

# Does money affect happiness? Experimental results from the tsunami “negative lottery”

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## Abstract

Research on the nexus between life satisfaction and income has looked at lottery winners or post-communism transition to document that exogenous changes in income generate effects of the same sign on happiness. In this paper we consider the unfortunate tsunami event as a *negative* lottery and examine the effects of the tsunami related income losses, net of the most ample possible set of concurring factors, on life satisfaction and self-esteem of a sample of Sri Lankan microfinance borrowers. Our empirical findings help to discriminate between different effects of material damages and monetary losses, both having strong significant impact on the dependent variables. Our contribution to the literature is in: i) identifying an exogenous shock which is temporary and does not suffer from voluntary participation bias (unfortunate “winners” of the negative lottery, exactly as the control sample, did not decide to “buy the lottery ticket”); ii) testing the money-happiness nexus on a sample of individuals close to the poverty line.

Keywords: life satisfaction, quasi natural experiment, tsunami, natural catastrophe.  
JEL numbers: I31, I32.

# 1. Introduction

A crucial issue in studies related to the link between economics and happiness is that of causality: does money make people happier or have happier people superior attitudes for developing their productive skills which ultimately lead them to greater economic success?<sup>1</sup> From a methodological point of view the problem has been tackled in many ways. A first approximation has been to evaluate whether the nexus holds when we move from level to first difference estimates, since it is more difficult to say that short term changes in life satisfaction generate immediate changes in income or employment status than viceversa. However, even in this case, the reverse causality nexus cannot be excluded. A second approach has been that of using panel fixed effects in order to disentangle the role of inherited individual traits which shape our *ego* in the first years of life. Another line of research performs a two-equation estimate in which the two causality directions are jointly estimated and disentangled<sup>2</sup>. The problem with this approach is that it requires sufficiently long time series and assumes the dependent variables to be continuous. Unfortunately, this is not the case for measures of life satisfaction which are inevitably discrete.

Given the problems with the methodologies mentioned above, one of the most reputed approaches which empirical studies use to solve the issue is lab or quasi-natural experiments. The advantages of lab experiments are the reproducibility and the capacity to insulate, *ceteris paribus*, the variation of one factor whose effects can be measured on the dependent variable. The main disadvantage is the lack of external consistency, or the risk of inconsistency of the artificial events produced in the

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<sup>1</sup> While economists are more inclined to look at changes that life events can produce on our wellbeing, psychologists remind us that personalities have fixed traits which are inherited from birth or childhood and affect our future life events. Researchers from both disciplines find reasonable arguments for their claims since biunivocal causality directions are plausible in almost all relationships between happiness and its determinants. Frey and Stutzer (2006) wonder whether marriage increases life satisfaction or rather happier people get more easily married. Becchetti et al. (2008) argue that investing in relationships has positive effects on happiness and that, at the same time, happier people have a more intense social life. Clark et al. (2006) argue that we need caution when drawing policy advices from studies on happiness and unemployment. Part of the effect that we measure is in fact the expression of an inverse causality nexus in which individuals with lower life satisfaction, or prone to pessimism, have relatively higher difficulties in finding a job. This part of unhappiness related to the unemployment condition can hardly be tackled by active labour policies.

<sup>2</sup> Becchetti et al. (2008) run a GMM panel VAR to create multiequation systems in which happiness and a given determinant are, in turn, dependent variable and explanatory factor. In their paper the authors use this approach to solve the causality problem between happiness and sociability.

laboratory with what happens in the reality of economic life. For this reason, even though there are no perfect approaches, economists look with great interest at “quasi-natural experiments” that is, at those real situations in which the occurrence of a particular historical event or shock can represent unequivocally an exogenous variation whose effects on target variables can be measured. Under these particular circumstances the exogeneity of the shock eliminates the suspicion of reverse causality so that the relationship between the exogenous variation and that of the target variable can be interpreted univocally. Examples of valuable studies identifying exogenous shocks in the empirical happiness literature are those of Gardner and Oswald (2006) looking at lottery wins and Frijters et al. (2004a, 2004b and 2006) considering aggregate changes in real income after transition or reunification in Russia and Germany respectively.

The novel contribution of this paper is the unique opportunity of investigating the impact of money on happiness by looking at the effects of tsunami on self-declared life satisfaction in a sample of 305 microfinance borrowers in Sri Lanka. If the money-happiness relationship has been investigated in quasi-natural experiments in case of positive shocks (lottery wins) or negative shocks in transition countries, this is the first case, to our knowledge, in which this is done for negative shocks in a specific group of low income individuals close to the poverty line. Furthermore, an additional advantage of our shock with respect to the previously considered ones is that is temporary and does not suffer from voluntary participation bias (unfortunate “winners” of the negative lottery, exactly as the control sample, did not decide to “buy the lottery ticket”).

The paper is divided into five sections (including introduction and conclusions). The second section describes the survey design. The third and the fourth present and comment descriptive and econometric findings respectively. The fifth concludes.

## 2. The survey

During the month of April 2007 one of the authors of the paper, Stefano Castriota, and two additional Italian researchers went to Sri Lanka to interview a sample of randomly selected MFI borrowers in the Southern coast in order to perform an impact evaluation of the tsunami and to study the recovery process. Interviews were performed face to face with the help of professional translators with economic background. The 305 selected people are clients of a Sri Lankan MFI, Agro Micro Finance (AMF), an organisation which received financial support from international organizations and Italian institutions after the natural catastrophe of December 2004.<sup>3</sup> Interviews were carried on during the monthly society meetings, at the borrowers' homes or in extra-meetings organized for this purpose by AMF.

We randomly selected a sample of 200 damaged (the treatment group) and 105 non-damaged (the control group) borrowers in the provinces of Galle, Matara and Hambantota. The treatment group is larger because in some relevant issues we are interested to subsamples of the treatment group which differ for damage typologies. From the methodological point of view it is important to reduce at minimum the possibility of interview biases: as it is possible to infer from the questionnaire,<sup>4</sup> the nexus between happiness and income is not the main focus of the survey whose aim is the evaluation of the impact of tsunami and recovery on respondents' wellbeing. Therefore, the risk of respondents manipulation on the specific money-happiness issue is presumably low.

The survey contains questions on socio-demographic, economic and psychological variables. A section is devoted to microcredit, savings and other loans and another to the damages from the tsunami. A bit less than half of the sample has both economic activity and house close to the sea (maximum 1 kilometre), the average age is 48.5 ranging from 23 to 73, 85 percent of respondents

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<sup>3</sup> AMF was funded in 2000 by the Agromart Foundation which started performing microfinance activities in 1994. After six years, the Agromart Foundation decided to delegate this task to AMF in order to better focus on its original activity, the provision of technical assistance and education to rural populations.

<sup>4</sup> The questionnaire is omitted for reasons of space and available from the authors upon request.

are female, 82 percent are married.<sup>5</sup> The average educational attainment is low for advanced economies (35 percent has no formal, 48 percent primary and 16 percent secondary or tertiary education). Most of people work in agriculture (21 percent), manufacturing (39 percent) and trade (49 percent), while a minority in fishery (2 percent) and other activities (9 percent)<sup>6</sup>. The average number of household members is 4.6 with 2.3 children.<sup>7</sup>

Since tsunami damages are the discriminating factor for inclusion in the two subsamples, and to reduce at minimum the omitted variable bias problem in our estimates, we demand details on them. In our questionnaire respondents report separately for six types of damages: (i) to family members (injured or dead), (ii) to the house, (iii) to office buildings, (iv) to working tools, (v) to raw materials and (vi) to the market of the respondent's activity. 19 percent of the sample declares damages to the residence house, 25 percent to buildings or assets, 28 percent to working tools, one third to raw materials of his/her productive activity and 49 percent to the economic activity through a fall in the market demand.<sup>8</sup> Only 4 percent of borrowers report injuries to family members. Multiple damages are frequent and 26 percent of respondents declare at least 3 types of them, while one third of interviewed individuals (the control sample) declare no damage. After the tsunami damaged people got assistance from international and national institutions: 32 percent received governmental subsidies (in most cases a four-month check of 5,000 Rps. to buy food), 27 percent donations and grants from international organizations and NGOs and 3 percent other forms of charity.

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<sup>5</sup> Evidence on these preliminary descriptive data is omitted for reasons of space and available upon request.

<sup>6</sup> The total exceeds 100% since some people have more than one business activity.

<sup>7</sup> It must be considered that the average wedding age is low, so the number of children currently living at home can be lower than the total number of sons and daughters because some of them are married and live in another house.

<sup>8</sup> As it is well known this problem is exacerbated when foreign aid occurs under the form of providing free goods to the local population, thereby generating negative effects on the demand to producers operating close to the emergency area.

### 3. Descriptive findings

The tsunami was an unexpected event and we could not record our survey data before it. Therefore we follow the approach used in the development literature of reconstructing time series by creating retrospective panel data with a “memorable event” approach in which we ask respondents to provide information around important moments of their recent life (see McIntosh et al., 2007). More specifically, during the interviews carried on in April 2007, we asked respondents to provide information about four different periods: (P1) the six month interval before the first MFI loan ever obtained; (P2) the period going from the first MFI loan to the tsunami date (26 December, 2004), (P3) the interval between the tsunami event and the first MFI refinancing and (P4) the period from the MFI refinancing to the survey date (April 2007). The problem in this analysis lies in the heterogeneity of the four considered time windows since only two points in time (the tsunami and the survey date) are common to every borrower, and only the first time interval (six months before the first AMF financing) is fixed in length, even though not coincident for all respondents.

Information on the length of the second and third interval is therefore fundamental to our analysis (see Table 1). With this respect, the average length of the second interval is one year and a half (and no longer than two years and a half for 75 percent of sample respondents). The length of the third interval is 6 months for the first quarter of the sample, 10 months for half of it and 15 months for the last quarter. This implies that heterogeneity in the last two time windows is not strong. However, we obviously control for it in our regression analyses.<sup>9</sup> Consider that time heterogeneity, at least in the second and third period, is not a weakness of our data but a methodological

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<sup>9</sup> The estimation of common effects in a sample of nonsynchronous events is a typical feature of event studies in finance (for a standard treatment see Campbell, Lo and McKinlay, 1997). In those studies nonsynchronicity concerns the event date and abnormal returns are calculated on the basis of the definition of a normal return model estimated in the period preceding the event window. In our study nonsynchronicity concerns the rightward boundary of the event window (the first AMF refinancing after tsunami), when measuring tsunami effects, and the leftward boundary of the event window (the same first AMF refinancing), when measuring refinancing effects. Hence, we have both nonsynchronicity and irregularly spaced event windows (see Figure 1). As it will be shown in the next sections, abnormality in our empirical work is measured intertemporally and cross-sectionally by comparing i) changes due to the shock with normal changes preceding the event window and ii) changes in the event period for the treatment and control sample.

requirement of the study (a reasonable upper boundary of the tsunami effect period is the loan refinancing date which is different for any borrower). In the rest of the paper we will try to reduce the heterogeneity of the time windows by explicitly introducing such variable in the estimates.

Some of the variables we consider for our analysis are built following the World Values Survey approach (full description of them is provided in Tables A1a and A1b in the Appendix). *Life satisfaction* and *self-esteem* range from a minimum of 1 to a maximum of 10, *trust* is dummy variable equal to one if the respondent believes that most of people can be trusted, *standard of living* is a self-evaluation of the standard of living in terms of consumption goods from 0 (not sufficient) to 4 (very good), *prob. meal* is a dummy equal to one if the respondent declares to have had problems in providing daily meals to household members. *Real income* is the real household income in terms of April 2007 Sri Lankan Rupees, while *hours worked* is the average number of hours worked per week. *Saving* measures the possibility to save money and ranges from 0 (not at all) to 4 (very much). To capture the tsunami effects we adopt three different approaches. First, we include a dummy variable taking the value of one if the individual reported any form of damage and zero otherwise (*damage*). Second, we build an indicator given by the sum of the six different types of damage suffered by respondents (*sumdam*). Third, we use 6 dummies picking up any of the different types of damage.<sup>10</sup>

Table 2 shows pairwise correlations among selected variables in the second and third period, which is the interval of interest for our research. We can see that life satisfaction and self-esteem are strongly correlated and that both are positively influenced by economic variables and negatively by the damages from the tsunami.<sup>11</sup> Trust towards other people is weakly correlated with socio-economic variables, while real income is obviously positively influenced by the number of hours worked and, negatively, by the damages from the tsunami. The other variables like standard of

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<sup>10</sup> *Dambuild*: damage to respondent's assets; *dammkt*: damage to the market of the respondent's activity; *damfamil*: injuries to members of the respondent's family; *damhouse*: damage to respondent's house; *damwtool*: damage to the respondent's working tools. The sixth type (damage to the raw materials) is not included in the regressions because its correlation with *damwtool* is equal to 0.73.

<sup>11</sup> Given the high correlation among the two variables, all the results which hold for life satisfaction hold for self-esteem as well.

living, savings and declaration of problems in providing daily meals to family members follow the same path of the real income.

To be sure that the tsunami shock acted as a random negative lottery we verify whether before the natural catastrophe the main economic and psychological characteristics of damaged people were similar to those of non-damaged ones. In Table 3 we compare ex-ante (second period) characteristics of damaged and non damaged respondents. The hypothesis of equality in means is not rejected for all these variables at 95 percent or even 99 percent level. The only difference which matters seem to be the share of people working in the agricultural sector which is obviously influenced by the location (damaged respondents live or have economic activities on the coast where trade and manufacturing are more developed than agriculture). Sample and treatment groups are therefore very similar before the tsunami event occurs in December 2004, while their situation becomes radically different in the third (post tsunami/pre refinancing) period.

From a descriptive point of view Figure 1 presents the cumulative distributions of changes in real household income in Sri Lankan Rps. and life satisfaction from the second to the third period for treatment and control sample. The evidence presented clearly documents first order stochastic dominance of the distribution of the two variables of individuals damaged by the tsunami with respect to those unaffected, the difference being bigger for the lowest ventiles. To provide some examples of the differences of the cumulative distributions in some selected points, we register after the tsunami negative changes in life satisfaction for only 20 percent of non-damaged people against 65 percent of damaged ones. Only 10 percent of non-damaged against 40 percent of damaged experience a drop of two points in the life satisfaction indicators. In spite of the shock, 40 percent of non-damaged people register positive changes in happiness against 15 percent of damaged ones. To interpret this finding notice that even among the damaged we register a share of respondents with



positive changes in income after the tsunami shock (around 30 percent against around 50 percent in the control sample).<sup>12</sup>

Table 4 provides additional comparative evidence on the effect of our “negative lottery” by testing whether changes from the second to the third period in some selected indicators are significantly different from zero. We can observe here that all the economic and psychological indicators worsen for damaged people, the loss being bigger when people declare a higher number of damages from the tsunami. On the contrary, this is not true for the control sample in which no change is statistically significant at 5 % level. Hence, in absence of the exogenous shock, no significant changes in income and in the other wellbeing indicators are registered in the control sample.

To give an idea of the magnitude of the effects, we observe a 37 percent reduction in real income for individuals with at least one damage and a 48 percent reduction for those with at least three damages. The same change in the control group is -5.6 percent but not significantly different from zero. These wide differences are hidden beyond a reduction in real income of around 25 percent in the overall (damaged and non-damaged) sample. With regard to life satisfaction we register an insignificant fall of 0.08 points on a 1-10 scale for non damaged individuals, against a reduction of 1.98 points for those with at least one damage and a drop of around 3.5 points for individuals with more than two damages. Similarly, self-esteem of non-damaged people does not register any significant change, while that of people with at least one damage drops by 1.37 points and that of people with at least three damages by 2.56 points, again on a 1-10 scale.

In order to compare shocks on monetary and psychological indicators, in Table 5 we scale their changes from P2 to P3 on the standard deviation of the change in the previous period (from P1 to P2). The magnitude of the effects is impressive and significantly higher for psychological indicators, especially for those who report to have been more heavily damaged by the tsunami. Life satisfaction and happiness show the biggest losses, respectively 1.5 and 0.48 standard deviations in

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<sup>12</sup> To understand further this point, consider as well that each respondent may be conceived, without lack of generality, as being subject to an additional random shock (drawn from a set of news unrelated to the tsunami event). The luckiest of them pick up from this set positive news which may compensate the negative effect of the tsunami on their income.

the full sample and 3.34 and 1.06 standard deviations in the subsample of people with at least three damages. We may therefore conclude from descriptive findings that: (i) markedly abnormal changes in life satisfaction occurred after the tsunami for those reporting at least one damage; (ii) such abnormal changes depend on the number of different types of damage suffered since nothing happened for those reporting no damage; (iii) the change in income is also highly significant for the treatment and not significant for the control sample, even if the psychological indicators vary more than income.

These preliminary findings lead us to conclude that that the exogenous shock of the tsunami acts as a “negative lottery” which determines simultaneous changes in income and life satisfaction for damaged individuals. In addition to these considerations we observe that the psychological variables seem to over-react with respect to economic ones, which implies that changes in happiness cannot be uniquely explained by changes in income, but must also be explained by additional negative effects of the tsunami shock which are unrelated to income. It is reasonable to assume that the dip in non-material wellbeing has been negatively affected not only by the income drop, but also by the damages to family members and wealth and by other psychological processes. The latter may include the despair of assisting to the destruction of something which has not just an economic, but also an affective value, a sense of guilt or frustration for being among those hit, etc.

#### 4. Econometric findings

In order to evaluate whether the exogenous change in income generated by the tsunami shock has affected life satisfaction and self-esteem of sample borrowers we estimate the following specification:

$$\Delta Wellbeing_i = \alpha_0 + \alpha_1 \Delta Income_i + \sum_k \alpha_{2k} Tsunami.Dam_{ik} + \sum_j \alpha_{3j} Control_{ij} + \varepsilon_i$$

where the dependent variable is the change in the selected wellbeing indicator (life satisfaction) from the second to the third sample period for the  $i$ -th individual. Since life satisfaction is a discrete qualitative variable which takes values from 1 to 10, the most suitable approach is an ordered probit estimate. However, given the extended range of our change in wellbeing measures<sup>13</sup>, in the literature the same dependent variable has sometimes been approximated to a continuous one so that both OLS and ordered probit models have been estimated (see Frey and Stutzer, 2006). We therefore estimate the specification under both approaches. All regressions are run by use of robust standard errors.

We expect the coefficient of the change in real household income to be positive and significant, while that of the variable capturing the damages from tsunami to be negative. To isolate the income from the many other effects on happiness that may have been generated by the tsunami shock we consider the largest possible number of concurring factors. In addition to the different types of damages our controls included in the estimates are dummies for the three provinces (*Galle*, *Matara* and *Hambantota*) and dummies for the level of education<sup>14</sup>, sex and age of the respondent, his/her field of activity<sup>15</sup>, a dummy if the respondent has other outstanding loans (*other loan*), and the concurring availability of remittances (*remittances*), government subsidies (*subsidies*) or grants (*grant*). Finally, in order to control for the heterogeneity in P2 and P3 time intervals, we introduce two variables measuring respectively the length in months of both periods (*length(P2)* and *length(P3)*).

Table 6 shows what we expected in case of a truly exogenous event: only the change in real income and the variables capturing the damages from tsunami have an effect on psychological wellbeing. All the other variables are not statistically significant. We repeat the experiment by replacing the generic *damage* dummy with *sumdam* and with different dummies for each of the possible

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<sup>13</sup> Consider that first differenced life satisfaction and self-esteem variables have an extended -9, +9 range with respect to the 1-10 correspondent level variables.

<sup>14</sup> *Incompleted*=incomplete primary school, *Primary*=completed primary school, *Secplus*=secondary or more. Less than primary school completion is the benchmark (34 percent of the sample).

<sup>15</sup> *Manuf*=manufacturing, *fish*=fishery, *agric*=agriculture, *trad*=trade, tourism being the omitted benchmark.

damages: life satisfaction is directly affected by the drop in real household income and by the loss connected to raw materials and office buildings which are, at the same time, a form of wealth accumulated in the past and a necessary tool to earn money in the future. Results are very similar when using ordered logit or ordinary least squares estimators. On the whole, we may infer that monetary outcomes matter a lot since people who realized a wealth loss, or a fall in current and/or future expected income, declared a strong dip in life satisfaction levels<sup>16</sup>.

Table 7 shows the magnitude of the effects of coefficients estimated in Table 6. We multiply the coefficients and the standard deviations of the regressors at time 3 and divide this figure by the standard deviation of the dependent variable at time 2. In this way we evaluate the magnitude of the effects on happiness and self esteem of a one standard deviation shock on the explanatory variable in the tsunami period, compared to the normal change in life satisfaction and self-esteem in the “normal” pre-tsunami period. We can observe that the change in real household income and the damages from the tsunami have strong impact on both wellbeing indicators, with a joint effect which is close to one and a half the standard deviation of the first difference of such indicators in the normal pre-tsunami period.

In order to provide an approximate evaluation of the share of variability explained by our target variables we look at the adjusted R-squares of OLS estimates from different specifications (see Table 8). By regressing first differenced dependent variables on only the constant and the change in real household income we find that the latter explains 14 percent of variation in life satisfaction. Regressions including only the constant and the *sumdam* variable lead to an R-squared equal to 12 percent. Running regressions with both the change in real income and one of the two variables capturing the damages from tsunami raises significantly the R-squared (38 percent). This final

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<sup>16</sup> As a further robustness check we also re-estimate the model by restricting the analysis to the respondents whose lengths of the second and third period are both lower than 24 months. In this way we reduce heterogeneity in time windows and ensure that average income levels before and after the tsunami date are computed over a period shorter than two years. The drawback is that we reduce considerably the number of available observations. Results on real income are very robust, while those on the damages from tsunami a bit weakened. As a general comment, the insignificance of the P2 and P3 lengths and the robustness of our results to the reduction of the heterogeneity in time windows seem to confirm that such heterogeneity does not impair the validity of our conclusions. Results are omitted for reasons of space but are available upon request.

check confirms that the effect of the shock is significant, but that the change in income is only part of it. To such change we must add wealth and non material effects captured by the different damage dummies.

#### **4.1 Robustness check using instrumental variable regression**

It would be difficult to imagine the possibility of a causality link between the tsunami damage, income loss and happiness different from the one described above if the window of the post tsunami/pre refinancing period would have been smaller for all sample respondents. However, in presence of an interval of several months we must convince the reader that, beyond the obvious material consequences of the damage, the loss of income is not also due to a “depression effect” immediately subsequent to the tsunami. To overcome this doubt we have a very nice instrument since material damages are definitely affecting changes in income but cannot be suspected of being determined by the change in happiness. We therefore run a regression of the change in life satisfaction on the change in real household income and a set of controls, where the change in real household income is instrumented using the dummy variables for the damages to buildings, tools, raw materials and economic market. Findings from the IV estimate (Table 9) show that the effect of the instrumented change in income on happiness is strongly positive and significant, net of the effect of the usual controls, confirming the robustness of our findings.

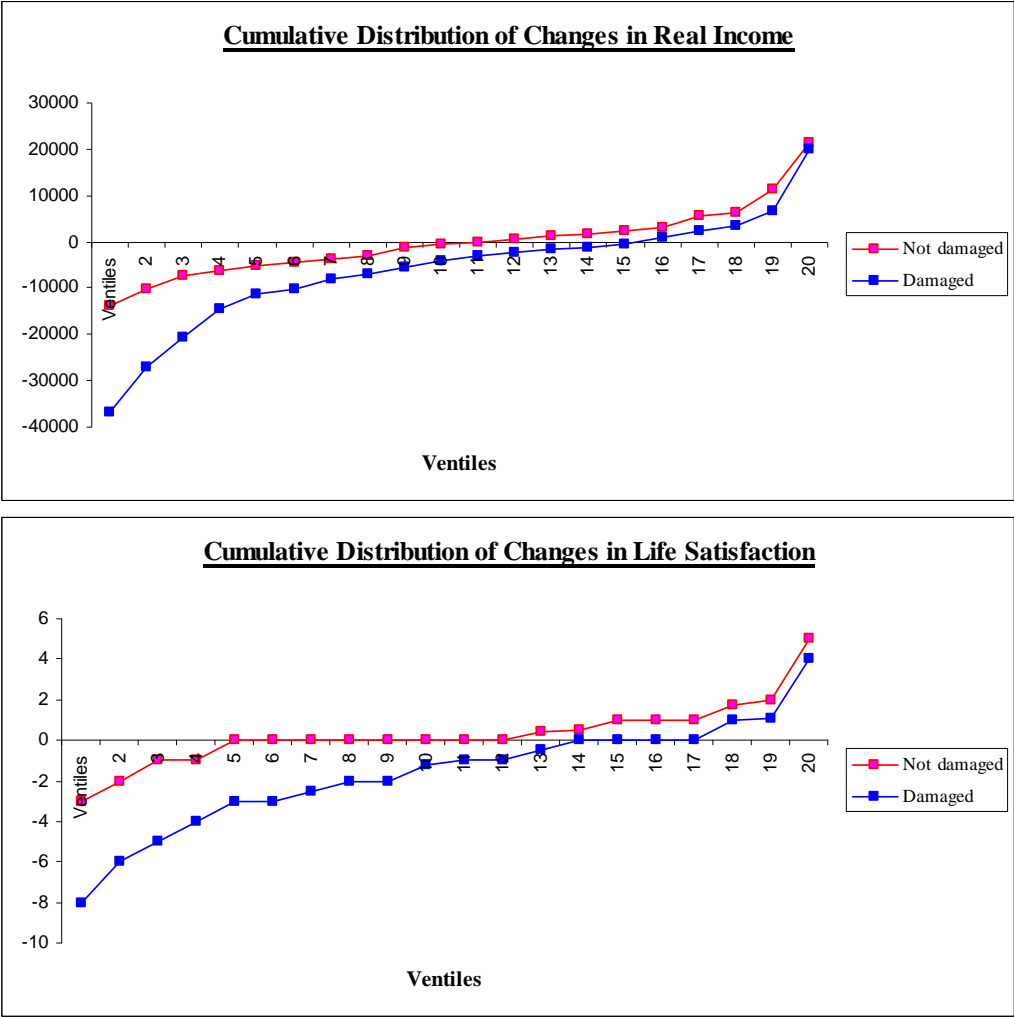
### **5. Conclusions**

One of the most debated issues in the happiness literature is whether, and eventually how much, income matters to life satisfaction. First differenced estimates in several empirical studies document that the relationship between changes in income and changes in life satisfaction is significant but

weak. In presence of a serious problem of reverse causality the most reliable test to identify the exact effect of income on happiness is a quasi natural experiment in which a given historical event can undoubtedly be classified as generating an exogenous shock on income. The current literature has so far identified such events in lottery wins (positive changes in income) and political shocks in transition countries after the end of communism. No one has ever investigated so far the effect of a negative shock on income for a sample of individuals close to the poverty line.

In our paper we identify the tsunami shock as a *negative* lottery event and rigorously define a treatment and a control sample of borrowers with homogeneous ex-ante characteristics. Both samples are made of borrowers of the same microfinance institutions, living in the same area, with no significant differences in MFI relationship seniority. In the paper we explain why we introduce heterogeneity in time spells relative to pre and post tsunami periods for our respondents and how we deal with it in a robustness check. Our results document that the effect of the shock is very serious since it generates significant concurring losses in income and fall in life satisfaction of damaged borrowers. The fact that nothing similar happens for the control group ensures us that the shock has to be attributed to the selection for the “negative lottery”. We show that changes in income and the material damages from the tsunami significantly affect life satisfaction, even though they cannot explain all their variation around this unfortunate event.

**Figure 1: Cumulative distributions by income ventiles, changes from P2 to P3**



*Legend:* changes in Real Income and Life Satisfaction are from pre-tsunami (P2) to post tsunami/pre refinancing (P3) periods for treatment and control sample. P2 is the period going from the first MFI loan to the tsunami date (26 December, 2004) while P3 is the interval between the tsunami event and the first MFI refinancing.

**Table 1: Cumulative distributions of the length of time windows in months**

<b>Cumulative %</b>	<b>Length of P2</b>	<b>Length of P3</b>
1%	1	1
5%	2	2
10%	6	4
25%	11	6
50%	18.5	10
75%	31	15
90%	54	18
95%	66	26
99%	90	26

*Legend:* P2 is the period going from the first MFI loan to the tsunami date (26 December, 2004) while P3 is the interval between the tsunami event and the first MFI refinancing.



**Table 2: Pairwise correlation matrix of selected socio-economic variables**

	<b>LifeS.</b>	<b>SelfE.</b>	<b>Trust</b>	<b>RealInc.</b>	<b>StandL.</b>	<b>ProbM.</b>	<b>Sav.</b>	<b>HoursW.</b>	<b>Damage</b>	<b>Sundam</b>
<b>Life Satisf.</b>	1									
<b>Self-Esteem</b>	0.70	1								
<b>Trust</b>	0.04	0.01	1							
<b>Real Income</b>	0.34	0.26	0.02	1						
<b>Stand. Liv.</b>	0.40	0.33	0.05	0.49	1					
<b>Prob. Meal</b>	-0.28	-0.20	-0.06	-0.25	-0.57	1				
<b>Saving</b>	0.26	0.15	0.02	0.34	0.38	-0.20	1			
<b>Hours Worked</b>	0.27	0.30	-0.01	0.20	0.27	-0.28	0.11	1		
<b>Damage</b>	-0.23	-0.22	0.00	-0.12	-0.19	0.16	-0.04	-0.11	1	
<b>Sundam</b>	-0.25	-0.21	0.01	-0.10	-0.18	0.15	-0.07	-0.15	0.68	1

*Note:* Variable details are reported in Table A1 in the Appendix.

**Table 3: Mean and confidence intervals of selected indicators in the second time window**

	Treatment Sample (damaged)			Control Sample (non-damaged)		
	Mean	95 percent confidence intervals		Mean	95 percent confidence intervals	
<b>Real Income</b>	18,117	15,028	21,206	15,948	14,189	17,706
<b>Self-Esteem</b>	7.87	7.62	8.12	8.16	7.82	8.50
<b>Life Satisfaction</b>	7.28	7.04	7.53	7.40	7.07	7.74
<b>Happiness</b>	2.77	2.68	2.86	2.80	2.66	2.94
<b>Prob. Meal</b>	0.09	0.05	0.12	0.07	0.02	0.12
<b>Trust</b>	0.49	0.42	0.57	0.50	0.40	0.60
<b>Hours Worked</b>	54.52	50.93	58.11	54.22	50.17	58.27
<b>Stand. Liv.</b>	2.46	2.34	2.57	2.45	2.29	2.61
<b>Female</b>	0.85	0.79	0.90	0.87	0.80	0.93
<b>Age</b>	48.53	47.09	49.98	48.39	46.34	50.43
<b>Agriculture</b>	0.16	0.10	0.21	0.36	0.27	0.46
<b>Number of Children</b>	2.46	2.25	2.67	2.22	1.94	2.49
<b>Incompleted Education</b>	0.39	0.32	0.46	0.28	0.19	0.36
<b>Primary Educ.</b>	0.46	0.39	0.53	0.50	0.41	0.60
<b>Secondary and Tertiary Educ.</b>	0.15	0.10	0.19	0.20	0.12	0.28
<b>Length</b>	26.17	23.35	29.00	22.06	18.85	25.27

**Table 4: Changes in mean of selected indicators from P2 to P3**

	Full sample	No damage	At least 1 damage	At least 3 damages
<b>Δ Real Income</b>	-5556.833 (-7.04)	-1255.463 (-1.55)	-8037.377 (-7.24)	-10453.94 (-5.94)
<b>Δ Equiv. Income PPP</b>	-1.675444 (-7.07)	-0.4536367 (-1.80)	-2.381209 (-7.16)	-3.039929 (-5.15)
<b>Δ Standard of Living</b>	-0.5377049 (-8.03)	-0.0095238 (-0.12)	-0.815 (-9.32)	-1.089744 (-7.03)
<b>Δ Self-Esteem</b>	-0.8654485 (-6.39)	0.0809524 (0.56)	-1.372449 (-7.50)	-2.564935 (-7.69)
<b>Δ Life Satisfaction</b>	-1.32392 (-8.94)	-0.0857143 (-0.53)	-1.987245 (-10.23)	-3.447368 (-10.86)
<b>Δ Happiness</b>	-0.8519737 (-12.05)	-0.0952381 (-1.25)	-1.251256 (-14.21)	-1.794872 (-14.14)
<b>Δ Hours Worked</b>	-9.203279 (-7.13)	-1.933333 (-1.48)	-13.02 (-7.28)	-21.19231 (-6.30)
<b>Δ Prob. Meal</b>	0.1836066 (7.49)	0.0380952 (1.42)	0.26 (7.78)	0.3717949 (6.41)

*Note:* Robust t-statistics in brackets. Variable details are reported in Table A1 in the Appendix.

**Table 5: Magnitude of the tsunami effect on selected variables**

	Full sample	No damage	At least 1 damage	At least 3 damages
<b>Δ Real income</b>	-0.160	-0.020	-0.099	-0.575
<b>Δ Equiv. Income PPP</b>	-0.144	0.001	-0.076	-0.559
<b>Δ Standard of living</b>	-0.731	-0.013	-0.280	-1.612
<b>Δ Self-esteem</b>	-0.733	0.075	-0.044	-2.187
<b>Δ Life satisfaction</b>	-1.222	-0.095	-0.310	-3.052
<b>Δ Happiness</b>	-1.507	-0.188	-0.655	-3.349
<b>Δ Hours worked</b>	-0.489	-0.109	-0.190	-1.061
<b>Δ Prob. meal</b>	0.757	0.160	0.347	1.346

*Note:* The magnitude is calculated as the ratio between the standard deviation of the change of the variable from post first financing/pre tsunami (P2) to post-tsunami/pre refinancing (P3) and the standard deviation of the change of the variable from pre-financing (P1) to post first financing/pre-tsunami (P2) periods. Variable details are reported in Table A1 in the Appendix.

**Table 6: The determinants of changes in Life Satisfaction after tsunami**

<b>Variable</b>	<b>Ordered probit</b>			<b>OLS</b>		
<b>Galle</b>	-0.833218 (-2.28)	-0.8625983 (-2.43)	-0.9463007 (-2.5)	-0.8028765 (-2.01)	-0.7877087 (-2.23)	-0.8191481 (-2.29)
<b>Matara</b>	-0.4141737 (-1.28)	-0.5442891 (-1.73)	-0.5188629 (-1.55)	-0.2754263 (-0.80)	-0.3756442 (-1.17)	-0.2826899 (-0.86)
<b>Agriculture</b>	0.5207444 (1.66)	0.3473404 (1.15)	0.3700208 (1.22)	0.5319147 (1.77)	0.3087566 (1.16)	0.2992394 (1.09)
<b>Fishery</b>	0.4560714 (0.60)	0.2604757 (0.47)	0.1496467 (0.30)	0.6260666 (0.80)	0.3666512 (0.61)	0.1988852 (0.33)
<b>Manufact.</b>	-0.0145947 (-0.06)	0.0503751 (0.19)	0.032337 (0.12)	-0.0772705 (-0.26)	0.0120903 (0.04)	-0.0633652 (-0.21)
<b>Age</b>	0.0092099 (0.73)	0.0078489 (0.63)	0.0039226 (0.29)	0.0135847 (1.00)	0.0126214 (1.01)	0.0080508 (0.61)
<b>Female</b>	-0.0769615 (-0.24)	-0.1476585 (-0.47)	-0.1664785 (-0.52)	0.0797021 (0.25)	-0.0062708 (-0.02)	0.0066675 (0.02)
<b>Primary</b>	0.1815764 (0.69)	0.0846596 (0.32)	0.1416947 (0.53)	0.165575 (0.56)	0.0006766 (0.01)	0.0501213 (0.18)
<b>Secplus</b>	0.165784 (0.52)	0.0999071 (0.34)	0.1754949 (0.58)	0.1823447 (0.55)	0.0628105 (0.21)	0.079117 (0.27)
<b>Num.Child.</b>	0.0300226 (0.37)	0.031835 (0.41)	0.0287761 (0.35)	0.0109364 (0.12)	0.0055683 (0.07)	0.0073072 (0.09)
<b>Δ Real Inc.</b>	0.0000569 (3.27)	0.0000483 (3.11)	0.0000505 (3.29)	0.0000558 (3.86)	0.0000449 (3.51)	0.0000465 (3.69)
<b>Damage</b>	-0.5351427 (-1.68)			-0.3331496 (-1.17)		
<b>Sundam</b>		-0.6391632 (-5.03)			-0.6334049 (-5.33)	
<b>Dam.Family</b>			-1.233426 (-1.36)			-2.096171 (-1.80)
<b>Dam.House</b>			-0.0841512 (-0.15)			-0.520788 (-0.96)
<b>Dam. Build.</b>			-0.6391655 (-1.66)			-0.6900087 (-1.73)
<b>Dam.Tools</b>			-1.686477 (-3.19)			-1.279893 (-2.25)
<b>Dam.Mkt.</b>			-0.4989021 (-1.61)			-0.35208 (-1.22)
<b>Remittances</b>	-0.2495981 (-0.33)	-0.4310788 (-0.62)	-0.2672197 (-0.37)	0.0106472 (0.02)	-0.1403423 (-0.24)	-0.1171605 (-0.19)
<b>Subsidies</b>	-0.9766874 (-3.03)	-0.4881622 (-1.66)	-0.4828677 (-1.62)	-1.3212 (-3.45)	-0.6233697 (-1.9)	-0.6736288 (-2.02)
<b>Don.Grants</b>	-1.206674 (-3.16)	-0.5573278 (-1.42)	-0.5412322 (-1.35)	-1.315902 (-3.25)	-0.542871 (-1.32)	-0.538647 (-1.23)
<b>Other Loans</b>	0.0908093 (0.34)	0.2037622 (0.74)	0.2663143 (0.98)	0.1813634 (0.70)	0.2621105 (1.03)	0.2613055 (1.02)
<b>Length P3</b>	-0.0076623 (-0.37)	-0.0148059 (-0.74)	-0.0127724 (-0.61)	-0.0198276 (-0.84)	-0.0249858 (-1.13)	-0.0215374 (-0.95)
<b>Length P2</b>	0.0026777 (0.39)	-0.0001023 (-0.02)	0.0032014 (0.45)	0.0047123 (0.59)	0.0014932 (0.20)	0.0034724 (0.46)
<b>Constant</b>				-0.4025316 (-0.56)	0.2361957 (0.36)	0.2414497 (0.36)
<b>N. of obs.</b>	242	242	242	242	242	242
<b>(Pseudo) R<sup>2</sup></b>	0.0905	0.1144	0.1173	0.3656	0.4434	0.4535

Note: Robust t-statistics in brackets. Variable details are reported in Table A1 in the Appendix.

**Table 7: Magnitude effects of selected regressors on changes in Life Satisfaction after tsunami**

	Logit		OLS		
$\Delta$ Real Income	0.66	0.56	0.65	0.52	0.54
Damage	-0.24		-0.15		
Sumdam		-0.98		-0.98	
Dam.Family			-0.21		-0.36
Dam.House			-0.03		-0.19
Dam. Build.			-0.26		-0.28
Dam.Tools			-0.69		-0.53
Dam.Mkt.			-0.23		-0.16

*Legend:* The magnitude of the effect is calculated as the product between the coefficient of the  $\beta(X)$  and the standard deviation of X both at time 3, divided by the standard deviation of Y at time 2. The coefficients  $\beta(X)$  are from Table 6a.

**Table 8: Adjusted-R<sup>2</sup> from OLS regressions**

Regressor	$\Delta$ Life Satisfaction			
$\Delta$ Real Income	x		x	x
Damage			x	
Sumdam		x		x
R2	0.14	0.12	0.21	0.38

*Note:* The x indicates the regressors included in the estimation, in addition to the constant.

**Table 9: IV Regression for the Change in Life Satisfaction from P2 to P3**

<b>Regressor</b>	<b>Coef.</b>	<b>Std. Err.</b>	<b>t</b>	<b>[95% Conf.</b>	<b>Interval]</b>
<b>Dam. Fam.</b>	-2.105396	0.7668492	-2.75	-3.615947	-0.5948452
<b>Dam House</b>	-0.4714288	0.406405	-1.16	-1.271972	0.329114
<b>Galle</b>	-0.5729625	0.4113242	-1.39	-1.383195	0.2372702
<b>Matara</b>	-0.2772555	0.3645601	-0.76	-0.9953714	0.4408605
<b>Agriculture</b>	0.4151766	0.3518468	1.18	-0.2778965	1.10825
<b>Fishery</b>	0.5231556	0.8785319	0.6	-1.20739	2.253701
<b>Manufact.</b>	-0.041359	0.2792474	-0.15	-0.5914247	0.5087067
<b>Age</b>	0.0052006	0.0136888	0.38	-0.0217638	0.0321649
<b>Female</b>	-0.136485	0.3613517	-0.38	-0.848281	0.5753109
<b>Primary</b>	0.0949809	0.2888935	0.33	-0.4740858	0.6640477
<b>Secplus</b>	0.232664	0.3980649	0.58	-0.5514502	1.016778
<b>Num.Child.</b>	-0.0583743	0.0899599	-0.65	-0.2355786	0.11883
<b>Real Income (t-1)</b>	-0.0000157	8.37E-06	-1.87	-0.0000322	8.26E-07
<b>Δ % Real Income</b>	5.613846	1.266112	4.43	3.11984	8.107853
<b>Remittances</b>	-0.6337795	0.5971504	-1.06	-1.810055	0.5424963
<b>Subsidies</b>	-0.753752	0.3432864	-2.2	-1.429963	-0.0775412
<b>Don.Grants</b>	-0.9339694	0.368243	-2.54	-1.65934	-0.2085987
<b>Other Loans</b>	0.2581561	0.2849595	0.91	-0.3031614	0.8194735
<b>Length</b>	0.0048377	0.0222718	0.22	-0.0390337	0.0487091
<b>Constant</b>	0.7290651	0.8507147	0.86	-0.9466856	2.404816
<b>N</b>	262				
<b>R2</b>	0.3741				

*Note:* Results are from a 2SLS regression where the change in real income is instrumented using the dummy variables for the damages to buildings, tools, raw materials and economic market.

## References

- [1] **Alesina, A., Di Tella, R. and MacCulloch, R. (2004)**, “Inequality and Happiness: Are European and Americans Different? *Journal of Public Economics*, Vol. 88, pp. 2009-2042.
- [2] **Becchetti, L., Pelloni, A. and Rossetti, F. (2008)**, “Sociability, Relational Goods and Happiness”, *CEIS Working Paper No. 255* and *Kyklos* (forth.).
- [3] **Campbell, J.Y., Lo A. and McKinlay, C. (1997)**, “The Econometrics of Financial Markets”, Princeton University Press, Princeton.
- [4] **Cheney J.S. and Rhine S.L.W. (2006)**, “How Effective Were the Financial Safety Nets in the Aftermath of Katrina?”, *FRB of Philadelphia Payment Cards Center Discussion Paper*, No. 06-01, Federal Reserve Bank of Philadelphia.
- [5] **Clark, A.E., Frijters, P., Shields, M.A. (2006)**, “Income and Happiness: Evidence, Explanations and Economic Implications”, *Paris Jourdan Sciences Economiques Working Paper*, No. 2006-24.
- [6] **De Neve, K.M. and Cooper, H. (1999)**, “The Happy Personality: a Meta-Analysis of 137 Personality Traits of Subjective Wellbeing”, *Psychological Bulletin*, Vol. 125, 197-229.
- [7] **Diener E. and Lucas R. E. (1999)**, “Explaining Differences in Societal Levels of Happiness: Relative Standards, Need Fulfillment, Culture, and Evaluation Theory”, *Journal of Happiness Studies*, Vol. 1, pp. 41-78.
- [8] **Edwards, M. E., Plotnick R., and Klawitter M., (2001)**, "Do Attitudes and Personality Characteristics Affect Socioeconomic Outcomes?: The Case of Welfare Use by Young Women." *Social Science Quarterly* 82(4)829-845.
- [9] **Ekman, P., Davidson, R. and Friesen W. (1990)**, “The Duchenne smile:emotional expression and brain physiology II”, *Journal of Personality and Social Psychology*, Vol. 58, pp. 342-353.
- [10] **Frey, B.S. and Stutzer, A. (2006)**, “Does Marriage Make People Happy, Or Do Happy People Get Married?”, *Journal of Socio-Economics*, Vol. 35(2), pp. 326-347.
- [11] **Frijters, P., Geishecker, I., Shields, M.A. and Haisken-DeNew, J.P. (2006)**, “Can the Large Swings in Russian Life Satisfaction be Explained by Ups and Downs in Real Incomes?”, *Scandinavian Journal of Economics*, Vol. 108(3), pp. 433-458.
- [12] **Frijters, P. (2000)**, “Do individuals try to maximize general satisfaction?”, *Journal of Economic Psychology*, Vol. 21(3), pp. 281-304.
- [13] **Frijters, P., Shields, M.A., and Haisken-DeNew, J.P. (2004a)**, “Money does matter! Evidence from Increasing Real Incomes in East Germany Following Reunification”, *American Economic Review*, Vol. 94, pp. 730-741.
- [14] **Frijters, P., Shields, M.A., and Haisken-DeNew, J.P. (2004b)**, “Changes in the Pattern and Determinants of Life Satisfaction in Germany Following Reunification”, *Journal of Human Resources*, Vol. 39, pp. 649-674.
- [15] **Frijters, P., Geishecker, I., Shields, M.A. and Haisken-DeNew, J.P. (2006)**, “Can the large swings in Russian life satisfaction be explained by ups and downs in real incomes?”, *Scandinavian Journal of Economics*, Vol. 108(3), pp. 433-458.
- [16] **Gardner, J. and Oswald, A. (2006)**, “Do Divorcing Couples Become Happier by Splitting Up?” *Journal of the Royal Statistical Society*, Vol. 169, pp. 319-336.
- [17] **Kahneman, D., Krueger, A.B., Schkade, D.A., Schwartz, D.N. and Stone, A.A. (2004)**, “A survey method for characterizing daily life experience; the day reconstruction method”. *Science*. 306 (5702), 1776-1780.
- [18] **McIntosh, C., Villaran, G. and Wydick, B. (2007)**, “Microfinance and Home Improvement: Using Retrospective Panel Data to Measure Program Effects on Fundamental Events”, (2007), *University of San Francisco Departmental Working Paper*.

- [19] **Pavot, William et al. (1991)**, "Further Validation of the Satisfaction with Life Scale: Evidence for the Cross-Method Convergence of Well-Being Measures", *Journal of Personality Assessment*, Vol. 57, pp. 149-161.
- [20] **Sandvik, E., Diener, E., and Seidlitz, L. (1993)**, "Subjective well-being: the convergence and stability of self and non self report measures", *Journal of Personality*, Vol. 61, pp. 317-342.
- [21] **Shedler, J., Mayman, M., and Manis, M. (1993)**, "The illusion of mental health", *American Psychologist*, Vol. 48 (11), pp. 1117-1131.
- [22] **Shiv B. and Huber, J. (2000)**, "The Impact of Anticipating Satisfaction on Consumer Choice", *Journal of Consumer Research*, Vol. 27, pp. 202-216.
- [23] **Stiglitz, J.E. (1990)**, "Peer Monitoring in Credit Markets", *World Bank Economic Review*, Vol. 4, pp. 351-366.

## APPENDIX

**Table A1. Description of economic and socio-demographic variables**

Galle	DV equal to 1 if the province is Galle
Matara	DV equal to 1 if the province is Matara
Hambantota	DV equal to 1 if the province is Hambantota
Female	DV equal to 1 if the gender is female
Age	Age of the respondent in years
HeadHous.	DV equal to 1 if head of the household
Incompleted	DV equal to 1 if the education level is incomplete primary
Primary	DV equal to 1 if the education level is complete primary
SecPlus	DV equal to 1 if the education level is higher than primary
Agriculture	DV equal to 1 if the sector of activity is agriculture
Fishery	DV equal to 1 if the sector of activity is fishery
Manufacturing	DV equal to 1 if the sector of activity is manufacturing
Trade	DV equal to 1 if the sector of activity is trade
NumChildren	Number of children currently living in the house
RealIncome	Real income in April 2007 Sri Lankan Rps.
RealYeq	Real equivalent income in April 2007 Sri Lankan Rps.
PPPYeq	Real equivalent income in April 2007 PPP USD
StandLiv.	Standard of living in terms of consumption goods
ProbMeal	DV equal to 1 if the respondent had problems in providing daily meals
PrivMed.	DV equal to 1 if the respondent could afford private medical consultations
Savings	Amount of savings from 0 (not at all) to 4 (very much)
Van	DV equal to 1 if the respondent owns a van
Tract	DV equal to 1 if the respondent owns a tractor
Motorbike	DV equal to 1 if the respondent owns a motorbike
Bicycle	DV equal to 1 if the respondent owns a bicycle
HoursWorked	Number of hours worked per week
Happiness	Self-declared level of happiness from 0 (not at all) to 4 (very happy)
Life Satisf.	Self-declared level of life satisfaction from 1 (min) to 10 (Max)
Self-Esteem	Self-declared level of self-esteem from 1 (min) to 10 (Max)
Trust	DV equal to 1 if most people can be trusted
Health	Self-declared level of health from 1 (min) to 10 (Max)
Dam.Family	DV equal to 1 if the respondent reported damages to the family



Dam.House	DV equal to 1 if the respondent reported damages to the house
Dam.Build.	DV equal to 1 if the respondent reported damages to the office buildings
Dam.Tools	DV equal to 1 if the respondent reported damages to the working tools
Dam.RawMat.	DV equal to 1 if the respondent reported damages to the raw materials
Dam.Mkt.	DV equal to 1 if the respondent reported damages to the market of its own activity
Sum.Dam.	Number of types of damage from 0 to 6
Tsun.Forced	DV equal to 1 if the tsunami forced the respondent to use personal savings after the tsunami
Remittances	DV equal to 1 if the respondent received remittances from foreign countries
Subsidies	DV equal to 1 if the respondent received governmental subsidies
Don.Grant	DV equal to 1 if the respondent received donations and grants
Oth.Charity	DV equal to 1 if the respondent received other forms of charity
Relative Loan	Ratio between real amount loaned in period P and average monthly income of period P-1

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