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The Arndt-Corden Division of Economics
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Abstract

This paper uses a simple empirical approach to estimate vulnerability to food inadequacy using a 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. We find that the distribution of vulnerability to food inadequacy over education of household head is more significant than that of observed food poverty. Our results support the argument that senior primary and tertiary education can help reduce the food risk that households face, i.e., the risk that a household is undernourished. Thus, public spending on these forms of education can provide a form of buoy that favors the poor in Timor-Leste.

Keywords: Poverty, Vulnerability, Cross-section data, Timor-Leste

JEL codes: C21, C23, I32, O57

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I. Introduction

Whereas 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 (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 by studying the effect of education on food poverty. 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 after such widespread destruction, the school system was largely rebuilt (Wu, 2003).

In this paper, our first goal is to understand how education can play a role in reducing food poverty. Here, we conceive of food consumption as a measure of economic well-being to address the concern that total consumption may rise above the poverty threshold in the short-term due to sporadic purchase of durables or other lumpy goods (Luttmer, 2002).[1]

Traditionally anti-poverty policy was only concerned 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 just 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 is adequate in food today but can become inadequate in the future because of shocks like disease, job loss, or natural disasters. Especially in Timor-Leste, food security is a concern 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 the concept of vulnerability to food inadequacy and consider the role of education in reducing that vulnerability. According to Holzmann and Jørgensen (2001), poverty and vulnerability are closely related concepts due to two

[1] Luttmer (2002) also discussed measurements error in well-being and used two other indicators of such well-being: income and subjective answers.

established facts: (i) the poor are typically most exposed to diverse risks, and (ii) the poor have the fewest instruments to deal with these risks.

Conceptually, studies differ in their definitions of vulnerability, partly due to the limitation 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 can directly estimate the probability distribution of the household's food consumption. However, panel data are typically not available, especially in developing countries like Timor-Leste. In practice, cross-sectional data can be used to estimate the inter-temporal variance by assuming homoskedasticity (Gibson and Rozelle, 2003) or allowing heteroskedasticity with the variance depending on some observable household characteristics, like 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 *overtime* for each household, ruling out the possibility that most parts of Timor-Leste face large fluctuation in food availability. This paper relaxes this assumption by calibrating the food consumption for each month over the year by using information about a subjective answer. This helps us 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 of education policies in overcoming food poverty in Timor-Leste.

The plan of the paper is as follows. Section II discusses the data and measurement of food poverty. Section III briefly discusses the recent situation of poverty and education in Timor-Leste. Section IV discusses determinants of food poverty in Timor-Leste. Section V analysis vulnerability to food inadequacy and section VI concludes the paper. To the best of our knowledge, this is the first analysis the role of education in reducing food poverty and vulnerability to food inadequacy in Timor-Leste.

[2] See Ligon and Schechter (2003) for another approach where vulnerability is considered as expected utility. This approach is only suitable for countries where panel data is available. See also Christiansen and Subbarao (2005), Christiansen and Boisvert (2002) and Scarmozzino (2006).

II. 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 diagnose the extent, nature and causes of poverty. It assembles information on household demographics, housing and assets, household expenditures and some components of income, agriculture, labor market data, basic health and education, subjective perceptions of poverty and social capital.

The TLSS has a sample size of 1,800 households from 100 susos (villages), or about one% of the total number of households in Timor-Leste. It covers three areas: the Major Urban Centers (Dili and Baucau), the Other Urban Centers and the Rural Areas. Within rural areas it covers three broad geographic regions (West, Center 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 Centers (378 in Dili and 72 in Bacau), 252 households in the Other Urban Centers and 1,098 households in the 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: 4 in Urban Baucau, 14 in Other Urban Centers and 61 in the Rural Areas. In the second stage, 3 aldeias (loosely localities) in each suco were selected, again with probability proportional to size. In the third stage, 6 households were selected in each aldeia with equal probability. This implies that the sample is approximately *self weighted* within the stratum[3] (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 minimum food-energy requirement. The survey followed common practice in East Asia and used as basic nutritional requirement 2100 calories per person per day. The survey defined the food bundle that yields this level of nutrition by looking at the prevailing consumption patterns. Following standard convention, the survey excluded alcoholic drinks, tobacco and betel, and residual sub-categories 'other'. For a poverty line, the survey obtained 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% in the case of the lower

[3] Otherwise, it may be necessary to use the pseudomaximum likelihood estimation, to taking into account effect of clustering, which can be implemented by using 'svy-intreg' in STATA (Gibson and Rozelle, 2003).

poverty line and 70% in the case of the upper poverty line. In this paper we use the upper poverty line. Correspondently, the food poverty line is US$10.8 per month per person. The food share accounts for 70% of the poverty line. With this poverty line, we estimate that 32.5% of the population is poor and that 32.1% of the population is undernourished.

III. Food poverty and education in Timor-Leste

On October 19, 1999, Indonesia's parliament voted to confirm the results of the referendum in Timor-Leste of August 30, 1999, which rejected autonomy under Indonesia and favored 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 massive 3.2% per year (Table 1).

Table 1: Timor-Leste's data profile

	2000	2005	2007	2008
Population and area				
Population, total (millions)	0.82	0.99	1.06	1.10
Population growth (annual %)	0.5	4.2	3.4	3.2
Surface area (sq. 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	1,520	2,460
GNI per capita, PPP (current international $)	790	1,490	3,110	4,690
People				
Life expectancy at birth, total (years)	56	60	61	61
Fertility rate, total (births per woman)	7.0	6.7	6.5	..
Mortality rate, under-5 (per 1,000)	129	105	97	..
Primary completion rate, total (% of relevant age group)	..	..	69	..
Economy				
GDP (current US$) (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	..

Source: World Development Indicators database, September 2009

* Our estimation from 2001 TLSS

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 export, public expenditure and aid. Table 2 shows that, following the 1999 referendum,

public expenditure grew rapidly from 39% in 1999 to 57% of non-oil GDP in 2000 and remained high for the following years. Table 2 also notes that donor programs sponsored about 70% of total public expenditures. It turns out that the non-oil GDP growth was driven by donor programs. The cut in aid after 2002 was followed by a significant contraction. The increase in the rate of poverty between 2001 and 2004 was, in turn, a consequence of poor growth performance.

Table 2: Public expenditure in non-oil GDP in Timor-Leste, 2000–2005

	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 programs:						
• - 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.

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

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

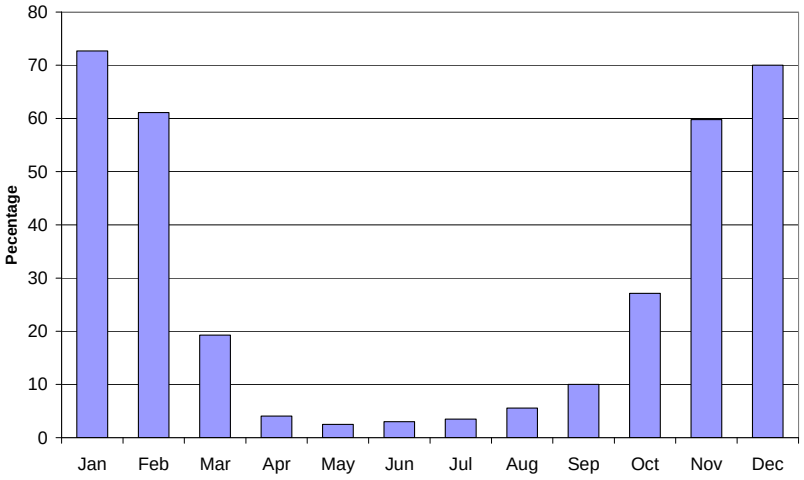
	Head count index		Contribution to total	
	Index	standard error	%	standard error
Dili/Baucau	29.2	2.3	9.7	0.3
Other urban	28.0	2.9	9.1	0.3
Rural center	36.0	2.2	41.4	2.2
Rural east	26.8	2.4	19.1	1.8
Rural west	34.8	3.2	20.7	2.0
Urban	28.6	1.8	18.8	0.4
Rural	33.1	1.5	81.2	0.4

Source: 2001 TLSS

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

Timor-Leste faces not only food inadequacy but also vulnerability to food inadequacy. Figure 1 illustrates the large fluctuation in food availability in Timor-Leste though 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 in number of months with food inadequacy between rural and urban areas are significant. For example, on average, households in Dili/Baucau experienced 1.8 months a year with food inadequacy, compared to roughly 4 months in rural areas. This again raises concern about food insecurity that the population is exposed to.

Figure 1: Food inadequacy by month



Source: 2001 TLSS

Table 4: Vulnerability to food requirement by region

	Less than adequate (# months)	Just adequate (# months)	More than adequate (# 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 center	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)

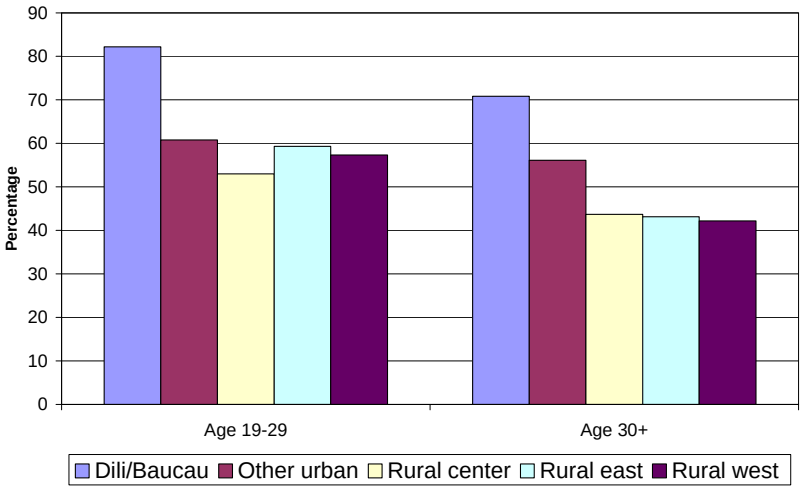
Source: 2001 TLSS

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

Inadequate education may be one of the proximate causes of the 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 year age group and 40% of those who are 30 and above have not ever attended school, in comparison with Dilli/Baucau and the other urban areas where 82% and 61%, respectively, of the population attended school.

Figure 2: Ever attended school by age and region



Source: 2001 TLSS

IV. Determinants of food poverty in Timor-Leste

Model specification

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

- *Regions*: indicator variables for Dili/Baucau, Other Urban, Rural Center, Rural East
- *Household demographics*: household size (number of household members), household size squared, number of members under 6.
- *Head characteristics*: age, age squared, gender, education, occupation
- *Assets:* land holding and savings
- *Housing:* house ownership; availability of, i) safe water to drink, ii) electricity; number of years lived in the dwelling, distance to the center.
- *Access:* distance to aledaie center

Table 5 provides some descriptive statistics on these variables.

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

	Mean	Std. Dev.	Min	Max
Log of real per capita monthly food expenditure	0.077	0.044	0	0.147
Region				
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
Demographics				
Household size	5.063	2.513	1	19
Household size squared	31.945	31.981	1	361
Number of persons under 6 age	5.063	2.513	1	19
Head				
Male	0.359	0	1	0.359
Age (years)	13.860	16	99	13.860
Age square	1346.731	256	9801	1346.731
Head's education				
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 pc monthly expend. on education (1000 rupiahs)	1.692925	6.925874	0	139.6407
Head's occupation				
Houseworker	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
Housing				
Dwelling is owned by hh	0.302	1	2	0.302
Number of years living in the dwelling	8.111	0	80.16666	8.111
Kms to aledeia 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
Assets				
Holding land (hectares)	3.032	0	100	3.032
Savings (1000US$)	2.644	0	100.2	2.644

Results from the food consumption estimation

The results of the basic model of food consumption estimated using 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 coefficients of control variables have the expected sign and are statistically significant.

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

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

After controlling for the region, demographic, education, occupation, housing and assets factors, the dummies for education of household head have positive coefficients, of which dummies for senior primary and university/academia level education have significant effects. It implies that there are significant gains from senior primary and tertiary education of the household head.

Robustness check

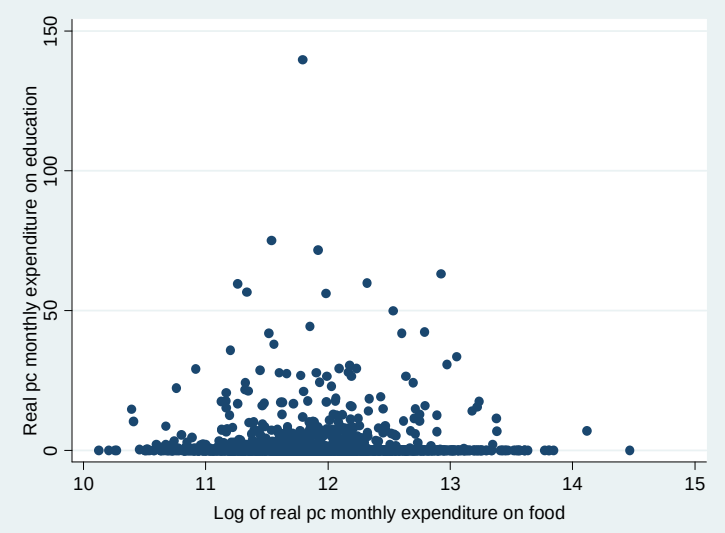
One potential problem with estimating equation (1) is that the dummies measuring education qualification of household heads could be endogenous. It is possible that the households who spend more on food expenditure also have more opportunity to obtain higher education. To address this problem we can use an instrumental variable which is correlated to education indicators but independent of food consumption. The variable used in this paper is household's monthly real expenditure on education, also available in the survey. 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 improving education will raise food consumption.

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)
Region	Dili/Baucau	0.002	0.011	0.009
		(0.056)	(0.055)	(0.055)
	Other urban	0.006	0.007	0.017
		(0.041)	(0.041)	(0.040)
	Rural center	0.076**	0.076**	0.097***
		(0.037)	(0.038)	(0.037)
	Rural east	0.085*	0.085**	0.105**
		(0.043)	(0.043)	(0.043)
Demographics	Household size	-0.312***	-0.316***	-0.311***
		(0.021)	(0.021)	(0.020)
	Household size squared	0.016***	0.016***	0.016***
		(0.002)	(0.002)	(0.002)
	Number of persons under age 6	0.000	0.000	0.000
		(0.000)	(0.000)	(0.000)
Head	Male	0.108***	0.130***	0.081**
		(0.040)	(0.039)	(0.040)
	Age (years)	0.018***	0.014**	0.017***
		(0.006)	(0.006)	(0.006)
	Age square	-0.000***	-0.000***	-0.000***
		(0.000)	(0.000)	(0.000)
Head's education	Upper primary	0.056	-	0.035
		(0.043)	-	(0.042)
	Junior primary	0.074	-	0.056
		(0.054)	-	(0.055)
	Senior primary	0.138***	-	0.119**
		(0.052)	-	(0.050)
	University/Academia	0.272***	-	0.228**
		(0.104)	-	(0.103)
	Real pc monthly expend. on education (1000 rupiahs)	-	0.004*	-
		-	(0.002)	-
Head's occupation	Houseworker	-0.232**	-0.241**	-0.220**
		(0.094)	(0.094)	(0.092)
	Farmer	-0.116***	-0.132***	-0.108**
		(0.043)	(0.043)	(0.042)
	Non-farm worker	-0.045	-0.054	-0.061
		(0.115)	(0.117)	(0.119)
	Trader	0.155**	0.155**	0.143**
		(0.061)	(0.062)	(0.060)
	Teacher/civil servant	0.036	0.109	0.005
		(0.070)	(0.069)	(0.069)
Housing	Dwelling is owned by hh	-0.054	-0.036	-0.050
		(0.045)	(0.044)	(0.045)
	Number of years living in the dwelling	0.006***	0.005***	0.005***
		(0.002)	(0.002)	(0.002)
	Kms to aldeia center	0.009***	0.009***	0.010***
		(0.002)	(0.002)	(0.002)
	Safe drinking water (tap or bottled)	-0.014	-0.008	-0.017
		(0.028)	(0.028)	(0.027)
	Electricity is main source of lighting	0.158***	0.175***	0.138***
		(0.039)	(0.039)	(0.039)
Assets	Holding land (hectares)	0.029**	0.029**	0.029**
		(0.013)	(0.014)	(0.013)
	Savings (1000US$)	0.013	0.013	0.010
		(0.011)	(0.012)	(0.011)
	Constant	12.428***	12.549***	12.546***
		(0.163)	(0.153)	(0.160)
	Observations	1800	1800	1800
	R-squared	0.327	0.324	0.339

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

Figure 3: Scatter plot of expenditure on food and education



V. Vulnerability to food inadequacy in Timor-Leste

Empirical strategy toward measuring vulnerability

As expected poverty, vulnerability to food inadequacy is the risk that a household (or individual) will, if currently having enough food, be inadequate in food, or if currently being inadequate in food, will remain inadequate in food or fall deeper into under-nutrition. Thus, vulnerability to food inadequacy of household (or individual) i at time t is defined by

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

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 remain the same across time the vulnerability (to food poverty) of household i can be defined as

$$VEP^i = \Pr(c^i \le z)$$

which is independent of time t, or

$$VEP^i = \int_0^z f_i(c_i)\mathrm{d}c_i$$

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 advantage[4] 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 proven to be a good approximation in a wide variety of settings is that consumption follows a lognormal distribution (see Glewwe, 2007; Gibson and Rozelle, 2003):

$$\ln c \sim N(\zeta, \sigma^2)$$

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

$$VEP^i = \Phi\left(\frac{\ln z - \zeta_i}{\sigma_i}\right) \quad (1)$$

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

In practice, cross-sectional data can also be used to estimate conditional mean and the inter-temporal variance by assuming homoskedasticity (Gibson and Rozelle, 2003). However, the homoskedasticity assumption rules out the possibility that different households face different volatilities of consumption. Hence, Chaudhuri et al. (2002) allowed heteroskedasticity and the variance to depend on some observable household characteristics, like conditional mean. The resulting estimation is based on the assumption that idiosyncratic shocks to consumption are identical *overtime* for each household. The assumption seems quite restrictive, especially since most parts of Timor-Leste face large fluctuation in food availability (World Bank 2003b).

[4] We could have used the alternate threshold mentioned. This would have raised the proportion of the vulnerable but would not have the advantage mentioned below. We have modelled vulnerability as per alternate thresholds but do not include the results for lack of space. These results are available upon request.

In this paper we try to take into account the information about household's capacity to keep food consumption constant over the year. This information is revealed in the survey in the Section on Subjective Wellbeing. 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 twelve months. We assume that the subjective wellbeing answer can be a proxy for idiosyncratic shocks to household's food consumption. More specifically, the shock will take value 0 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 to 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). Afterward, the consumption can be predicted for each month of the year to obtain a series of monthly food consumption over the year for each household. From these series we will estimate inter-temporal standard error of month food consumption σ_i for household i in Eq. (1).

A profile of vulnerability to food inadequacy in Timor-Leste

Based on the estimation results for mean (Table 6, col. 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, 2002), 0.5. We then conduct a vulnerability profile for Timor-Leste, focusing distribution of the vulnerability by education of household head.

Firstly, Table 7 presents vulnerability to food inadequacy by region. The distribution of households who are vulnerable to food requirement across the regions is approximately the same as the observed incidence of food poverty in Table 3, except that rural west is the most vulnerable region and the rural center 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 education of household head is more significant than that of observed food poverty. For example, of the population living in households with heads with degrees of university or academia, 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% 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.

Table 7: Vulnerability to food inadequacy by region

	Head count 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 center	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

Source: 2001 TLSS

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

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

Source: 2001 TLSS

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

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. Selection of control variables is the same as in the model for food consumption (Table 6, col.1). The estimation results using OLS are reported in (Table 9, col.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 control variables have the expected sign and are statistically significant. We now turn to a brief discussion of the empirical findings.

It is not clear whether living in 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 for the household to cope with temporary food shortage.[5] However, this positive effect weakens with household size because the coefficient on (average) household size squared is negative and significant. We do not find any significant association between age or gender of the household head with volatility of food consumption. However, the occupation of 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 associated with the volatility of food consumption. It can be seen from Table 9 that savings significantly reduces food consumption volatility. However, we don't find any significant evidence 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 a significant gain from education of the household head in reducing the food consumption volatility.

One potential problem with estimating equation (1) is that the dummies measuring education qualification of household heads could be endogenous. It is possible that households who spend more on food expenditure 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 from food consumption. The variable used is household's monthly real expenditure on education also available in the survey. 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, col. 2). The results once again support our hypothesis that investing in upper primary and tertiary education will raise food consumption.

[5] See World Bank (2003a) for methods to cope with food shortage in Timor-Leste.

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

VARIABLES		SE of log of real pc monthly food	
		(1)	(2)
Region	Dili/Baucau	-0.035***	-0.036***
		(0.004)	(0.004)
	Other urban	0.012***	0.012***
		(0.003)	(0.003)
	Rural center	-0.001	-0.001
		(0.002)	(0.002)
	Rural east	-0.013***	-0.013***
		(0.003)	(0.003)
Demographics	Household size	0.004***	0.005***
		(0.002)	(0.002)
	Household size squared	-0.000**	-0.000**
		(0.000)	(0.000)
	Number of persons under 6 age	0.000	0.000
		(0.000)	(0.000)
Head	Male	-0.003	-0.004
		(0.003)	(0.003)
	Age (years)	-0.000	-0.000
		(0.000)	(0.000)
	Age square	0.000	0.000
		(0.000)	(0.000)
Head's education	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 expend. on education (1000 rupiahs)	-	-0.000***
		-	(0.000)
Head's occupation	Houseworker	-0.232**	0.005
		(0.094)	(0.006)
	Farmer	-0.116***	0.012***
		(0.043)	(0.003)
	Non-farm worker	-0.045	0.009
		(0.115)	(0.008)
	Trader	0.155**	0.000
		(0.061)	(0.006)
	Teacher/civil servant	0.036	-0.008
		(0.070)	(0.006)
Housing	Dwelling is owned by hh	-0.005	-0.007*
		(0.004)	(0.004)
	Number of years living in the dwelling	-0.000	-0.000
		(0.000)	(0.000)
	Kms to aldela center	-0.000**	-0.000**
		(0.000)	(0.000)
	Safe drinking water (tap or bottled)	0.003*	0.003*
		(0.002)	(0.002)
	Electricity is main source of lighting	-0.015***	-0.016***
		(0.003)	(0.003)
Assets	Holding land (hectares)	-0.000	-0.000
		(0.000)	(0.000)
	Savings (1000US$)	-0.000*	-0.000
		(0.000)	(0.000)
	Constant	0.090***	0.084***
		(0.010)	(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

VI. Conclusion

Our paper supports the argument that education, particularly at higher levels,[6] can help reduce the risk of food inadequacy faced by households. Thus, spending on these forms of education can provide a form of buoy that favors the poor. This is an especially relevant finding in Timor-Leste, in part because the existing education system is underdeveloped since gaining independence. We used a simple empirical measurement that allows estimating the vulnerability to food inadequacy from a cross-section data in the 2001 Timor-Leste Living Standard Measurement Survey. This measurement is based on the assumption that households expose to the same kind of shock. We found that the distribution of vulnerability to food inadequacy over education of household head is more significant than that of observed food poverty. While this approach cannot capture all dimensions of vulnerability, it at least begins to raise the policy interest that vulnerability should be considered alongside poverty.

[6] A similar result has been found for the case of poverty in India by Jha et al. (2007).

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