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The Impact of Natural Disasters on Children Morbidity in Rural Mexico

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At least two of the eight core Millennium Development Goals that are set to agreed targets by 2015 comprise aspects directly related with under five children morbidity (i.e., reduce under five mortality and combat the spread of diseases, especially malaria). It has therefore become an imperative to understand how the consequences of a changing climate and some of its most

[1] We would like to thank Emma Samman for her comments on an earlier draft of this paper.

hostile manifestations in the form of droughts and floods, can impinge on human well-being and welfare through health as a fundamental dimension of development.

Leaving aside the fact that poverty can create a breeding ground for increased children morbidity through lower expenditures on goods that improve health, such as safe water, staples and basic sanitation. Climatic risks can also be a source of main health problems. Shortage of safe drinking water and infection from contaminated water (i.e., declines in both the quantity and quality of water) often leads to an increase in cases of hepatitis-A, cholera and diarrhoea. Moreover, disruption of croplands results in general under-nourishment of population, particularly in rural areas, increasing susceptibility to infections or even leading to large-scale movements of people which put pressure on water supplies and sanitation facilities in the host communities making the degradation of the public health environment more likely for hosts and migrants alike (Nagy, et al. 2006).

In line with this concerning impact of climate change on health, this paper aims to determine if natural disasters in specific rural areas in Mexico increase exposure to disease among children aged between 0-5 years. In doing so, the first section sets the context in which this study takes place. Section 2 specifies the nature of the information sources employed. We rely on biannual data from 1998 to 2000 coming from the household surveys (Encuestas de Evaluación de los Hogares or ENCEL) used to evaluate the impact of the Health, Education and Nutrition Program PROGRESA on rural communities.[2] Section 3 tackles the methodological issues that arose while exploring the propensity of rural children to morbidity

[2] *Progresa* was introduced in 1997 and re-launched as *Oportunidades* in 2002. Its basic objective is to improve the education, health and nutrition of poor families, particularly children and their mothers. In addition to nutrition supplements, it provides cash transfers to families in exchange for regular school attendance and visits to health posts,. The payments are provided directly to mothers or the female head of households.

given a wide range of climatic shocks.[3] Most of the analysis relies on a series of logistic models that will be applied to cross sectional and pooled data, and some further exploration is carried out through panel data techniques. Section 4 presents the empirical results of the analysis described beforehand and engages in a discussion on the findings to conclude.

1. Background

We will be analyzing a group of households located in agrarian communities that have already been portrayed as extremely poor and engaged in high-risk and mostly single-crop agriculture with limited access to formal insurance mechanisms (García-Verdu, 2002). During the full period that will be analyzed in our sample (May 1998 - November 2000), only about 10 percent of localities on average declared having a public health facility or access to drinking water (See Table 3). These figures give us a glimpse of the low-living conditions of the households under study.

Such precarious conditions are compounded by the localities' high exposure to health and weather-related shocks. For instance, the second half of 1998 and the first half of 1999 were particularly critical for the vast majority of localities in this sample. In this period, three out of every four villages reported experiencing a drought while only around 17 percent of them did not undergo any type of natural disaster.

[3] Risk in this work refers to possibly occurring events that can damage wellbeing (Dercon, 2001). Some authors find it useful to distinguish risk and shocks implying that shocks go one step further than risk. Shocks are defined as realizations of highly unexpected events that cause welfare losses. In other words, risk refers to the prospect of a shock or, alternatively, shocks can be thought as the realization of risks (Fafchamps, 2004). Throughout this paper we use interchangeably both concepts.

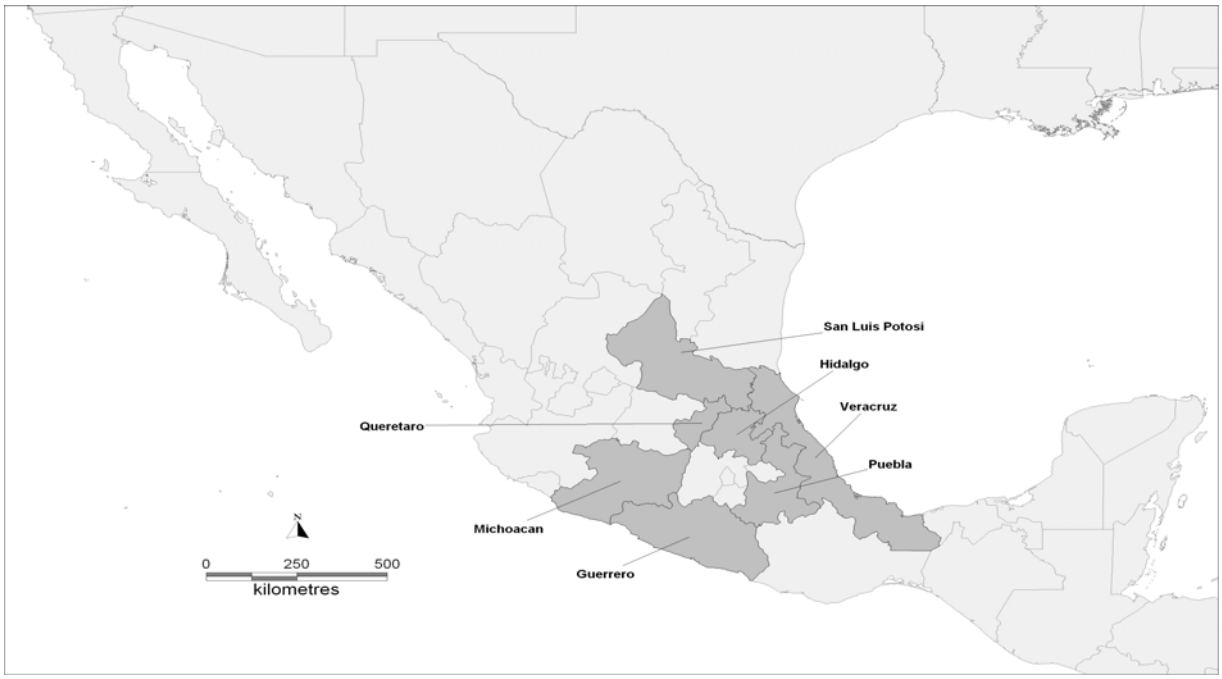
Table 1. Frequency of Shocks (% communities reporting them)

Shock	May-Nov 98	Dec 98-May 99	June-Nov 99	Dec 99-May 00	June-Nov 00
Drought	70.75%	74.34%	38.60%	30.52%	30.10%
Frost	10.47%	18.38%	28.60%	14.26%	6.14%
Floods	9.09%	1.01%	13.40%	2.81%	1.39%
Hurricanes	4.15%	2.22%	14.40%	1.20%	0.99%
Earthquakes	1.19%	9.09%	5.80%	0.40%	0.20%
None	17.39%	16.77%	33.00%	56.43%	59.60%
Source: Own calculations from Locality Encel Questionnaires.					

Although weather-related risks seem to be ever-present in these communities, they differ in terms of their location, scope and periodicity. Within the seven entities that comprise our sample,[4] earthquakes are more common in the state of Guerrero in the Pacific Coast and Puebla where there is presence of intense volcanic activity occasioned by the volcano Popocatépetl. Coastal entities, such as Guerrero, Veracruz and Michoacán, or regions within states with proximity to the coast like northern Puebla are prone to suffer from hurricanes. In contrast, landlocked localities in the states of Hidalgo, Puebla, Querétaro, and San Luis Potosi are more likely to face droughts and fires (See Map 1).

[4] Guerrero GRO, Hidalgo HGO, Michoacán MICH, Puebla PUE, Querétaro QRO, San Luis Potosí SLP, and Veracruz VER.

Map 1. Survey States in Mexico



In our sample, a great many children were affected by the worst droughts over the century in most states in 1998-99. Torrential rains occasioned by a tropical depression in October 1999 manifested in floods over Puebla, Hidalgo, and Veracruz (and Tabasco and Oaxaca) as well as an usually active hurricane season in the Atlantic Ocean (Gulf of Mexico) which had an effect on the same group of states. Finally, an intense earthquake was registered in June 1999 affecting the states of Puebla, Veracruz and Guerrero (and Tlaxcala, Mexico City, Morelos and Oaxaca). To face these perils, there is almost an absolute absence of formal risk-pooling institutions inside communities: in the initial period that we analyze, less than 3 percent of localities mentioned any production or consumption (insurance) or credit cooperative within them.

Table 2. Percentage of children experiencing shocks by state and round

		DROUGHT	FLOOD	FROST	QUAKE	HURRICANE	CHILD SICK
GRO	Nov-98	6.50	0.40	1.20	0.80	6.00	27.6
	May-99	4.24	0.33	1.23	51.00	1.00	25.5
	Nov-99	1.44	0.00	11.90	0.00	0.10	18.7
	May-00	3.01	2.71	10.54	5.42	2.41	15.5
	Nov-00	12.11	0.12	0.00	0.46	0.12	17.3
HGO	Nov-98	50.65	5.79	4.79	0.12	0.59	30.9
	May-99	46.10	1.65	4.88	0.51	0.00	13.4
	Nov-99	9.16	9.81	19.82	0.98	17.00	14.23
	May-00	12.96	1.05	5.78	0.00	0.18	24.3
	Nov-00	1.73	0.00	0.14	0.00	0.00	15.19
MICH	Nov-98	3.51	2.13	1.14	0.15	0.60	29.28
	May-99	13.43	0.53	2.72	0.97	1.32	25.3
	Nov-99	4.40	0.35	5.61	0.00	0.00	22.68
	May-00	16.03	1.40	3.41	0.40	0.20	30
	Nov-00	2.57	0.00	1.05	0.00	0.00	12.84
PUE	Nov-98	36.23	1.51	4.20	0.00	0.70	18.5
	May-99	47.33	1.55	13.43	12.22	0.69	28.02
	Nov-99	7.23	24.02	28.98	5.01	12.83	27.05
	May-00	6.77	10.90	15.04	0.19	0.94	20.5
	Nov-00	2.00	0.21	2.90	0.21	0.07	13.87
QRO	Nov-98	31.13	4.28	3.31	0.00	0.58	27.18
	May-99	34.07	2.22	3.23	0.00	0.00	28.19
	Nov-99	2.73	0.21	15.34	0.00	0.00	25.05
	May-00	25.31	0.00	12.86	0.00	0.00	25.95
	Nov-00	8.23	0.00	0.73	0.00	0.00	22.33
SLP	Nov-98	30.85	1.92	2.25	0.00	0.27	20.36
	May-99	75.80	0.85	1.51	0.00	0.00	18.96
	Nov-99	10.83	0.56	7.24	0.00	0.00	18.88
	May-00	41.11	4.10	1.69	0.24	0.00	17.66
	Nov-00	21.77	0.07	0.47	0.40	0.00	20.49
VER	Nov-98	58.90	4.01	3.25	0.30	0.86	23.47
	May-99	70.41	1.13	5.89	2.86	0.19	16.64
	Nov-99	8.80	9.26	4.18	4.38	8.46	23.3
	May-00	10.26	3.15	3.45	0.22	0.67	22.37
	Nov-00	0.93	0.14	0.14	0.00	0.32	12.48

Source: Own calculations from ENCEL98N, ENCEL99M, ENCEL99N, ENCEL00M, ENCEL00.

Bearing in mind the wide presence of shocks faced by our sample of rural households along with the existence of high degrees of poverty, we will try to determine if children living in households affected by climatic shocks are more susceptible to disease. Incidentally we will also learn if the children in those households who appear less deprived are less likely to

become ill.

It would not be unusual to expect a higher incidence of diseases in those households affected by climatic shocks given the marked shortage of services and facilities that we observe coupled with the scarcity of risk-sharing arrangements inside these communities. Moreover, a preliminary review of the literature suggests that a reduced access to and ownership of assets including labour, physical tools, community infrastructure and housing facilities can increase the prospect of children in rural households to experience an illness during a natural disaster.

2. Data Sources

The main source of information for this paper comes from a group of households located in 506 localities across seven states of Mexico: Guerrero, Hidalgo, Michoacán, Puebla, Querétaro, San Luis Potosí and Veracruz. They comprise some of the most deprived rural communities in the country and were set to be the prime target of the poverty alleviation Program in Education, Health and Nutrition (*Progresa* and since 2002 *Oportunidades*). A broader sample was initially surveyed in August 1997 (Encuesta de Características Socioeconómicas de los Hogares or ENCASEH) at the onset of the program to determine its beneficiaries. Subsequently, a series of socio-economic household surveys (Encuesta de Evaluación de los Hogares or ENCEL) were carried out approximately every six months for a period of three years (from March 1998 to November 2000) with the purpose of providing inputs for assessing the program's performance. These successive questionnaires provide a total of six rounds of information for the same group of households. These surveys were supplemented with questionnaires from the localities where the surveyed households reside (Cuestionario de Localidad or ENCELLo).

The ENCEL examines households and their communities in great detail. For households, it provides information on their sources of expenditure and income levels, labour market participation, socio-demographic characteristics, health and education, housing, asset ownership and family wealth, among other things. At the community level, it includes the socio-economic characteristics of localities, such as their main economic activities, as well as their access and distance to physical and public infrastructure, among other items. Furthermore, the ENCEL includes information on three substantive areas related with risks: first, on shocks themselves; second, on the transmission channels conditioning their impact to households and communities; and third, on the responses to these impacts at the household level, and the forms of support available to mitigate these impacts at the locality level.

For our analysis, we consider all rounds except the first, which has no information on risk variables. Therefore we concentrate upon rounds 2 through 6, which cover from November 1998 through late 2000. A few variables are derived from the community questionnaires while the remainder are created at the individual and household level. Children aged between 0 and 5 years are our core unit of analysis.

Risks

The ENCEL contains information on the frequency of the two types of risks that have been more commonly cited in rural areas in Mexico, namely, weather-related and health-related shocks (World Bank 2005). Agro-climatic hazards are determined by asking whether any drought, flood, frost, earthquake or hurricane affected the household in the six months prior to the date of the survey. We convert this group of answers into dichotomous variables for our analysis, but one has to be aware of their limits in some respects. As Tesliuc and Lindert (2002) pointed out from their data for shocks in Guatemala, shocks do not have their own

measurement unit, it is possible that the same qualitative response (Did you experience a drought during the last 6 months? Yes or No) masks considerable heterogeneity. This means shocks would be modelled as if they were of the same magnitude, even though their impact could be very different across households. This deficiency is simply acknowledged.

In the case of health shocks, the ENCEL covers illnesses experienced by any member of the household one month prior to the date of each survey. From this information, we derive our core dichotomous variable which is based on households' self report of whether any children aged between 0-5 became sick during the last month. There was no other objective variable available in the survey to capture children morbidity. We were aware of the problems that a variable of this nature might entail, most notably the adaptive preferences of deprived people accepting poor health as normal (Sen 1979, 1987, 1993, 2002). But if anything this fact would only support our central argument as a further discussion on this problem and its impact on results will show below in section 3.

Asset endowments and household and community characteristics

Most rounds in the ENCEL contain information on the household socio-demographic characteristics, including the size and life-cycle of the family according to the age and gender composition of its members; as well as their health, education and occupational features. In particular, we take into account household size and composition, as expressed by the ratio of dependent to non-dependent members. We also control for the age and gender of children as well as some of the main attributes of the household head, including his/her ethnicity, age, sex and occupation (being an agricultural labourer), and the education of the mother. We also extract details on possession of the following household goods: a blender, refrigerator, gas heater, water heater, radio, television, and record player, all synthesized in a composite index.

Through community questionnaires we collect information on access to health services within villages. These data on access to health care facilities and other public services can be linked to household level data, and hence be valuable in undertaking the proposed assessment. Table 3 presents descriptive statistics for the main variables employed throughout the paper.

Table 3. Summary Statistics Nov. 1998 – 2000

Variable	Unit	Mean	Std. Dev.	Min	Max
Individual level					
child age	#	2.78	1.67	0	5
child male	%	0.51	0.50	0	1
Household level					
household size	#	6.88	2.44	2	24
dependency ratio	#	1.57	0.88	0	9
head indigenous	%	0.40	0.49	0	1
head age	#	40.39	12.95	16	97
female head	%	0.06	0.24	0	1
head is agricultural labourer	%	0.66	0.47	0	1
mother schooling	#	5.30	3.89	0	24
working members at home	%	0.22	0.11	0	1
composite asset index		0.21	0.21	0	1
Community level					
potable public water in locality	%	0.10	0.29	0	1
waste disposal in open air	%	0.13	0.34	0	1
public health clinic in locality	%	0.11	0.32	0	1
imss-solidaridad clinic in locality	%	0.04	0.19	0	1
Shocks					
children sick per household	#	0.39	0.72	0	5
child <=5 sick	%	0.21	0.41	0	1
days child sick	#	1.06	3.02	0	31
diarrhoea	%	0.03	0.18	0	1
respiratory disease	%	0.03	0.17	0	1
fever	%	0.09	0.29	0	1
cold	%	0.09	0.28	0	1
drought	%	0.25	0.44	0	1
flood	%	0.03	0.18	0	1
frost	%	0.05	0.23	0	1
earthquake	%	0.02	0.15	0	1
hurricane	%	0.02	0.14	0	1

Source: ENCEL98N, ENCEL99M, ENCEL99N, ENCEL00M, ENCEL00N.

3. Methodology

Logistic models, including a Fixed Effects Logit for unbalanced panel reported in column (7) of Tables (4) and (5)

4. Results

We employed a series of logistic models to quantify the extent to which the occurrence of weather-related shocks, apart from other more permanent disadvantages, can translate into an increased likelihood of disease for those children residing in households that experienced a natural disaster anytime during the six months prior to reporting the illness.

There seems to be strong and statistically significant evidence for supposing that children became more susceptible to diseases as a result of weather-related shocks. Table 3 shows that in the pooled and panel data alike, all five shocks increased the probability of experiencing disease for children in the affected households. For the pooled cross-sections in column (6), the higher odds range from 21 to 48 percent while for the Fixed Effects regression outputs reported in column (7) these go from 16 to 56 percent.

Children in those households affected by the extensive drought that took place between the second half of 1998 and the first half of 1999 had about 12 percent more probability of becoming ill than their counterparts in non-affected households. Similarly, the relatively wide number of children living in households affected by floods -in Hidalgo, Puebla and Veracruz- and frosts -in all states- in the second half of 1999 had about a one fifth and one quarter higher chance of experiencing sickness, respectively. Similarly, the earthquake in the states of Puebla and Guerrero during the first semester of 1999 increased the likelihood of experiencing an illness by 79 percent for those children living in affected households.

An alternative way to assess the increased exposure to disease of children in households affected by natural shocks is to look at those households that reported no climatic shocks. As Table 5 shows children in this type of household across the whole period of analysis have a lower probability of becoming sick: about 25 percent less chance of becoming sick according to the pooled data and 20 percent less likelihood in the panel dataset.

Table 4. Logistic Regression on Reported Child Morbidity (Odds Ratios)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Nov98	May99	Nov99	May00	Nov00	Nov98-00	Nov98-00
household suffered drought	1.128	1.117	0.939	0.919	1.746	1.210	1.161
	(2.50)**	(1.97)**	(0.63)	(0.78)	(4.97)***	(6.82)***	(3.86)***
flood	1.418	1.028	1.214	1.027	0.735	1.267	1.413
	(2.83)***	(0.11)	(2.09)**	(0.12)	(0.29)	(3.64)***	(2.78)**
frost	1.291	1.333	1.237	1.272	0.605	1.261	1.214
	(2.04)**	(2.54)**	(2.85)***	(1.51)	(1.31)	(4.59)***	(2.87)**
earthquake	1.798	1.798	1.203	0.776	0.484	1.485	1.568
	(1.28)	(6.14)***	(1.14)	(0.49)	(0.68)	(5.23)***	(4.55)***
hurricane	1.003	0.919	1.104	3.162	3.444	1.169	1.152
	(0.01)	(0.21)	(0.98)	(2.49)**	(1.93)*	(1.85)*	(1.35)
child age	0.879	0.902	0.846	0.869	0.925	0.882	0.754
	(9.47)***	(6.12)***	(11.01)***	(6.01)***	(4.29)***	(17.06)***	(13.47)***
child male	1.000	1.002	1.004	0.930	1.145	1.016	1.222
	(0.01)	(0.03)	(0.08)	(0.91)	(2.20)**	(0.63)	(0.96)
household size	0.946	0.967	0.940	0.953	0.946	0.953	0.965
	(5.05)***	(2.45)**	(4.89)***	(2.55)**	(3.54)***	(8.00)***	(1.45)
dependency ratio	0.969	0.937	0.947	0.896	0.859	0.931	0.993
	(1.04)	(1.72)*	(1.55)	(1.94)*	(3.25)***	(4.19)***	(0.15)***
head age	1.002	1.003	0.997	1.007	1.004	1.001	0.995
	(0.80)	(1.15)	(1.24)	(1.81)*	(1.20)	(0.64)	(0.54)
female head	0.920	1.112	1.161	0.849	1.037	1.025	0.770
	(0.76)	(0.52)	(1.28)	(1.01)	(0.30)	(0.42)	(0.79)
head indigenous	0.925	0.753	0.903	0.838	0.877	0.857	
	(1.61)	(4.84)***	(1.85)*	(2.06)**	(1.98)**	(5.89)***	
head is agricultural labourer	0.903	0.919	0.938	0.828	0.705	0.864	0.906
	(2.03)**	(1.46)	(1.10)	(2.20)**	(5.34)***	(5.46)***	(2.56)*
mother years of schooling	1.024	1.027	1.014	1.044	1.052	1.026	0.875
	(3.53)***	(3.29)***	(1.82)*	(3.56)***	(5.62)***	(7.08)***	(1.34)
% working members at home	1.595	1.584	1.950	1.508	1.993	1.720	2.159
	(1.97)**	(1.56)	(2.44)**	(1.05)	(2.03)**	(4.15)***	(3.90)***
health clinic in locality	1.111	0.684	0.657	0.987	0.533	0.789	0.817
	(0.84)	(2.58)***	(3.05)***	(0.06)	(2.82)***	(3.43)***	(1.32)
N	10678	8860	9533	3783	8454	41308	20367

(6) Logistic Regression on Pooled data; (7) Fixed Effect Logistic Regression on Unbalanced Panel for all Rounds.

* p<0.10, ** p<0.05, *** p<0.01

Table 5. Logistic Regression on Child Reported Morbidity (Odds Ratios)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Nov98	May99	Nov99	May00	Nov00	Nov98-00	Nov98-00
no_shock	0.839	0.849	0.821	0.916	0.594	0.765	0.795
	(3.73)***	(2.91)***	(3.59)***	(0.97)	(5.01)***	(10.49)***	(6.53)***
child age	0.880	0.902	0.846	0.871	0.925	0.881	0.760
	(9.43)***	(6.14)***	(11.04)***	(5.93)***	(4.30)***	(17.10)***	(13.16)***
child male	0.997	1.000	1.003	0.931	1.146	1.014	1.217
	(0.06)	(0.01)	(0.06)	(0.91)	(2.22)**	(0.57)	(0.94)
household size	0.945	0.970	0.941	0.951	0.947	0.953	0.967
	(5.15)***	(2.26)**	(4.84)***	(2.71)***	(3.48)***	(8.02)***	(1.39)
dependency ratio	0.967	0.945	0.948	0.897	0.857	0.932	0.992
	(1.12)	(1.51)	(1.54)	(1.92)*	(3.31)***	(4.12)***	(0.18)
head age	1.002	1.002	0.997	1.007	1.003	1.001	0.995
	(0.72)	(0.60)	(1.32)	(1.77)*	(1.14)	(0.42)	(0.54)
female head	0.920	1.094	1.167	0.865	1.045	1.026	0.770
	(0.75)	(0.44)	(1.33)	(0.89)	(0.36)	(0.44)	(0.79)
head indigenous	0.911	0.755	0.887	0.851	0.882	0.849	
	(1.93)*	(4.84)***	(2.21)**	(1.90)*	(1.90)*	(6.26)***	
head is agricultural laborer	0.897	0.881	0.939	0.837	0.702	0.860	0.903
	(2.17)**	(2.23)**	(1.10)	(2.09)**	(5.42)***	(5.65)***	(2.64)**
mother years of schooling	1.023	1.021	1.013	1.042	1.053	1.025	0.874
	(3.37)***	(2.62)***	(1.73)*	(3.43)***	(5.68)***	(6.83)***	(1.34)
% working members at home	1.593	1.758	1.944	1.561	1.953	1.753	2.199
	(1.96)**	(1.93)*	(2.43)**	(1.14)	(1.97)**	(4.30)***	(3.99)***
health clinic in locality	1.102	0.657	0.650	0.959	0.535	0.783	0.821
	(0.78)	(2.86)***	(3.13)***	(0.19)	(2.80)***	(3.55)***	(1.29)
N	10678	8860	9533	3783	8454	41308	31775

(6) Logistic Regression on Pooled data; (7) Fixed Effect Logistic Regression on Unbalanced Panel for all Rounds.

* p<0.10, ** p<0.05, *** p<0.01

Turning to the rest of the model in Tables 4 and 5, the age control for children is significant and below one meaning that as the child ages the risk of becoming sick decreases. The children's sex is not significant showing that girls are equally able withstand shocks as boys in this sample (i.e., no discriminatory effect against girls). The presence of health clinics within villages shows a negative and significant correlation with climatic risks, suggesting that such facilities improve the capacity of user families to avoid the chance of their children contracting a disease.

The model however does not corroborate the usual predictions regarding the determinants of children morbidity with respect to standard household characteristics. Low-earning jobs carried out by the household head, large families and high dependency ratios appear to reduce the risk of illness in children. Moreover, valuable assets for households in terms of their human and physical stock, including mother's education, the percentage of working members at home and the possession of various household appliances summarized in the asset index –though not reported in tables- have a strong and positive correlation with children morbidity.

It would be hardly credible that more deprived households are better prepared against weather-related shocks that could potentially translate into illnesses affecting their children. A more plausible explanation could be taken from the relatively standard finding in the literature that poor households are less likely to report diseases and a poor health status (Dercon et al. 2005). This is explained through a habituation effect, which states that a person brought up in a household with a great many diseases and few

medical facilities in the community may generally be unaware of the distinction between good health and bad health status, taking many disease symptoms as normal (Sen 1979, 1987, 1993, 2002; Kleinman 1988).

Our suspicion of lower (higher) self-reported illness episodes in worst-off (better-off) families is confirmed looking at some cross tabulates of health shocks reported by households, with consumption quintiles as indicators of socio-economic status. In Table 6, the proportion of children reported sick in the top decile is 27 percent which contrasts with the 18 percent reported by their counterparts in the bottom. The number of households reporting sick children as well as the number of days experiencing illness gradually increases from worst to better-off families. This appears to alter the expected destitution-morbidity link, making most household socio-economic correlates show the 'opposite' direction in the logistic regressions.

This adaptive preferences bias does not entail that we should reject our previous result on shocks and morbidity. As Table 6 shows climate shocks are all equally distributed across consumption quintiles. Moreover, if anything, the adaptive preferences bias at work reassures the validity of our central finding in this sample as it would lead to an understatement of results given that most households are poor. And yet there are strong and positive effects on children's morbidity occasioned by natural disasters.

Table 6. Household Characteristics (mean values)

	Quintiles				
	1	**2**	**3**	**4**	**5**
household size (#)	7.92	7.16	6.61	6.05	5.26
dependency ratio	1.60	1.52	1.41	1.37	1.14
head indigenous (%)	0.61	0.44	0.35	0.29	0.23
head is agricultural labourer (%)	0.69	0.67	0.65	0.62	0.54
mother schooling (years)	4.10	4.80	5.24	5.51	6.15
working members at home (%)	0.22	0.23	0.23	0.24	0.26
consumption per capita ($)	87.05	120.99	149.26	185.24	288.76
composite asset index	0.12	0.18	0.22	0.25	0.33
child sick (%)	0.18	0.19	0.22	0.23	0.27
days child sick (#)	0.90	0.96	1.14	1.24	1.48
drought	0.28	0.27	0.26	0.24	0.23
flood	0.03	0.03	0.04	0.04	0.03
frost	0.04	0.05	0.06	0.06	0.06
earthquake	0.03	0.02	0.02	0.02	0.02
hurricane	0.03	0.02	0.02	0.02	0.01

Note: Consumption in August 1998 pesos.

Source: Own calculations from ENCEL98N, ENCEL99M, ENCEL99N, ENCEL00M, ENCEL00N.

Having shown that rural Mexico is affected by a wide variety of weather-related shocks, it is important to stress that within the country, some states are more likely to suffer the consequences of this diversity. In our sample, Puebla is a clear example of this situation. Despite being landlocked and thus probably more prone to drought, its northern part is relatively close to the Gulf of Mexico, making the presence of hurricanes possible; while some of its regions are affected by an important presence of volcanic activity, making earthquakes a constant (See Map 1 and Table 2). Therefore, given the negative and statistically significant impact that weather-related shocks seem to have on children morbidity it is imperative to be aware of this 'double exposure' for those below five in rural areas in Puebla. As Table 7 corroborates, this age group is quite vulnerable against all sorts of climatic risks in this state during the period of study.

Table 7. Logistic Regression on Children Morbidity by Entity (Odds Ratios)							
	GRO	HGO	MICH	PUE	QRO	SLP	VER
household suffered drought	1.768	1.354	1.242	1.406	0.902	1.212	1.234
	(3.46)***	(4.17)***	(1.51)	(4.89)***	(0.73)	(2.92)***	(4.30)***
flood	0.687	1.646	1.453	1.362	0.950	0.578	1.167
	(0.48)	(3.33)***	(1.05)	(2.87)***	(0.11)	(1.68)*	(1.29)
frost	1.085	1.211	1.314	1.292	1.415	0.658	1.353
	(0.41)	(1.58)	(1.27)	(2.96)***	(1.70)*	(2.03)**	(2.52)**
earthquake	1.383	0.644	1.286	1.828			1.109
	(2.55)**	(0.76)	(0.42)	(4.59)***			(0.59)
hurricane	0.853	1.121	0.576	1.387			1.116
	(0.51)	(0.69)	(0.94)	(2.14)**			(0.71)
child age	0.880	0.884	0.841	0.895	0.865	0.883	0.892
	(5.14)***	(6.15)***	(7.86)***	(6.06)***	(4.54)***	(6.66)***	(8.25)***
child male	1.053	1.081	0.996	0.996	0.904	1.074	0.976
	(0.62)	(1.18)	(0.05)	(0.06)	(0.94)	(1.13)	(0.53)
household size	0.950	0.970	0.945	0.947	0.950	0.961	0.943
	(2.54)**	(1.72)*	(3.13)***	(3.56)***	(2.22)**	(2.46)**	(5.14)***
dependency ratio	0.911	0.979	0.893	0.956	0.870	0.893	0.916
	(1.57)	(0.43)	(2.23)**	(1.16)	(1.85)*	(2.54)**	(2.62)***
head age	1.007	0.997	1.004	1.000	1.002	1.002	1.003
	(1.63)	(0.84)	(1.07)	(0.05)	(0.33)	(0.76)	(1.11)
female head	1.001	1.224	0.650	1.198	1.016	1.074	0.976
	(0.00)	(1.33)	(2.21)**	(1.32)	(0.07)	(0.51)	(0.20)
head indigenous	1.007	1.001	0.647	0.788	0.705	0.776	0.947
	(0.08)	(0.01)	(0.88)	(3.44)***	(1.54)	(3.29)***	(1.09)
head is agricultural labourer	0.920	0.755	0.876	0.906	0.826	0.874	0.956
	(0.96)	(3.67)***	(1.77)*	(1.45)	(1.71)*	(2.00)**	(0.81)
mother years of schooling	1.061	1.018	1.048	1.015	1.022	1.060	1.011
	(5.21)***	(1.77)*	(3.70)***	(1.57)	(1.33)	(5.77)***	(1.61)
% working members at home	1.096	2.479	1.040	1.777	1.848	1.427	2.111
	(0.26)	(2.41)**	(0.09)	(1.77)*	(1.10)	(0.92)	(3.07)***
health clinic in locality		0.593	1.008	1.866		0.805	0.820
		(3.41)***	(0.04)	(2.45)**		(1.27)	(1.75)*
N	3571	5979	4372	6621	1875	6674	12200
Pooled data from Nov98-Nov00							
* p<0.10, ** p<0.05, *** p<0.01							

Bibliography

Dercon, Stefan (2001) "Assessing Vulnerability to Poverty. Report Prepared for the Department of International Development," Oxford: Jesus College and CSAE, Department of Economics, Oxford University: 1-79.

Dercon, Stefan with J. Hoddinott and T.Woldehanna (2005) "Shocks and consumption in 15 Ethiopian Villages, 1999-2004", in *Special Issue on Risk, Poverty and Vulnerability in Africa, Journal of African Economies*: 1-31.

Fafchamps, Marcel (2003) *Rural Poverty, Risk and Development*. Cheltenham UK: Edward Elgar.

García-Verdu, Rodrigo (2002) "Risk-sharing in Rural Mexico." *Mimeo*. Chicago: University of Chicago.

Kleinman, A. (1988) *The illness narrative: suffering, healing and the human condition*. New York: Basic Books.

Nagy, Gustavo, et al. (2006) "Understanding the potential impact of Climate Change and Variability in Latin America and the Caribbean" *Supporting Commissioned Research for the Stern Report on the Economics of Climate Change,*.

Sen, Amartya K. (1979) "Utilitiarianism and Welfarism." *The Journal of Philosophy* 76(9): 469-483.

_____ (1987) *The Standard of Living.* G Hawthorn. Cambridge. Cambridge University Press: 1-38.

_____ (1993) "Positional Objectivity." *Philosophy and Public Affairs* 22 (2): 126-145.

_____ (2002) "Health: Perception versus Observation." *British Medical Journal,* 324(7342): 860-861.

Tesliuc, Emil D and Lindert, Kathy (2002) "Vulnerability: A Quantitative and Qualitative Assessment," *Guatemala Poverty Assessment Program.* Washington, D.C.: The World Bank: 1-91.

World Bank (2005) *Income Generation and Social Protection for the Poor - Mexico.* Washington, D.C.: World Bank.