Vulnerability and resilience in Mexico: A gender and ethnicity differentiated empirical analysis based on household survey data[♦]

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Abstract:

This paper analyzes gender and ethnic differences in vulnerability and resilience to external shocks and stresses in Mexico. Vulnerability and resilience are measured by a combination of the level of household incomes per capita and the degree of diversification of these incomes. Thus, households which have poorly diversified incomes falling below the national poverty line are classified as highly vulnerable, whereas households which have highly diversified incomes above the poverty line are classified as highly resilient. Determining the true factors that affect vulnerability is important in order to devise effective policies to reduce vulnerability.

Keywords: Livelihood diversification; vulnerability; gender; ethnicity; South America; Mexico.
JEL classification codes: D13, I32, O54.

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1. Introduction

Devising sound policies to reduce vulnerability requires a good understanding of the factors that are most strongly associated with vulnerability. Many policy initiatives and interventions a priori assume that women and indigenous people are amongst the most vulnerable population groups, but often without counting on much supporting evidence for this assumption. It is simply considered common knowledge. The purpose of this paper is to test this assumption empirically for the case of Mexico.

Several other papers have discussed vulnerability in Mexico, but without actually being able to quantify and compare vulnerability by gender and ethnicity. Saldaña-Zorrilla (2007), for example, argues that the vulnerability in the agricultural sector in Mexico has increased lately due to a combination of increasing frequency of natural hazards, a 50% drop in agricultural output prices, and a sharp drop in agricultural insurance coverage. The response of farmers, he argues, is either rural-urban migration, which tends to expand slums on marginal land and thus increase vulnerability in major cities, or outright emigration. While his arguments are convincing, he does not actually develop a measure of vulnerability, and thus cannot demonstrate that it is higher in rural areas, that it is increasing over time, and that the ones most likely to migrate are the most vulnerable groups.

Likewise, Buechler (2009) argues that women in the Sonora region of Mexico are more vulnerable than men because they are more dependent on natural resources, such as water, for their fruit and vegetable production. But the analysis is very localized and qualitative, and thus does not provide a solid basis that would allow generalizations about the relationship between gender and vulnerability. Indeed, the quantitative analysis of the present paper suggests that

female headed households are significantly less vulnerable than male headed households in Mexico.

Borja-Vega and de la Fuente (2013) actually develop a quantitative measure of vulnerability in Mexico, but their unit of analysis is the municipality, so they cannot test differences in vulnerability by gender or ethnicity. Their analysis basically shows that municipalities located at the coast are currently more vulnerable because of the higher exposure to hurricanes and the ensuing flood risk.

Eakin et al. (2006) do develop a measure of vulnerability at the farm level, but since their methodology require the application of special household surveys, it could only be applied in a single municipality in Mexico (the municipality of González, in the state of Tamaulipas) as a case study, the results of which were compared to another single municipality in Argentina. They conclude that diversification remains a viable—and perhaps necessary—risk reduction strategy for farmers operating on the economic margin, whereas among commercial producers, the determining factor in their vulnerability is their access to financial and material resources that can buffer against climatic risk. While their methodology could have permitted a differentiation by gender and ethnicity, their sample size was too small to do so, and they did not even mention potential differences in vulnerability by gender and ethnicity.

The advantage of the methodology presented in the present study is that it requires only standard household surveys, which are readily available for most countries at several points in time and with national coverage.

Vulnerability is obviously a complex and multifaceted concept. In order to analyze it empirically, it is necessary to simplify it considerably. For the purpose of this paper,

vulnerability is an undesirable state which reflects the "inability to anticipate, cope with, resist, and recover from the impacts of a shock." Resilience, on the other hand, is considered a desirable state for a household or a community, as it reflects a "capacity to anticipate, cope with, resist, and recover from the impacts of a shock." There is a continuum of states in between reflecting lower or higher degrees of resilience, and we consider adaptation to be "the process of taking deliberate actions to become more resilient (or less vulnerable) in the face of adverse shocks or stresses" (see Figure 1).

Figure 1: A simple conceptualization of vulnerability, resilience and adaptation

Vulnerability   **Resilience**

Adaptation: The process of taking deliberate actions to become more resilient (or less vulnerable) in the face of adverse shocks or stresses.
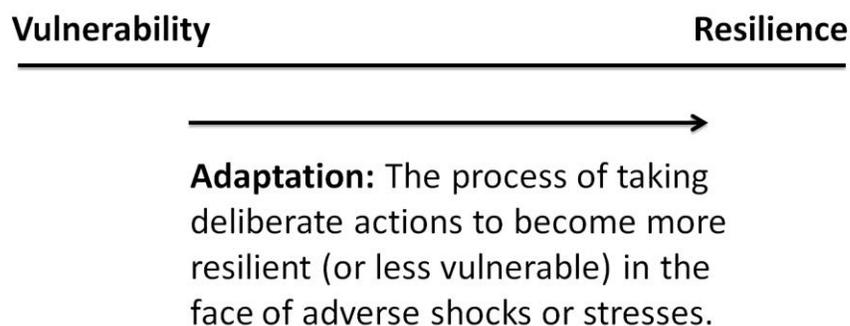
Source: Andersen et al. (2014).

Since vulnerability is an undesirable state, households will naturally try to take deliberate actions to become less vulnerable. In developed countries, buying insurance is a common way of protecting against some of the potential threats. However, not all shocks can be insured against, and insurance also comes at a significant cost, which poor and vulnerable households may not be able to afford. The population in OECD countries spends on average more than USD 3,000 per person per year on insurance (OECD, 2014), which corresponds to almost 10% of GDP. In developing countries insurance is rare, but an alternative strategy for coping with risk is livelihood diversification (Ellis, 2000; Ellis and Freeman, 2005). The greater the diversity of

income, the greater is the resilience of livelihoods to disruption from particular shocks (Adger 1999). Government policies can also help households and communities become less vulnerable, as long as there is a good understanding of which households are most vulnerable and which policies are effective at reducing vulnerability. It is to this understanding the present paper attempts to contribute by developing a quantitative measure of vulnerability which can be estimated for all households in standard national household surveys, thus allowing us to assess which factors are associated with high vulnerability.

The remainder of the paper is organized as follows. Section 2 explains the methodology applied to measure vulnerability as well as the Mexican household survey used. Section 3 estimates the underlying determinants of each of the dimensions of vulnerability: income levels and income diversification. Section 4 presents a typology of household vulnerability, and section 5 and 6 determines the factors associated with high resilience and high vulnerability, respectively. Section 7 concludes with an analysis of the policy implications.

2. Methodology and data

In order to explore which population groups are particularly vulnerable to adverse shocks, we apply the vulnerability indicators of Andersen and Cardona (2013).

Andersen and Cardona (2013) argue that although vulnerability is a very complex concept, it can usefully be quantified and analyzed at the household level using just two main indicators: i) per capita household income and ii) household income diversification. The groups that are most vulnerable would be those who simultaneously have low levels of income and low levels of diversification.

Andersen and Cardona (2013) develop a simple typology of vulnerability based on these two indicators. Households that have per capita incomes below the national poverty line and have a Diversification Index below 0.5 are classified as highly vulnerable, while households that have per capita incomes above the poverty line and a Diversification Index above 0.5 are classified as highly resilient. We have adapted this typology to the Mexican case (see Figure 2).

Figure 2: The four main vulnerability types used in this study
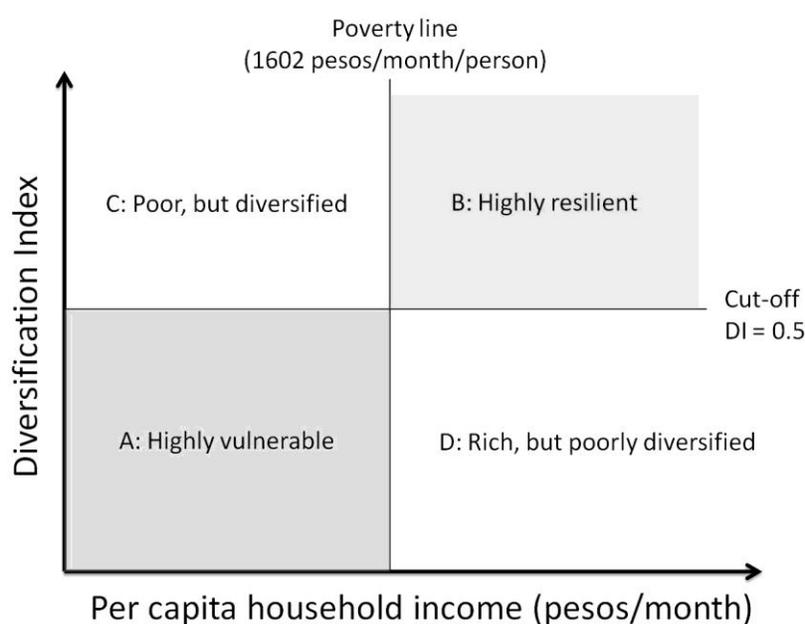
Source: Adapted from Andersen and Cardona (2013).

Diversification is the opposite of income concentration, so a simple and logical way of constructing a Diversification Index, *DI*, is simply one minus the widely used Herfindahl–Hirschman Index of Concentration:

$$DI = 1 - \sum_{i=1}^{N} p_i^2 \qquad (1)$$

where N is the total number of income sources and p_i represents the income proportion of the i-th income source. The value of the Index is zero when there is complete specialization (100% of

total household income comes from one source only) and approaches one as the number of independent income sources increases and no single source dominates household incomes (Andersen and Cardona, 2013).

The advantage of using the Diversification Index, instead of just the number of different livelihood sources, is that it that the Index is not very sensitive to the grouping of small income sources together with bigger ones. For example, if a household had three sources, contributing 90%, 9% and 1%, respectively, the Diversification Index would be 0.1818. If we lump together the last two sources, the index changes only marginally to 0.1800. This is a reduction of less than 1% in the Index, whereas the reduction in number of livelihood sources would be 33%. This property of robustness to alternative classifications is important as we will necessarily have to make some assumptions about how to classify and group different income sources together (Andersen and Cardona, 2013).

In principle, one should define "income sources" in such a way that there is very low correlation across states of nature. Thus, if both the husband and the wife is engaged in subsistence agriculture, that would count as only one income source, because adverse climatic or market conditions would affect both in a very similar way. If they also had some cattle; that would count as an additional income source, as cattle and agricultural productivity are not strongly correlated. Indeed, cattle are often used as a self-insurance mechanism in Latin America. In practice, the exact classification of sources will depend on the amount of detail available in the household surveys of the country analyzed.

In this paper, we use the 2008 ENIGH household survey from Mexico. This survey has very detailed income information for a sample of 29,407 households involving almost 120,000

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individuals. In Table 1 we show the 17 different income sources identified, the percentage of individuals that receive each type of incomes, and the average level of income from each of these sources for those who do receive it.

The most common livelihood source is the rental value of own housing. About two thirds of all individuals benefit from the imputed rental value that living in a fully owned and paid house implies and the average benefit amounts to 422 pesos per person per month[1]. The second most common income type is primary labor income, which is received by 39% of the population. The average value of this income, for those who receive it, is 5,251 pesos per month, making it by far the most valuable source of income. The third most common type of income are the benefits received from the Conditional Cash-Transfer program called "Oportunidades" at the time of the survey (now called Prospera). The average benefit from this source amounts to 292 pesos per person per month. Non-governmental cash transfers (donations from NGOs and other households as well as remittances) are almost as frequent as the "Oportunidades" payments, but more than three times larger, on average, so these also constitute a very important source of income for many households. The fifth most frequent type of income is pension payments, which are received by 4.8% of the population and which, on average, amount to 63% of primary labor incomes. This is followed in importance by secondary labor incomes, received by 2.5% of the population, and amounting to an average of 2,151 pesos per person engaged in such an activity.

Autoconsumption of own production, agricultural income, livestock income and income from hunting, gathering, logging and fishing only benefit a few percent of the Mexican population.

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[1] The exchange rate is roughly 13 pesos to one USD.

Table 1: Importance of different income sources in Mexico, individual level, 2008

Type of livelihood	% of population who benefits from this livelihood type	Average benefit per person who benefits from this type (Pesos per month)
i) Primary labor income	39.4	5,251
ii) Secondary labor income	2.5	2,151
iii) Rental income from land and real estate	1.2	3,662
iv) Interest payments, stock returns, and patents	0.4	2,266
v) Pension payments	4.8	3,284
vi) Insurance payments received	0.4	2,707
vii) Scholarships	1.2	571
viii) Donations from NGOs and other households	6.2	997
ix) Remittances	1.9	1,589
x) Benefits from the Oportunidades program	8.4	292
xi) Benefits from the Procampo program	0.8	782
xii) Benefits from other social programs	0.7	657
xiii) Agricultural income	1.7	1,644
xiv) Livestock income	0.6	2,453
xv) Hunting, gathering, fishing, logging income	0.2	1,229
xvi) Autoconsumption	2.2	298
xvii) Value of own housing property	67.4	422

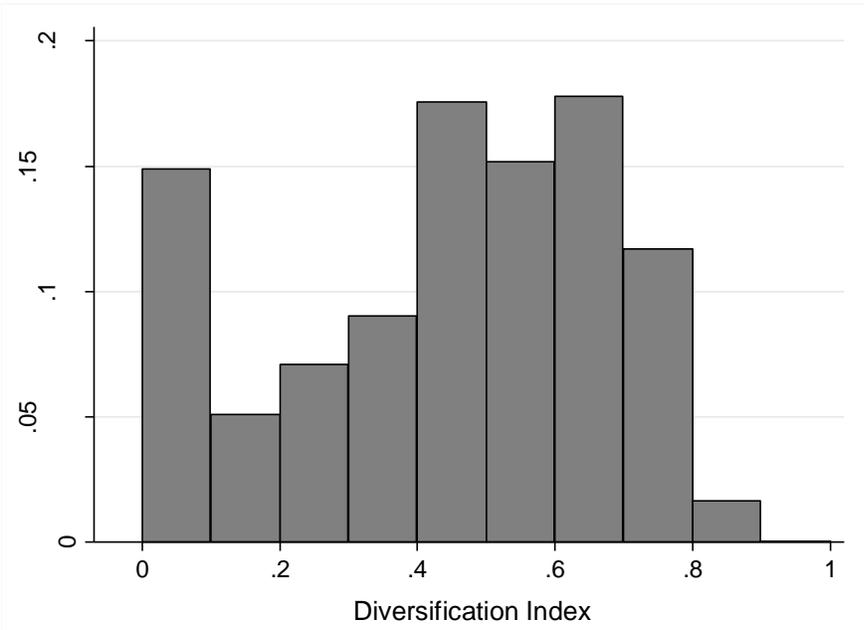*Source:* Authors' calculation based on the 2008 ENIGH household survey in Mexico.

In total, the average per capita income in Mexico is calculated at 2804 pesos per month. The poverty line was calculated at 1602 pesos in order for the poverty rate to coincide with the official poverty rate for 2008, which was 47.8% according to the World Bank's World Development Indicators.

The next step is to calculate the number of reasonably independent income sources within each household. We assume that the labor incomes of each household member are relatively

independent, so that if we have a household head who works mainly as a construction worker, but also sometimes as a taxi-driver, and a spouse who works as a teacher but also sometimes as a wedding planner, this will count as four different sources of livelihood. In contrast, if several persons in the household receive benefits from the Oportunidades program, we will count this as only one income source, because they are highly correlated (for example, the government might cancel this program at any time, affecting all recipients simultaneously). Each of the sources from iii) to xvii) are pooled within the household and count only as one income source each.

With those assumptions, we can calculate the Diversification Index for Mexico. The average Diversification index is 0.439 with a distribution as shown in Figure 3. The most common level of the Index is between 0.4 and 0.7, which is quite decent but about 15% of all households have a Diversification Index of less than 0.1.

Figure 3: Histogram for Mexico's Diversification Index

On average, rural households are significantly more diversified than urban households[2] ($DI_{rural} = 0.486$, $DI_{urban} = 0.414$), indigenous households[3] are significantly more diversified than non-indigenous households ($DI_{indigenous} = 0.527$, $DI_{no\_indigenous} = 0.430$), and households with low education levels are significantly more diversified than households with high education levels ($DI_{lowedu} = 0.497$, $DI_{highedu} = 0.381$). In contrast, there are no significant differences between male headed and female headed households ($D_{maleHH} = 0.436$, $D_{femaleHH} = 0.447$).

Obviously, there is a strong correlation between being rural, being indigenous and having low education levels, so regression analysis is necessary to disentangle the effects. In the following section we run some simple linear regressions to understand which factors are important in explaining both the level of household income per capita and the level of income diversification in the household.

3. The underlying determinants of the level of income and the level of income diversification

Table 2 shows the results of simple OLS regressions done for all households in the 2008 ENIGH household survey. The first regression shows the determinants of income, while the second regression shows the determinants of income diversification. The explanatory variables are the same for both regressions, and include the key characteristics of each household, such as level of education, location, age of the head, gender of the head, whether the head speaks an indigenous language, the number of persons in the household, and the dependency ratio. The dependency ratio is defined as the number of children (0-14 years) and old people (>64 years) divided by the number of people of working age (15-65 years) in each household.

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[2] Urban is here defined as an agglomeration of at least 15,000 persons.
[3] The classification as indigenous is by native language.

Table 2: Determinants of household income and income diversification, Mexico 2008

	Dependent variable	
Independent variables	**Log household income per capita**	**Diversification Index**
Educational attainment of head of household (excluded category is less than completed primary)		
• Primary	0.2535	0.0102
	(14.67)	(2.16)
• Secondary	0.5605	-0.0093
	(29.23)	(-1.77)
• College	1.2108	-0.0095
	(59.33)	(-1.70)
• Masters/doctorate	1.8636	-0.001
	(48.51)	(-0.14)
Location (excluded category is localities with less than 2500 inhabitants)		
• Village (2,500 – 14,999 inhabitants)	0.2209	-0.0448
	(13.59)	(-10.04)
• Town (15,000 – 99,999 inhabitants)	(0.3627	-0.0663
	(23.97)	(-15.97)
• City (100,000+ inhabitants)	0.5008	-0.0633
	(39.68)	(-18.28)
Age of head of household	0.0133	0.0055
	(38.51)	(57.57)
Female head of household dummy	-0.0615	0.0340
	(-5.67)	(11.42)
Indigenous dummy	-0.2789	0.0445
	(-18.18)	(10.57)
Number of persons in household	-0.097	0.0456
	(-39.80)	(67.91)
Dependency ratio	-0.2802	-0.0597
	(-0.4045)	(-31.41)
Number of obs.	*27,861*	*27,861*
R^2	*0,4614*	*0.2884*

Source: Authors' OLS estimation using ENIGH 2008 household survey in Mexico. The numbers in parenthesis are *t*-values.

The results for income are as expected: Per capita incomes increase with the level of education of the head, the size of the locality in which they live, and the age of the household head. Female

headed households have slightly lower per capita incomes (about 6% less than male headed households), while indigenous households have substantially lower incomes than non-indigenous households, with the difference being close to 30%. The more people in the household, the lower the level of per capita income. This is particularly so if the additional people are children or of retirement age, thus increasing the dependency ratio in the household.

The results concerning income diversification suggest that more people in the household is better, except if these are children or retired people. Both indigenous and female headed households tend to be more diversified, whereas living in urban areas or having higher education reduces the level of income diversification.

These general relationships are important to keep in mind as we analyze vulnerability and resilience in the following sections.

4. A typology of household vulnerability types based on income and diversification levels

We construct the following four groups of households with distinct vulnerability levels by combining income levels and diversification levels:

> A. Low-income and low-diversification (highly vulnerable)
>
> B. High-income and high-diversification (highly resilient)
>
> C. Low-income and high-diversification (poor, but diversified)
>
> D. High-income and low-diversification (rich, but poorly diversified).

Group A is of particular concern because it is a highly vulnerable group. Group B is interesting because it has successfully diversified without compromising income levels, thus making it highly resilient. The remaining two groups (C and D) are reference groups which we will use in

regressions to establish the determinants and factors associated with high resilience and high vulnerability, respectively.

The cut-off points used to divide the households into four groups are Diversification Index = 0.5 and per capita household income equal to the national poverty line of 1,602 pesos per person per month (see Figure 2).

This division gives us the following distribution of households in the 2008 survey:

Table 3: Number of households in each vulnerability category in the 2008 survey

	Low income	High income
High diversification	C: 5,389 households	B: 9,123 households
Low diversification	A: 6,673 households	D: 8,222 households

Source: Authors' estimation based on the 2008 ENIGH household survey in Mexico.

Table 4 provides some summary statistics for each group. The highly vulnerable group is characterized by being close to average in terms of household size, household location, percentage of households headed by a woman and ethnicity. However, this group has the lowest average age of household head and the highest average dependency ratio. In contrast, the highly resilient households stand out by having the highest education levels, the highest proportion of urban households, the smallest average household size and the smallest proportion of indigenous households.

The group that contains by far the most indigenous households is the poor, but diversified group C. In contrast female headed households are spread quite evenly across group, with only a slightly higher prevalence in the rich, but poorly diversified group D.

Table 4: Summary statistics for each category of household types

	A: Highly vulnerable	B: Highly resilient	C: poor, but diversified	D: rich, but poorly diversified	Mexico
Percent of household heads who completed secondary education	46	70	21	52	51
Average number of persons in household	4.1	3.0	5.3	4.2	4.0
Percent of households located in urban areas	56	81	32	76	65
Average age of head of household	43	46	51	54	48
Percent of households that are headed by a woman	24	25	23	27	25
Percent of households that are indigenous	9	4	22	5	9
Average dependency ratio[4]	0.96	0.47	0.86	0.44	0.65

Source: Authors' estimation based on the 2008 ENIGH household survey in Mexico.

The determinants of high resilience and high vulnerability will be formally examined in the following sections.

5. Determinants of high vulnerability

In order to understand the determinants of high vulnerability, we create a dummy which is 1 if the household is in group A and 0 if not. We then run probit regressions to see which factors are

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[4] The dependency ratio is calculated as the number of people in the household outside working age (younger than 15 or older than 65 years) divided by the number of people in the household of working age (15-65 years).

correlated with high vulnerability. We use three different reference groups: Category C, category D, and all other households. When comparing category A against category C we are asking which factors make the difference between low and high diversification within the poor group. When comparing category A against category D we are asking which factors make the difference between low and high incomes within the poorly diversified group. And, finally, when comparing category A against all others we are asking which factors are generally associated with high vulnerability.

We use probit regression and report the marginal effects as calculated by Stata 12 in Table 5.

Table 5: Determinants of belonging to category A (highly vulnerable)

Independent variables	Reference group		
	D (income channel)	C (diversification channel)	B,C,D
Educational attainment of head of household			
• Primary	-0.155	0.006	-0.029
	(-7.79)	(0.38)	(-3.35)
• Secondary	-0.332	0.070	-0.081
	(-17.20)	(3.76)	(-8.97)
• College	-0.484	0.151	-0.198
	(-44.18)	(5.51)	(-34.07)
• Masters/doctorate	-0.412	0.320	-0.194
	(-84.03)	(2.23)	(-60.26)
Number of persons in household	0.093	-0.098	-0.017
	(25.49)	(-32.80)	(-12.23)
City dummy	-0.197	0.264	-0.013
	(-15.50)	(22.21)	(-2.05)
Town dummy	-0.135	0.190	0.017
	(-9.74)	(13.58)	(2.15)
Village dummy	-0.045	0.134	0.046
	(-2.75)	(9.45)	(5.08)
Age of head of household	-0.006	-0.010	-0.007
	(-16.51)	(-24.00)	(-35.12)
Female head of household dummy	0.073	-0.074	-0.014
	(6.14)	(-5.85)	(-2.48)

Indigenous dummy	0.125	-0.141	-0.030
	(6.73)	(-10.18)	(-4.03)
Dependency ratio	0.130	0.096	0.117
	(16.22)	(14.10)	(32.70)
Number of obs.	*14865*	*11472*	*27900*
R^2	*0.2603*	*0.2149*	*0.1387*

Source: Authors' estimation of the marginal effects from probit regressions using ENIGH 2008 household survey in Mexico. The numbers in parenthesis are *z*-values.

Analyzing the results in the last column we can see that the most important factor in reducing high vulnerability is the educational attainment of the head of household, specifically completing post-secondary education. This characteristic reduces the probability of belonging to the highly vulnerable group by 19 percentage points compared to incomplete primary education, and the positive effects works through the income channel. Another important factor is the age of the head of household. An extra decade reduces the probability of falling into the highly vulnerable category by 7 percentage points and works both through the diversification channel and through the income channel.

Although having more people in the household reduces vulnerability, it is important that these additional people are of working age, because a high dependency burden is another very important factor in increasing vulnerability. A high dependency ratio increases vulnerability both through the income channel (by reducing per capita income in the household) and through the diversification channel.

Having a female as head of household has a small, barely significant effect on reducing vulnerability. Classification as indigenous has a slightly larger beneficial effect, which works exclusively through the diversification channel. When controlling for education, location, family

composition, etc, indigenous households are about 3 percentage points less likely to be highly vulnerable than non-indigenous households.

Location does not seem to be an important determinant of vulnerability as the location variables had an unsubstantial effect on belonging to the vulnerable group, with the exception of the village dummy variable, which had a small, positive effect (increasing the likelihood of being highly vulnerable by close to 5 percentage points compared to rural households).

6. Determinants of high resilience

Similarly, to establish the determinants of high resilience we create a dummy which is 1 if the household is in group B and 0 if not. We then run probit regressions to see which explanatory factors are correlated with high resilience. We use three different reference groups: Category D, category C, and all other households. Again, the interpretation is slightly different in each case. When comparing category B against category D we are asking: Which factors make the difference between low and high diversification within the rich group? When comparing category B against category C we are asking which factors make the difference between low and high incomes within the highly diversified group. And, finally, when comparing category B against all others, we are asking which factors are generally associated with being highly resilient.

We use Stata 12 to run probit regressions and report the marginal effects in Table 6.

Table 6: Determinants of belonging to category B (Highly resilient)

Independent variables	Reference group		
	C (income channel)	D (diversification channel)	A,C,D (total effect)
Educational attainment of head of household			
• Primary	0.137	-0.017	0.114
	(9.04)	(-0.76)	(10.16)
• Secondary	0.266	-0.092	0.162
	(18.47)	(-4.10)	(12.53)
• College	0.400	-0.112	0.216
	(44.41)	(-5.03)	(14.77)
• Masters/doctorate	0.367	-0.104	0.254
	(68.30)	(-3.35)	(9.30)
Number of persons in household	-0.046	0.144	0.033
	(-19.20)	(46.24)	(23.68)
City dummy	0.381	-0.070	0.130
	(35.22)	(-4.97)	(16.70)
Town dummy	0.224	-0.073	0.099
	(19.77)	(-4.46)	(9.42)
Village dummy	0.136	-0.030	0.068
	(10.13)	(-1.61)	(6.01)
Age of head of household	0.006	0.010	0.009
	(15.68)	(30.05)	(40.96)
Female head of household dummy	-0.026	0.112	0.030
	(-2.19)	(10.97)	(4.51)
Indigenous dummy	-0.199	0.056	-0.077
	(-12.61)	(2.84)	(-8.92)
Dependency ratio	-0.184	-0.156	-0.149
	(-22.14)	(-19.68)	(-31.28)
Number of obs.	*12977*	*16428*	*27900*
R^2	*0.3211*	*0.1905*	*0.1279*

Source: Authors' estimation of the marginal effects from probit regressions using ENIGH 2008 household survey in Mexico. The numbers in parenthesis are *z*-values.

In the last column of Table 6 we can see that the most important factor in explaining the probability of being a highly resilient household (as judged by the size of the *z*-value) is the age of the head of household. Each decade extra increases the probability of being in the highly

resilient group by 9 percentage points. As expected, this beneficial effects works both through the income channel and the diversification channel. The second most important factor is the dependency ratio. A family with one dependent person per working age person would on average be 15 percentage points less likely to be resilient than a family with zero dependents per working age person. Again, this effect works through both channels, as a large dependency ratio has a detrimental effect on the level of diversification and the level of income.

Other important factors in determining resiliency are the number of persons in the household and the educational attainment of the household head. Although the number of persons in the household has a negative effect on income, overall each additional person increases the likelihood of being highly resilient by about 3 percentage points, all other things equal. Households with more members are more likely to be highly resilient, but the members have to be of working age, as a high dependency ratio (more children and old people per working age person) has a negative effect on resilience. Although more education generally means less diversification, the overall effect of education on resilience is positive, as the income channel dominates the diversification channel. Households with a head who holds a masters or doctoral degree are 25 percentage points more likely to be highly resilient than households with heads that have not completed primary education.

Location also seems to matter: the more urban the setting, the larger the positive effect on resiliency. This effect works exclusively through the income channel, as urban households tend to be significantly less diversified. Living in a city increases the probability of a household being in the highly resilient group by 13 percentage points, compared to living in rural areas, all other things equal.

While having a female head of household negatively affects income, the overall effect on resilience is positive, as female headed households tend to be much more diversified. All other things equal, having a female head of household increasing the chances of belonging to the highly resilient group by 3 percentage points.

Classification as indigenous, meanwhile, reduces the probability of being in the highly resilient group by about 8 percentage points, an effect which works exclusively through the income channel.

7. Conclusions and policy implications

This paper has analyzed gender and ethnic differences in vulnerability and resilience to external shocks and stresses in Mexico. Vulnerability and resilience are measured by a combination of the level of household incomes per capita and the degree of diversification of these incomes. Thus, households which have poorly diversified incomes falling below the national poverty line are classified as highly vulnerable, whereas households which have highly diversified incomes above the poverty line are classified as highly resilient.

We have analyzed the determinants of falling in both the highly vulnerable category and the highly resilient category, and in neither case are gender and ethnicity important factors. Indeed, controlling for all other factors, female headed households and indigenous households are less likely fall in the highly vulnerable group than male headed and non-indigenous households. Female headed households are also more likely to fall in the highly resilient category than male headed households, whereas indigenous households are substantially less likely to fall in the

highly resilient category. This means that indigenous households are more likely to fall in the category of households that are poor, but diversified.

While gender and ethnicity are not very important factors for determining vulnerability, education levels, dependency ratios, and the age of the head of household are very important. Public policies can be implemented to help reduce vulnerability by targeting these three important factors.

First, the government can promote access for everybody to high-quality education at least up to college-level. This involves standard interventions promoting both supply of and demand for education.

Second, the government can promote adequate family planning, which helps prevent both high dependency ratios and very young family heads. Households whose heads are 26 years or younger are twice as likely (43%) to be highly vulnerable than households whose heads are 27 years or older (22%). If, in addition, these young households have one or more kids, the probability of being highly vulnerable increases to 57%.

While female headed households are not particularly vulnerable according to the present analysis, women within male headed households may suffer disproportionately in the face of shocks. Women and girls are often responsible for most of the unpaid care tasks around the household, which means they may be more directly affected by external shocks. For example, climate change is expected to cause more extreme precipitation patterns, with more droughts and more floods (IPCC, 2013), and in both cases it is typically women that have to work harder to obtain water during droughts, and dealing with the mess and increased disease burden caused by floods (Denton, 2009). Also, if the male head is responsible for generating most of the income in

the household, the female partner is left extremely vulnerable in case something happens to the male head.

Public policies can help reduce the vulnerability of women within male headed households by promoting women's access to the labor market. Free public pre-school facilities of good quality makes it easier for mothers to work, thus not only increasing household income, and increasing household income diversification, but also making wives less dependent on their husbands' income earning capacity. Encouraging labor legislation that allows more flexible work arrangements would generally also help families with children.

Indigenous families are concentrated in the category with low, but diversified incomes. The challenge for this group is to increase incomes without sacrificing diversification. According to our income regression, the main factors associated with higher incomes are the level of education of the household head and the size of the locality in which they live. Indigenous heads of household are less than half as likely to have completed high school as non-indigenous heads of household (21% versus 53%) and they are almost three times more likely to reside in rural areas (52% for indigenous households versus 19% for non-indigenous households).

While public investment can be increased to improve the access of indigenous children to education, it is less clear how to increase urbanization rates for indigenous people, or even if such a policy would be desirable. Indigenous people tend to have a strong sense of "belonging" to their territory, often defining themselves with reference to a territory and a particular way of living there (Del Popolo et al., 2007). The distinction between land and territory is therefore important, with the former being understood as a means of production and the latter as a culturally-constructed life environment (Bartolomé, 1997). The concept of territoriality has

served as the basis for the demands of indigenous movements, thereby making territory an aspect of identity (Toledo-Llancaqueo, 2005). Add to this attachment to ancestral territories the problem of discrimination against indigenous people in cities, as well as the much higher costs of living in urban areas (Del Popolo et al., 2007), and the low rate of urbanization among indigenous people becomes understandable.

Still, some indigenous people are migrating, and the process is gaining momentum. The high level of poverty in indigenous territories is an important push-factor (Rodríguez, 2004), as is forced displacement (Bello, 2004), and once indigenous migrant communities have been established in the cities (often indigenous ghettos), these tend to attract further indigenous migrants. According to Bastos (1999), indigenous migrants establish multiple and complex connections with their communities of origin and the indigenous migrant communities at their destination, thus transcending the concept of space as a closed and exclusive entity and turn it into a symbolically inclusive category.

According to Rodríguez (2007), the main policy-challenges related to indigenous migration are the following: (a) maximize the positive impact of migration for those indigenous people who choose that path; (b) use migratory flows creatively to strengthen cultures of origin, while preventing a "cultural lockdown" from blocking out the culture of the destination; (c) stamp out those forces that generate forced displacement from places of origin (especially rural areas); (d) ensure that the drain of relatively skilled people in the prime of their working life does not result in a serious deterioration of the communities of origin in rural areas; and (e) take advantage of migration as a source of resources and ties for precisely those communities that remain in the ancestral territories (Rodríguez, 2007).

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