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Are some groups more vulnerable to macroeconomic shocks than others? Hypothesis tests based on panel data from Peru

Paul Glewwe [a,*], Gillette Hall [b]

[a] *Policy Research Department, The World Bank, Washington, DC, USA*
[b] *International Studies Program, University of Oregon, Eugene, OR, USA*

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Abstract

Which socio-economic groups are most vulnerable to welfare declines during a macroeconomic shock? After clarifying the difference between poverty and vulnerability, this paper presents an analytical framework and applies it to panel data from Peru. Major findings are: (1) Households with better educated heads are less vulnerable; (2) Female headed households are no more vulnerable than male headed households; (3) Households with more children are more vulnerable; (4) Transfer networks that assist the poor in relatively stable periods do not protect them during a major shock, unless they originate from outside Peru; and (5) Peru's social security program is targeted neither to vulnerable nor to poor households, but other transfer programs are better targeted.

Keywords: Poverty; Vulnerability; Macroeconomic shocks; Education; Household transfers; Peru

1. Introduction

The 1980s were difficult years for most developing countries. Many experienced unexpected macroeconomic shocks, such as sharp drops in export prices and increased real interest rates, and in response adopted structural adjustment pro-

Abbreviations: O15; I32; D31; E65

* Corresponding author. Policy Research Department, The World Bank, 1818 H Street NW, Washington, DC 20433, USA. Fax: +1-202-522-1153; e-mail: pglewwe@worldbank.org.

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grams. Many observers claim that certain socio-economic groups are particularly vulnerable to shocks and adjustment programs (see Cornia et al., 1987 and World Bank, 1990 inter alia), yet there is very little research on who is vulnerable, or *why* they are vulnerable. Rigorous analyses are rare because they require at least two comparable cross-sectional household surveys, which many developing countries, particularly those whose economies have performed poorly, do not have. Panel data, which provide added advantages, are rarest of all.

Peru is one developing country that has household level panel data that span a recent macroeconomic shock. Peru implemented a 'heterodox' adjustment program from 1985 to 1990. This program led to a shock that hit Peruvian households hard; by 1990 GNP per capita had dropped a stunning 30%, while real wages had declined by 50–70%. This paper uses a panel data set from Lima, Peru, for the years 1985–1986 and 1990, to test hypotheses regarding the vulnerability of different types of urban households to this shock.

The paper is organized as follows. Section 2 discusses the nature of vulnerability and presents hypotheses concerning which households are vulnerable. The next section focuses on Peru as a case study for analyzing vulnerability. Section 4 provides a formal framework for testing hypotheses on vulnerability, and Section 5 applies it to the Peruvian data. Section 6 summarizes the findings.

2. Vulnerable groups and poverty—clarifying the issues

Poverty concerns one's current socio-economic status, while vulnerability focuses on *changes* in socio-economic status. The poor are not necessarily vulnerable; for example, subsistence farmers in remote areas are usually poor but their relatively autarchic status limits the impact of national and international economic events. The literature on poverty and vulnerability focuses on the intersection, i.e., on groups that are already poor *and* more likely to experience larger than average declines in socio-economic status. Little concern is shown for non-poor households that may also be vulnerable.

2.1. The sequence of vulnerability

Vulnerability is a dynamic concept, involving a sequence of events after a macroeconomic shock. This is shown in Fig. 1. A household's standard of living before the shock is SL_0. The shock reduces it to SL_1. The shock has two components, an economic shock and a social services shock. The former includes: (a) declines in real household income (excluding government transfers); and (b) relative price changes, which may not affect households equally. Government responses to new macroeconomic realities yield a second shock: reductions in direct government provision of goods, services, and income transfers. Households

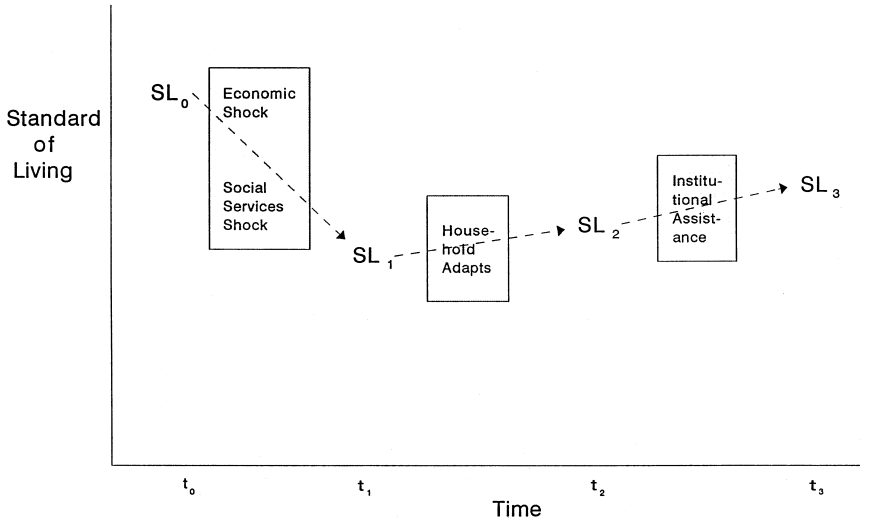

Fig. 1. Sequence of vulnerability.

adapt to these changes, raising their standard of living to SL_2. Finally, new forms of government assistance may arise for at least some households, raising their standard of living to SL_3. If the overall movement from SL_0 to SL_3 were similar across households, they would be equally vulnerable. Yet, at each step, households are affected differently, and thus overall vulnerability will vary across households.

2.2. Two types of vulnerability

Vulnerable groups may differ across countries, and over time in a given country. However, some groups may be vulnerable over a wide range of country experiences, and this is the type of vulnerability we wish to consider. Two types of vulnerability can be distinguished, one concerning specific changes in government programs and another, more general vulnerability to changes in socio-economic conditions, including inability to adapt to such changes. We call the first *policy-induced* vulnerability, and the second *market-induced* or 'robust' vulnerability. The latter affects the same groups in different countries; in market economies, certain groups are more likely to experience lower income (or increased income uncertainty) during a macroeconomic shock, or are less able to adapt so as to minimize income declines. Such 'robust' vulnerability reflects market forces that produce similar interactions between household characteristics and income earning ability (and the ability to adapt) in a rapidly changing economic environment. For example, older individuals tend to have more obsolete skills, and fewer (life-cycle) incentives to learn new ones; their incomes may decline more than average after a macroeconomic shock.

In contrast, policy-induced vulnerability reflects government decisions, which vary widely across countries and thus may not affect the same groups in different countries. Of course, similar structural adjustment policies across countries may produce the same 'vulnerable' groups in those countries. But these groups could be made 'invulnerable' by choosing different policies; there is no underlying economic phenomenon to investigate. This paper focuses on market-induced vulnerability, identifying those groups that are inherently vulnerable to the workings of a (rapidly changing) market economy. In terms of Fig. 1, the focus will be on: (1) vulnerability to economic (but not social services) shocks; and (2) the ability of households to adapt to and/or minimize these shocks.

Market-induced vulnerability can be measured by changes in household consumption of goods and services, after making two adjustments. [1] First, government transfers should be subtracted from consumption expenditures, since their impact on consumption will reflect policy-induced vulnerability. Second, household health and education expenditures should be excluded since they may reflect price and quality changes induced by new government policies, and thus reflect policy-induced vulnerability.

A *descriptive* analysis of market-induced vulnerability examines correlation between household characteristics and changes in living standards. For example, one could compare the average declines in income or consumption of male- and female-headed households. Yet such comparisons reveal little about *causes* of market-induced vulnerability. Suppose female-headed households suffer larger drops in income. This could occur if less educated workers experience greater drops in income than do well educated workers (since female household heads tend to be less educated than male heads), even if female headship per se does not cause vulnerability. Causal inferences regarding specific household characteristics cannot be drawn until one controls for other relevant household characteristics, which requires regression analysis of the (reduced form) determinants of changes in income or consumption.

One conceptual issue remains: what is a 'more than average' decline in a welfare indicator? One usually thinks in percentage terms—a group that suffers a 20% decline in some welfare indicator, when the average decline is only 15%, is more vulnerable. However, if that group is already relatively poor, it may be considered vulnerable even if its expenditures declined by less than 15%. More precisely, a household is more vulnerable if its *utility* declines (in percentage terms) by more than average. For poorer households, a greater than average decline in expenditures is not required if utility is a concave function of consump-

[1] Income data (excluding transfers received from the government) could also be used, but they present two disadvantages: (1) household survey income data, particularly self-employment income, may be unreliable; (2) income data may not capture changes in living standards caused by increased income instability if consumption declines in response to greater uncertainty (e.g., precautionary savings).

tion. Unfortunately, observed behavior reveals little about the shape of households' utility functions. Thus, in empirical work one should use both consumption expenditures and a concave function of consumption expenditures to check for robustness of results.

2.3. Hypotheses on who is vulnerable

Many assessments of structural adjustment programs express concern for vulnerable groups, but few specify who is vulnerable. For example, Cornia et al. (1987) is subtitled 'Protecting the Vulnerable and Promoting Growth', yet the authors (and many others, such as World Bank, 1990) do not clearly state which groups are vulnerable. They also tend to confuse vulnerability, a dynamic concept, with poverty, a static concept. We now present two lists culled from the literature on vulnerability: (1) reasons why some households may be more susceptible to economic shocks (movement from SL_0 to SL_1 in Fig. 1); and (2) strategies households may use to adapt to economic shocks so as to minimize their impact (from SL_1 to SL_2 in Fig. 1). We include only hypotheses for which we found, or could construct, a clear line of reasoning.

2.3.1. Why are some households more susceptible to economic shocks? [2]

- *Interdependence within the larger economy*. Most households' incomes are sensitive to regional, national and international economic conditions. In contrast, subsistence farmers and other relatively autarchic households are less affected by, and thus less vulnerable to, economic shocks.
- *Less diversified household income*. Just as diversifying investments enables one, conditional on some level of risk, to attain higher (expected) returns, households with several income sources, such as different occupations, can reduce their risk to major drops in income. Smaller households, with fewer working age members, are less able to diversify and thus more vulnerable.
- *Less stable employment*. Some workers may have less stable jobs because they are relatively less valuable to their firms, or because their firms suffer the brunt of a macroeconomic shock. Younger workers have little job-specific human capital, which firms value (and earn a monopsony profit on), and thus may be more likely to lose their jobs (see Becker, 1993). The construction, manufacturing and agricultural export sectors may be more sensitive to economic conditions; white collar occupations, including government employment, may be relatively stable.

[2] None of these hypotheses concern vulnerability to changes in relative prices. Economic forces could change relative prices in almost any direction, making it difficult to predict who is a priori vulnerable. Price changes induced by government actions imply policy-induced, not market-induced, vulnerability.

· *Reduced demand for lower level skills as technology changes*. It may be that long-run changes in technology are moving in favor of highly skilled individuals (Juhn et al., 1993), and that macroeconomic shocks produce discrete shifts in labor demand in this direction. This implies that less educated workers (those with fewer technological skills) are more susceptible to economic shocks.

2.3.2. Strategies households use to reduce the impact of economic shocks

· *Dissaving and selling physical assets*. Households hit by income shocks may adapt by drawing on savings or selling assets (Deaton, 1989). More assets and savings imply less vulnerability.

· *Increased labor force participation*. Households may increase labor force participation in response to economic shocks (World Bank, 1990). Thus, households with few employable members, or with members facing labor market discrimination (women, minorities), may be more vulnerable (Cornia et al., 1987).

· *Finding new jobs that use existing skills*. While higher job-specific work experience helps older workers keep their jobs, it adds little to productivity, and thus to wages, in new jobs. Conditional on losing one's job, older workers are less able to recoup their former wages in new jobs.

· *Receipt of inter-household transfers*. Households may soften income shocks by forming informal insurance arrangements (Alderman and Paxson, 1992). Also, chronically poor households may receive income transfers from relatives or friends living in better off households (Cox, 1987).

· *Use of credit for consumption purposes*. Households with access to credit (such as those with assets suitable as collateral) may absorb shocks by obtaining loans for consumption purposes.

· *Altering consumption patterns*. Some households may respond to shocks by spending more of their income on food, or substituting cheaper foods into their diets. This may be easier for better off households, since poorer households may already be doing so. This strategy involves *reallocation* of, as opposed to *changes* in, total expenditures. Because efforts to raise utility conditional on total expenditures are difficult to measure, we will not investigate this adaption mechanism. [3]

· *Directly producing consumption goods*. To maintain food consumption, rural households may turn to subsistence farming as other income sources decline. This is not viable in urban areas.

· *Schultz's education hypothesis*. Schultz (1975) argued that educated individuals adapt more easily as economic circumstances change, using assets more efficiently, obtaining better credit arrangements, and exploiting new income opportunities more quickly. This is distinct from increased returns to education; rather it involves the ability to adapt more quickly and effectively.

[3] We also ignore intra-household allocation of consumption, which may affect some household members (women, children) more than others. Unfortunately, our data provide no direct information on such intra-household allocations. For further discussion, see Haddad and Kanbur (1990).

Table 1
Characteristics of households and individuals and economic vulnerability

Characteristic	Effect on vulnerability	Reasoning
Rural residence	Reduces	Less interdependence; more able to produce for own consumption
Smaller households	Increases	Less income diversity
White collar employment	Reduces	More stable employment
Government employment	Reduces	Same as above
Blue collar employment	Increases	Less stable employment
High household assets	Reduces	Can draw down assets; can use to obtain credit
Women members	Increases	Limits increased labor force participation
Elderly members	Increases	Same as above
Infirm or handicapped individuals	Increases	Same as above
Children	Increases	Same as above
Minorities	Increases	Same as above
Households with diverse kinship networks	Reduces	Informal inter-household insurance; long-run obligations
Access to credit	Reduces	Borrow for consumption
More experienced (older) workers	Mixed	Less likely to lose job; More (job-specific) human capital is lost when job is lost
Higher education levels	Reduces	Favored by technology changes; adapt better

The above discussion is summarized in Table 1. All the hypotheses in Table 1 can be examined using the Peru data except: (1) the urban/rural hypothesis, since the 1990 data exclude rural areas; and (2) the minorities hypothesis, since we cannot identify households of Indian origin (information on the language of interview is of no use since almost all households speak Spanish).

3. Peru as a case study for analyzing vulnerability

Peru provides an excellent opportunity to examine vulnerability. It experienced a rapid economic decline in the late 1980s. More importantly, panel data exist to compare household welfare in 1985 and 1990. This section describes Peru's experience in the late 1980s, and the data available to analyze it. It also examines correlations between household characteristics and vulnerability.

Table 2
Basic indices of Peru's economy: 1980, 1985, and 1990

	1980	1985	1990
GDP per capita	100	87	70
Average real minimum wage, Lima	100	54	21
Consumer prices[a]	100	3474	40,216,592
Exports (US$)[b]	100	76	83
Net international reserves[c]	100	89	−13

[a] June of each year, through June 1, 1990.
[b] Estimated from data through September 1990.
[c] June of each year.

3.1. The Peruvian economy from 1985 to 1990

Table 2 presents basic economic data on Peru for 1980, 1985 and 1990. Peru's economy was already weak in the early 1980s. The APRA (Alianza Popular Revolucionaria Americana) party won the 1985 elections, promising to revive economic growth while protecting the poor. The new government immediately took radical steps to 'jump-start' the economy, breaking off World Bank and IMF negotiations and limiting international debt payments to 20% of foreign exchange earnings; funds from unpaid debts were channeled toward public consumption and government investment. These policies boosted economic growth in 1985 and 1986, but by 1988 the economy began to collapse; hyperinflation and recession forced Peru into a somewhat chaotic structural adjustment. Table 3 shows that consumption levels in Lima declined 54% from 1985 to 1990. Aggregate consumption fell furthest in the poorest deciles, while wealthier households were less affected (or better able to adapt). The government lost the 1990 election.

Table 3
Per capita consumption levels in Lima, Peru, 1985–1986 and 1990, by decile

Decile	1985–1986	1990	% Change
1	2258.6	848.9	−62.4
2	3181.1	1345.2	−57.7
3	3808.8	1731.9	−54.5
4	4386.9	2015.2	−54.1
5	5164.7	2349.7	−54.5
6	6098.9	2739.6	−55.1
7	7128.5	3218.5	−54.9
8	8669.9	3970.8	−54.2
9	11,451.5	5311.0	−53.6
10	25,657.8	11,796.0	−54.0
All Lima	7774.4	3531.7	−54.6

Source: Peru Living Standard Surveys 1985–1986 and 1990.
Note: Values are in thousands of June 1, 1990, Intis per month. For details see Glewwe and Hall (1994).

Table 4
Variation in economic vulnerability: transition matrix from 1985 to 1990

1985 Quintile	1990 Quintile				
	1	2	3	4	5
1	7.7%	4.4%	3.4%	2.6%	1.0%
2	4.4%	5.2%	4.0%	2.9%	1.7%
3	2.8%	4.3%	6.3%	4.7%	3.0%
4	1.0%	2.8%	4.7%	5.9%	5.5%
5	0.6%	1.8%	2.6%	5.9%	11.0%

Percentage on diagonal: 36.0%
Percentage that move by one quintile: 37.8%
Percentage that move by two or more quintiles: 26.2%

Table 4 shows that Peruvian households were not affected equally. Of 699 panel households, two thirds (64%) moved into a different quintile from 1985–1986 to 1990. Most striking, one fourth (26%) moved across two or more quintiles. Clearly, there were major differences in how hard Peruvian households were hit by the shock, and in their ability to adapt to it. [4] Table 5 shows that inter-household transfers among Peruvian households faltered in the late 1980s. While 36% of Lima residents received transfers in 1985–1986, only 18% did in 1990. Giving of transfers also declined, from 31 to 14%, and the real value of transfers dropped by more than 50%.

3.2. The Peru living standards surveys

Tables 3–12 are based on the 1985–1986 and 1990 Peru Living Standards Surveys. The latter survey was explicitly designed to be comparable to the former. For more information on these surveys see World Bank (1993).

Return visits in 1990 to the 1280 dwellings in Lima surveyed in 1985–1986 yielded panel data on 699 households, as seen in Table 6. In 1990, 1057 households were interviewed, of which 312 were dropped because all 1985 members were gone by 1990. Of the remaining 745, 93% had the same head in both years. For the other 7%, three outcomes were possible: (a) the household head changed, but the 1985 head was still a member in 1990; (b) the 1985–1986 head was absent in 1990, but the 1990 head was a member in 1985–1986; and (c) the 1985–1986 head was absent in 1990 and the 1990 head was absent in 1985–1986. For the first outcome, the 1985 head was treated as the head in both years, and the 1990 head was so treated for the second outcome. Twelve households of the third type, and 34 others with incomplete data, were dropped.

[4] This statement must be tempered. Random measurement errors may generate some of the movement between quintiles shown in Table 4. But if measurement error alone were the cause, these changes would display no pattern; the empirical work below demonstrates that this is not the case.

Table 5
Transfer networks in Lima, Peru in 1985 and 1990

	1985–1986	1990
I. Participation (% of population)		
Receive transfers	22.6%	14.2%
Give transfers	17.4	10.2
Give and receive	13.9	3.5
No participation	46.1	72.0
II. Size and Source of Transfers		
From within Lima	147.6	–
From other areas of Peru	133.3	–
From abroad	90.4	–
Total	371.6	173.7

(1) All values are in terms of June 1, 1990, thousands of Intis per capita per month.
(2) The 1990 data do not disaggregate total transfers by source.

We use consumption expenditures per capita to measure household welfare, for two reasons. First, income data are probably less reliable, particularly for households operating small businesses (a common phenomenon in Lima). Second, in 1990 inflation was extremely high, and the expenditure data are easier to deflate because they use the same reference period for all households (in contrast, most income data were collected by allowing respondents to choose a convenient reference period). We exclude health and education expenditures from consumption, as explained in Section 2.

Table 6
Panel households, 1990

Total number of dwellings in sample	1280
Address lost by 1990	20
Dwelling demolished/unoccupied/no longer private residence	83
Occupants refused interview/interview incomplete	101
Informant absent or speaks only foreign language	5
Dwellings with interviews	1032
Households interviewed	1057
Household occupied by same family in both years	745
1985–1986 Head not present in 1990, and 1990 head not present in 1985–1986	12
Households lacking complete consumption data	18
Households lacking complete parents of head data	13
Households with outlying consumption data	1
Households lacking data in education of head	2
Total number of households in working panel	699

3.3. Correlates of vulnerability

Testing whether a particular socio-economic characteristic is correlated with vulnerability is straightforward. We regress the (percentage) change in per capita consumption of each household separately on each household characteristic of interest, plus a constant term. We also examine whether, in 1985–1986, the same characteristics are correlated with lower living standards. Table 7 presents *t*-statistics from these regressions for all the hypotheses in Table 1 that can be tested using the PLSS data, in terms of both per capita and log per capita consumption.

Turn first to hypotheses about employment in particular economic sectors. As expected, employment of the head in government or white collar jobs (these two categories overlap somewhat) is negatively correlated with poverty, while blue collar employment is positively correlated. In contrast, no significant relationship emerges between these economic sectors and vulnerability.

To examine the hypothesis that households with more assets are less vulnerable, we examine two types of assets, small business capital and (monetary)

Table 7
Household characteristics correlated with poverty and vulnerability (*t*-statistics from single variable regressions)

Characteristic	Poverty (1985 consumption)		Vulnerability (% change in consumption, 1985 to 1990)	
	Level	Logarithm	Level	Logarithm
Head has white collar job	4.83	7.02	0.41	1.59
Head has blue collar job	−3.50	−5.20	−0.06	−0.77
Head has government job	2.54	4.00	−0.01	0.71
HH capital stock	7.30	4.33	−0.44	0.08
Savings	7.54	5.67	−0.12	0.29
Female headed households	−1.87	−2.17	1.43	1.17
Age of household head	0.32	−0.36	0.06	0.18
Children/HH size	−1.77	−1.16	−3.89	−4.15
Ill or invalid/HH size	−2.26	−2.41	2.66	2.44
Elderly/HH size	3.10	2.07	3.06	2.86
Household size	−7.17	−9.64	−1.49	−2.77
HH has lent money to others	10.32	5.81	−0.73	−0.24
HH owes money to others	1.68	2.26	−1.11	−1.11
HH has a formal loan	5.25	4.59	−0.84	−0.15
Transfers received in 1985	6.69	4.71	0.72	0.37
Received or gave transfers in 1985	1.85	2.01	−0.39	−0.62
Years education of head	8.68	10.92	2.37	3.84

(1) For poverty columns a positive (negative) *t*-statistic indicates a household less (more) likely to be poor.
(2) For vulnerability column, a positive (negative) *t*-statistic indicates a less (more) vulnerable household.

savings. The first two columns of Table 7 reveal that both are associated with being better off, but neither appears to reduce vulnerability.

Are women and/or children more vulnerable? Table 7 indicates that female-headed households are more likely to be poor, but *not* more vulnerable, than male-headed households. A similar result (not shown) holds when households are classified as majority male vs. majority female. In contrast, the proportion of children is uncorrelated with poverty but strongly correlated with vulnerability. The age of the household head is uncorrelated with both poverty and vulnerability; perhaps effects in two different directions (cf. Table 1) cancel each other out.

Table 7 also tests hypotheses regarding elderly, handicapped and ill household members. The proportion of elderly household members is *negatively* correlated with poverty and vulnerability. Households with ill or handicapped heads [5] are relatively worse off, but less vulnerable. These findings on vulnerability are counterintuitive. Perhaps households with elderly or otherwise incapacitated members receive transfers, reducing vulnerability. Transfers will be examined below. A related hypothesis is that larger households are less vulnerable. [6] In Table 7, the level regression shows no significant effects, but the log regression suggests that larger households are more vulnerable. Both results contradict the hypothesis that larger households are less vulnerable, perhaps because these correlations do not control for the fraction of household members who are dependents.

Access to credit is difficult to measure. We make three attempts: (a) households that have lent money to others, which suggests access to credit; (b) households that have borrowed money from other households; and (c) households that have borrowed from formal lenders. The last two indicators imply at least some access to credit, although they exclude households that had access but did not use it. [7] All three characteristics are correlated with being better off, but uncorrelated with vulnerability. Overall, our admittedly crude indicators yield no evidence that access to credit reduces vulnerability.

Table 7 also examines two distinct indicators of inter-household transfers: (1) the value of transfers received in 1985; and (2) participation in a transfer network (receiving or sending) in 1985. The former measures transfers that are long-run obligations, while the latter examines informal insurance arrangements 'among equals'. The results shed little light on either hypothesis. Both indicators are negatively correlated with poverty but not significantly correlated with vulnerability.

[5] These individuals are those who did not work during the past 7 days due to illness or handicap.

[6] Testing for poverty (lower living standards at a point in time) is problematic because the choice of equivalence scales effectively determines whether larger households are better or worse off than smaller ones (Lanjouw and Ravallion, 1995), and all methods of estimating equivalence scales are open to strong criticisms (Browning and Meghir, 1991). However, if equivalence scales are constant over time, one can examine changes in living standards (vulnerability) and household size.

[7] Also, some households that report no loans may have received them, but chose not to reveal it.

Finally, the last line of Table 7 examines the education hypothesis. Households with well educated heads are clearly better off than average *and* less vulnerable to economic shocks. This result is consistent with Schultz's hypothesis: education reduces vulnerability.

To summarize these simple hypothesis tests, the data suggest that households with a relatively high proportion of elderly, ill and/or invalid members, and households with better educated heads, are less likely to be vulnerable. Larger households and households with a high proportion of children appear more vulnerable. The level and logarithmic specifications usually agree. But these results are correlations only; a more rigorous treatment is needed to investigate the causes of vulnerability.

4. A framework for empirical work

While the descriptive analysis presented above examined which groups are vulnerable, it did not examine *why* they are vulnerable. For example, larger households may be more vulnerable simply because they have more children, a trait positively correlated with vulnerability. To infer causality, a theoretical framework incorporating the determinants of household consumption is needed. This section provides such a framework.

4.1. Which initial conditions determine vulnerability?

To investigate which households, classified by initial characteristics ($\boldsymbol{X}_i$), are more vulnerable to macroeconomic shocks, one needs only *reduced form* estimates of the determinants of consumption at different points in time:

$$C_{it} = \theta_t(\boldsymbol{X}_i, A_{it}; \delta_i, \rho_i, u_{it}) \tag{1}$$

where C_{it} is consumption of household i at time t, $\boldsymbol{X}_i$ is a vector of exogenous variables (specifically, characteristics of the household head when he or she became an adult), A_{it} is household age at time t, δ_i and ρ_i are rates of time preference and risk aversion, respectively, and u_{it} is unobserved factors.

Anticipating the case of Peru, replace the t subscripts in Eq. (1) with the 1985 and 1990, (before and after Peru's macroeconomic shock), and assume that θ_{85} and θ_{90} are log-linear: [8]

$$\ln(C_{i85}) = \beta_{85}\boldsymbol{X}_i + \alpha_{85}A_{i85} + \delta_{1i} + \rho_i + \delta_{2i}A_{i85} + u_{i85} \tag{2}$$

$$\ln(C_{i90}) = \beta_{90}\boldsymbol{X}_i + \alpha_{90}A_{i90} + \delta_{1i} + \rho_i + \delta_{2i}A_{i90} + u_{i90} \tag{3}$$

OLS estimates of Eqs. (2) and (3) will be biased if any unobserved term (δ_{1i}, ρ_i,

[8] Specifying δ_i, the rate of time preference, as linear implies relatively high or low consumption at *all* points in time. Thus, Eqs. (2) and (3) contain two terms, a constant (δ_{1i}) and a term interacted with age (δ_{2i}).

$\delta_{2i} A_{it}$ or u_{it}) is correlated with the observable variables. The fact that δ_{1i} and ρ_i are fixed effects suggests the use of panel data.

Changes in the vector β over time reveal which households best protected their consumption levels. Consider the data at two points in time. Let $\Delta\beta$ equal $\beta_{90} - \beta_{85}$ and subtract Eq. (2) from Eq. (3):

$$\ln(C_{i90}/C_{i85}) = (\alpha_{90}5 + \beta_{c90} - \beta_{c85}) + \Delta\beta \boldsymbol{X}_i + \Delta\alpha A_{i85} + (u_{i90} - u_{i85}) + \delta_{2i}5 \quad (4)$$

where β_{c85} and β_{c90} are constant terms. Household specific risk aversion has dropped out, as has the linear component of the rate of time preference. The random errors u_{i90} and u_{i85} are now differenced, which may reduce correlation between them and the observed variables. Eq. (4) gives direct estimates of the changes in α and all elements of β from 1985 to 1990; households with high values of a variable for which $\Delta\beta$ is negative (positive) are relatively vulnerable ('invulnerable'). [9]

One could also assume that Eq. (1) is linear, instead of log–linear. In an earlier version of this paper (Glewwe and Hall, 1995), we show how to manipulate this functional form to remove unobserved rates of risk aversion and time preference. The linear specification yields empirical results very similar to those obtained using the log–linear specification, and thus they are not reported here.

Finally, the advantage of panel data, relative to repeated cross-sections, requires clarification. OLS estimates of Eq. (4) are equal to the difference in the least squares estimates of Eqs. (2) and (3). [10] Thus, panel data cannot reduce bias in estimates of $\Delta\beta$. Rather, the benefit is more *efficient* estimates of $\Delta\beta$. To see this, let h_i denote unobserved household fixed effects, and denote other unobserved terms by u_i. Ignoring age (for simplicity), the covariance matrices of $\hat{\beta}$ in Eqs. (2) and (3) are $\sigma^2_{h+u_{85}}(\mathbf{X}'\mathbf{X})^{-1}$ and $\sigma^2_{h+u_{90}}(\mathbf{X}'\mathbf{X})^{-1}$, respectively. [11] The variance of the difference of the estimates of β in Eqs. (2) and (3) based on cross-sectional data is $(\sigma^2_{h+u_{85}} + \sigma^2_{h+u_{90}})(\mathbf{X}'\mathbf{X})^{-1}$. If u and h are uncorrelated (a standard assumption), this equals $(2\sigma^2_h + \sigma^2_{u_{85}} + \sigma^2_{u_{90}})(\mathbf{X}'\mathbf{X})^{-1}$. In contrast, the covariance matrix of $\Delta\beta$ in Eq. (4) is $(\sigma^2_{u_{85}} + \sigma^2_{u_{90}})(\mathbf{X}'\mathbf{X})^{-1}$, which is clearly smaller if household fixed effects exist. In summary, estimates of $\Delta\beta$ from repeated cross-sections are identical to those from panel data, but less efficient.

[9] Interpreting the coefficient on age ($\Delta\alpha$) is more difficult. But since age cannot be altered by the household or the government, knowing the correct interpretation is of little practical importance.

[10] Denoting the dependent variable by the vector $\boldsymbol{y}$ and the independent variables by the matrix $\mathbf{X}$, OLS parameter estimates of Eqs. (2) and (3) are $(\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\boldsymbol{y}_{85}$ and $(\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\boldsymbol{y}_{90}$, respectively. Their difference is $(\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'(\boldsymbol{y}_{90} - \boldsymbol{y}_{85})$, which is the OLS estimate of Eq. (4).

[11] The $h + u$ subscripts on the σ terms indicate that those terms represent the variance of $h + u$.

4.2. The role of endogenous variables in determining vulnerability

If an economy experiences rapid and unexpected changes, life cycle consumption plans will change. Many households may find themselves in favorable or unfavorable positions because past choices had unexpected (and unintended) consequences under new, unforeseen, economic conditions. This subsection discusses estimation of the impact of endogenous variables on vulnerability.

The above framework for the determinants of consumption can also be used to estimate the (reduced form) determinants of other endogenous variables. Recalling Eq. (1), the determinants of any endogenous variable of interest, N_{it}, are:

$$\begin{aligned} N_{it} &= \theta_{Nt}(\boldsymbol{X}_i, A_{it}; \delta_i, \rho_i, u_{nit}) \\ &= \beta_{Nt}\boldsymbol{X}_i + \alpha_{Nt}A_{it} + \delta_{Ni} + \rho_{Ni} + u_{nit} \end{aligned} \tag{5}$$

where the second line is a linear approximation of θ_{Nt} (δ_i is specified as a simple fixed effect, i.e., no interaction with age). After a household chooses N_{it} at time t, tentative consumption plans are made for future time periods (and even for time t) conditional on N_{it} and all exogenous variables ($\boldsymbol{X}_i$): [12]

$$\ln(C_{it}) = \mu_t N_{it} + \beta_t'\boldsymbol{X}_i + \alpha_t' A_{it} + \delta_i' + \rho_i' + u_{it}' + \delta_2 A_{it} \tag{6}$$

One example of N_{it} is an individual's occupation—past occupational choices cannot easily be changed, and may offer unexpected advantages or disadvantages after a large macroeconomic shock.

Estimation of Eq. (6) causes difficulties because the unobserved terms may be correlated with N_{it}. Indeed, the unobserved factors determining N_{it} (δ_{Ni}, ρ_{Ni} and N_{it}) are found in the error term of Eq. (6); OLS estimates of μ_t in Eq. (6) may be biased downwards. [13] One empirical strategy is to assume that N_{it} rarely changes, being determined for most households many years ago. This could occur if changing N_{it} is costly—for example, an occupational change sacrifices job-specific human capital. While subsequent events may cause regret for past choices of N_{it}, households may opt to live with their choices, so that current consumption plans take N_{it} as given. Intuitively, this approach may limit downward bias.

This first approach, quite frankly, simply assumes away the problem and has no econometric justification. A second approach is to find suitable instrumental variables for N_{it}, but in practice finding such instruments is difficult. A third

[12] Clearly, N_{it} and C_{it} are simultaneously determined at time t. This presents no theoretical difficulties; by the envelope theorem, C_{it} conditional on the optimal value of N_{it} will equal C_{it} when both are jointly determined. Of course, endogeneity of N_{it} complicates estimation of Eq. (6), as discussed below.

[13] For example, consider u_{it}'. Substituting Eq. (5) into Eq. (6) (replacing 85 with t in Eq. (2)), yields $u_{it}' = u_{it} - \mu_t u_{Nit}$. The bias is negative because u_{it}' is negatively correlated with N_{it} if u_{it} is uncorrelated with N_{it}.

approach is to take the difference in Eq. (6) at time t and some later point. Recalling Peru, use time periods 1985 and 1990:

$$\ln(C_{i90}/C_{i85}) = \Delta\mu N_{i85} + (\alpha'_{90}5 + \beta'_{c90} - \beta'_{c85}) + \Delta\beta' \boldsymbol{X}_i + \Delta\alpha' A_{i85} + \delta_{2i}5 + (u'_{i90} - u'_{i85}) \quad (7)$$

Two points are worth noting with respect to Eq. (7). First, all unobserved fixed effects disappear, which could substantially reduce any bias plaguing the estimation of Eq. (6). Second, because this paper focuses on vulnerability and household characteristics before the shock, the term involving N_{it} in Eq. (6) is $\Delta\mu N_{i85}$, not $\mu\Delta N_i$, even though N_{it} may have changed.

5. Estimation results

This section uses the above framework to examine the causes of market-induced vulnerability in Peru. We first discuss which variables can be considered exogenous, and then present our results.

5.1. Empirical specification

Reduced form estimation of Eqs. (2)–(4) requires consumption data and variables that can be considered exogenous. We use per capita consumption as calculated in Glewwe and Hall (1994). Regarding exogeneity, there are several competing theories on the determinants of household consumption. We do not wish to test these theories, but seek only to present estimates that are informative regardless of the 'true model'. The life-cycle/permanent income hypothesis has the fewest assumptions regarding which household and individual characteristics are exogenous, so the only variables we treat as exogenous are those considered to be exogenous by that theory. [14] Basically, only those characteristics of household heads that are determined by the age of adulthood are assumed to be exogenous. These variables are the head's age, educational attainment and place of birth, plus the education and main occupation of the head's parents.

Several endogenous variables are of interest with respect to vulnerability. The sex of the household head may be endogenous because a husband may migrate to find work, leaving behind a female household head. [15] The head's occupation in

[14] The life-cycle/permanent income model of consumption has been modified and tested by many economists in recent years. There are also newer models of consumption behavior, such as those based on precautionary savings or liquidity constraints. See Deaton (1992) for a recent review of the evidence. For our purposes, we need not worry about which model is correct since none of the variables we assume to be exogenous are considered to be endogenous in these newer models of consumption behavior.

[15] This argument implies that *any* characteristic of the household head could be endogenous. However, as long as spouses have similar socio-economic backgrounds, a husband's decision to work away from home will not greatly affect the characteristics considered as exogenous in the previous paragraph. In the contrast, such an event, by definition, reverses the sex of the head of household.

Table 8
Descriptive statistics

Variables	Mean	Standard deviation	Definition
Per capita consumption 1985	7752.41	7216.75	Household Consumption per capita, 1985
Per capita consumption 1990	3693.26	3247.41	Household consumption per capita, 1990
Age of head, 1985	47.19	13.28	Age of household head in 1985
Head's years of education	15.68	14.32	Total years of education, household head
Head born in Lima	0.33	0.47	Household head in 1985 born in Lima
Head born in rural area	0.14	0.35	Household head in 1985 born in rural area
Head's mother's years of education	4.86	4.00	Total years of education, head's mother
Head's mother's education missing	0.08	0.26	Education level of head's mother missing
Head's father's years of education	7.04	4.18	Total years of education, head's father
Head's father's education missing	0.10	0.30	Education level of head's father missing
Parent(s) living	0.53	0.50	Father and/or mother of household alive, in 1985
Father white collar	0.15	0.35	Father of household head was employed in white collar position
Female head	0.22	0.41	Household head is female
Head public sector	0.18	0.38	Household head employed in public sector, 1985
Head blue collar	0.20	0.40	Household head employed in blue collar job, 1985
Head white collar	0.25	0.43	Household head employed in white collar job, 1985
Head's mother self-employed	0.08	0.27	Mother of household head was self-employed
Family members abroad	0.02	0.15	Dummy variable indicating family member lived abroad in 1985
Household size	5.45	2.60	Household size in 1985
Number of children in 1985	1.97	1.76	Number of children under age 16, 1985
Number of elderly in 1985	0.44	0.67	Number of adults over age 60, 1985
Number ill/invalid in 1985	0.17	0.44	Number of household members ill or invalid
Transfer, rural	243.16	1301.75	Household received transfer from rural area in Peru, 1985
Transfer Lima	293.57	1196.92	Household received transfer from within Lima, 1985
Transfer, foreign	114.16	1010.45	Household received transfer from abroad, 1985
Household savings	1082.10	6147.85	Value of household savings in 1985
Household loans	812.69	5809.85	Value of loans taken out by household, 1985
Loans to household businesses	235.97	2952.09	Value of loans to household businesses, 1985
Household credits	70.61	364.39	Value of loans owed to household, 1985
Household business assets	12,028.52	153,893.43	Value of household business assets, 1985

1985 may be endogenous because individuals do change jobs, albeit infrequently. The proportion of household members that are children, elderly, etc., could also change in response to changing economic conditions. Finally, three variables of interest, inter-household transfers, access to credit, and savings and other assets, are clearly endogenous. We examine three types of transfers: (1) transfers between households in Lima; (2) transfers between Lima households and other households in Peru; and (3) transfers between Lima households and households outside Peru. Table 8 provides descriptive statistics on all variables used.

5.2. Exogenous household characteristics and vulnerability

Which households were best able to protect themselves during Peru's sharp macroeconomic decline from 1985 to 1990? Columns 1 and 2 of Table 9 present reduced form estimates of the determinants of (log) consumption for each year. The assumption of homoscedasticity was not rejected for either regression (using the test of White, 1980). The 1985–1986 estimates reveal no evident pattern by

Table 9
Determinants of per capita consumption and change in per capita consumption

Variables	Log consumption				Change in log consumption	
	1985–1986		1990		1985–1986 to 1990	
	Coefficient	*t*-statistics	Coefficient	*t*-statistics	Coefficient	*t*-statistics
Intercept	7.7876	29.37	7.4918	29.00	−0.2958	−1.05
Age of head	0.0059	0.57	−0.0165	−1.65	−0.0224	−2.06
(Age of head)^2	0.0000	0.14	0.00024	2.39	0.00023	2.07
Head years of education	0.0400	6.84	0.0517	9.08	0.0117	1.90
Head born in Lima	0.0721	1.29	0.0628	1.15	−0.0092	−0.16
Head born rural area	0.1145	1.80	−0.0422	−0.68	−0.1567	−2.33
Head's mother's education (years)	0.0166	2.23	0.0189	2.60	0.0023	0.29
Head's mother's education missing	−0.0497	−0.50	−0.0196	−0.20	0.0301	0.29
Head's father's education (years)	0.0117	1.60	0.0114	1.60	−0.0003	−0.04
Head's father's education missing	−0.0563	−0.69	0.0044	0.06	0.0607	0.70
Parent(s) living	0.1207	2.33	0.0687	1.36	−0.0520	−0.95
Father white collar	0.1358	1.86	0.1863	2.62	0.0506	0.65
Mother self-employed	0.0280	0.34	−0.1746	−2.15	−0.2026	−2.30
R^2	0.1949		0.2927		0.0401	
Sample size	699		699		699	

the age of the head, which suggests that the head's work experience is not a major determinant of consumption levels. [16] As expected, the head's education has a significant and strong positive impact on consumption. [17] Having a head born in Lima entails few advantages in 1985, but having a head born in a rural area may help (significant at the 10% level). This last effect is surprising, since migrants from rural areas would be disadvantaged if rural schools are of poor quality. Perhaps households that migrate are a more motivated, select group, or receive transfers from their household of origin until they get settled.

Turning to characteristics of the head's parents (which were not included in the correlation analysis of Section 3), the head's mother's education has a positive impact beyond that of the head's own education, and father's education may also play a role. Note that the head's parents are rarely household members; only 4% of households had one or both of the head's parents present. Parental education may have an impact for several reasons. Better educated parents may be more able to find high wage jobs for their children, yet this effect may already be picked up by the (marginally) significant impact of the father having a white collar job. [18] Parental education may also reflect interhousehold transfers from parents or from similarly well educated siblings (or other relatives). Transfers from parents may also explain the significantly positive impact of parents being alive.

The second column in Table 9 provides estimates of the determinants of log consumption in 1990. Overall, the 1990 results resemble those of 1985, with four exceptions: (1) the age of the head is now significant; (2) there is no advantage of being born in a rural area; (3) there is a disadvantage associated with the head's mother being self-employed; and (4) there is no advantage to one's parents being alive. If the impact of parents being alive in 1985 reflects transfers from parents, this may indicate that transfer networks deteriorated over time. [19] This will be examined in more detail below.

One can compare the 1985–1986 and 1990 results directly to see which characteristics reflect vulnerability in terms of changes in consumption over time. For example, the years of education coefficient is about 30% higher in 1990, suggesting that education reduces vulnerability. The last estimates in Table 9 presents more precise evidence. Recall that although the log change estimates are simply the difference between the estimates in the first two regressions in Table 9, estimation of Eq. (4) is more efficient. The statistically significant findings in the last estimates of Table 9 confirm most of the results derived from the previous

[16] Stelcner et al. (1988) and King (1990) find positive returns to experience for wage earners in Lima, but Moock et al. (1990) find no effect of experience for the self-employed.

[17] When average schooling of other adult household members is added, it is completely insignificant.

[18] In regressions not shown here, other dummy variables regarding both father's and mother's occupation were added. Only the ones shown in this table ever showed any statistical significance.

[19] Perhaps this result comes about because some of these parent's died before 1990. Unfortunately, the 1990 survey contains no information on the head's parents.

columns—the head's age is now statistically significant, households with heads born in rural areas lost their former advantage, households whose head's mother was self-employed are more vulnerable, and better educated households are less vulnerable. [20] However, the change in the impact of the head's parents being alive is insignificant.

Perhaps the most intriguing finding in Table 9 is the increased impact of education over time, which is consistent with Schultz's hypothesis that better educated individuals adapt more quickly in times of economic disequilibrium. However, two alternative hypotheses exist. First, all households may adjust to new equilibria at the same pace, but the 1990 equilibrium in Peru favors better educated households because returns to education have permanently increased (perhaps due to higher demand for more skilled workers). To determine which hypothesis is correct, data for the mid-1990s must be examined; since Peru's economy has been relatively stable in the mid-1990s, the Schultz hypothesis predicts that returns to education will not be as high as in 1990, while under this alternative hypothesis the returns to education would remain high. Second, one might argue that better educated households have steeper life-cycle income profiles that, when combined with an inability to borrow from future earnings when young, results in a steeper life-cycle consumption profile. This hypothesis implies that an interaction term between the age and school attainment of the head would be statistically significant in the first two regressions in Table 9. The data do not support this; in regressions not shown here such an interaction term was statistically insignificant in both years.

5.3. Endogenous variables and vulnerability

The first estimates in Table 10 investigate whether female-headed households are more vulnerable by adding a dummy variable for female headship, which was excluded from Table 9 because it may be endogenous. This dummy variable is positive but significant only at the 10% level, which implies that female- headed households were *less* vulnerable than male-headed households in Peru in the late 1980s. [21] This finding contradicts much of the literature on poverty and structural adjustment. The second regression in Table 10 examines whether workers in some sectors tend to be more vulnerable. No significant differences are found; households headed by blue collar workers, white collar workers and government workers are neither more nor less vulnerable than other households.

[20] The *t*-statistic on the head's education is not quite significant at the 5% level, but dropping the four variables on the head's parents' education (which are jointly insignificant), makes the head's education significant at the 5% level. Treating our data as repeated cross-sections yields a *t*-statistic of only 1.43, which suggests that household fixed effects indeed exist and demonstrates the advantage of panel data.

[21] A different variable, the proportion of household members that are female, gave similar results.

Table 10
Change in per capita consumption: sex and occupation of head, and household composition

Variables	Sex of head		Occupation of head		Household composition	
	Coefficient	*t*-statistics	Coefficient	*t*-statistics	Coefficient	*t*-statistics
Intercept	−0.3439	−1.22	−0.3226	−1.13	−0.3621	−1.24
Female head	0.1015	1.67	–	–	–	–
Head was government worker in 1985	–	–	0.0048	0.06	–	
Head was white collar in 1985	–	–	−0.0410	−0.52	–	–
Head was blue collar in 1985	–	–	−0.0116	−0.18	–	–
Household size in 1985	–	–	–	–	0.0251	1.70
Number of children in 1985	–	–	–	–	−0.0702	−3.21
Number of elderly in 1985	–	–	–	–	0.0648	1.18
Number of ill/invalid in 1985	–	–	–	–	0.1090	1.78
Age of head	−0.0220	−2.03	0.0212	−1.91	−0.0187	−1.54
(Age of head)^2	0.00023	2.05	0.0002	1.91	0.0002	1.16
Head's years of education	0.0150	2.32	0.0130	1.96	0.0141	2.27
Head born in Lima	−0.0132	−0.22	−0.0109	−0.18	−0.0211	−0.36
Head born in rural area	−0.1493	−2.22	−0.1588	−2.35	−0.1258	−1.85
Head's mother's years of education	0.0015	0.19	0.0023	0.29	−0.0042	−0.54
Head's mother's education missing	0.0152	0.15	0.0298	0.28	0.0930	0.89
Head's father's years of education	−0.0015	−0.19	−0.0002	−0.02	0.00035	0.45
Head's father's education missing	0.0641	0.74	0.0603	0.70	0.0341	0.39
Parent(s) living	−0.0494	−0.90	−0.0500	−0.91	−0.0213	−0.39
Father white collar	0.0466	0.60	0.0541	0.70	0.0709	0.92
Mother self-employed	−0.2047	−2.33	−0.2045	−2.30	−0.1566	−1.78
R^2	0.0440		0.0406		0.0732	
Sample size	699		699		674	

The last regression in Table 10 examines family composition. Recall that although interpreting the impact of household size, and of the number of children, in the level regressions is problematic, change regressions are less susceptible to these criticisms. First, there is weak evidence that larger families are more able to diversify to protect their consumption levels. This differs from the correlation analysis findings of Table 7, and thus shows the importance of controlling for other variables. Second, the presence of children has a strong negative effect on changes in welfare levels, suggesting that households with many children, and thus

children in general, are more vulnerable to macroeconomic shocks. Finally, there is no evidence that households with more elderly or ill/invalid individuals are more vulnerable; indeed there is weak evidence that the latter are less vulnerable.

Table 11 examines transfer network and asset accumulation variables, which are obviously endogenous. The first estimates in Table 11 consider the impact of

Table 11
Change in per capita consumption: transfers and household assets

Variables	Transfers received		Transfer network		Household assets	
	Coefficient	*t*-statistics	Coefficient	*t*-statistics	Coefficient	*t*-statistics
Intercept	−0.2238	−0.79	−0.2278	−0.79	−0.2947	−1.04
Value of 1985 transfers recieved from rural areas	−0.00007	−2.23	–	–	–	–
Value of 1985 transfers recieved from Lima	−0.00001	−0.28	–	–	–	–
Value of 1985 transfers recieved from foreign country	0.00009	1.81	–	–	–	–
Received or gave transfers in 1985	–	–	−0.0571	−1.19	–	–
Received/gave foreign transfers in 1985	–	–	0.1296	0.82	–	–
Household savings	–	–	–	–	0.0000	0.05
Household loans	–	–	–	–	−0.0000	−0.44
Household owes money to others	–	–	–	–	−0.000004	−1.18
Household has lent money to others	–	–	–	–	−0.00002	−1.10
Household business assets	–	–	–	–	−0.0000	−0.33
Age of head	−0.0270	−2.44	−0.0239	−2.18	−0.0220	−2.00
(Age of head)^2	0.0003	2.51	0.0002	2.16	0.0002	2.02
Head's years of education	0.0107	1.74	0.0111	1.80	0.0129	2.00
Head born in Lima	−0.0179	−0.30	−0.0097	−0.16	−0.0176	−0.29
Head born rural area	−0.1463	−2.18	−0.1574	−2.34	−0.1650	−2.43
Head mother's years of education	0.0022	0.28	0.0023	0.30	0.0015	0.19
Head's mother's education missing	0.0337	0.32	0.0303	0.29	0.0299	0.28
Head's father's years of education	0.0020	0.26	0.0002	0.02	0.0008	0.10
Head's father's education missing	0.0588	0.69	0.0625	0.73	0.0711	0.81
Parent(s) alive	−0.0290	−0.53	−0.0456	−0.83	−0.0615	−1.11
Father white collar	0.0564	0.73	0.0511	0.66	0.0502	0.63
Mother's self-employed	−0.1866	−2.13	−0.1991	−2.23	−0.1951	−2.17
R^2	0.0549		0.0431		0.0466	
Sample size	699		699		682	

transfers received in 1985 on changes in consumption from 1985 to 1990. The next regression is similar but uses dummy variables to indicate participation in a transfer network (either receipt or sending). The first regression views transfers as long-run obligations, while the second sees them as short-run informal insurance. The first set of estimates indicates that receipt of transfers from households residing in foreign countries reduces vulnerability, while transfers from other households in Lima have no effect; it also suggests that transfer networks based on receipts from rural areas of Peru collapsed. The second regression provides no evidence that informal insurance networks reduce vulnerability.

The finding that only transfers received from overseas reduced vulnerability is somewhat sobering. The vast majority of recipients (90%) received transfers from elsewhere in Peru. It is easy to see why overseas transfers survive. Peru's economic shock hit almost all households inside Peru, causing those sending transfers to cut back sharply (cf. Table 5). In contrast, transfers received from households outside Peru appear unaffected, probably because those households were unaffected by the shock inside Peru. These results have clear policy implications. Estimates of transfer activity from one cross-section of data (e.g., Cox and Jimenez, 1990) should not be used to infer how transfers will operate in later years. In particular, such estimates could greatly overestimate the role private transfers can play in cushioning households from nationwide income shocks.

Does asset accumulation protect households from macroeconomic shocks? The last regression in Table 11 examines several asset variables. Quite simply, none of these variables had a significant impact. One interpretation is that our data on savings, loans and assets are unreliable. In any case, we find no evidence that savings and/or household assets reduce vulnerability.

5.4. Do Peru's assistance programs protect vulnerable groups? [22]

While the discussion of transfers above focused on interhousehold transfers, both the Peruvian government and private charitable organizations also provide transfers to households. We do not have data on all programs in Peru; in fact, we have only two variables, transfers received from Peru's Social Security program (IPSS) and transfers from charitable programs, both government and non-government. We wish to investigate whether either of these transfers are well-targeted to vulnerable groups, or at least well-targeted to the poor (a distinction we will return to below). To assess this, we simply regress (the log of) the value of these transfers on changes in (log) consumption, and on (log) consumption in 1990. Because most households do not receive these transfers (only 20 households report receiving Social Security transfers while 59 report receiving transfers from charitable programs), we estimate simple Tobit regressions.

[22] We would like to thank an anonymous referee for suggesting the topic of this subsection.

Table 12
Vulnerability and transfers from the government and charitable organizations

Explanatory variables	Dependent variables			
	Log (social security transfer)		Log (transfer from charities)	
	Coefficient	*t*-statistics	Coefficient	*t*-statistics
Regression 1				
Constant	−25.5579	−4.39	−12.1699	−6.73
Change in log consumption	−0.5491	−0.28	−1.4219	−1.66
Regression 2				
Constant	−40.2650	−2.29	23.3543	3.29
Log consumption in 1990	1.8996	0.98	−4.3533	−4.38

(1) All regressions are Tobit regressions.
(2) Asymptotic *t*-statistics given in parentheses.

Table 12 presents estimates of how well government and charitable transfers are targeted. The top half of the table shows how well these transfers are targeted toward vulnerable households, while the bottom half shows how well they are targeted to poor households. The estimates on Peru's Social Security program clearly show that such transfers are targeted neither toward the vulnerable nor toward the poor. While it may be that such targeting was not the main purpose of the program, it is useful to verify that this program is not very effective at protecting either the poor or the vulnerable. Transfers from charitable organizations are clearly targeted toward the poor, but only weakly targeted (significance level of 10%) toward the vulnerable, i.e., toward households whose consumption has dramatically declined. However, this may be perfectly reasonable if the ultimate objective of transfer programs is to assist the poor, as opposed to assisting only the vulnerable. More generally, we would argue that while transfer programs should assist households that recently became poor due to a large decline in consumption, they should not neglect poor households that have been poor for many years.

6. Conclusion

This paper began with a question: Which households are most vulnerable to macroeconomic shocks? Perhaps the most interesting finding of the paper is that households headed by relatively well-educated persons appear less vulnerable, which is consistent with T.W. Schultz's hypothesis that education allows individuals to adapt quickly to new economic circumstances. However, alternative hypotheses are possible, one of which can be tested only with more recent data.

A second result is that female-headed households appear less vulnerable to macroeconomic shocks than male-headed households. This is contrary to the common assertion that female-headed households, and women per se, are particularly vulnerable to economic downturns and structural adjustment. A third result is that households with more children are more vulnerable to economic shocks, which is consistent with claims often made in the literature. We have less confidence in our fourth result because of the potential for biased estimation, which is that domestic transfer networks may not protect the poor during a major economic collapse that affects virtually all socio-economic groups. In contrast, transfer networks involving family members and/or friends currently overseas appear to be quite resilient. Finally, we find evidence that Peru's Social Security program is not at all targeted to either vulnerable or poor households. In contrast, public and private charitable programs are clearly targeted toward the poor, and somewhat targeted to the vulnerable.

While this paper has shed some light on who is vulnerable to macroeconomic shocks, and why, much more can be done. First, future data from Peru can be used to test the Schultz hypothesis against the alternative that returns to education permanently changed in Peru. Second, similar studies need to be done in other countries, to see whether our results from Peru extend to other developing countries. Third, more could be done to investigate why certain groups are more vulnerable. Finally, given that certain groups are vulnerable, much more thought (perhaps along the lines of Grosh, 1994) needs to be given to the best mechanisms for protecting those groups.

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