Institute for Advance Development Studies

02/2013

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Development Research Working Paper Series
02/2013

First version: June 2013
This version: September 2014

Building Resilience against Adverse Shocks: What are the determinants of vulnerability and resilience?♦

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Abstract:

This paper proposes a simple way to measure livelihood diversification, and uses this measure together with income levels to classify Bolivian households by level of vulnerability. Regression analysis is then carried out to determine the factors and strategies associated with high resilience or high vulnerability. The results show that the single most important strategy for resilience is to have a working and income earning spouse in the household. This is still much too uncommon in Bolivia. A second important factor is the age of the head of household. Young families are considerably more vulnerable than more mature families, as the former have not had time to build up assets (physical, human and social capital) that can provide alternative sources of livelihood. One of the most surprising results of the study is that urban households are considerably more vulnerable to adverse shocks than rural households, whereas gender and ethnicity are irrelevant. The paper finishes with a comprehensive list of policy recommendations.

Keywords: Livelihood diversification, resilience, vulnerability, external shocks, Bolivia.
JEL classification codes: D13, I32, O54.

♦ The authors are grateful for the constructive feedback and suggestions received from Ioulia Fenton, Beatriz Muriel and participants at the 5th Bolivian Conference on Development Economics held in Santa Cruz de la Sierra November 14-15, 2013.

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1. Introduction

Adverse shocks to livelihoods can take many forms: Natural disasters, climate change, illness, unemployment, technological change, price fluctuations, conflict, vandalism, fire, robbery, pest attacks, accidents, etc. The list is endless, and it is important for households to build up resilience against all of these, so that they will be able to overcome the adverse shocks that will inevitably happen from time to time.

Buying insurance is a common way of protecting against some of these threats in developed countries. However, not all shocks can be insured against, and insurance also comes at a significant cost. The population in OECD countries spends on average more than USD 3,000 per person per year on insurance1, which corresponds to almost 10% of GDP. In developing countries insurance is rare, but an important strategy for coping with risk is livelihood diversification (Ellis, 2000; Ellis and Freeman, 2005). The greater the diversity of income, the greater the resilience of livelihoods to disruption from particular sources (Adger 1999). Ellis (2000) defines livelihood diversification as "the process by which households construct an increasingly diverse portfolio of livelihood activities and assets in order to survive or improve living standards."

Livelihood diversification contributes to the resilience of a household because adverse shocks typically attack only one livelihood source at a time, leaving households with many different and unrelated livelihood sources better able to keep functioning in the presence of an adverse shock. However, some authors have noted that diversification may come at a cost if there is a trade-off between the benefits of diversification and the benefits of specialization (Eriksen et al., 2005). Anderson and Deshingkar (2005) argue that diversification of income sources does not necessarily increase a household's income due to the cost of diversification. In their study in rural India, they find that when a household change from one to two income sources – their total income is reduced by 15%, on average, because of the cost of diversification. This trade-off is confirmed by the present paper, as we find a clear negative correlation between livelihood diversification and level of income.

However, we are mainly interested in the exceptions to this general negative relationship. That is, households that have managed to achieve high levels of income and high levels of diversification (resilient households) as well as those who have failed in both dimensions (vulnerable households). The objective of this paper is to explore which factors and strategies are associated with resilience and which factors are associated with high vulnerability.

In the literature, livelihood diversification has been studied mainly in the rural context (e.g. Ellis 1989; Barrett et al., 2001; Niehof, 2004; Valencia & Vera, 2009). In this paper, however, we show that urban households are in general less diversified and more vulnerable. This has rarely been indicated in the literature, although the relatively high level of livelihood diversification in rural Bolivia has also been noticed by other authors. Jimenez (2007), for example, shows that only 52% of rural incomes come from agro-pastoral activities, while the rest comes from non-farm work such as teaching or commerce, government transfers, remittances, and rental income.

[1] OECD: http://www.oecd-ilibrary.org/finance-and-investment/average-insurance-spending-per-capita_20755066-table3.

In this paper we first present a simple index of livelihood diversification and calculate it for all households in the 2011 Household Survey in Bolivia (section 2). We then use the results to demonstrate the average trade-off between income level and diversification level which allows us to calculate the average cost of diversification (section 3). We then proceed to divide households into a typology of four different vulnerability categories: A: Low-income and low-diversification (highly vulnerable); B: High-income and high-diversification (highly resilient); C: Low-income and high-diversification (poor, but resilient); and D: High-income and low-diversification (rich, but vulnerable), and we describe typical members of each of the four categories (section 4). The second group is the most desirable, and we use regression analysis to explore the determinants of ending up in this group (section 5), just as we explore the determinants of ending up in the most vulnerable group (section 6). In section 7 we conduct a sensitivity analysis by classifying households in alternative ways. Finally, section 8 provides conclusions and policy recommendations.

2. A simple index of livelihood diversification

A key to resilience is to have several independent sources of livelihoods, so that the loss of any one of them does not dramatically affect the household's ability to function (Adger 1999). However, some income sources may be very marginal (for example interest earned on bank savings) so it is not quite enough just to count the number of different income sources, as is done for example in Valencia & Vera (2009).

The concept of diversification that we are trying to measure is the opposite of income concentration, so a simple and logical way of constructing a Diversification Index, *D*, is simply one minus the widely used Herfindahl–Hirschman Index of Concentration:

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

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 incomes come from one source only) and approaches one as the number of income sources increases and no single source dominates household incomes. For reference, Table 1 shows the Diversification Index values for different numbers of *equally important* income sources.

Table 1: Reference values of the Diversification Index for different numbers of equally important income sources

Number of equally important income sources	1	2	4	5	8	10
Diversification Index value	0	0.5	0.75	0.8	0.88	0.9

Source: Authors' calculation based on formula (1).

It is important to notice, however, that the Diversification Index will not always increase with the number of income sources, as the distribution across income sources is more important than the number of income sources. For example, if a household has one main income source that is responsible for 90% of all household incomes, and 10 other sources that are very marginal (1% each), this household is still very vulnerable, because the income is extremely concentrated, and the household will be unable to function if it loses its main source (usually the primary labor income of

the household head). The Index will reflect this vulnerability with a low value of 0.189, suggesting that it is better than having just one income source, but not as good as having two equally important income sources.

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 has 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 the 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.

This measure of diversification has also been used by other authors. Fiszbein (2013), for example, uses the same formula to construct an Index of Agricultural Diversification as well as an Index of Diversification Potential at the county level in the United States in the early XXth century, and uses this to demonstrate a significant and long-lasting causal effect between the level of diversification in 1860 and the development outcomes both 60 and 140 years later.

The first step towards calculating the Diversification Index is to identify all the different sources of livelihoods for each individual. In the standard household surveys conducted by the National Statistical Institute (INE) of Bolivia it is possible to identify the following ten types[2]: i) primary labor income (including payments in kind, such as housing), ii) secondary labor income, iii) pension payments (including veteran benefits, incapacity benefits, and widow/orphan benefits), iv) the school incentive (Bono Juancito Pinto), v) the maternal health incentive (Bono Juana Azurduy), vi) remittances (and other cash transfers received from other households, including child support), vii) rental income (including interest and dividends), viii) value of other donations and exchanges in kind, ix) value of auto-consumption of own production and x) imputed rental value of own housing property.

Table 2 shows that 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 Bs. 137 per person per month[3]. The second most common income type is primary labor income, which is received by 38% of the population. The average value of this income, for those who receive it, is Bs. 2104 per month, making it the most valuable source of income. The third most common type of income is the school incentive (Bono Juancito Pinto), but it amounts to only Bs. 17 per month, so it is important only for the poorest of the poor. Remittances and similar transfers from other households are both common (7.2% of individuals receive remittances) and important (averaging Bs. 793 per month).

[2] Some rare categories have been merged with other similar types of incomes, so that no category is so rare that less than one percent of the population receives it.
[3] The exchange rate is roughly Bs. 7 to one USD.

Table 2: Importance of different livelihood types in Bolivia, individual level, 2011

Type of livelihood	% of population who benefits from this livelihood type	Average benefit per person who benefits from this type (Bs. per month)
i) Primary labor income	38.4	2104
ii) Secondary labor income	3.3	975
iii) Pension payments etc.	8.3	633
iv) Bono Juancito Pinto	16.4	17
v) Bono Juana Azurduy	1.6	55
vi) Remittances etc.	7.6	801
vii) Rental income etc.	2.5	844
viii) Value of donations etc.	7.7	52
ix) Value of auto-consumption of own production	10.0	446
x) Value of own housing property	63.1	137

Source: Authors' calculation based on INE's 2011 Household Survey.

The next step is to calculate the number of reasonably independent livelihood 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 they have three kids who each receive the Bono Juancito Pinto, we will count this as only one livelihood source rather than three, because they are highly correlated (for example, the government might cancel this incentive at any time, affecting all three simultaneously). Each of the sources from iii) to x) are pooled within the household and count only as one livelihood source each.

With those assumptions, Table 3 shows that in 2011, the most common number of livelihood sources among Bolivian households was four. Obviously, larger households tend to have more different sources, but even single-person households tend to diversify. For example, in the 2011 survey of 8851 Bolivian households we identified 197 single-person households with four distinct income sources.

Table 3: Distribution of Bolivian households by number of household members and number of income sources per household, 2011

Number of income sources per household	Number of persons in household										Total
	1	2	3	4	5	6	7	8	9	10+	
0	3	2	1	1	0	1	0	0	0	0	8
1	266	88	132	71	38	6	2	0	0	0	603
2	263	224	281	228	102	29	3	2	0	0	1132
3	240	320	391	387	216	75	18	4	4	0	1655
4	197	298	352	400	274	131	60	12	6	1	1731
5	133	224	230	312	276	162	80	39	12	6	1474
6	55	144	123	182	197	175	103	42	21	16	1058
7	6	71	58	95	120	107	61	50	23	15	606
8	1	24	23	33	53	58	54	34	21	25	326
9	0	5	5	12	11	27	27	17	20	9	133
10+	0	0	1	10	17	18	20	17	14	28	125
Total	1164	1400	1597	1731	1304	789	428	217	121	100	8851

Source: Authors' calculation based on INE's 2011 Household Survey.

It is of note however that many of the income sources contribute only marginally to total household income and do not contribute much to the Diversification Index. Whereas two equally important income sources imply a Diversification Index of 0.5, an un-equal pair of income sources (e.g. 90% and 10%, respectively) implies an Index of only 0.18.

Table 4 shows the average Diversification Index for different household sizes, indicating a clear positive relationship, with more populous households being more diversified.

Table 4: Average Diversification Index for different household sizes, Bolivia 2011

Number of household members	1	2	3	4	5	6	7	8	9	10+
Diversification Index value	0.337	0.446	0.398	0.440	0.458	0.504	0.536	0.563	0.605	0.652

Source: Authors' calculation based on INE's 2011 Household Survey.

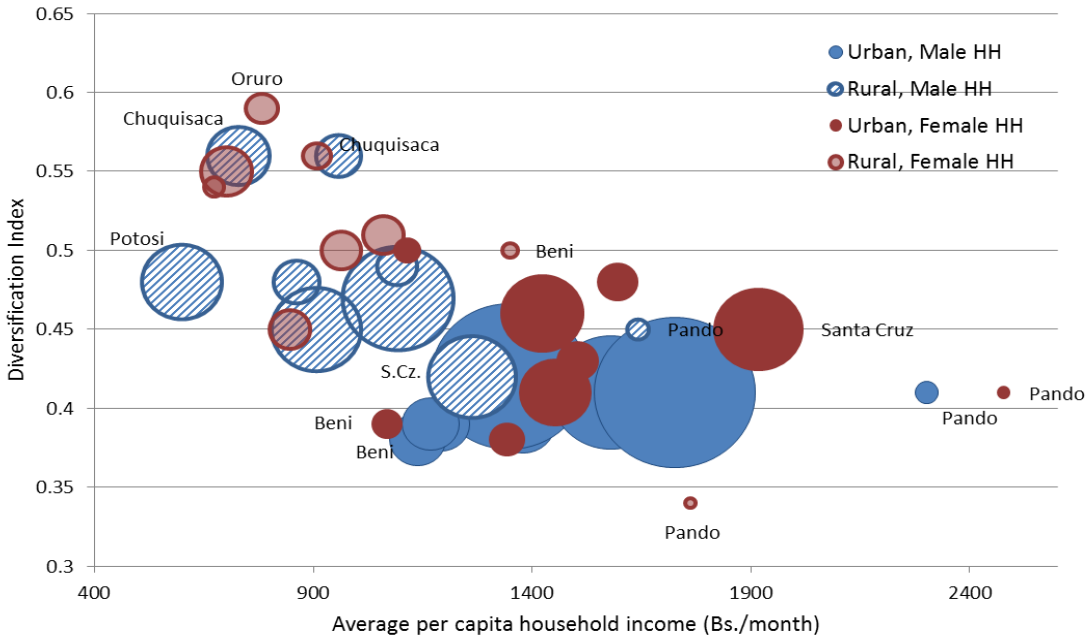
On average, rural households are significantly more diversified than urban households (D_{rural} = 0.483, D_{urban} = 0.421) and female headed households are a bit more diversified than male headed households (D_{maleHH} = 0.434, $D_{femaleHH}$ = 0.464). Indigenous households[4] are more diversified than non-indigenous households ($D_{indigenous}$ = 0.473, $D_{no\_indigenous}$ = 0.420), while relatively educated households are significantly less diversified than households where the head has not completed secondary education (D_{lowedu} = 0.469, $D_{highedu}$ = 0.396). All the mentioned differences are statistically significant with more than 95% confidence.

[4] The classification as indigenous is by native language.

3. The costs of livelihood diversification

Figure 1 shows a scatter plot of the Diversification Index against average per capita household income by state, gender of the head of household and area in 2011. There is a clear negative correlation indicating that the level of income is inversely related to the level of diversification. Urban households in Pando have by far the highest levels of per capita income, but they also have very low levels of livelihood diversification, which makes them vulnerable to external shocks, such as a drop in the price of Brazil nuts or a devastating wild fire. In contrast, rural female headed households in Oruro and Chuquisaca are among the most diversified groups in the figure. They also have very low levels of income, however.

Figure 1: Diversification Index and average per capita household income by state, gender of the head of household and area, 2011



Source: Authors' calculation based on INE's 2011 Household Survey.

The negative relationship between income levels and diversification levels implies that livelihood diversification is not purely beneficial but that there might be some costs involved. Eriksen et al. (2005), for example, found that there were economies of scale to be reaped when specializing and concentrating efforts in Africa. Likewise, Anderson and Deshingkar (2005) found significant costs of diversification in rural India.

To confirm this negative relationship at the household level, we run a simple regression of the Diversity Index, D_i, on per capita income, Y_i:

$$Y_i = \alpha + \beta D_i + \varepsilon_i \qquad (2)$$

Table 5 shows the regression coefficient, β, for all households as well as for rural and urban households.

Table 5: Estimates of the trade-off between income and diversification

	β	*Std.error*
Rural households	-1454***	96
Urban households	222**	88
Bolivia	-363***	69

Source: Authors' estimation based on INE's 2011 Household Survey.

*** Coefficient statistically different from 0 at a 99% confidence level.

** Coefficient statistically different from 0 at a 95% confidence level.

The overall coefficient of -363 indicates that households that have a Diversification Index of 0.5 rather than 0.4, would tend to have per capita incomes that are lower by about Bs. 36 per month. However, this trade-off appears to be purely a rural phenomenon. Here, an increase in the Diversification Index from 0.4 to 0.5 would be associated with a reduction in per capita income of Bs. 145 per month. In contrast, in urban areas there is no-trade off, indeed the coefficient is slightly positive, indicating that higher diversification and higher income goes hand in hand.

It is not clear why there would be such a strong trade-off between income and diversification in rural areas. Previous studies have showed that diversification into non-agricultural activities help both to increase and to stabilize incomes in rural Bolivia (Andersen & Valencia, 2010; Valencia & Vera, 2009; Jimenez, 2007). It may partially be an artifact of the construction of the Index, as very marginal income sources, such as the Bono Juancito Pinto, may constitute a significant income source in the poorest households, and thus pull up the Index value, whereas the same Bono is insignificant for richer households and hardly moves the Index.

In the present paper, we are mostly interested in the exceptions to this negative relationship: Households that have managed to successfully diversify livelihoods without sacrificing income (highly resilient households) and households that have managed neither to diversify nor to increase incomes (highly vulnerable households). The rest of the paper is dedicated to determining the factors and strategies that make households either resilient or vulnerable in this sense.

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

By combining income levels and diversification levels, we can construct the following four groups of households with distinct vulnerability levels:

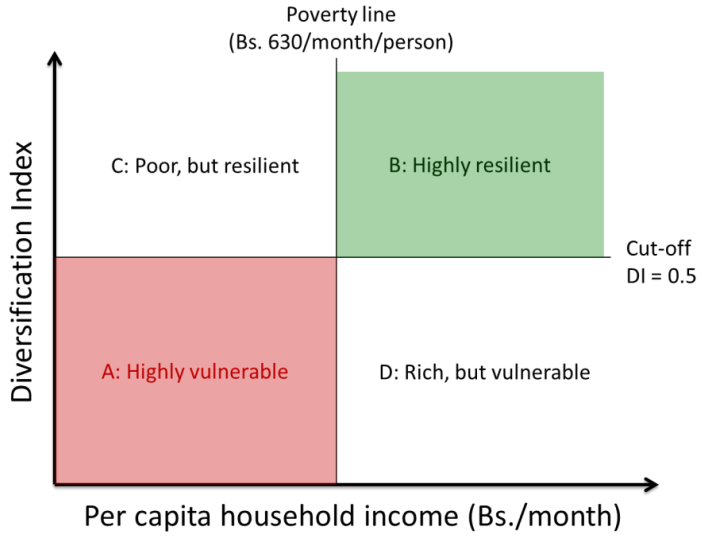
A. Low-income and low-diversification (highly vulnerable)
B. High-income and high-diversification (highly resilient)
C. Low-income and high-diversification (poor, but resilient)
D. High-income and low-diversification (rich, but vulnerable).

The first group is of particular concern because it is a highly vulnerable group. The second group is interesting because it has successfully diversified without compromising income levels, thus making it highly resilient. The remaining two groups 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 Bs. 630 per person per month. See figure 2.

Figure 2: Four main vulnerability types



This division gives us the following distribution of households in the 2011 survey:

Table 6: Number of households in each vulnerability category in the 2011 survey

	Low income	High income
High diversification	C: 1466 households	B: 2886 households
Low diversification	A: 1409 households	D: 3090 households

Source: Authors' estimation based on INE's 2011 Household Survey.

Table 7 provides some summary statistics for each group. The highly vulnerable group is characterized by being average in terms of education level, household size, location, indigenousness and dependency ratio. However, these households stand out in other aspects. For example, they are relatively young households (as judged by the age of the head of household), very few of them receive remittances, few have managed to land a public sector job, and few include a working spouse. In contrast, the highly resilient households stand out by being relatively old, having very low dependency ratios, having the highest likelihood of receiving remittances, and being about four times more likely to have a working spouse and a public sector job than the highly vulnerable group.

Table 7: Summary statistics for each category of household types

	A: Highly vulnerable	B: Highly resilient	C: poor, but resilient	D: rich, but vulnerable	Bolivia
Average years of education of head of household	7.8	8.9	*4.9*	**10.3**	8.6
Average number of persons in household	**4.6**	4.1	**4.6**	*2.9*	3.8
Percent of households located in urban areas	63	**76**	*32*	**76**	67
Average age of head of household	*38*	**52**	50	42	46
Percent of households that are headed by a female	*18*	**25**	24	22	23
Percent of households that are indigenous	47	33	**69**	*29*	40
Average dependency ratio	1.24	1.05	**1.48**	*0.84*	1.07
Percent of households that receive remittances	*2.5*	**7.8**	6.6	5.2	5.9
Percent of households that have somebody working in the public sector	*5.5*	**22.2**	4.8	15.5	14.4
Percent of households with a working (income earning) spouse	*15.2*	**58.5**	26.1	25.5	34.8

Source: Authors' estimation based on INE's 2011 Household Survey.
Note: Lowest value in each line are in italic and highest value in bold.

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

5. Determinants of high resilience

In order 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. 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 resilient?

We use Stata 12 to run probit regressions and report the marginal effects in Table 8.

Table 8: Determinants of belonging to category B (Highly resilient)

	Reference group		
Independent variables	**C (income channel)**	**D (diversification channel)**	**A,C,D (total effect)**
Years of education of head of household	0.014 (7.38)	-0.004 (2.78)	0.002 (2.14)
Number of persons in household	-0.046 (-12.40)	0.078 (17.68)	0.012 (4.34)
Urban dummy	0.244 (13.15)	-0.126 (6.84)	0.026 (2.06)
Age of head of household	0.005 (9.32)	0.012 (22.02)	0.010 (26.30)
Female head of household dummy	-0.019 (-1.02)	0.051 (2.89)	0.016 (1.25)
Indigenous dummy	-0.167 (-9.96)	-0.022 (-1.31)	-0.077 (-6.61)
Dependency ratio	-0.019 (-4.38)	-0.002 (-0.35)	-0.015 (-4.69)
Remittance dummy	0.069 (2.74)	0.160 (5.47)	0.120 (5.04)
Public sector dummy	0.183 (9.33)	0.037 (1.91)	0.087 (5.37)
Working spouse dummy	0.169 (10.33)	0.331 (23.18)	0.312 (27.39)
Number of obs.	*4351*	*5937*	*8848*
R^2	*0.2687*	*0.2175*	*0.1747*

Source: Authors' estimation of the marginal effects from probit regressions using INE's 2011 Household Survey. The numbers in parenthesis are z-values.

In the last column of Table 8 we can see that the factor that is most important in explaining the probability of being a highly resilient household (as judged by the size of the z-value) is the presence of a working spouse in the household. This characteristic increases the probability of belonging to the highly resilient group by about 31 percentage points. As expected, this beneficial effects works both through the income channel and the diversification channel. The second most important factor is the age of the age of head of household. Each decade extra increases the probability of being in the highly resilient group by 10 percentage points. Again, this effect works through both channels, as age has both a beneficial effect on the level of diversification and the level of income.

Two other factors with similar positive effects in both directions, although on a smaller scale, are: remittances and a public sector job. Households that receive remittances (national or international) are about 12% more likely to belong to the highly resilient group than those that do not; and households that hold at least one public sector job are about 9 percentage points more likely to belong to the successful group, 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.

The factors that negatively affect the likelihood of being resilient are the classification as indigenous by native language (reduces likelihood by 8 percentage points) and a high dependency ratio[5]. These two factors work mainly by reducing income, whereas the effect on diversification is insignificant.

Education and urban location have a very small, barely significant effect on resilience. Having a female as head of household instead of a male, has no significant effect on resilience.

6. Determinants of high vulnerability

In a similar fashion, 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 correlated with high vulnerability. Again 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?

Again we use probit regression and report the marginal effects as calculated by Stata 12 in Table 9.

Table 9: Determinants of belonging to category A (highly vulnerable)

	Reference group		
Independent variables	**D (income channel)**	**C (diversification channel)**	**B,C,D**
Years of education of head of household	-0.013 (-7.48)	0.007 (2.45)	-0.004 (-5.15)
Number of persons in household	0.110 (24.60)	-0.016 (-3.08)	0.027 (15.70)
Urban dummy	-0.038 (-2.07)	0.329 (14.98)	0.043 (5.65)
Age of head of household	-0.005 (-9.05)	-0.011 (-13.46)	-0.005 (-19.85)
Female head of household dummy	0.074 (3.71)	-0.099 (-3.73)	-0.005 (-0.52)
Indigenous dummy	0.069 (4.03)	-0.049 (-2.16)	0.027 (3.31)
Dependency ratio	0.036 (6.68)	0.012 (1.73)	0.019 (7.90)

[5] 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).

Remittance dummy	-0.115 (-3.90)	-0.131 (-2.76)	-0.070 (-6.69)
Public sector dummy	-0.106 (-5.06)	0.072 (1.56)	-0.059 (-6.37)
Working spouse dummy	-0.141 (-9.32)	-0.263 (-11.25)	-0.122 (-18.21)
Number of obs.	*4487*	*2875*	*8848*
R^2	*0.2210*	*0.1997*	*0.1480*

Source: Authors' estimation of the marginal effects from probit regressions using INE's 2011 Household Survey. The numbers in parenthesis are z-values.

From analyzing the results in the last column we can see that the most important factor in reducing high vulnerability is the age of the head of household. Adding 20 years will reduce the probability of being in the highly vulnerable category by 10 percentage points, and again it works through both the income and diversification channels. Another important factor is having a working spouse in the household. This reduces the probability of falling into the highly vulnerable category by 18 percentage points and works both through the diversification channel and through the income channel. The next most important factors are remittances and a public sector job, which both reduce the probability of falling into the worst category by about 6 or 7 percentage points. Education also works, but the effect is not large. Ten extra years of education will only decrease the probability of high vulnerability by 4 percentage points. This effect works through the income channel.

Among the factors that increase the probability of falling into the high vulnerability category is the number of persons in the household. For each additional person the probability increases by 3 percentage points. This effect works exclusively through the per capita income channel, suggesting that the income tends to be shared by more non-income earning people. On top of that, an increasing dependency ratio also adds to the vulnerability.

Living in an urban area increases the probability of falling into the highly vulnerable group by 4 percentage points. This effect works exclusively through the diversification channel, as urban households are less able to diversify than rural households, basically because of the difficulty of growing or hunting food for auto-consumption (Machicado, Muriel & Jemio, 2010).

Indigenous households are slightly more likely to be highly vulnerable, but the additional risk is only 3 percentage points. Female headed households are not more likely to be highly vulnerable than male headed households: Although they tend to earn less, they also tend to be more diversified, so the two effects cancel each other out in terms of vulnerability.

7. Sensitivity analysis

In order to test how sensitive the results are to different classifications, we created another two groups, defined the following way:

E. Very low-income and very low-diversification (extremely vulnerable)
F. Very high-income and very high-diversification (extremely resilient)

As cut-off points we use 0.3 and 0.7 for the diversification index and Bs. 430 and Bs. 830 for the per capita income dimension. These cut-off points were chosen rather arbitrarily, with a view to securing an adequate number of households in the sample of extremely vulnerable households (4.5% of all households) and extremely resilient households (7.3% of all).

We then run probit regressions to determine the determinants of belonging to these two extreme groups, as opposed not to. The results are presented in Table 10.

Table 10: Determinants of belonging to categories E (extremely vulnerable) and F (extremely resilient)

	Dependent variable	
Independent variables	**E (extremely vulnerable)**	**F (extremely resilient)**
Years of education of head of household	0.000 (-1.36)	0.000 (-0.38)
Number of persons in household	0.005 (7.83)	0.011 (10.79)
Urban dummy	0.019 (6.72)	0.018 (3.78)
Age of head of household	-0.001 (-9.63)	0.003 (17.65)
Female head of household dummy	0.002 (0.64)	0.010 (1.91)
Indigenous dummy	0.001 (0.45)	-0.008 (-1.89)
Dependency ratio	0.004 (4.59)	-0.005 (-3.92)
Remittance dummy	-0.018 (-5.99)	0.049 (3.87)
Public sector dummy	-0.018 (-5.67)	0.030 (4.22)
Working spouse dummy	-0.045 (-13.59)	0.058 (10.19)
Number of obs.	*8848*	*8848*
R^2	*0.1503*	*0.1837*

Source: Authors' estimation of the marginal effects from probit regressions using INE's 2011 Household Survey. The numbers in parenthesis are z-values.

The results for these extreme groups confirm the results found above. The probability of belonging to these two extreme groups are already very small (5-7 percent) so the marginal effects are much smaller than before, but they maintain statistical significance, they maintain the same signs, and they maintain roughly the same order of importance. The most important factors associated with extremely high resilience are: age of the head of household, number of persons in the household, and the presence of a working spouse. Similarly, the most important factors associated with extremely high resilience are the lack of a working spouse, a young head of households and a large number of persons in the household. Notice that a large number of persons in the household can be both a

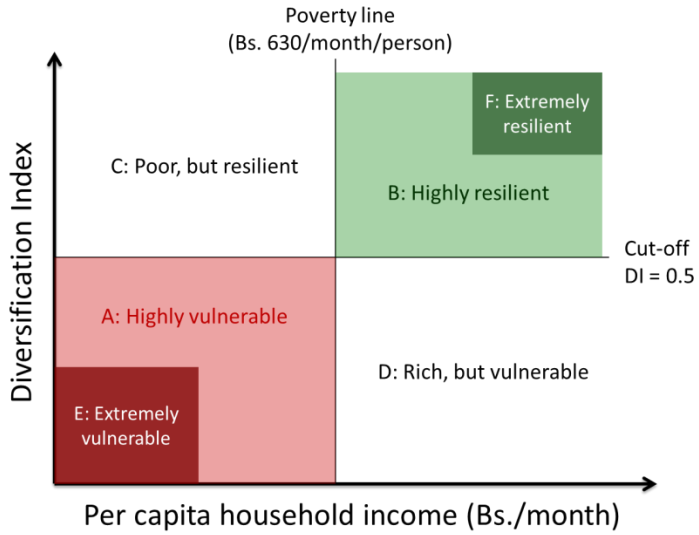
strategy to become extremely resilient, but is also a risk factor for extreme vulnerability. If the additional members are mainly children or old people, it increases the risk of extreme vulnerability, whereas if the additional members are of working age, they can contribute to extreme resilience.

All other things equal, location in an urban area increases the probability of falling into the extremely vulnerable category by 2 percentage points, which is quite dramatic, given that the average probability of being in this category is only 4.5 percent. It also increases the likelihood of getting into the extremely resilient category, however, by approximately the same magnitude. In contrast, whether the head of household is female or indigenous does not affect the probability of falling into either of the extreme categories. Neither does education seem to have a significant effect.

8. Conclusions and policy implications

In this paper we have proposed a simple measure of livelihood diversification and we have used this measure to classify Bolivian households into the six vulnerability groups depicted in Figure 3:

Figure 3: The six vulnerability types used in the paper



We then explored the determinants of falling into the categories representing high and extreme resilience and vulnerability: That is, categories A, B, E and F. The conclusions are the following: By far the most important strategy for households to develop resilience is to have a working and income earning spouse in the household. Only about one third of Bolivian households use this strategy, as there is still a strong tradition for married women to dedicate their time to child rearing and domestic chores. According to the 2011 household survey, 42% of working age spouses are not economically active at all. Another 17% do work at least part time, but without getting paid. So, in total, 59% of working age spouses do not bring any income into the household. This is the single most important factor associated with high and extremely high vulnerability in Bolivia.

The decision to work at home or participate in the labor market is of course mostly a private decision, but there is plenty the government can do to help facilitate the option for spouses to be economically active. Free public pre-school facilities of good quality would be on the top of the list, as they would

not only help mothers to be able to work at least part time, but it would also help to prepare kids better for primary school, which is urgently needed in order to improve returns to education in Bolivia (Andersen, 2010a). Next on the list would be flexibilization of labor regulations. The current strict labor laws discourage hiring in general, because of the high indirect costs and the near impossibility of laying off employees (Muriel & Machicado, 2012), but they especially discourage the hiring of young women, as it is perceived as particularly costly and risky by employers, who are obliged to pay maternity leave, nursing time and milk subsidies on top of the already high indirect costs to any employee. Third, they can encourage more flexible work arrangements. Especially, they can promote Hour Banking, a system which allows employees to accumulate extra work hours and use these savings later when needed for personal reasons. This system also benefits employers, who can use employees more intensively during high season and give them time off during low season, without having to lay them off completely (Muriel & Machicado, 2012).

The second most important factor is the age of the head of household. Young families are much more likely to be vulnerable than more mature households. This is a natural life-cycle effect: young families have not had time to build up assets that can provide supplementary income (such as rental income), and at the same time they often have young children to take care of. However, there are still a range of policy interventions that could help reduce this problem. Bolivia has one of the highest adolescent fertility rates in South America[6] (Guzmán et al., 2000) and, according to the 2011 household survey in Bolivia, there are currently more than 30,000 families with kids, where the head of household is no more than 20 years old. 46% of these households are highly vulnerable. More than 11,000 of these very young households already have 2 or more kids. The probability of being highly vulnerable is 59% for this group and the probability of being highly resilient is less than 2%. This kind of situation can be prevented by better family planning education and support. Alfonso (2008) shows that simple information about the menstrual cycle and traditional and modern birth control methods can significantly reduce the probability of teen pregnancy in Bolivia. The free distribution of the "morning-after pill" to adolescents, as implemented in Chile and Argentina (Rohter, 2006; Román, 2007), may also help. Finally, legalizing abortion has been shown to help break the vicious intergenerational cycle of teen pregnancy, poverty and vulnerability (Donohue, 2009).

A third factor that has been shown to substantially affect the probability of either belonging to the successfully diversified group or the highly vulnerable group is remittances or similar transfers from other households. Again, this is mostly a private strategy, often arising from the choice to split a family and have some family members migrate to another place in Bolivia or another country, either for work or for study. This strategy has both costs and benefits. The hardships suffered by migrants and the costs of broken families have been widely described (e.g. Sayad, 2004; Hinojosa, 2009). However, Andersen (2002) and Andersen (2011) show that, in the case of rural-urban migration in Bolivia, the benefits to the migrants seem to outweigh the costs, as the migrants vastly improve their socio-economic situation in comparison to the peers that stay in rural areas, and even quickly surpass the average incomes at their urban destinations. In addition, Andersen (2010b) uses a panel data set from Nicaragua to investigate the short- and long-run effects on the families that stay behind, and find that even more important than the cash remittances received is the concept of social remittances,

[6] According to the World Development Indicators, every year 7.5% of teenage girls (15-19 years old) in Bolivia give birth.

i.e. the transfer of new values, attitudes or concrete business ideas from the migrated household members to the household members that stayed behind. This has not only a positive immediate effect from more cash, but a positive long-term effect on the growth of household incomes.

Governments can help stimulate the benefits from migration and remittances by facilitating beneficial migration instead of obstructing it. Apart from removing excessive obstacles to migration and excessive taxes or fees on remittances, they could actively help migrants get settled and get their documents in order quickly; they could make sure all children learn several languages so that they can adapt quickly in many different places; they could promote student exchanges in high-schools and universities to make young people more aware of opportunities outside their area of birth; and they could finance studies abroad. All of these initiatives help make the population more mobile and thus less vulnerable to external shocks.

Some of the unexpected results of this analysis are that neither female headed nor indigenous households seem to be more likely to be highly vulnerable, but that urban households are. In rural areas households often benefit from free access to water, fish, game, fuel wood, construction materials, fruits, nuts, herbs, medicinal plants, natural pastures for grazing, etc. (Machicado, Muriel & Jemio, 2010). This is a tremendous advantage that is almost inexistent in urban areas, where all this has to be bought – often at great expense. Governments, as well as development institutions, often assume that female headed, indigenous and rural households are the most vulnerable to external shocks, but this research suggests that this may not be true. Instead, there is a large group of young urban households with high dependency burdens which depend almost exclusively on the fragile and informal earnings of one young household head. These urban households are unable to benefit from the gifts of nature like their rural counterparts, so they need money every month to buy food and pay rent. If the main labor income of the family is lost due to unemployment, health problems or an accident, the urban household cannot just sell a cow or hunt a wild pig to make up the shortfall. They usually cannot get a loan either, and there is little government support, so they are indeed very vulnerable to adverse shocks, and this is a neglected group that any policy aiming at reducing vulnerability needs to consider.

However, more in-depth research is needed on the vulnerability of urban and peri-urban households and the policies and initiatives that could potentially help these households become more resilient. While this paper has suggested many different policies that might help, it is not at all clear where the bottlenecks are located and which investments would yield the highest social returns. This paper suggests that it would be important to facilitate an increase in the labor market participation of spouses, but a series of multi-disciplinary research projects would be needed in order to identify the best ways to achieve this.

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