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Macroeconomic Conditions and Health: Inspecting the Transmission Mechanism

Emilio Colombo* Valentina Rotondi† Luca Stanca‡

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Abstract

This paper studies the effects of labor market conditions on individual-level health, investigating the factors that moderate and mediate this relationship. Using a large and representative sample of individuals in Italy between 1993 and 2012, we shed light on the transmission mechanism, focusing on the role played by health behaviors (smoking, alcohol consumption, physical activity, eating habits) and economic stress. We find that, overall, higher local unemployment negatively affects health, with a dynamic response that differs across health conditions. Employment status and educational level play a significant role as moderators of these effects. Eating habits, in addition to economic stress, are found to play a key role in the transmission mechanism, while physical activity acts as a buffer against the adverse health effects of unemployment shocks.

Keywords: economic conditions, unemployment, health behaviors, health outcomes.
JEL codes: I1, I10, I12, I18

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1 Introduction

The growing concerns about the pervasiveness and persistence of joblessness in advanced economies, and particularly in Europe, are fueled by the perception that the social costs of unemployment are far greater than the economic costs measured by reduced income levels. The World Health Organization (WHO) has forcefully warned policymakers against the adverse health consequences of the recent global financial crisis (WHO, 2009, 2011). Yet, the literature is still far from reaching a consensus about the effects of macroeconomic conditions on health outcomes. More importantly, relatively little is known about the transmission mechanism from aggregate economic fluctuations to individual health conditions.

Following the seminal work by Ruhm (2000), a number of studies have found a pro-cyclical pattern of mortality and chronic diseases, while other studies have found either counter-cyclical or a-cyclical patterns (Svensson, 2007; Charles and DeCicca, 2008; Stuckler et al., 2009). Moreover, these effects vary substantially by age group, gender, and type of health condition, and the results are generally sensitive to the specific indicators used to measure economic conditions (Stevens et al., 2015; Tekin, McClellan, and Minyard, 2013). To date, several papers have shown that weakening economies are associated with changes in either health outcomes, such as mortality (Edwards, 2008), heart attacks (Svensson, 2007) and mental disorders (Gili et al., 2013), or health behaviors, such as smoking (Ruhm, 2005), alcohol consumption (Ruhm and Black, 2002; Dee, 2001; Cotti, Dunn, and Tefft, 2015), lack of physical exercise and bad eating habits (Dave and Kelly, 2012). Given these broad effects, the challenge is to understand the underlying mechanisms linking macro-economic conditions to individual-level health (Xu, 2013).

The medical literature has identified several frameworks that underpin the relationship between economic conditions and health, such as the University of Michigan job stress model (Israel et al., 1996) and the Karasek's model (Karasek and Theorell, 1990; Karasek et al., 1998). In both these frameworks, the economic environment generates some *stressors*, that are either psychosocial (such as time pressure, uncertainty, job insecurity, etc.) or physical (heavy work-shifts, etc.). The exposure to such stressors generates perceived stress which, in turn, determines either physiological (e.g., heart attack) or psychological (e.g., anxiety, nervous disorders) negative health outcomes.

According to the medical literature, the most significant health problems directly related to stress are cardiovascular diseases (Belkic, Paul Landsbergis, and Baker, 2004; Kivimäki et al., 2006), nervous and mental disorders (Bonde, 2007; Netterstrom et al., 2008), diabetes (Heraclides et al., 2012), ulcer (Mayer,

2000) and arthritis (Hassett and Clauw., 2010; Walker et al., 1999). Likewise, it is widely documented that risky health behaviors affect health. Lack of regular physical activity increases the risk of several chronic conditions, including coronary and hearth diseases (Warburton et al., 2010) and type 2 diabetes (Miller and Dunstan, 2004). Smoking increases substantially the risk of coronary and heart diseases, as well as respiratory conditions (US Department of Health and Human Services, 2014). Alcohol consumption is related with - among others - cirrhosis, diabetes, heart and mental conditions (Rehm et al., 2009). Bad eating habits increase the risk of several chronic health conditions, as documented by WHO (2003).

From an economist's point of view, what is less clear is how these health behaviors are affected by aggregate economic conditions. On the one hand, bad economic conditions increase uncertainty about the future and trigger economic stress, altering the marginal costs and benefits of healthy behaviors (Catalano and Dooley, 1983); as a consequence, individuals may be induced to smoke more, consume more alcohol, or practice less physical activity. On the other hand, during recessions individuals experience a reduction (or expected reduction) in disposable income. As a consequence, alcohol consumption and smoking might fall. At the same time, during economic downturns the opportunity cost of time and, consequently, the opportunity cost of time-intensive activities, such as leisure, physical activity, household production and social relations, fall (Ruhm, 2000). Individuals who face a lower opportunity cost of leisure, may spend more time in health-improving activities, such as physical exercise, producing and consuming healthy meals, spending time in recreational activities and interpersonal relationships.

In this paper, we exploit detailed individual-level information about health behaviors and health conditions from the *Multipurpose Survey on Households* (ISTAT, 2015), together with data on local labor market conditions at NUTS-3 level, to implement an identification strategy based on the variation over time and across provinces of local unemployment and individual health. Our study contributes to the existing literature in several respects. First, we provide evidence on the effects of macroeconomic conditions on health outcomes at individual level. Although the literature on macro-data is abundant, the evidence at micro level is more limited. In addition, while most existing studies focus on the static relationship between aggregate economic conditions and health, we take into account the fact that changes in economic conditions affect health outcomes over time. Second, we address explicitly the role played by individual characteristics as moderators, focusing on employment status, educational level and gender. Third, we provide a unified framework to identify the transmission mechanism from macroeconomic conditions to

health outcomes, focusing on the role played by health behaviors and economic stress as mediators. We are thus able to disentangle the direct effects of macro-economic conditions from those mediated by health behaviors. This is a step forward with respect to the existing literature, which generally addresses the effects of local economic conditions on either health behaviors or health outcomes (e.g., Charles and DeCicca (2008), Ruhm (2000), Tekin, McClellan, and Minyard (2013), Contoyannis and Jones (2004)), thus failing to address the systemic nature of the relationship between economic conditions, health behaviors and health outcomes.

The paper is structured as follows. Sections 2 and 3 describe the data and methods, respectively. Section 4 presents the results. Section 5 concludes.

2 Data

We study the relationship between local labor market conditions and individual-level health using repeated cross-section data from the *Multipurpose Survey on Households*, provided by the Italian National Institute of Statistics (ISTAT). The survey is conducted yearly since 1993[1] on a representative sample of about 24,000 households, corresponding to 54,000 individuals, through face-to-face interviews. The data set contains detailed information about social behaviors, perceptions and time use in everyday life, in addition to individual and household characteristics.

We carry out our analysis by considering different measures of health status. More specifically, we consider self-reported measures of health.[2] We start by considering indicators of general health. First, satisfaction with health, measured on a four-item ordinal scale (not at all, not much, enough, very much). We re-code this variable into two alternative binary variables: *very dissatisfied with health conditions*, equal to one if the respondent has chosen the first item of the scale, and *dissatisfied with health conditions*, equal to one if the respondent has chosen one of the first two items of the scale. Second, we consider three alternative indicators of hospitalization: first, a dummy variable indicating whether the subject has been recently in hospital; second, a variable measuring the number of times the subject has been in hospital; third, a variable measuring the total number of days in hospital. We

[1] The survey has not been implemented in 2004.

[2] Despite their limitations, there is common agreement in the literature that subjective health assessments are informative indicators of objective health conditions (Miilunpalo et al., 1997). However, people may tend to mis-report illnesses (Bound, 1991; Johnston, Propper, and Shields, 2009). Therefore, our estimates of the effects of economic conditions on health may be subject to attenuation bias, and should be viewed as conservative.

also consider the presence of a number of specific chronic conditions: hypertension, infarct, angina, bronchial asthma, allergies, tumor, ulcer, liver stone, kidney stone, cirrhosis, arthritis, osteoporosis, and nervous disorders.

Regarding the transmission mechanism, we examine the role played as mediators by health behaviors commonly identified by the literature such as smoking (number of cigarettes per day), alcohol consumption (drink alcohol outside meals), physical inactivity (practicing no physical activity), and eating habits. We construct an index of diet variety as a weighted average of the type of food consumed, from a list of 12 different food items, with weights represented by the frequency of weekly consumption. The resulting index is recoded into a dummy variable with *poor diet variety* being equal to one when the index is lower than the median of the sample. Finally, we include among mediators a measure of economic stress, proxied by a dummy variable indicating dissatisfaction with respect to economic conditions (equal to one when the subjects reports to be dissatisfied or very dissatisfied with her own economic conditions).

Following the literature, we proxy economic conditions with local (province-level) unemployment rates.[3] By using several waves of the *Territorial Accounts* by ISTAT, we were able to reconstruct the unemployment rate series at NUTS-3 level for 103 provinces from 1993 to 2012. Since the Italian territorial division at NUTS-3 level has changed during the period considered, we have reclassified provinces to 103 in order to have units consistent across the period considered.[4] In order to focus on working-age adults that are still tied strongly to the labor force, we restrict the sample to individuals between the age of 18 and 66, and further exclude from the analysis individuals who retired or are unable to work. This yields a final sample size of about 620,000 individuals. Table 1 provides summary statistics for the relevant variables.

[3] As a robustness check, when splitting the sample by gender, we also used gender-specific unemployment rates, obtaining qualitatively unchanged results.

[4] In principle, it would be possible to use alternative indicators of economic activity, such as GDP growth. However these indicators of real activity are not appropriate for our purposes for two main reasons: first, what matters most for individuals is the possibility of loosing (or not finding) a job, rather than the fact that GDP growth is high or low. In fact, local labor market conditions are likely to be crucial, particularly in a country like Italy, traditionally characterized by low labor market mobility. Second, the variability of GDP growth across provinces is much lower than that of unemployment, thus reducing the effectiveness of the identification strategy.

Table 1: Descriptive statistics

Variable	Mean	Std. Dev.	Min.	Max.	N. Obs
Diabetes	0.02	0.15	0	1	613861
Hypertension	0.09	0.29	0	1	614117
Stroke	0.01	0.09	0	1	612840
Angina	0.02	0.12	0	1	612966
Asthma	0.02	0.15	0	1	612814
Allergy	0.09	0.28	0	1	613516
Tumor	0.01	0.09	0	1	612574
Ulcer	0.03	0.18	0	1	612863
Liver stone	0.02	0.13	0	1	612765
Cirrhosis	0.00	0.05	0	1	612478
Kidney stone	0.02	0.14	0	1	612555
Arthritis	0.16	0.36	0	1	613974
Osteoporosis	0.03	0.18	0	1	612614
Nervous disorders	0.04	0.19	0	1	607068
Smoking (heavy smoker)	0.10	0.3	0	1	562868
Alcohol (heavy drinker)	0.06	0.23	0	1	574374
Physically inactive	0.37	0.48	0	1	477055
Diet poor	0.33	0.47	0	1	628148
Economic stress	0.46	0.5	0	1	565472
Health satisfaction: low	0.13	0.33	0	1	614897
Health satisfaction: very low	0.02	0.15	0	1	614897
Been in hospital	0.04	0.19	0	1	624015
Times in hospital	0.05	0.39	0	86	623900
Days in hospital	0.38	3.45	0	365	623288
Unemployment (province)	0.10	0.07	0.01	0.33	577383
Gender	0.49	0.50	0	1	577383
Age	42.09	12.8	18	66	577383
Work: Employed	0.60	0.49	0	1	577383
Work: Student	0.16	0.37	0	1	577383
Work: Housewife	0.05	0.21	0	1	577383
Married	0.64	0.48	0	1	577383
Divorced	0.02	0.13	0	1	577383
Widowed	0.03	0.17	0	1	577383
Upper education	0.37	0.48	0	1	577383
Medium education	0.46	0.50	0	1	577383
Lower education	0.17	0.37	0	1	577383

Notes: Source: Multipurpose Survey on Households (ISTAT, 2015).

3 Methods

Our baseline specification relates individual health outcomes to province-level economic conditions, a set of individual-level controls, in addition to province and year fixed effects:

$$H_{ipt} = \beta_0 + \beta_1 U_{pt-j} + X_{ipt}\Pi + \mu_p + \lambda_t + \varepsilon_{ipt} \tag{1}$$

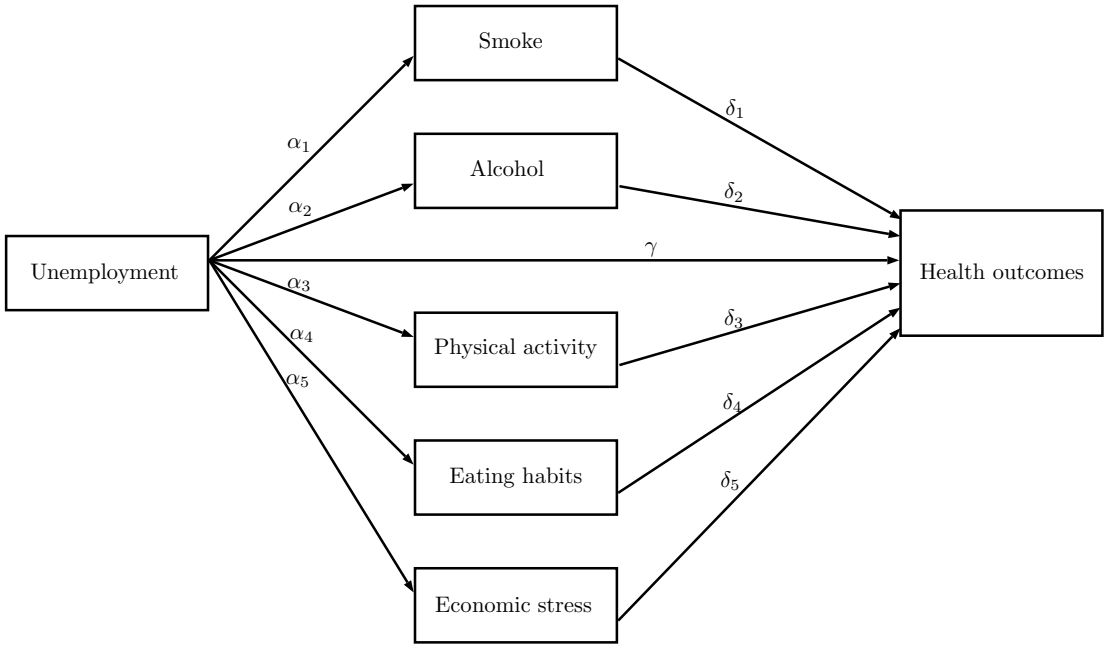
where H_{ipt} denotes the health status of individual i in region p at time t, U_{pt-j} is the unemployment rate in province p at time $t-j$, X is a vector of individual controls (marital status, education, age, gender, etc.), with coefficients denoted by Π, μ_p and λ_t represent province and time (year) fixed effects, and ε_{ipt} the individual-level disturbance term. Equation (1) is estimated for different lags of the province-level unemployment (t, $t-1$, $t-2$, $t-3$), in order to allow for the possibility that changes in economic conditions affect health outcomes after some time.

The use of province-level unemployment rates ensures exogeneity with respect to individual-level health outcomes, while the inclusion of province fixed effects allows us to control for any unobservable time-invariant province-specific effects. Year fixed effects allow us to capture unobserved aggregate time effects or time trends. We estimate (1) using a linear probability model for three reasons. First, the SUR approach we employ for the estimation of the indirect effects of unemployment on health conditions, described below, is based on a linear model. Second, by using a linear model we avoid the difficulties associated to the interpretation of interaction effects (moderators) in nonlinear models. Third, the results are qualitatively unchanged when using probit or logit estimators. Standard errors are clustered at province level.

In order to investigate the transmission mechanism from economic conditions to health outcomes, we follow the approach by Preacher and Hayes (2008), illustrated in Figure 1. Economic conditions can affect health outcomes either directly (parameter γ in the figure) or indirectly, through the mediator variables. We thus estimate the effect of economic conditions on the mediators (parameter α_j) and the effect of mediators on health outcomes (parameter δ_j). The indirect effect of economic conditions on health outcomes via mediator j is obtained as the product of the two coefficients (i.e., $\alpha_j\delta_j$). Therefore, the total indirect effect of economic conditions is estimated as $\sum_j \alpha_j\delta_j$, and the total effect as the sum of the direct and indirect effects ($\gamma + \sum_j \alpha_j\delta_j$).

Empirically, we implement a Seemingly Unrelated Regression (SUR) estimator, where point estimates and standard errors of combinations of parameters are computed using the Delta method, which provides an appropriate

Figure 1: Effect of unemployment on health outcomes: the role of mediators



approximation in a large sample.[5] As discussed above, we consider five mediators, each with a negative expected effect on health conditions: smoking, alcohol consumption, physical activity (lack of), eating habits (low diet variety) and economic stress.

4 Results

We start by characterizing the dynamic relationship between province-level unemployment and individual-level health outcomes. Next, we assess the role played by individual characteristics as moderators, focusing on employment status, educational level and gender. Finally, we examine the transmission mechanism from labor market conditions to health outcomes, focusing on the role played by a number of health behaviors as possible mediators, in addition to economic stress.

[5]The Delta method expands a function of a random variable around its mean, generally with a one-step Taylor approximation, and then computes the variance (Oehlert, 1992).

4.1 Local unemployment and health outcomes

Table 2 presents estimation results for equation (1), using general health outcomes as dependent variables and different lags of the province-level unemployment rate as the key explanatory variables. Each cell reports, for a given health outcome, the estimated coefficient (and the standard error) of the unemployment rate (U_{pt-j}). Province-level unemployment is positively and significantly related to the likelihood of being unsatisfied or very unsatisfied with health, and to the number of days of hospitalization. The size and significance of the relevant coefficients do not change substantially for different lags of unemployment. Province-level unemployment is also positively related to the probability of being hospitalized and to the number of times in hospital, although the estimated coefficients are not statistically significant.

Table 2: Unemployment and health outcomes

	U_t	U_{t-1}	U_{t-2}	U_{t-3}	N.Obs Max/Min
Unsatisfied with health	0.106*	0.110*	0.120	0.131*	565171-462596
	(0.049)	(0.053)	(0.062)	(0.053)	
Very unsat. with health	0.023*	0.029*	0.033*	0.029	565171-462596
	(0.011)	(0.013)	(0.016)	(0.015)	
Been in hospital	0.011	0.020	0.013	0.012	573562-470017
	(0.013)	(0.012)	(0.014)	(0.015)	
Hospital times	0.009	0.030	0.034	0.023	573456-469893
	(0.023)	(0.028)	(0.018)	(0.019)	
Hospital days	0.244	0.373*	0.393**	0.303*	572904-469581
	(0.144)	(0.153)	(0.137)	(0.149)	

Notes: Each cell reports the coefficient from regressions of individual's health outcomes on province-level unemployment at time t, $t-1$, $t-2$, $t-3$. Controls include gender, age, age squared, education, employment and occupation status, household characteristics, time dummies, province dummies. Standard errors clustered at province level. Minimum (maximum) number of observations refers to U_{t-3} (U_t). * p <0.05, ** p <0.01

Table 3 reports estimation results for equation (1), using individual chronic health conditions as dependent variables. Worse local labor market conditions significantly increase the likelihood of reporting cardio-vascular disorders, such as hypertension, heart attack and angina. Higher unemployment is also positively and significantly related to the presence of diabetes, ulcer, arthritis, cirrhosis and nervous disorders. These results are consistent with findings in the literature (e.g., Lee et al., 2010; Svensson, 2007; Tapia Granados, 2008): on the one hand, we find evidence of a positive relation between local

economic conditions and stress-related diseases; on the other hand, consistently with the theoretical predictions, we find no significant effects on chronic conditions that are not stress-related, such as allergies, liver and kidney stones and osteoporosis.

Interestingly, the lag structure of the effects of unemployment is consistent with the pattern that is outlined in the medical literature: while perceived stress has a positive contemporaneous effect on arthritis, cirrhosis and nervous disorders, the effects on circulatory conditions and diabetes are larger and statistically significant for higher lags of unemployment. The magnitude of the impact of local unemployment is consistent with the findings in the literature. For example, a one percentage point increase in the province-level unemployment rate is associated to a 0.03 per cent increase in the probability of experiencing asthma. Similarly, a one percentage point increase in the province unemployment rate is associated to a 0.06 per cent increase in the probability of experiencing nervous disorders.

The results in Tables 2 and 3 indicate that local labor market conditions affect health outcomes at different lags. A natural question to address is therefore whether we can identify a dynamic response of health outcomes following an unemployment shock. Tables 4 and 5 report the cumulative effects of unemployment on individual heath outcomes and conditions based on a fully dynamic model (i.e., the effects of a permanent shock to the unemployment rate). Although our setting is not ideal to perform such analysis, since at unemployment rates are strongly correlated from one year to another, the dynamic model generally confirms our previous results. Higher local unemployment negatively affects individual health outcomes, but only for longer lags.

4.2 Employment status, education and gender as moderators

There are several reasons to expect that the effects of province-level unemployment may differ across population sub-groups (Tekin, McClellan, and Minyard, 2013). Subjects whose current or expected employment status are more affected by labor market fluctuations are more likely to experience negative health effects (Charles and DeCicca, 2008). Therefore, we allow the estimated effect of local labor market conditions to vary across sub-samples defined on the basis of employment status (employed vs unemployed), education level (low vs high) and gender.

Employment status can moderate the effect of macro-economic fluctuations on individual-level health by altering the opportunity cost of time and the availability of economic resources (Ruhm, 2000). These two mechanisms, also referred to as the substitution and income effects of economic fluctua-

Table 3: Unemployment and health conditions

	U_t	U_{t-1}	U_{t-2}	U_{t-3}	N. Obs Max/Min
Diabetes	0.018	0.024*	0.029*	0.042**	564342-461385
	(0.012)	(0.012)	(0.012)	(0.010)	
Hypertension	0.010	0.022	0.068*	0.096**	564552-461468
	(0.031)	(0.030)	(0.032)	(0.029)	
Heart attack	0.007	0.011*	0.015**	0.013*	563389-460422
	(0.004)	(0.004)	(0.004)	(0.006)	
Angina	0.013	0.015	0.020*	0.009	563504-460499
	(0.008)	(0.008)	(0.008)	(0.008)	
Asthma	0.032	0.025	0.023	0.025	563360-460400
	(0.016)	(0.015)	(0.017)	(0.016)	
Allergy	0.030	0.035	0.043	0.034	564000-460998
	(0.037)	(0.034)	(0.031)	(0.032)	
Tumor	0.003	0.001	0.005	-0.006	563135-460182
	(0.006)	(0.006)	(0.007)	(0.006)	
Ulcer	0.028	0.029	0.058*	0.061**	563410-460402
	(0.023)	(0.022)	(0.025)	(0.023)	
Liver stones	0.016	0.011	0.018	0.016	563332-460336
	(0.013)	(0.012)	(0.014)	(0.011)	
Cirrhosis	0.007*	0.008*	0.010**	0.010**	563058-460130
	(0.003)	(0.003)	(0.003)	(0.003)	
Kidney stones	0.016	0.017	0.024	0.027	563126-460194
	(0.013)	(0.014)	(0.016)	(0.019)	
Arthritis	0.165**	0.160**	0.208**	0.203**	564446-461340
	(0.050)	(0.052)	(0.066)	(0.063)	
Osteoporosis	-0.013	-0.016	0.005	0.009	563183-460242
	(0.014)	(0.015)	(0.018)	(0.019)	
Nervous dis.	0.058**	0.052**	0.080**	0.066**	558038-455072
	(0.019)	(0.018)	(0.025)	(0.021)	

Note: Each cell reports the coefficient from regressions of individual health conditions on province-level unemployment at time t, $t-1$, $t-2$, $t-3$. Controls include gender, age, age squared, education, employment and occupation status, household characteristics, time dummies, province dummies. Standard errors clustered at province level. Minimum (maximum) number of observations refers to U_{t-3} (U_t). * p <0.05, ** p <0.01

Table 4: Unemployment rate and health conditions: dynamic effects

	Unsat. health	Very unsat. health	Hospital	Hospital times	Hospital days
U_t	0.076	-0.008	0.007	0.041	0.361
	(0.074)	(0.020)	(0.024)	(0.030)	(0.228)
U_{t-1}	0.060	0.007	0.030	0.049	0.343
	(0.053)	(0.016)	(0.019)	(0.027)	(0.290)
U_{t-2}	0.088	0.023	0.014	0.042	0.264
	(0.073)	(0.022)	(0.018)	(0.023)	(0.175)
U_{t-3}	0.167*	0.033*	0.020	0.044*	0.452**
	(0.069)	(0.017)	(0.017)	(0.020)	(0.138)
R^2	0.06	0.02	0.01	0.00	0.01
N. obs.	462596	462596	470017	469893	469581

Note: cumulative effects. Controls include gender, age, age squared, education, employment and occupation status, household characteristics, time dummies, province dummies. Standard errors clustered at province level. * p <0.05, ** p <0.01

Table 5: Unemployment rate and health outcomes: dynamic effects

	Diabetes	Hypert.	Heart att.	Ulcer	Cirrh.	Arthr.	Nervous d.
U_t	-0.016	-0.037	-0.006	0.023	0.010*	0.088	0.059
	(0.021)	(0.043)	(0.011)	(0.030)	(0.004)	(0.074)	(0.030)
U_{t-1}	0.010	-0.089	-0.003	-0.034	0.002	0.010	0.001
	(0.023)	(0.049)	(0.009)	(0.023)	(0.004)	(0.067)	(0.039)
U_{t-2}	-0.010	-0.026	0.012	0.027	0.005	0.161*	0.093**
	(0.022)	(0.057)	(0.009)	(0.035)	(0.004)	(0.080)	(0.032)
U_{t-3}	0.040**	0.072*	0.014*	0.063*	0.013**	0.245**	0.092**
	(0.014)	(0.033)	(0.005)	(0.029)	(0.004)	(0.073)	(0.022)
R^2	0.04	0.12	0.02	0.02	0.00	0.17	0.02
N. obs.	461385	461468	460422	460402	460130	461340	455072

Note: cumulative effects. Controls include: gender, age, age squared, education, employment and occupation status, household characteristics, time dummies, province dummies. Reported standard errors clustered at province level. * p <0.05, ** p <0.01

tions on health, may have different signs, depending on individual-level employment status. During economic downturns, individuals who face lower opportunity costs of time, i.e., the unemployed, may spend more time in activities intended to improve their health, such as physical exercise, producing and consuming healthy meals, spending time in recreational activities and interpersonal relationships. At the same time, during recessions people make more effort to avoid losing their job. Thus, they may invest more time in working activity (if employed) or in job-search (if unemployed) and reduce, therefore, the time devoted to other non-market activities that would have had a positive effect on their health, e.g., physical exercise. Moreover, while the reduced availability of economic resources reduces investment in unhealthy habits, such as alcohol consumption and smoking, the resulting difficulty in coping with financial obligations triggers economic stress, which alters the marginal costs and benefits of healthy behaviors (Catalano and Dooley, 1983).[6]

Our hypothesis is that the income effect is low for an employed worker, since she is only marginally affected by macro-economic conditions. At the same time, the opportunity cost of her time is only marginally altered, since employment status is not directly affected by labor market fluctuations. What is affected by macro-economic conditions is, instead, her labor market prospects (i.e., a less intense work schedule, or the probability to lose the job), or the labor market prospects of her peers, that generate economic stress (Caroli and Godard, 2016). For the unemployed, we expect that the income effect is larger than for their employed counterparts. At the same time, unemployed individuals could have more leisure time than their employed counterparts, provided they do not fully devote it to job search activities. Regarding economic stress, two opposite factors are at play. On the one hand, for those who have already lost their job, worsening economic conditions do not increase the fear of joblessness. On the other hand, they reduce the likelihood of finding a new job.

Education has been shown to affect health behaviors and health outcomes (e.g., Brunello et al., 2015; Clark and Roayer, 2013; Conti, Heckman, and Urzua, 2010). In fact, while more educated workers are less at risk during economic downturns, thus weakening the stress channel (Charles and DeCicca, 2008), they are also more likely to avoid unhealthy behaviors, have a health insurance, and live in better neighborhoods (Lochner, 2011). Finally, given the literature on gender differences in health and labor market outcomes (e.g., Crimmins, Kim, and Solé-Auró, 2010; Van de Velde, Bracke, and Levecque, 2010; Seguino, 2010; Booth, Francesconi, and Frank, 2002), we expect women to be more at risk than men in the presence of worsening of economic conditions

[6] Catalano et al. (2011) identifies a further mechanism, namely, frustration-aggression. We refer the reader to their work for further explanations.

(Hoynes, Miller, and Schaller, 2012).

We estimate equation (1) by adding among the predictors interaction terms between the moderator and each regressor (e.g., the product of the moderator and province-level unemployment rate). If a moderator effect is present, the interaction term in the regression model should be statistically significant. Table 6 reports the results, focusing on general health outcomes and the chronic health conditions which the medical literature reports as more closely linked to perceived stress and health behaviors. More specifically, we focus on cardiovascular conditions, diabetes, ulcer, cirrhosis, arthritis and nervous disorders.

Consistent with the theoretical predictions, the adverse effects of local unemployment on health conditions are, overall, significantly less strong for unemployed and highly educated individuals. Similar results are obtained when considering chronic health conditions. Gender does not appear to play a role as moderator when looking at general health conditions (e.g., Prause, Dooley, and Huh, 2009). However, the probability to experience diabetes and nervous disorders following economic downturns is lower for women than for men.

4.3 Health behaviors and economic stress as mediators

As shown in Figure 1, while a moderator can affect the strength and/or the direction of the relationship between labor market conditions and individual-level health, a mediator variable explains how labor market conditions affect individual-level health. In other words, the mediator is in the middle of a causal chain linking aggregate economic conditions to individual-level health. This relationship is estimated using the methodology presented in Section 3, which allows us to disentangle the direct effect of macroeconomic fluctuations on health outcomes from the indirect effect through the mediators. More specifically, we focus on five mediators: smoking, alcohol consumption, physical inactivity, diet variety and economic stress.

First, we assess whether the selected health behaviors and economic stress qualify as potential mediators, by estimating the relationship between unemployment (at different lags) and each of these variables. Table 7 reports the results. Consistent with Charles and DeCicca (2008), and in contrast with Ruhm (2005), higher province-level unemployment is associated to a significant increase in smoking (except for U_t), with a stronger effect for longer time lags. Higher local unemployment is instead associated with a significant decrease in alcohol consumption (except for U_{t-3}), in line with the findings in Ruhm and Black (2002) and Johansson et al. (2006) and in contrast with Dee (2001). Interestingly, province-level unemployment is negatively associated with physical

Table 6: Unemployment and health: moderators

	U_t	U_{t-1}	U_{t-2}	U_{t-3}
Unsatisfied with health				
Employed	-0.182**	-0.214**	-0.280**	-0.280**
High Education	-0.199**	-0.175**	-0.139*	-0.078
Female	-0.011	0.013	0.033	0.02
Hospital days				
Employed	-0.327	-0.644*	-0.458	-0.458
High Education	-0.531	-0.835	-0.772**	-0.213
Female	-0.16	0.023	0.142	0.157
Diabetes				
Employed	-0.039	-0.042*	-0.068**	-0.068**
High Education	-0.045**	-0.052**	-0.010	-0.089**
Female	-0.006	-0.018	-0.048*	-0.025
Hypertension				
Employed	-0.112**	-0.102**	-0.139**	-0.139**
High Education	-0.037	-0.036	-0.073	-0.047
Female	-0.047	-0.050	-0.069	-0.058
Heart attack				
Employed	-0.010	-0.011	-0.014	-0.014
High Education	-0.011	-0.014	-0.052**	-0.009
Female	0.008	0.012	0.004	0.003
Ulcer				
Employed	0.014	0.019	-0.007	-0.007
High Education	-0.013	-0.019	-0.056*	-0.044
Female	0.018	0.03	0.025	0.022
Cirrhosis				
Employed	0.000	0.003	-0.001	-0.001
High Education	-0.009	-0.010	-0.013	-0.019**
Female	-0.003	-0.004	-0.005	-0.009
Arthritis				
Employed	-0.092	-0.068	-0.140*	-0.140*
High Education	-0.160	-0.180	-0.217**	-0.101
Female	0.022	0.045	0.014	-0.011
Nervous disorders				
Employed	-0.061*	-0.054	-0.138**	-0.138**
High Education	-0.112**	-0.113**	-0.074	-0.100**
Female	-0.029	-0.024	-0.088**	-0.064**

Note: each cell reports differences by population sub-groups (employment status, education level, gender) for the effect of province-level unemployment at time t, $t-1$, $t-2$, $t-3$ on individual-level health conditions. For example, the coefficient for Employed reports the differential effect for employed of the effect of unemployment on the relevant health outcome. Controls include gender, age, age squared, education, employment and occupation status, household characteristics, time dummies, province dummies. Standard errors clustered at province level. * p <0.05, ** p <0.01

inactivity (Ruhm, 2005; Colman and Dave, 2013, e.g.,), while it is positively and significantly related to lack of diet variety (Dave and Kelly, 2012). Finally, higher local unemployment is positively and significantly related to economic stress (Caroli and Godard, 2016), with the only exception of U_{t-3}.

Table 7: Unemployment and health: mediators

	U_t	U_{t-1}	U_{t-2}	U_{t-3}
Smoking	0.048	0.052*	0.061*	0.065**
	(0.028)	(0.025)	(0.024)	(0.024)
Alcohol consumption	-0.053*	-0.058*	-0.056*	-0.034
	(0.024)	(0.024)	(0.025)	(0.024)
Physical inactivity	-0.159*	-0.121*	-0.079	0.059
	(0.062)	(0.053)	(0.066)	(0.102)
Diet poor	0.245**	0.273**	0.282**	0.252**
	(0.078)	(0.079)	(0.085)	(0.094)
Economic stress	0.338**	0.286**	0.186*	0.128
	(0.065)	(0.072)	(0.076)	(0.071)

Note: Each cell reports the estimated effects of province-level unemployment at time t, $t-1$, $t-2$, $t-3$ on individual-level health behaviors. Controls include: gender, age, age squared, education, employment and occupation status, household characteristics, time dummies, province dummies. Standard errors clustered at province level. * p <0.05, ** p <0.01

Second, we estimate the direct and indirect effects of unemployment using a SUR estimator, as described in Figure 1. Table 8 reports the results. Each cell measures the indirect effect of unemployment on the relevant health outcome through each of the five mediators. The last two columns report the total indirect effect, i.e. the sum of the indirect effects of unemployment through each mediator ($\sum_{j=1}^{5} \alpha_j \delta_j$ in Figure 1), and the direct effect (γ in Figure 1). Note that, given the nature of our data set, we cannot account for the lagged effect of mediators on health outcomes, since our individual-level data is a repeated cross-section. Therefore, we account only for the lagged effects of unemployment on mediators, which are then assumed to have a contemporaneous effect on outcomes.[7]

For each of the health conditions under investigation, the indirect effect of unemployment through smoking (column 1) is not statistically significant. The indirect effect through alcohol consumption is positive and significant for dissatisfaction with health and for the presence of diabetes. Interestingly, the

[7]We only report the indirect effects of unemployment on selected health outcomes, i.e., those for which the link with health behaviors and economic stress is acknowledged by the medical literature.

Table 8: Unemployment and health: transmission mechanism

	(1) Smoking	(2) Alcohol	(3) Phys. inact.	(4) Diet poor	(5) Econ stress	(6) Total	(7) Direct
Unsat. health	0.000	0.001*	-0.006*	0.005**	0.037**	0.038**	0.080
	(0.000)	(0.001)	(0.002)	(0.001)	(0.007)	(0.008)	(0.047)
Hospital days	-0.001	0.004	-0.013*	0.002	0.023**	0.015	0.394**
	(0.001)	(0.002)	(0.005)	(0.001)	(0.005)	(0.008)	(0.097)
Diabetes	0.000	0.000*	-0.001*	0.000	0.003**	0.002**	0.018
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.016)
Hypertension	-0.001	0.000	-0.000	0.001**	0.007**	0.008**	0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.032)
Heart attack	-0.000	0.000	-0.000	0.000**	0.001**	0.001**	0.009
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.006)
Ulcer	0.001	0.000	-0.000	0.001**	0.004**	0.006**	0.028
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.021)
Cirrhosis	0.000	-0.000	-0.000*	0.000*	0.000**	0.000**	0.010**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)
Arthritis	0.000	-0.000	-0.000	0.000	0.015**	0.015**	0.157**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)	(0.003)	(0.047)
Nervous dis.	0.001	0.000	-0.001*	0.001**	0.006**	0.007**	0.060**
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.002)	(0.015)

Note: Each cell represents the effect of unemployment at time t on each health outcome mediated by each health behavior and economic stress. Total: sum of all indirect effects. Controls include gender, age, age squared, education, employment and occupation status, household characteristics, time dummies, province dummies. SURE estimator, standard errors clustered at province level. * p <0.05, ** p <0.01

indirect effect of unemployment through physical inactivity is negative and significant for both dissatisfaction with health and days of hospitalization. It is also negative and significant for individual health conditions, such as diabetes, cirrhosis, and nervous disorders. These findings reflect the fact that, as shown in Table 7, when province-level unemployment rises, physical inactivity falls. The unemployment rate has a positive and significant indirect effect, through lower diet variety, on dissatisfaction with health and on each of the health conditions considered, with the only exception of diabetes and arthritis. Local unemployment has the strongest indirect effects on health outcomes through economic stress. The estimated indirect effects are negative, large and significant for both indicators of general health status, and for each of the health conditions considered.

The total indirect effect (column 6) is positive and strongly significant for dis-satisfaction with health and for each of the individual health conditions considered. The total indirect effect is generally smaller than the direct effect.

Interestingly, however, the total indirect effect is about half the size of the direct effect in the case of dis-satisfaction with health, and it is even larger than the direct effect in the case of hypertension. Overall, the results suggest that health behaviors play a key role in the transmission mechanism explaining the relationship between labor market conditions and individual-level health outcomes. By negatively affecting eating habits and economic stress, worse local labor market conditions decrease satisfaction with health and significantly increase the likelihood of all the specific health conditions under investigation. On the other hand, worse local labor market conditions are associated with less physical inactivity which, in turn, reduces the likelihood of experiencing negative health conditions.

5 Conclusions

It is well know that macroeconomic fluctuations matter for individual-level health. This study sheds light on the underlying transmission mechanism. In order to design informed policy interventions aimed at offsetting the potentially harmful consequences of weakening economies, it is indeed more important to understand *why* and *how*, rather than just *if*, macroeconomic fluctuations affect health.

Following the approach by Preacher and Hayes (2008), we disentangled the direct and indirect effects of labor market conditions on health outcomes. Indirect effects were investigated by focusing on the mediating role played by a number of different health behaviors, such as smoking, alcohol consumption, physical inactivity, and poor diet, in addition to economic stress. The results indicate that higher province-level unemployment rate negatively affects health, while the dynamic response to unemployment shocks differs across health conditions: while unemployment has a contemporaneous effect on the presence of arthritis, cirrhosis and nervous disorders, the effects on circulatory diseases and diabetes become manifest only after two or three years.

Employment status and educational level play a significant role as moderators: the adverse effects of local unemployment on health conditions are, overall, significantly less strong for unemployed and highly educated individuals. In contrast, gender plays a minor role as moderator. As for the transmission mechanism, the negative relationship between local unemployment and health is mainly explained by eating habits (lack of diet variety) and economic stress (dissatisfaction with economic conditions). The effect of unemployment on health outcomes is instead partially offset by physical activity, since lack of physical exercise falls during recessions.

As in Xu (2013), our findings indicate that macroeconomic fluctuations

have heterogeneous effects on time-intensive and income-intensive health behaviors. As a consequence, different health behaviors play different roles in mediating the effect of labor market conditions on health outcomes (Charles and DeCicca, 2008). The public policy implications of these findings are relevant. Interventions aimed at mitigating financial insecurity, by reducing exposure to economic stress, or at reducing the opportunity cost of time, may have different effects on the relationship between unemployment and health outcomes.

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