0.3
Other urban	21.7	2.6	10.5	0.3
Rural centre	25.1	2.0	43.0	2.7
Rural east	14.3	2.0	15.1	2.0
Rural west	28.2	3.0	25.0	2.5
Urban	17.4	1.5	17.0	0.4
Rural	22.8	1.3	83.0	0.4

Note: Results are corrected for the effect of stratification and sampling weights.
Source: 2001 TLSS.

Table 8. Vulnerability to food inadequacy by household head's education

	Observed rate of food poverty	Rate of vulnerability to food poverty
No school/lower primary	27.5	33.8
Upper primary	33.8	18.4
Junior primary	29.7	14.0
Senior primary	21.6	2.2
University/academia	9.9	0.0
Overall:	32.1	21.6

Note: Results are corrected for the effect of stratification and sampling weights.

Source: 2001 TLSS.

same as the observed incidence of food poverty in Table 3, except that rural west is the most vulnerable region and the rural centre is observed to be the poorest.

We then consider the distribution of vulnerability by education of household head. It is clear from Table 8 that the distribution of vulnerability to food inadequacy over the education of the household head is more significant than that to observed food poverty. For example, of the population living in households with heads with degrees from university or other academic institutions, 9.9% are observed to be inadequate in food but none is expected not to have enough food in the future. At the same time, of the population living in households with heads who did not go to school or finished only with lower primary school, 27.5% are observed not to be undernourished but up to 33.8% are expected to have inadequate food. In general, the less education the household head obtained, the higher the level of vulnerability to food inadequacy the household faces.

5.3 Determinants of Volatility of Food Consumption

To understand the role of education in reducing the volatility of food consumption, we ran a regression of standard error of log food consumption on indicator variables for education and some observable control variables. The selection of control variables is the same as in the model for food consumption (Table 6, column 1). The estimation results using OLS are reported in Table 9, column 1. In general, the model performs well. The goodness-of-fit measure, R^2 , is 0.30, sufficiently high for models using cross-sectional data. In addition, coefficients of many of the control variables have the expected sign and are statistically significant. We now turn to a brief discussion of the empirical findings.¹⁰

It is not clear whether living in an urban or rural area is associated with higher volatility of food consumption. The results show that large household size significantly increases volatility of food consumption, *ceteris paribus*. This can be explained by the fact that the larger the household size, the harder it is for the household to cope with temporary food shortages.¹¹ However, this effect weakens with household size because the coefficient on (average) household size squared is negative and significant. We did not find any significant association between the age or gender of the household head and volatility of food consumption. However, the occupation of the household head has a significant effect on food consumption volatility: food consumption volatility is lower for households with heads who are working as house workers or farmers, but higher for households with heads who are working as traders.

As expected, assets are negatively associated with the volatility of food consumption. It can be seen from Table 9 that having savings significantly reduces food consumption

Table 9. Estimates of standard error of log real per capita food consumption

Variables	SE of log of real pc monthly food	
	(1)	(2)
<i>Region</i>		
Dili/Baucau	− 0.035*** (0.004)	− 0.036*** (0.004)
Other urban	0.012*** (0.003)	0.012*** (0.003)
Rural centre	− 0.001 (0.002)	− 0.001 (0.002)
Rural east	− 0.013*** (0.003)	− 0.013*** (0.003)
<i>Demographics</i>		
Household size	0.004*** (0.002)	0.005*** (0.002)
Household size squared	− 0.000** (0.000)	− 0.000** (0.000)
Number of persons under age 6	0.000 (0.000)	0.000 (0.000)
<i>Head</i>		
Male	− 0.003 (0.003)	− 0.004 (0.003)
Age (years)	− 0.000 (0.000)	− 0.000 (0.000)
Age square	0.000 (0.000)	0.000 (0.000)
<i>Head's education</i>		
Upper primary	− 0.003 (0.003)	—
Junior primary	− 0.005 (0.004)	—
Senior primary	− 0.007** (0.003)	—
University/academia	− 0.029*** (0.008)	—
Real pc monthly expenditure on education (1000 rupiahs)	—	− 0.000*** (0.000)
<i>Head's occupation</i>		
House worker	− 0.232** (0.094)	0.005 (0.006)
Farmer	− 0.116*** (0.043)	0.012*** (0.003)
Non-farm worker	− 0.045 (0.115)	0.009 (0.008)
Trader	0.155** (0.061)	0.000 (0.006)
Teacher/civil servant	0.036 (0.070)	− 0.008 (0.006)
<i>Housing</i>		
Dwelling is owned by household head	− 0.005 (0.004)	− 0.007* (0.004)
Number of years living in the dwelling	− 0.000 (0.000)	− 0.000 (0.000)

Table 9. Continued

Variables	SE of log of real pc monthly food	
	(1)	(2)
Kilometres to <i>aldeia</i> centre	− 0.000** (0.000)	− 0.000** (0.000)
Safe drinking water (tap or bottled)	0.003* (0.002)	0.003* (0.002)
Electricity is main source of lighting	− 0.015*** (0.003)	− 0.016*** (0.003)
<i>Assets</i>		
Holding land (hectares)	− 0.000 (0.000)	− 0.000 (0.000)
Savings (1000US\$)	− 0.000* (0.000)	− 0.000 (0.000)
Constant	0.090*** (0.010)	0.084*** (0.010)
Observations	1800	1800
R-squared	0.295	0.293

Note: Standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

volatility. However, no significant evidence was found that holding land is associated with volatility of food consumption.

After controlling for the region, demographic, education, occupation, housing and assets factors, the dummies for education of household head have negative coefficients, of which dummies for senior primary and university/academia have significant effects. The results also show that there is a significant gain from the education of the household head in reducing food consumption volatility.

One potential problem with estimating Equation (5) is that, as discussed earlier, the dummies measuring the educational qualification of household heads could be endogenous. It is possible that households who spend more on food also have more opportunity to obtain higher education. To address this problem, we again use an instrumental variable, which is correlated to education indicators but independent from food consumption. The variable used is of household's monthly real expenditure on education. Figure 3 shows that there is no evidence of correlation between expenditure on food and education. The results show that households with higher expenditure on education have higher food consumption per capita (Table 6, column 2). The results once again support our hypothesis that investing in upper primary and tertiary education will raise food consumption.

6. Conclusion

Our paper supports the argument that education, particularly at higher levels,¹² can help reduce the risk of food inadequacy faced by households. Thus, spending on these forms of education can provide a form of support that favours the poor. This is an especially

relevant finding in Timor-Leste, in part because the existing education system is underdeveloped. We have used a simple empirical measurement to estimate vulnerability to food inadequacy from cross-section data in the 2001 Timor-Leste Living Standard Measurement Survey. This measurement is based on the assumption that households are all exposed to the same kind of shock. We found that the distribution of vulnerability to food inadequacy is more significantly related to the education of the household head than to observed food poverty. Although this approach cannot capture all dimensions of vulnerability, it at least begins to raise the concern that vulnerability should be considered alongside poverty from a policy perspective.

Notes

- ¹ Luttmer (2002) also discussed measurement error in well-being and used two other indicators of such well-being: income and subjective answers.
- ² See Ligon & Schechter (2003) for another approach where vulnerability is considered as expected utility. This approach is suitable only for countries where panel data are available. See also Christiansen & Subbarao (2005), Christiansen & Boisvert (2002) and Scarmozzino (2006).
- ³ Otherwise, it may be necessary to use the pseudomaximum likelihood estimation, to take into account effects of clustering, which can be implemented by using "svy-intreg" in STATA (Gibson & Rozelle, 2003).
- ⁴ Or has a lower calorie intake than the minimum requirement as per the Timor-Leste Living Standards Measurement Survey.
- ⁵ The food poverty line is defined as the minimum expenditure needed to buy 2100 calories per person per day.
- ⁶ But, allowing for economies of scale can alter this basic correlation. However, there remains debate over how to measure these economies. Lanjouw & Ravallion (1995) indicate that the correlation between household size and poverty vanishes, in the case of Pakistan, when the size elasticity of the cost of living is 0.6. Anand & Morduch (1999) provide a succinct summary of analysis of the relationship between poverty and population.
- ⁷ It is difficult to gauge causality in cross-section data. To see the importance of the education variable we estimated the model (as in Table 6) without this variable. We also estimated the same model without the educational dummy variables. The signs and significance of the variables are largely unchanged, however the magnitudes are smaller and the fit of the equation is marginally poorer. These results are not reported here to conserve space.
- ⁸ We could have used the alternative threshold mentioned. This would have raised the proportion of the vulnerable but would not have the advantage that if a household is just at the poverty line and expects a mean zero shock it has vulnerability to poverty of 0.5 (Pritchett *et al.* 2000). We modelled vulnerability using both thresholds but do not include the results for lack of space. These results are available on request.
- ⁹ It should be noted that household responses are elicited from a particular individual within the household, rather than the household. As such, responses from wives may differ from those of husbands. Further, respondents may have different views on how food is shared within the household. Moreover, individual responses may themselves depend on who is conducting the interview. Thus, the results of the analysis undertaken may be sensitive to who responds and who conducts the interview. For more details, see Dercon (2004, 2005), Dercon *et al.* (2005) and Harrower & Hoddinott (2005). We are grateful to an anonymous referee for pointing out this argument and literature to us.
- ¹⁰ As in the case of Table 6, we proceeded to investigate the importance of the education variable by estimating a model (as in Table 9) without this variable. We also estimated the same model without the educational dummy variables. The signs and significance of the variables are largely unchanged, however the magnitudes are smaller and the fit of the equation is marginally poorer. These results are not reported here to conserve space.
- ¹¹ See World Bank (2003a) for methods of coping with food shortages in Timor-Leste.
- ¹² A similar result has been found by Jha *et al.* (2007) for the case of poverty in India.

References

- Anand, S. & Morduch, J. (1999) Poverty and the population problem, in: M. Livi-Bacci & G. De Santis (Eds) *Population and Poverty in Developing Countries* (Oxford: Oxford University Press), pp. 9–24.
- Chaudhuri, S. (2003) Assessing vulnerability to poverty: concepts, empirical methods and illustrative examples. Mimeo, Columbia University, Economics Department.
- Chaudhuri, S., Jalan, J. & Suryahadi, A. (2002) Assessing Household Vulnerability to Poverty from Cross-sectional Data: A Methodology and Estimates from Indonesia, *Economics Department Discussion Papers*, V. 0102-52.
- Christiaensen, L. & Subbarao, K. (2005) Towards an understanding of household vulnerability in rural Kenya, *Journal of African Economies*, 14, pp. 520–558.
- Christiaensen, L. J. & Boisvert, R. N. (2002) On Measuring Household Food Vulnerability: Case Evidence from Northern Mali, *Working Paper*, Cornell University.
- Dercon, S. (2004) *Insurance against Poverty* (Oxford: Oxford University Press).
- Dercon, S. (2005) Vulnerability: a micro perspective. Mimeo, Oxford University, available at: http://www.fasid.or.jp/kaisai/080,807/material_1.pdf (accessed 18 December 2011).
- Dercon, S., Hoddinott, J. & Woldehanna, T. (2005) Shocks and consumption in 15 Ethiopian villages 1999–2004, *Journal of African Economies*, 14(4), pp. 559–585.
- Gibson, J. & Rozelle, S. (2003) Poverty and access to roads in Papua New Guinea, *Economic Development and Cultural Change*, 52(1), pp. 159–185.
- Glewwe, P. (2007) Measurement error bias in estimates of income growth amongst the poor, *Economic Development and Cultural Change*, 56(1), pp. 163–187.
- Harrower, S. & Hoddinott, J. (2005) Consumption smoothing in the Zone Lacustre, Mali, *Journal of African Economies*, 14(4), pp. 489–519.
- Holzmann, R. & Jørgensen, S. (2001) Social risk management: a new conceptual framework for social protection, and beyond, *International Tax and Public Finance*, 8, pp. 529–556.
- Jha, R., Biswal, B. & Biswal, U. (2007) An empirical analysis of the impact of public expenditures on education and health in Indian states, in: A. Tavidze (Ed.) *Global Economics: New Research* (New York: Nova Science), pp. 129–147.
- Jha, R., Dang, T. & Tashrifov, Y. (2010) Economic vulnerability and poverty in Tajikistan, *Economic Change and Restructuring*, 43(1), pp. 95–112.
- Lanjouw, P. & Ravallion, M. (1995) Poverty and household size, *The Economic Journal*, 105(433), pp. 1415–1434.
- Ligon, E. & Schechter, L. (2003) Measuring vulnerability, *The Economic Journal*, 113(486), pp. C95–C102.
- Luttmer, E. P. (2002) Measuring poverty dynamics: disentangling real events from noisy data. Mimeo, University of Chicago.
- Pritchett, L., Suryahadi, A. & Sumarto, S. (2000) Quantifying Vulnerability to Poverty: A proposed Measure with Application to Indonesia, *SMERU Working Paper*.
- Scaramozzino, P. (2006) Measuring Vulnerability to Food Insecurity, *ESA Working Paper*.
- World Bank (2001) Timor-Leste Living Standard Measurement Survey (Washington, DC: World Bank).
- World Bank (2003a) *Poverty in a New Nation: Analysis for Action (Poverty Assessment)*, Vol. 1 (Washington, DC: World Bank).
- World Bank (2003b) *Poverty in a New Nation: Analysis for Action (Poverty Assessment)*, Vol. 2 (Washington, DC: World Bank).
- World Bank (2005) Timor-Leste Living Standards Measurement Survey: Basic Information Document, unpublished.
- Wu, B. K. (2003) The pre-existing conditions, education and poverty, *Poverty in a New Nation: Analysis for Action (Poverty Assessment)*, Vol. 2 (Washington, DC: World Bank).