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A competing risk model for health and food insecurity in the West Bank

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Abstract

This paper explores the interactions between the risk of food insecurity and the decision to health insure in the Palestinian Territories. The risk of adverse health conditions is insurable; the risk of food insecurity is a background risk and no market insurance exists. The vulnerability to food insecurity influences the individual utility from health insuring. We present a competing risk model to reveal this interdependence. We specify the empirical model as a bivariate probit model and evaluate the impact of food insecurity on the household decision to health insure. We find evidence of significant complementarity between the risk of food insecurity and the propensity to health insure. The predicted conditional probabilities reveal that the propensity to health insure is higher in presence of food insecurity among Palestinian households. This study shows that, in presence of a background risk, there are complementarities among risks that policy should be mindful of.

Keywords: Food insecurity, Health insurance, Competing risks, Bivariate Probit

JEL Classification: I11 015 C35

1 Introduction

The capability approach is a widely accepted paradigm in policy debates about human development (Sen, 1985; Nussbaum & Sen, 1993). There is an emerging consensus in economics that the notion of individual well-being goes well beyond material gains and it encompass several non-income dimensions such as health, education, political freedom and democracy (Becker *et al.* , 2005). Sufficient access to each of these domains is a key issue of

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human well-being and enhancing economic well-being entails the designing of system of risk protection of these domains.

Health-care systems are the social institutions that defend the right to health. Effective and accessible health-care systems are vital to human development because health is a vital domain of human security (Chen & Narasimhan, 2004; King & Murray, 2002). One of the goals of an effective health-care system is to provide financial risk protection from adverse health conditions. The achievement of universal health insurance schemes are recognised as the mean to attain a basic adequate standard of health risk protection. Conflict is an additional hazard to the right to health. Constant exposure to threats and unsafe environments affect people perception of risks. The Palestinian experience is a case point to this regard.

Palestinians live in state of severe insecurities and war-like conditions since 1948. Years of political stalemate and poor governance have led the Palestinian Territories to face serious conditions of economic insecurity, only partially mitigated by a heavy dependence on foreign resources and international aid. Malnutrition and food insecurity are still the most pronounced health outcomes of such economic insecurity. These risks are interacting with the risk to health and the consequent decision to acquire health insurance (i.e. to health insure). The risk of food insecurity pertains to the environment where the individuals live and there is no economically viable insurance market against it. Such uninsurable risks are called *background risk*[1].

In this paper, we examine the interactions between the risk of food insecurity and the health insurance coverage. Table 1 shows the cross tabulation of insurance coverage and food insecurity status. It reveals that the probability of being food insecure and not-insured is low, only 4.63%. On the contrary, the probability that food insecure households are insured is 3.5 times as high. If the probability to insure was only a function of the ability to pay for insurance poorer individuals might be expected to insure less as

[1]Limits for a market to insure against food insecurity risk are related to asymmetric information problems, such as moral hazard and adverse selection; the imprecision of risk assessment and the size of the loss and the possible existence of correlated risks. Moral hazard problem relates to the fact that incentives to prevent the occurrence of the risk would reduce, should a food insecurity insurance exists. Also, since losses from food insecurity may be difficult to verify and quantify, claims might be overstated, creating an ex-post moral hazard. Estimating the chances of the event "food insecurity" occurring may be very problematic. No easily accessible historical data exist for such purpose. This unable to set premiums and it may leave the hypothetical insurer with only the pool of bad risks (adverse selection problem). Food insecurity entails long term consequences in health, education and personal development. Evaluating such losses is difficult, if not impossible. Even in case of possible consequence quantification, the size of the loss would be large. The capacity required to cover such losses for a high number of people may be nearly impossible. Also, changes in the external environment, such as atmospheric conditions or conflict related events, may change the risk landscape radically, complicating additionally risk assessment. Finally, food insecurity is likely to be correlated with other risks, making diversification impossible. For all these reasons we consider food insecurity an uninsurable risk for which there exists no market solution for insurance. There might be other ways of protection against food insecurity than buying insurance, such as savings and forms of self-insurance. These non-market based methods are topics for further research.

they might be likely to substitute their expenditures for consumption.

Table 2 shows the probabilities conditional on food (in)security status. Table 2 reports the estimates for the whole sample and the estimates for a restricted sample (in brackets), excluding government employees and refugees who have a compulsory insurance coverage[2]. The estimates reveal that food insecure households are more likely to health insure. Given that a household is food insecure, the probability to be insured is 0.75 (0.60 in the restricted sample); a little higher than the probability to be insured given that the household is food secure that is 0.74 (0.59 for the restricted sample). In light of the fact that food insecure households are generally poorer, the 1% difference offers an interesting insight: it suggests that the attitude toward the risk to health, and hence the decision to health insure, is affected by the condition of food insecurity into a different direction than traditionally expected[3].

The presence of background risks in the environment, such as the risk of food insecurity, affect the attitude toward other risks and the demand for risk protection. Potentially, there might be important interactions among the reduction of one risk and the decision to insure against other risks, especially for individuals constrained by fewer resources. This paper aims to explore how the background risk influences this decision. The descriptive statistics suggests that the risk of food insecurity and buying health insurance are complements and exhibit a positive correlation. This correlation might reflect separate phenomena.

First, the correlation may arise because the food insecurity risk and the decision to insure respond to similar factors. In particular, these can be local environment factors or individual characteristics which influence the perception of risk. This leads to a correlation through the observed characteristics, as in Clark & Etilé (2005) who discuss behaviour interactions between spouses through social learning about health risks.

Secondly, interdependence may be a product of household-decision making in response to individual attitudes toward risks. The literature suggests that an increase in background risk raises the probability to insure against those risks that are insurable[4]. Measuring perceptions of increased background risks is a difficult task. This corresponds to forms of correlation in the unobserved terms. Our empirical approach allows unobservable shocks to be correlated.

This paper contributes to understanding economic well-being under mul-

[2]Section 2 outlines this condition in more details.

[3]This result holds also for the sample of households whose insurance coverage is voluntary as shown by the estimates in brackets.

[4]This is true under the condition of risk vulnerability as explained and proved in Gollier & Pratt (1996) and partial insurance coverage as explained in Guiso & Jappelli (1998). It has been proved that similar effects hold whether the background risk is independent or positively correlated with the insurable risk (see Eekhoudt & Kimball (1992)).

tiple risks. It relates to both the literature on the effects of competing risks to longevity as in Dow *et al.* (1999) and to the literature on the value of life, in particular to those works evaluating the income elasticity of the value of risk reduction as in Viscusi & Evans (1990) and Evans & Viscusi (1993). These works evaluate the income elasticity of the implicit value of risk, such as the risk of job injuries. Our paper differs because it incorporates the effect of income in explaining the health insurance coverage in presence of a background risk. Hence, the focus is the effect of resource endowment and other household characteristics *across* risks, specifically, how changes in background sources of risk induce variation in health insurance coverage. The theoretical framework of this paper is the theory of background risk and the demand for insurance developed in Eekhoudt & Kimball (1992); Eekhoudt *et al.* (1996). It also relates to the theory of state-dependent utility, developed from the seminal contributions by Arrow (1964), Hirshleifer (1970) and Zeckhauser (1970) and to emerging works on human security such as King & Murray (2002).

The paper is organised as follows. Section 2 presents a brief overview of the Palestinian health-care system with special emphasis on its peculiarities. It also briefly explains the state of food insecurity among Palestinian households and its main causes. Section 3 presents the model used to examine how the decision to health insure changes to variations in background risk. Section 4 discusses the data used in this study. Section 5 discusses the econometric approach and the empirical results and Section 6 concludes.

2 The Palestinian Health-Care System

The current Palestinian health-care system is a direct result of peculiar political conditions of the Palestinian Territories. Since the Oslo Accords in 1994 the Palestinian Ministry of Health (MoH) is responsible for delivering health-care services to Palestinians. The Palestinian government sources reports that MoH provides 68% of primary care delivery (MoH, 2010). Beside the role of the MoH, there are three additional providers of health-care to Palestinians: the UN Relief and Work Agency delivers health services and other key services since 1948 to registered Palestinian refugees[5], a number of non-governmental organisations and the private sector. Mataria *et al.* (2009) point out that the operations of these four main providers is not the result of an efficient division of labour but it is mainly driven by the political and economic conditions and the reaction to emergency situations. This

[5]The term *refugees* refers to people who were displaced and forcibly dispossessed during the 1948 Arab-Israeli war and their descendants. In 2008 refugees were about 34% of the Palestinian population; 6.8% of them living in camps, nowadays urban settlements, inside the occupied Palestinian Territories; the remaining part living in urban (21.2%) or rural areas (7.0%).

leads to a fragmented health-care system which reflects contrasting priorities and inadequate coordination of funding sources.

The health plan is based on the system inherited by the Israeli administration and imposes a compulsory health insurance for government employees. National health plans since MoH inception have aimed to achieve universal health insurance coverage in the Palestinian Territories. To this end, eligibility was expanded and premiums were reduced. In 2000, the number of households covered by the national insurance scheme increased significantly by means of waiving premium programmes, such as the decree of provision of free insurance for victims of the Intifada and people in hardship conditions. However, coverage is still far short of universal coverage. Our data estimate the percentage of households uncovered by any insurance schemes is 25%.

The promotion of enrollment through reduction or waiving of premium contributions has severely undermined the financial viability of the Palestinian health-care system. The system suffers the problem of adverse selection enhanced by voluntary enrollments. Since people are allowed to enroll at almost any time, healthy people have the incentive to stay out of the system until they are sick[6]. Also, the sum of health insurance premiums and tax revenues allocated to the MoH is insufficient to meet the demand for health services. The continuous deficit of the Ministry of Health has hindered investments and developments in the health-care provision, causing quality of care to decline. This in turn contributes to eroding public trust in government services.

The lack of capacity has resulted into an increasing number of referrals for treatment abroad thereby contributing to the financial burden. There is a reported lack of coordination between the Ministry of Health and the Ministry of Finance which allocates the budget to the health sector. The centralised management structure of the public sector impairs the incentive to provide health-care efficiently and reduce accountability of hospital managers. In conclusion, a substantial part of the cost of health care services in Palestinian Territories relies on foreign donors and NGOs and out-of-pocket spending by patients themselves. This necessarily impairs the equity of access to health services as discussed in Abu-Zaineh *et al.* (2008). Health-care payments compromises the financial livelihood of households living in financial hardship or vulnerable financial conditions. Similar problems exists elsewhere in the world, however in the Palestinian Territories they are exacerbated by the Israel's separation policies in place.

Food insecurity is a protracted risk in the Palestinian Territories. The World Food Program (WFP) and the Food and Agriculture Organisation (FAO) report that about 25% of the Palestinian population in the West

[6]Schoenbaum *et al.* (2005) reports an interesting example of de-facto "institutionalised" adverse selection: "[...]UNRWA pays to enroll people in the government insurance program when they are diagnosed with cancer".

Bank were food insecure in 2008 and most of those households are chronically food insecure. Food insecurity in the West Bank is mainly the product of a lack of economic access to food, rather than a lack of food accessibility, as food products are generally supplied in sufficient quantity mainly through imports. Economic accessibility to food is constrained because of artificially inflated food prices due to high transportation costs, limited local food production and heavy dependence on Israeli imports. Also, the lack of income and earning possibilities impair household purchasing power and make them highly sensitive to variations in prices and income shocks.

Food insecurity imposes permanent costs on lives and livelihoods of Palestinians, through foregoing health and other expenditures, endangered nutritional status and health conditions, which in turn affect the chances of future income-generating opportunities. The high risk of food insecurity might affect the perception of other risks to life and the demand for risk protection. The next section proposes a theoretical model to analyse the effect of the presence of a background risk of food insecurity on health insurance coverage.

3 The model

We first abstract from the background risk and suppose that the individual preferences can be represented by a von Neumann-Morgenstern non-separable utility function which depends on income, $U(y) > 0$, and utility is increasing in income, $U'(y) > 0$. If the individual buy a health insurance, she needs to pay an enrollment fee π. The utility with insurance is $U(y-\pi)$. If the individual does not buy insurance she might have to pay the cost of hospitalisation in case of illness. Let c be the cost of health service and p the exogenous probability of bad health status. The utility under no-insurance is $pU(y-c)+(1-p)U(y)$. Individuals will insure provided that the utility with insurance exceeds the expected utility under no-insurance.

Individuals in the population are heterogenous and their decision to insure depends on their income, risk aversion and specific tastes. In addition, a characteristic of the environment is the presence of food insecurity risk. This risk is a background risk and there is no economically viable insurance market against the risk of food insecurity. This missing market adds an additional sources of randomness to the utility function. We aim to see whether the presence of background risk influences the probability of buying health insurance.

The utility function subject to a background risk is $U(y, \tilde{f})$. In a more general framework it is possible to assume a human security function which includes all risks affecting human security and it enters the Neumann-Morgenstern

utility function[7]. To ease notation we assume one risk to human security, namely $\tilde{f}$, the risk of food insecurity. This has support $\tilde{f} \in R_0^+$.

In this framework, the observed choice between to insure and not-to insure reveals which status provides the greater utility, subject to the presence of background risk and the budget constraint. But it is not feasible to observe the single utilities. That is, the indirect utility is the maximum of the two conditional indirect utility, $EV^{insured}$ and $EV^{uninsured}$ (which we abbreviate in EV^{ins} and EV^{uns} respectively):

$$EV(y, \pi, p, c, \tilde{f}, x) = max[EV^{ins}(y, \pi, p, \tilde{f}, x), EV^{uns}(y, c, p, \tilde{f}, x)] \quad (1)$$

$$s.t. \qquad C + S \leq Y \quad (2)$$

where x are the individual characteristics and the budget constraint is made of consumption, C, and savings, S. For simplicity we assume that S is either equal to the price of insurance π if people decide to insure or it is zero if people decide not to insure. This is a simplifying assumption, however it is in line with the evidence that individual savings in the West Bank are very low and have been exhausted by the deteriorating income-generating opportunities (FAO-WFP, 2009).

Under these assumptions, the unobserved elements of the utility function could be individual-specific preference factors, such as risk perception, or specific vulnerability to risk. Following McFadden(1981) we assume an additive separable random error for each insurance coverage state: ϵ^{ins} in case of insurance, ϵ^{uns} in case of no-insurance. They decide to health insure only if

$$\Delta \bar{EV} = \bar{EV}^{ins} - \bar{EV}^{uns} > 0 \quad (3)$$

where $\bar{EV}$ indicates the deterministic component of EV. To the deterministic component, a stochastic component ϵ^i it is added to allow for unobserved factors of choice i ($i = insured, uninsured$). ϵ^i is assumed to be distributed with a standard normal distribution. The probability to insure is therefore

$$\begin{aligned} Pr(to\ Y_1^*|\ x) &= Pr(\Delta EV > 0|\ x) \quad (4) \\ &= \Phi(x'\beta^{ins} + \epsilon^{ins} - x'\beta^{uns} - \epsilon^{uns} > 0|\ x) \\ &= \Phi(x'(\beta^{ins} - \beta^{uns}) > \epsilon^{uns} - \epsilon^{ins}|\ x) \end{aligned}$$

The food insecurity risk is jointly determined with this probability. However, the food insecurity risk is unobserved. From the data, we observe the actual condition of food insecurity conditional to an arbitrary threshold level. This imposes a bivariate structure of the probability of being health insured and food insecure. This implies that a bivariate probit model can

[7] The Neumann-Morgenstern utility function will then depends on income and human security, $U(y, H(\tilde{r}_k))$, where $H(\tilde{r}_k)$ is the human security function including $\tilde{r}_k$ risks, with $k = 1, ..K$.

describe the propensity to health insure in presence of a background risk of food insecurity.

The framework we propose can be placed into the class of latent variable models. Our model is represented as follows

$$\begin{aligned} y_{1i}^* &= \beta_1' x_{1i} + \epsilon_{1i} \quad (5) \\ y_{2i}^* &= \beta_2' x_{2i} + \epsilon_{2i} \quad (6) \\ & \{\epsilon_{1i}, \epsilon_{2i}\} \sim \Phi_2(0, 0, 1, 1, \rho) \end{aligned}$$

where the values for $y_{.i}^*$ are unobservable and related to the following binary dependent variables, on the basis of these conditions:

$$y_{1i} = 1 \quad if \quad y_{1i}^* > 0, \quad 0 \; otherwise, \quad (7)$$

and

$$y_{2i} = 1 \quad if \quad y_{2i}^* > 0, \quad 0 \; otherwise, \quad (8)$$

where $y_{1i} = 1$ denotes that the individual is health insured, which depends on personal and family characteristics, job sector and geographical attitudes to be insured; $y_{2i} = 1$ denotes that the individual is food insecure, which depends on personal and family characteristics and geographical factors. The errors $(\epsilon_{1i}, \epsilon_{2i})$ are assumed to have the standard bivariate normal distribution, with $Cov(\epsilon_{1i}, \epsilon_{2i}) = \rho$. There are two channels that link the two outcomes. The first channel is through the observable variables: if some x_i has similar effects on y_{1i} and y_{2i}, this induces the outcomes to be correlated. The second channel is an unobservable link: the unobserved factors that influence ϵ_{1i} might be similar to those unobservable factors affecting ϵ_{2i} (e.g. vulnerability to ill health might be similar to unobservable vulnerability to food insecurity).

The probability of an individual to be insured and food insecure is given as

$$\begin{aligned} Pr(to\ insure, food\ insecurity|\ x) &= Pr(y_{1i} = 1, y_{2i} = 1|\ x) \quad (9) \\ Pr &= (X_{1i} < x_{1i},\ X_{2i} < x_{2i}|\ x) \\ &= \int_{-\infty}^{x_{2i}} \int_{-\infty}^{x_{1i}} \phi_2(z_{1i}; z_{21}; \rho) dz_{1i}, dz_{2i} \\ &= \Phi(\beta_1' x_{1i}, \beta_2' x_{2i}, \rho) \end{aligned}$$

where ϕ_2 and Φ denote the density function and the bivariate standard normal distribution function, respectively[8]. Since y_{1i} and y_{2i} are both observed

[8]The model can be extended to K competing risks. Let $k = 1, ..., K$ denote K competing risks. In this case, the latent random variable $y_k^* > 0$ for $k = 1, .., K$ would be the probability of being subject to the k^{th} particular risk. The probability of a risk cannot be observed. The available information is the actual outcome $y_k = 1$ if $y_k^* > 0$. In our specification we have $K = 2$.

and keep full observability in terms of the four possible combinations, the efficient estimates for the bivariate probit are provided by maximum likelihood (Zellner & Lee, 1965; Ashford & Sowden, 1970; Greene, 1998). The next section introduces the data on which we base our estimations; section 5 will discuss the estimation results.

4 Data

The data are from the Socio-Economic and Food Security Survey 2009 in the West Bank, administered by the World Food Programme (WFP), the the Food and Agriculture Organisation (FAO) and the Palestinian Central Bureau for Statistics (PCBS) during January and February 2009. The survey provides information about the demographic composition of 4,791 households in the West Bank, their socio-economic conditions and the food security situation during the second half of 2008. The household sample is random, but households with expenditure below the 1^{st} percentile or above the 99^{th} percentile have been dropped.

Food insecurity is a multidimensional phenomenon. The Rome Declaration on World Food Security (1996) and the World Food Summit Plan of Action define that food security exists when "all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life". The definition includes four main components: (i) adequacy of food supply or availability; (ii) stability of supply, without fluctuations or shortages from season to season or from year to year; (iii) accessibility to food or affordability; (iv) quality and safety of food.

Capturing the food insecurity risk by statistical indicators is complicated and there is not a universally accepted indicator. Like all indicators reflecting multidimensional phenomena, there exists a trade-off between synthesis and comprehensiveness in each feasible indicator. In addition, perception-based versus standardised scale indicators often give different pictures. Furthermore, indicators are context dependent. Overlooking the context might suggest misleading implications. A common indicator of food insecurity, for instance, is the number of calories consumed per day based on consumed quantity of food. When this is possible to compute, this indicator offers a precise and comparable measure of calory intake. However, the indicator tends to increase when food is externally provided by food-aid agencies. Despite condition (i) and (iv) above might be met in this situation, supply is not stable and the condition is not self-sustainable. The risk of food insecurity remains high in such a situation.

The literature has provided various indicators. Each of them capture different aspects of food insecurity. From the survey, we have been able to

compute a number of alternative food insecurity indicators. These include: the Household Food Insecurity Access Prevalence, the number of meals per children per day, the number of meals per adult per day, the food insecurity indicator proposed by FAO within the framework of the Socio-Economic and Food Security Monitoring System in the West Bank.

The Household Food Insecurity Access Prevalence (HFIA) is based on the frequency of occurrence of certain consequences which result from an insufficient availability of food (such as running out of food, going to bed hungry, going a whole day and night without eating) and/or household anxiety whether the food is sufficient to meet basic needs[9]. Households are categorised in four levels of food insecurity as they experience those conditions more frequently. These level categorisations generate a categorical variable, HFIA, coded as follows: 1 = Food secure; 2 = Mildly food insecure; 3 = Moderately food insecure; 4 = Severely food insecure. We also create a dichotomous food insecurity indicator based on the same categorisation. This binary variable is equal to 1 if the household falls into the "severely food insecure" category, 0 otherwise.

The frequency of meals is the number of meals eaten per days. Two separate indicators are computed: one refers to meals eaten by children and the second to meals consumed by adults. Both indicators range from a minimum value of 1 to a maximum of 5 meals per day. In the empirical analysis that follows, these indicators are reversed to make them consistent with the other food insecurity indicators. Hence, the highest value is associated with the most severe condition of food insecurity.

The food insecurity indicator proposed by FAO classifies households in four category according to their consumption and income levels. The categorical indicator we use is the FAO indicator recoded as follow: Food secure household = 1; Marginally food secure = 2; Vulnerable (to food insecurity) = 3; Food insecure = 4. The detailed procedure and the methodology for this indicator are available on www.apis.ps and FAO (2009).

To capture the risk of food insecurity, our preferred indicator is the HFIA indicator. This is because the indicator includes a measure of household anxiety regarding the availability of food which is direct reflection of the perception of the risk of food insecurity. The analysis in the next section is based on the HFIA indicator. Results using alternative indicators are presented in Table 4 and commented on the text. Control variables and coding details are summarised in Appendix 1.

[9]The indicator is created following the guidelines in Coates *et al.* (2007). A discussion about the validity of food insecurity indicators based on self-reported behaviours and perceptions can be found in Coates *et al.* (2007) and Webb *et al.* (2006).

5 Empirical results

This section discusses the estimates of the bivariate probit model in equations (5) and (6), reported reported in Table 3. In the reduced form, the probability of food insecurity and the probability of being health insured are functions of only exogenous variables. The vector of exogenous covariates x_{ki} is a vector of household characteristics including income, educational level, whether the household is female-headed and refugee status. The choice to insure might be influenced by learning about health risks: we control for this by including a variable indicating whether the households faced any severe health problems in the last 6 months. We also control for the location of residence, employment sector (private sector, government employee, foreign government employee or charity organisation[10]) and the ownership of a crop cultivated field. In addition, we include a series of governorate dummies to take into account the importance of area-effects.

Column (2) in Table 3 reports the coefficient estimates for the health insurance equation. Column (3) reports the estimates for the food insecurity equation based on the HFIA indicator. The residual correlation while not large (0.087) is statistically different from zero[11]. The t-ratio on this coefficient is 2.4 and LR test statistics for the hypothesis that the two equations are independent is 6.0 with p-value 0.014: this suggests that there is a significant degree of interdependence between the two equations which creates some form of correlation between the residuals. The positive correlation indicates that households that experience more food insecurity than the model predicts, are also more likely to be health insured. This is consistent with the theoretical literature on background risk: increases in the uninsurable risk raises the probability to insure against the insurable risk[12].

Table 4 presents the results computed with a number of alternative food insecurity indicators. The indicator based on the number of meals per adult and the FAO indicator lead to the same conclusion. The correlation with the former indicator is equals to 0.086; however this estimates is not significant at conventional level. Food insecurity measured by the FAO indicator leads to a significant correlation equals to 0.10. The indicator based on the number of meals per children reports a small negative correlation, statistically insignificant. The range of the correlations is approximately similar across

[10] We do not control for employees in international organisations as there are not enough observations in the sample to provide efficient estimates.

[11] When ρ is not equal to zero, Zellner & Lee (1965) have shown that estimating the two equations jointly yields more efficient estimates than a single equation approach. Provided the two outcomes are fully observable, it is always possible to estimate the two probit equations separately. This imposes the correlation to be equal to zero.

[12] Due to the existence of compulsory health insurance scheme for some category of employees, the health insurance coverage does not necessarily reflect a voluntary choice. This is the case of government employee for example. Since we cannot observed whether the decision to insure is voluntary or not for other sector employees, it is not straightforward whether the health insurance equation in this paper should be interpreted as a demand or a supply equation.

all indicators and it is in line with the results from Table 3.

The revealed correlations between the health insurance equation and the food insecurity equation might be interpreted in term of food insecurity being predetermined to the decision to health insure[13]. This leads to a recursive simultaneous-equation probit model. We estimate such model for various indicators of food insecurity. These estimates are shown in Table 5. Two indicators based on the Households Food Insecurity Access Prevalence and the FAO indicator are positively associated with the decision to health insure and statistically significant. This confirms the complementarity revealed by our analysis. Two indicators based on the number of meals consumed have small insignificant coefficients.

To detect how the propensity to health insure changes in presence of food insecurity, we predict conditional probabilities for a number of household categories, based on the estimates in Table 3. These estimates are shown in Table 6. Column(2) and (3) in Table 6 present conditional probabilities of being health insured given that the household is classified as food insecure, that is $Pr(y_1 = 1|y_2 = 1)$ in the system (5) and (6). Column (4) and (5) present conditional probabilities for health insurance coverage given the household is food secure, that is $Pr(y_1 = 1|y_2 = 0)$. We differentiate among households with refugee and non-refugee status. Columns (2) and (4) refer to non-refugee households while columns (3) and (5) refer to refugee households. The probabilities are computed for a representative household with average income of her own category, which is male-headed unless specified, with a post-secondary school diploma, no serious disease in the past had occurred and the household lives in a urban neighbourhood of Ramallah governorate and owns no crop field. The Table reports the conditional probabilities for different employment categories, location of residence, occurrence of diseases in the past and female versus male-headed households.

In presence of food insecurity, the probabilities of being health insured among non-refugees are higher for all employment sector categories. These are highlighted in bold. A food insecure private sector employee has a predicted probability to health insure equal to 0.49 while the probability falls to 0.14 for a food secure employee with otherwise the same characteristics. Other employment categories share the same trend. Due to the existence of compulsory insurance scheme for government employees, the predicted probability of being health insured is as high as 0.93 for a food insecure households and 0.59 for, other things equal, a food secure household. A foreign government employee has 0.48 probability of health insure, while a charity sector employees has 0.56 if at risk of food insecurity. Probabilities are smaller under food security conditions.

[13]Food insecurity being predetermined to the decision to health insure is a suggested interpretation that unfortunately cannot be verified with the data available. Should more detailed data and follow-up surveys over time be available, this issue could be investigated and tested.

Such estimates also show that employment sector is an important determinant to shape the pattern of health insurance coverage among households. This reflects the issue of an involuntary decision to health insurance which we cannot directly observe from the data. For example, government employees are subject to a compulsory Palestinian Authority health insurance which explains the high value of the predictive probabilities for such category. To the same token, refugees are provided with free-of-charge UNRWA health insurance which explains why refugees have probability of health insuring higher than 0.90 on average, as it appears in column (3).

Table 6 shows that rural dwellers who are food insecure are more likely to be covered by insurance than urban dwellers: the former have a probability to insure of 0.74 while urban dwellers have a probability of 0.70. However the pattern is reversed if they are food secure: food secure rural dwellers insure with a probability of 0.21 while urban dwellers with a probability of 0.30. Food insecure female-headed households have a lower probability to health insure (0.65) than comparable male-headed households (0.70), however they are less likely to be food insecure in general[14].

Having experience some forms of disease in the past six months raises the probability of being health insured remarkably: the probability of being health insured for a private employee having experienced two forms of disease in the past increases from 0.49 to 0.59; for a government employee it increases from 0.93 to 0.96[15]. The influence induced by the occurrence of a past disease diminishes when conditioning on food security. In this situation, the conditional probabilities with a disease having occurred and the conditional probabilities with no disease been experienced are very similar: a private employee with two past diseases has a probability to health insure equals to 0.14, the same as a private employee with no past disease. A government employee with past diseases has a probability to insure of 0.53, slightly lower than the same individual with no disease (0.59).

In conclusion, food secure households are on average less likely to health insure than food insecure households. Table 7 presents the odds ratios for the household characteristics discussed in the previous paragraphes. Government employees have the highest probability to insure among different job sectors in both food (in)security conditions and foreign sector employees the least probability. Conditioning on food insecurity raises the probabilities to insure of all employment sectors: the probability that a private employee insures if food insecure is 3.5 times higher than the probability that the same individual insures if she is food secure. A food insecure government

[14]The marginal probability of being food insecure for a female-headed household is 0.14; for a male-headed household is 0.20. Marginal probabilities of health-insurance coverage and food insecurity for a number of household characteristics are shown in Appendix 2.

[15]The nature of the data do not allow to distinguish whether the insurance scheme was adopted only after the disease or it was in place before. However, cases of taking up a government insurance just before a needed hospitalisation service are not unusual in the West Bank.

employee is 1.6 time more likely to insure than her food secure colleague. A foreign sector employee is the less likely to insure among all job sectors, but if she is food insecure, she will be 4.8 times more likely to health-insure.

6 Conclusions

This paper explores the interactions between the risk of food insecurity and the decision to health insure in the West Bank. The risk of food insecurity is an uninsurable risk since no economically viable market for insurance exists against this risk. The vulnerability to the background risk influences the individual utility from health insuring. We find empirical evidence of behavioural cross-risk effects. The interdependence between the risk of food insecurity and the decision to health insure has modest size (0.087) and it is statistically different from zero. The positive correlation suggests that the increases in the background risk raises the probability to buy a health insurance. The predicted conditional probabilities reveal that the propensity to health insure is higher in presence of food insecurity than without. The estimates show that employment sector is an important determinant to shape the pattern of likelihood to health insure among Palestinian households.

This study suggests that there is a significant degree of complementarity between food insecurity risk and the decision to insure against the risk to health. We find evidence of a cross-risk spillover effect between the risk of food insecurity, its perception and the sense of deprivation that is likely to arise from this condition and the propensity to buy health insurance. This means that changes in the vulnerability to food insecurity might induce changes in how the risk to health is perceived. The revealed complementarity suggests that a particular policy that decreases the probability of food insecurity also diminishes the propensity to health insure.

Our evidence suggests that the presence of background risks alters the incentives to invest in health protection. It is important that policy makers are aware of this incentive structure. However, it is difficult to identify the structure of causality, hence policy recommendations are not clear-cut. The revealed complementarity suggests that food aid policies that improves household food security conditions may reduce the propensity to health insure. A larger quota of people less inclined to insure in presence of a health insurance system which itself is not effective (e.g. because of premium waivers programmes) might create important welfare costs, problems of financial viability of the health-care system and consequent inefficiencies (e.g inequity of access and quality deterioration). Welfare improving policies targeted to erase household vulnerability to food insecurity should include elements aimed to counterbalance the negative incentive to the propensity to health insure outlined in this analysis.

We did not consider empirically other background risks and specific causes of human insecurity, such as violence from conflict. Identifying the inherent complementarities is an important question to inform policy interventions about how the structure of incentive to health protect is altered, albeit indirectly, and which is the direction and the magnitude of these incentive spillovers. Further analysis on multiple background risks and their interactions with the risk to health is warranted and it is a topic for future research.

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APPENDIX 1.

Table 1.1: Data and variable descriptions

	VARIABLE	DESCRIPTION	RANGE	NOTES
Dependent variables				
	y_{1i}	Health-insurance coverage	Dichotomous variable, where 1 indicates the household is health-insured, 0 if not health-insured	
	y_{2i}	Food Insecurity indicator		
	HFIA	Household Food Insecurity Access Prevalence	Indicator from 1 to 4, where 1 is "food secure" and 4 is "severely food insecure". The indicator is summarised as a dichotomous variable equals to 1 if HFIA is 4, 0 otherwise	
	meal child	Frequency of meals eaten by children per day	Indicator from 1 to 5. The indicator is summarised as a dichotomous variable equals to 1 if kids eat less than 2 meals per day, 0 otherwise	
	meal adult < 1	Frequency of meals eaten by adults per day	Indicator from 1 to 5. The indicator is summarised as a dichotomous variable equals to 1 if adults eat less than 1 meals per day, 0 otherwise	
	meal adult < 2	Frequency of meals eaten by adults per day	Indicator from 1 to 5. The indicator is summarised as a dichotomous variable equals to 1 if adults eat less than 2 meals per day, 0 otherwise	
	FAO	FAO elaborated indicator	The indicator is based on income and goes from 1 to 4. It is recoded such that 1 is "food secure" and 4 is "food insecure". The indicator is summarised as a dichotomous variable equals to 1 if "food insecure", 0 otherwise	FAO source
Control variables				
	income	Household monthly expenditure	in logarithm scale	
	educ level	Educational level	From 1 to 10. 1 (illiterate) until 10 (PhD)	
	fem head	Female-headed household	Dichotomous variable: 1 if female-headed household, 0 if male-headed	
	refugee	Refugee status	Dichotomous variable: 1 if household-head is a registered refugee, 0 otherwise	
	disease	Use of health services in the last 6 months	From 0 to 8. 0 (no need of health service) until 8 (8 different health services used)	
	urban	Urban dweller	Dichotomous variable: 1 if household live in urban areas, 0 otherwise	
	rural	Rural dweller	Dichotomous variable: 1 if household live in rural areas, 0 otherwise	
	private	Private sector employee	Dichotomous variable: 1 if household-head is employed in the private sector, 0 otherwise	
	government	Government sector employee	Dichotomous variable: 1 if household-head is employed in the gov. sector, 0 otherwise	
	foreign	Employee by a foreign gov.	Dichotomous variable: 1 if household-head is employed by a foreign government, 0 otherwise	
	charity	Employee by a charity/NGO	Dichotomous variable: 1 if household-head is employed by a charity/NGO, 0 otherwise	
	crop	Ownership of crop-cultivated field	Dichotomous variable: 1 if household owns a crop-cultivated field, 0 otherwise	
Macro fixed effects				
	gov#	Governorate fixed effect	12 dummy variables	

Notes: ''FAO" stands for Food and Agriculture Organization of the United Nations.

APPENDIX 2.

Table 2.1: Predicted Marginal Probabilities of Health Insurance and Food Insecurity by household category.

Characteristics	(2) Pr(Health insured) $Pr(y_1 = 1)$	(3)	(4) Pr(Food Insecurity) $Pr(y_2 = 1)$	(5)
	Non-refugee	Refugee	Non-refugee	Refugee
private	0.44	0.91	0.20	0.23
government	0.91	0.99	0.16	0.19
foreign	0.44	0.90	0.22	0.25
charity	0.50	0.93	0.07	0.08
female headed*	0.38		0.14	
male headed*	0.44		0.20	
rural*	0.50		0.27	
urban*	0.44		0.20	
disease* : no	0.44		0.20	
disease* : yes	0.54		0.25	
land* : no	0.50		0.27	
land* : yes	0.52		0.23	

Note: $*$ imposes working in the private sector.

Table 1: Joint Probabilities.

	Not-insured	Insured	
Food secure	20.6	**60.7**	81.3
	[32.5]	[48.1]	[80.6]
Food insecure	4.6	**14.1**	18.7
	[7.6]	[11.8]	[19.4]
	25.2	74.8	
	[40.1]	[59.9]	

Notes: Figures are in percentages. Estimates in brackets are from the restricted sample, excluding government employees and refugees.

Table 2: Conditional Probabilities.

Conditioning	Not-insured	Insured
Food secure	0.25	0.74
	[0.40]	[0.59]
Food insecure	0.24	0.75
	[0.39]	[0.60]

Notes: Estimates in brackets are from the restricted sample, excluding government employees and refugees.

Table 3: Bivariate Probit estimates of Health Insurance coverage and Food Insecurity risk.

Dependent variable	(2) Insurance $Pr(y_1 = 1)$	(3) Food Insecurity $Pr(y_2 = 1)$
income	0.038	-0.293 ***
	(0.042)	(0.039)
educ level	0.020	-0.081 ***
	(0.015)	(0.014)
fem head	-0.165 *	-0.234 ***
	(0.092)	(0.083)
refugee	1.477 ***	0.11 **
	(0.075)	(0.053)
disease	0.118 ***	0.08 ***
	(0.020)	(0.017)
urban	-0.703 ***	-0.031
	(0.235)	(0.095)
rural	-0.559 **	0.203 **
	(0.239)	(0.103)
private	-0.544 ***	-0.022
	(0.07)	(0.061)
government	0.969 ***	-0.154
	(0.141)	(0.098)
foreign	-0.558 **	0.061
	(0.260)	(0.251)
charity	-0.405	-0.647
	(0.427)	(0.537)
crop	0.055	-0.121 **
	(0.058)	(0.060)
const	3.21 ***	1.195 ***
	(0.549)	(0.342)
N	4598	
MLL	-3905.9	
ρ	0.087**	
	(0.035)	
LR test	6.00	p-value = 0.014

Notes: Government fixed effects are included but not reported. ρ is the correlation parameter. Standard errors are in parenthesis. The dependent variables are $y_1 = 1$ if the household head is health insured, 0 otherwise; $y_2 = 1$ if the household is classified as ''severely food insecure" according to HFIA criteria described in section 4

Table 4: Bivariate Probit estimates of Health Insurance coverage and Food Insecurity risk by various Food Insecurity indicators

	Dependent variables: Health Insurance (ins) and Food Insecurity indicator (as specified)									
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	ins	HFIA[1]	ins	meal child$<1^2$	ins	meal child $<2^3$	ins	meal adult$< 1^2$	ins	FAO[4]
income	0.038	-0.293***	0.037	-0.227**	0.037	-0.266***	0.036	-0.24***	0.036	-0.774***
	(0.042)	(0.039)	(0.042)	(0.097)	(0.042)	(0.036)	(0.042)	(0.059)	(0.042)	(0.04)
educ level	0.02	-0.081***	0.02	-0.082**	0.02	-0.037***	0.02	-0.021	0.02	-0.089***
	(0.015)	(0.014)	(0.015)	(0.038)	(0.015)	(0.012)	(0.015)	(0.021)	(0.015)	(0.014)
female headed	-0.165*	-0.234***	-0.165*	-0.24	-0.164*	0.446***	-0.166*	-0.111	-0.169*	-0.735***
	(0.092)	(0.083)	(0.092)	(0.218)	(0.092)	(0.077)	(0.092)	(0.132)	(0.092)	(0.085)
refugee	1.477***	0.11**	1.473***	0.022	1.474***	0.022	1.474***	0.191**	1.474***	0.13**
	(0.075)	(0.053)	(0.075)	(0.135)	(0.075)	(0.046)	(0.076)	(0.078)	(0.075)	(0.052)
disease	0.118***	0.08***	0.118***	0.064	0.117***	-0.096***	0.117***	0.047*	0.118***	0.04**
	(0.02)	(0.017)	(0.02)	(0.044)	(0.02)	(0.016)	(0.02)	(0.026)	(0.02)	(0.017)
urban	-0.703***	-0.031	-0.716***	0.007	-0.714***	0.212**	-0.717***	0.302*	-0.719***	-0.185**
	(0.235)	(0.095)	(0.235)	(0.247)	(0.235)	(0.085)	(0.235)	(0.154)	(0.236)	(0.093)
rural	-0.559**	0.203**	-0.57**	-0.059	-0.568**	0.057	-0.572**	0.139	-0.572**	0.106
	(0.239)	(0.103)	(0.239)	(0.271)	(0.239)	(0.093)	(0.24)	(0.168)	(0.24)	(0.10)
private	-0.544***	-0.022	-0.542***	-0.02	-0.541***	-0.78***	-0.54***	0.081	-0.543***	-0.157***
	(0.07)	(0.061)	(0.07)	(0.156)	(0.07)	(0.054)	(0.07)	(0.097)	(0.07)	(0.06)
government	0.969***	-0.154	0.967***	0.164	0.967***	-0.805***	0.972***	0.194	0.963***	-0.416***
	(0.141)	(0.098)	(0.141)	(0.242)	(0.141)	(0.083)	(0.141)	(0.144)	(0.141)	(0.094)
foreign	-0.558**	0.061	-0.551**	0.255	-0.553**	-0.37*	-0.551**	-0.18	-0.554**	0.108
	(0.26)	(0.251)	(0.26)	(0.505)	(0.26)	(0.199)	(0.26)	(0.468)	(0.259)	(0.262)
charity	-0.405	-0.647	-0.411	1.37***	-0.407	-0.443	-0.405	1.127***	-0.404	-0.234
	(0.427)	(0.537)	(0.426)	(0.488)	(0.427)	(0.305)	(0.425)	(0.361)	(0.428)	(0.395)
crop	0.055	-0.121 **	0.057	-0.225	0.058	0.028	0.056	-0.056	0.057	-0.02
	(0.058)	(0.06)	(0.058)	(0.174)	(0.058)	(0.053)	(0.058)	(0.094)	(0.057)	(0.055)
const	3.21***	1.195***	3.228***	-4.805	3.229***	2.636***	3.234***	-1.095**	3.236***	3.857***
	(0.549)	(0.342)	(0.549)	(681.505)	(0.549)	(0.309)	(0.549)	(0.548)	(0.549)	(0.479)
N	4598		4598		4598		4598		4598	
MLL	-3905.9		-2112.4		-4577.5		-2627.6		-4123.4	
ρ	0.087**		-0.019		-0.022		0.086		0.10***	
se (ρ)	(0.035)		(0.85)		(0.032)		(0.055)		(0.033)	
p-value*	0.014		0.821		0.431		0.114		0.002	

Notes: [1] Household Food Insecurity Access Prevalence (HFIA) : $y_{2i} = 1$ if severe food insecure. [2] Indicator based on number of meals eaten per day by children (adult): $y_{2i} = 1$ if the children (adult) eat less than 1 meal per day. [3] Indicator based on number of meals eaten per day by children (adult): $y_{2i} = 1$ if the children eat less than 2 meal per day. [4] Indicator based on FAO classification: $y_{2i} = 1$ if the household is classified as severe food insecure or vulnerable to food insecurity. * P-value refers to the p-value of the LR test on the null hypothesis that $\rho = 0$. Governorate fixed effects are included but not reported.

Table 5: Health Insurance coverage with predetermined food insecurity- Probit estimates with Governorate fixed effects

Dep var: Health Insurance $Pr(y_{1i}=1)$					
	(2)	(3)	(4)	(5)	(6)
income	0.049	0.053	0.031	0.105**	0.037
	(0.042)	(0.042)	(0.050)	(0.045)	(0.042)
educ level	0.022	0.026*	0.008	0.026*	0.020
	(0.015)	(0.015)	(0.018)	(0.015)	(0.015)
fem head	-0.157*	-0.153*	0.188	-0.117	-0.165*
	(0.092)	(0.092)	(0.153)	(0.093)	(0.092)
refugee	1.475***	1.471***	1.576***	1.469***	1.472***
	(0.076)	(0.076)	(0.094)	(0.076)	(0.075)
disease	0.115***	0.112***	0.099***	0.115***	0.118***
	(0.020)	(0.020)	(0.022)	(0.020)	(0.020)
urban	-0.703***	-0.700***	-0.499**	-0.707***	-0.717***
	(0.235)	(0.236)	(0.250)	(0.236)	(0.235)
rural	-0.568**	-0.567**	-0.370	-0.581**	-0.571**
	(0.239)	(0.240)	(0.255)	(0.240)	(0.239)
private	-0.543***	-0.549***	-0.455***	-0.536***	-0.542***
	(0.070)	(0.070)	(0.097)	(0.070)	(0.070)
government	0.974***	0.970***	1.059***	0.989***	0.967***
	(0.141)	(0.142)	(0.163)	(0.142)	(0.141)
foreign	-0.563**	-0.581**	-0.627**	-0.566**	-0.551**
	(0.260)	(0.260)	(0.284)	(0.260)	(0.260)
charity	-0.395	-0.393	-0.153	-0.379	-0.408
	(0.426)	(0.426)	(0.548)	(0.430)	(0.426)
crop	0.060	0.060	0.000	0.054	0.057
	(0.058)	(0.058)	(0.067)	(0.058)	(0.058)
HFIA[1]	**0.140****				
	(0.062)				
HFIA[2]		**0.059*****			
		(0.021)			
meal child[3]			-0.011		
			(0.045)		
FAO				**0.091*****	
				(0.023)	
meal adult[3]					-0.000
					(0.042)
N	4598	4598	3424	4597	4597
pseudo R^2	0.287	0.288	0.291	0.289	0.286
MLL	-1852.9	-1851.4	-1375.5	-1847.3	-1855.4

Notes: [1] HFIA dichotomous indicator: $y_{2i}=1$ if severe food insecure. [2] Food Insecurity ordinal indicator: y_{2i} goes from 1 to 4, where 4 is the severe food insecurity; [3] Indicator based on number of meals eaten per day by children (adult). The indicator is reversed for consistency: it goes from 1 to 5 where 5 is severe food insecurity. Governorate fixed effects and a constant are included but not reported.

Table 6: Predicted Conditional Probabilities of Health Insurance by household characteristics.

Characteristics	(2) Pr(Health insured | food insecurity) $Pr(y_1 = 1 \mid y_2 = 1)$	(3)	(4) Pr(Health insured | non-food insecurity) $Pr(y_1 = 1 \mid y_2 = 0)$	(5)
	Non-refugee	Refugee	Non-refugee	Refugee
private	**0.49**	0.92	**0.14**	0.46
government	**0.93**	0.99	**0.59**	0.61
foreign	**0.48**	0.92	**0.10**	0.41
charity	**0.56**	0.95	**0.39**	0.76
urban*(male-headed)	**0.70**	0.97	**0.30**	0.50
rural*	0.74	0.98	0.21	0.35
rural (in private sector)	0.54	0.94	0.08	0.33
rural (in government)	0.95	0.99	0.58	0.47
disease*	0.78	0.98	0.28	0.40
disease (in private sector)	0.59	0.95	0.14	0.39
disease (in government)	0.96	0.99	0.53	0.52
female-headed*	0.65	0.96	0.35	0.62

Notes: Probabilities are computed for a representative household with average income of her own category, male-headed with a post-secondary school diploma, with no serious disease occurred in the past and living in a urban neighbourhood of Ramallah governorate, owning no crop field. $*$ indicates that the effect of employment sector has been omitted.

Table 7: Predicted Odds Ratios by Household characteristics

Characteristics	Non-refugee $\frac{Pr(y_1=1\|y_2=1)}{Pr(y_1=1\|y_2=0)}$	Refugee $\frac{Pr(y_1=1\|y_2=1)}{Pr(y_1=1\|y_2=0)}$
private	3.5	2.0
government	1.6	1.6
foreign	4.8	2.2
charity	1.4	1.3
urban*(male-headed)	2.3	1.9
rural*	3.5	2.8
rural (in private sector)	6.8	2.8
rural (in government)	1.6	2.1
disease*	2.8	2.5
disease (in private sector)	4.2	2.4
disease (in government)	1.8	1.9
female-headed*	1.9	1.5

Notes: Predicted odds ratios are the ratio of the conditional probability of a positive outcome when the conditioning variable is active to the conditional probability of positive outcome when the conditioning variable is inactive.
$*$ indicates that the effect of employment sector has been omitted.