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S.I.: NATURAL DISASTERS AND THE ECONOMY

Regional labor markets after an earthquake. Short-term emergency reactions in a cross-country perspective. Cases from Chile, Ecuador, Italy

César Andrés Mendoza[1,3] · Giulio Breglia[2,4] · Benjamín Jara[2]

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Abstract Disasters can generate different economic effects in the short run in local economies. Our goal is to reveal how natural disasters reshaped labor markets in three countries that faced massive earthquakes in the past decade: Italy (2009 *L'Aquila* earthquake), Chile (2010 *Concepción* earthquake-tsunami) and Ecuador (2016 earthquake in the coast of *Manabí* and *Esmeraldas*). These three countries present a mix of heterogeneity and homogeneity in observable characteristics of the individuals, socio-economic structure of the affected areas, institutional factors and macroeconomic characteristics, as well as the actions and budgets allocated by different governments for reconstruction and recovery in the affected areas. Using three short run labor surveys and different regression models (wage estimations and a double difference approach), we show an increase in labor income and worked hours (in average) in Ecuador for males and females, while in Italy we found an increase only in worked hours for females but not for males. In Chile no significant earthquake effects were found, neither in labor income, nor in worked hours. Our results suggest that the short run is critical to describe how regional labor markets will perform, differences and particularities of each country could be explained by institutional differences, economic trends, and how governments responded to their particular catastrophes.

✉ C. A. Mendoza
cesar.mendoza@ucuenca.edu.ec

1 GIER—Facultad, de, Ciencias Económicas y Administrativas, Universidad de Cuenca, Av. 12 , de Abril y Av. Loja, 010203 Cuenca, Ecuador

2 Gran Sasso Science Institute, Viale, France, sco Crispi 7, 67100 L'Aquila, Italy

3 IDEAR—Departamento, de, Economía, Universidad Católica del Norte, Av. Angamos 0610, 1240000 Antofagasta, Chile

4 Department of Political Sciences, University of Rome "Roma Tre", Via Gabriello Chiabrera 199, 00145 Rome, Italy

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Regionale Arbeitsmärkte nach einem Erdbeben. Kurzfristige Notfallreaktionen aus länderübergreifender Perspektive. Fälle aus Chile, Ecuador, Italien

Zusammenfassung Naturkatastrophen können kurzfristig verschiedene wirtschaftliche Auswirkungen in örtlichen Wirtschaften zur Folge haben. Unser Ziel ist es vorzuzeigen, wie Naturkatastrophen die örtlichen Arbeitsmärkte in drei Ländern beeinflusst haben, welche das letzte Jahrhundert von schweren Erdbeben betroffen waren: Italien (2009 Erdbeben von *L'Aquila*), Chile (2010 Tsunami-Erdbeben von *Concepción*), Ecuador (2016 Erdbeben an der Küste von *Manabi-Esmeraldas*). Die drei Länder weisen eine Mischung aus Heterogenität und Homogenität auf in Bezug auf erkennbare Eigenschaften der Individuen, sozialwirtschaftliche Strukturen der betroffenen Gebieten, institutionelle Faktoren und makroökonomische Eigenschaften, sowie bei der Bereitstellung von Maßnahmen und Finanzierungen der verschiedenen Regierungen für den Wiederaufbau und die Erholung der betroffenen Gebiete. Anhand von drei kurzfristigen Arbeitsumfragen und verschiedenen Regressionsmodellen (Gehaltsschätzungen und ein Differenz in der Differenzschätzung) zeigen wir in Ecuador einen Anstieg des Arbeitseinkommens und der Arbeitsstunden (mittlere) für Männer und Frauen, wobei wir in Italien nur eine Erhöhung der Arbeitsstunden für Frauen fanden, jedoch nicht für Männer. In Chile wurden keine signifikanten Erdbeben Auswirkungen gefunden, weder bei Gehaltseinkommen, noch bei Arbeitsstunden. Unsere Ergebnisse zeigen auf, dass es in einem kurzen Zeitraum schwierig ist, zu beschreiben wie regionaler Märkte funktionieren, Unterschiede und Besonderheiten der jeweiligen Länder können durch die institutionellen Unterschiede, wirtschaftlichen Trends, und die Art der Regierungen auf die Katastrophen zu reagieren, erklärt werden.

1 Introduction

Humans have lived in contact with potential harmful natural phenomena since the beginning of history (Pelling 2003), but events such as earthquakes rarely release their force over human settlements so strongly, that end up reshaping their social order in what we call a disaster. We can firmly assess that "a natural disaster is not a natural event" (Hallegatte 2014, p. 9), because nature forces can be followed and even the strongest event can cause very few casualties. Moreover, in many cases that qualify as a disaster, the hardest time was the medium-term after the tragedy, when institutions were not always able to rearrange a new harmonic situation and many conflicts arose (Alexander 2000).

For these reasons, many scholars consider it more appropriate to consider the human perspective and define such disasters as "socio-natural" (Arteaga and Ugarte

2015). From an economic point of view, these events cause disruption to the functioning of an economic system, with significant negative impacts on well-being, assets, production factors, output, employment, and/or consumption (Hallegatte 2014).

When an earthquake or any other natural disaster occurs, there are direct and indirect costs a region should bear. Direct costs are the ones showing an effect on the physical environment, labor and housing markets in the affected areas, while indirect costs are the ones that slow productive systems and lower purchasing power, with potential negative spillover effects. One of the most relevant markets influenced both by indirect and direct costs is the labor market (Meyer et al. 2013).

We know that many countries are heterogeneous (economically, culturally and institutionally), so in order to have a broader vision on how local labor markets change after these events, we explore short-term changes across three countries in this study: Italy (European high income), Chile (South American high income) and Ecuador (South American upper middle income).

To obtain a broader perspective of the post-disaster labor market adjustment mechanisms, we develop a comparative analysis between these countries in order to understand and systematize the main differences and similarities of their labor market dynamics.

Disasters can generate ambiguous economic effects in the short and long run (Skidmore and Toya 2002; Rampa 2020), but specific economic effects will depend on the context and region in which the event occurs. Earthquakes often destroy local productive infrastructure in the affected areas and cause severe damage to dwellings, private and public infrastructure, e.g.: schools, hospitals, buildings, machinery, equipment, roads, electric transmission lines, among others (Committee for Reconstruction and Productive Reactivation 2016). Therefore, it is reasonable to think that labor markets dynamics within the seismic zones will be affected. Research in this area has documented increases in unemployment (Xiao and Feser 2014) and shifts towards informality (Mendoza and Jara 2020), how job seekers change their behavior (Ohtake et al. 2012) and mismatches between job offers and demand (Higuchi et al. 2012; Ohtake et al. 2012). Earthquakes could also cause structural changes in the medium or long run (Belasen and Polachek 2008; Mehregan et al. 2012). Some economic sectors linked to the reconstruction will experience a boom during the reconstruction period (Chang and Rose 2012); new industries could be born and replace inefficient infrastructure (Ohtake et al. 2012; Xiao and Nilawar 2013).

In order to understand how local labor markets change in the aftermath of an earthquake we use individual labor surveys for each country, focusing in three specific ways local labor markets adapt to new scenarios: (1) employment, (2) wage, and (3) worked hours. Our research objective is to find out whether individuals located within the most seismic regions in each country had a positive or negative likelihood of being employed, increase their wages or change their worked hours. Our empirical strategy consists in a descriptive analysis that compares post-disaster dynamics of labor markets in each country. Firstly, we present descriptive comparisons of labor income differences for affected and unaffected areas between pre and post disaster periods in each country. Second, we perform Mincerian regressions and double difference (DD) estimations, for labor income and worked hours in order to find out if there was an earthquake effect in regional labor markets. Third, we estimate the likelihood of being employed using logistic regressions using a nonlinear DD approach. To compare countries appropriately, we choose specific regions as areas affected by the corresponding earthquakes: (i) the provinces of Manabí and Esmeraldas for Ecuador, (ii) the region of Maule and Biobío for Chile, and (iii) the Abruzzo region for Italy.

We found significant associations between the earthquakes and labor market dynamics in the short term. Distributional differences showed that the earthquakes probably had heterogeneous effects on wages (depending on the labor income quintile). Mincerian wage regressions and DD estimates found higher labor income and worked hours for males and females in Ecuador. In Chile no effect was found, and in Italy we found a positive (significant) effect only for females, who increased their working hours. Finally, we did not find a short run association between the earthquakes and the probability of being employed for individuals located in seismic areas.

This article is divided in six sections, the next section introduces the relevant literature of regional labor markets after a disaster, Sect. 3 describes our empirical cross-country comparison methodology and dataset, Sect. 4 presents information of the three case studies and the dataset that we used in our analysis, Sect. 5 shows the results, and Sect. 6 discusses and concludes.

2 Regional labor markets after a socio-natural disaster

This section will review some of the relevant literature that has explored the relationship between labor markets and disasters in the past. To organize this revision, we first look at studies that explain cross-country differences, how scale and development issues have been considered to study labor market resilience, and finally how specific aspects of the workforce environment is reshaped after a catastrophe.

Although the literature has already empirically determined some effects of disasters on labor markets, some studies have focused on high income countries (Horwich 2000; Belasen and Polachek 2008; Di Pietro and Mora 2015; Karnani 2015; Dresdner and Sehnbruch 2010), while others have looked at developing and middle income countries (Mueller and Quisumbing 2009; Rodríguez-Oreggia et al. 2013; Gagnon 2013; Mendoza and Jara 2020).

A good starting point for comparisons between countries using cross country data is the article by Skidmore and Toya (2002). They show how ambiguous the economic effect of disasters could be, finding that geological disasters are negatively correlated with growth, but climatic disasters are positively correlated with increases in total factor productivity, economic growth and human capital accumulation. Creative destruction (Schumpeter 1942) might be a possible explanation, as pointed out by some authors (Ohtake et al. 2012; Xiao and Nilawar 2013), since it causes the birth of new industries by freeing up resources, replacing less efficient infrastructure, and increasing productivity due to technological improvements. Crespo Cuaresma et al. (2008) point out that this relationship might not hold in developing countries, as it is difficult for them to introduce and disseminate new technologies, weakening the role of creative destruction. This ambiguity in the effects motivates us to contribute to close this gap in current research.

Another important insight from this literature is the idea of economic resilience of scale (Xiao and Nilawar 2013), which states that—in aggregate—an economy can be resilient since the destructive effect of a disaster disappears as you move away from its core. When we analyze smaller spatial units, the negative effects of a disaster are perceived less, and the opposite happens when the affected area is larger. This is another important motivation for this article, as our case studies include large, medium, and small affected geographic areas. In the article by Ohtake et al. (2012) it is mentioned that some studies have determined that a large-scale disaster will produce a negative economic impact in the short run (Loayza et al. 2009; Raddatz 2007; Noy 2009); a smaller scale natural disaster would have a positive economic impact given that the losses are less than the effects of reconstruction (Loayza et al. 2009).

Many relevant findings in the broad disaster literature are focused in high income countries. Ewing et al. (2005) evaluate changes in the labor market as a result of Hurricane Bret (1999) and the following recovery, finding that the unemployment rate in the long run is reduced. In developing countries other perspectives must be considered, such as social vulnerability, segregation and informality (Mendoza and Jara 2020).

Some disasters have been studied using multiple approaches. One example is the 1993 Midwest flood in the US. Xiao and Drucker (2013), Xiao (2011), and Xiao and Feser (2014) studied its effects through time series econometrics and impact evaluation techniques, finding that, on average, counties with greater economic diversity experienced rapid growth in employment, showing evidence of resilience[1] in their labor markets. They also find negative effects on personal income and increased unemployment rates in the short run and for the most affected counties. Apparently, local economies in aggregate seem to be resilient to natural disasters, being able to absorb the shock caused by the flood, although the agricultural sector seems to have experienced long lasting effects.

Xiao and Drucker (2013) specifically linked economic diversity with resilience, and explain this relationship because the effects of shocks in a specific place are less extensive if few industries are the main source of employment, similar to a portfolio effect[2] (Frenken et al. 2007; Malizia and Ke 1993).

Ohtake et al. (2012) study the effect on the Japanese labor market of the Great Hanshin-Awaji earthquake (1995) over time. They found that the number of job placements was reduced for part-time workers in the short run, possibly due to a shortage of job offers. For full-time workers, they found that growth in the number of job placements decreased abruptly, possibly due to a mismatch between labor supply and demand.

[1] Understood as resistance and recovery. Diversity (measured in employment) helps the affected counties to return to their path of growth and employment in the long run.

[2] Diversity also improves matching between workers and employees, reduces labor search costs, and increases productive efficiency (Duranton and Puga 2004; Mion and Naticchioni 2009), and it facilitates the inter-industrial transfer of ideas and knowledge (Audretsch 2003; Jacobs 1969).

Other studies have focused on understanding what happens in the post-disaster labor market from a broad perspective (see Kirchberger 2017). Belasen and Polachek (2008) find a positive sectoral impact for hurricane-hit counties in construction and services, while a negative one in manufacturing, commerce, transportation, utilities, finance, investment and real estate. Mehregan et al. (2012) studied the composition of the labor market in Bam (Iran) after the 2003 earthquake through a shift-share analysis. They found that for affected zones, manufacturing and mining gained employment between 1996 and 2006 (increased their shares), which probably occurred due to the reconstruction process. Similarly, Mueller and Quisumbing (2009) looked into the effects on the labor market caused by the 1998 flood in Bangladesh, and found that non-agricultural labor markets are more affected in the long run (reduction of wages) possibly because they depend on the recovery of other markets, while on the other hand, agricultural labor markets had a negative effect in the short term. Sectoral changes seem to happen frequently after a disaster, at least in the short run, some economic sectors might be winners while others might be losers (Xiao and Nilawar 2013).

There is also a strand of literature that studies post-disaster labor markets tied to reconstruction. Chang and Rose (2012) review the literature that includes both empirical studies and formal models. Among the main findings they point to significant increases in employment in the short run as a result of the reconstruction (Dacy and Kunreuther 1969; Chang 2010), with sectors related to reconstruction showing significant gains (Chang and Rose 2012). It has been shown that pre-disaster economic trends and performance are usually accentuated during the recovery period (Chang 2000, 2010; Dahlhamer and Tierney 1998; Alesch et al. 2009). The authors conclude that the more severe the disaster is, the more it can cause structural changes in the affected local economies in the long run, such as sectoral composition, competitiveness and business types (Alesch et al. 2009; Lam et al. 2009; Chang 2010). Ohtake et al. (2012) indicate that after the reconstruction period the number of vacancies, job searches and jobs placements would be lower than pre-earthquake[3] levels if there were initial spillover effects. In the first years after a disaster, households should find their own way to restart their lives, some authors believe that the best way to get out from the "infantilization trap" of earthquake victims is through labor (Castorina and Pitzalis 2019).

Our article also aims to separate labor market effects by gender. Many reports have stated the importance of gender equality (Bradshaw 2004) in post-disaster scenarios, as women might be more likely than men to lose their job or decrease their wages. This undesirable effect can occur in any kind of economic crisis (Hallward-Driemeier et al. 2017; Weisser 2019), but in the case of disasters reconstruction policies have often ignored gender issues. Women can lose their jobs because of general labor market responses (Möller and Aldashev 2006; Kirchberger 2017), but also because households dynamics can lead women to be less encouraged to participate in labor markets in times of crisis (Dagsvik et al. 2013). Men might ask their wives to stay at home and to not look for a job for many reasons specific to each culture.

[3] There will be a mismatch if job seekers are not willing to work in the construction sector, which limits the growth of job placements (in the reconstruction period, job vacancies increase).

These phenomena are not only driven by pure market reactions, Lewis (1992) gives some insights about how welfare regimes could help or discourage female work participation.

Even after all this evidence, it is difficult to grasp a generalized insight on what are the possible outcomes for labor markets that experienced these types of shocks. Our article tries to shed light on this literature by performing a simple descriptive analysis in three countries that have comparable enough data.

3 Data set and methodology

As the number of cross-country academic papers increases, it is of utmost importance to make cases comparable with similar data and methods of evaluation (Maddison 2005; Jilke et al. 2015). Because of its relative novelty as a research field, disaster studies have strongly relied on cross-country comparisons. It is very important to compare coherent cases with similar data and process them with the same methodology (Smith 2001; Maddison 2005; Beghelli et al. 2020). For this article, the three selected case studies are Ecuador, Chile and Italy, in order from the latest to the oldest disaster.

3.1 Data set

For all three countries, we will use short-term micro data. For the Ecuadorian case we used a two-period data panel from December 2015 (pre-earthquake) to December 2016 (post-earthquake) of the National Survey of Employment, Unemployment and Underemployment (ENEMDU), developed by the Ecuadorian Institute of Statistic and Censuses[4] (INEC). For Chile we use the post-earthquake National Socioeconomic Characterization Survey (CASEN) which was an extension of a cross-sectional survey taken in 2009, repeated in 2010 for six regions in central Chile. For Italy we use the "*Rilevazione sulle Forze di Lavoro—Dati trasversali trimestrali*" compiled by the National Statistics Institute (ISTAT), containing information for 2009 (post-earthquake) and 2008 (pre-earthquake). On this case the data was collected for *Abruzzo* and its neighboring regions.

In order to have a clear and meaningful comparison, we only use variables that are similarly collected across countries. Since the surveyed populations differ, the comparable groups of analysis are not whole nations, but only the affected regions for each country. So, there are between 1.3 and 3 million people in the most affected areas (with the presence of both seaside and mountainous areas) and about 15 million people in the overall population for all cases. The country capital cities (*Roma, Quito* and *Santiago*) are included in the analysis. The most affected regions (*provincias*) for Ecuador are *Esmeraldas* and *Manabí*[5]. In Chile the most affected regions were *Biobío* and *Maule*, while the others are *O'Higgins, Valparaiso, Metropolitana* and

[4] Sampling for this survey is done through a rotating panel (2-2-2), so the dwellings surveyed in December 2015 coincide with those surveyed in December 2016 (INEC 2017).

[5] ENEMDU does not investigate Galápagos Islands, but it does include all the other provinces.

Araucanía. In Italy, the *Abruzzo* region was the most affected while *Umbria, Marche, Lazio* and *Molise* comprise the rest of the sample. In the final datasets (cleaned databases), the number of observations per year for Ecuador are 51,126, 58,293 for Chile and 19,695 for Italy[6].

Because of several mismatches in survey design and the inter-temporal construction, the number of independent variables are restricted to the comparable ones, such as occupational status, sex, age, education, household size, a dummy for self-employment, dummy of work stability, and the economic sector[7].

3.2 Methodology

In our research we use individuals distributed across different regions as the unit of analysis (provinces for Ecuador, regions for Chile and Italy). The individuals located in the most affected regions (see Fig. 1) are compared in pre and post-earthquake scenarios in the short term with the individuals in their respective surrounding regions (with exception of Ecuador in which we can use the remaining provinces as control). A more granular or nation-level analysis was not applicable because we lacked the proper data for Italy and Chile, so in order to find a proper control cluster of regions, the analysis had to be implemented just for the closer ones, so results are fully comparable.

Although we do not attempt to find causal relationships in this article, it is very important to note that our identification strategy assumes total exogeneity of the shocks. We believe that this is not a problematic assumption, as the two South American countries are effectively located inside a continental fault line, making self-sorting within both countries unfeasible. In Italy this is different at a national scale, but for the treatment and control regions used in this study (central Italian regions) the assumption still holds.

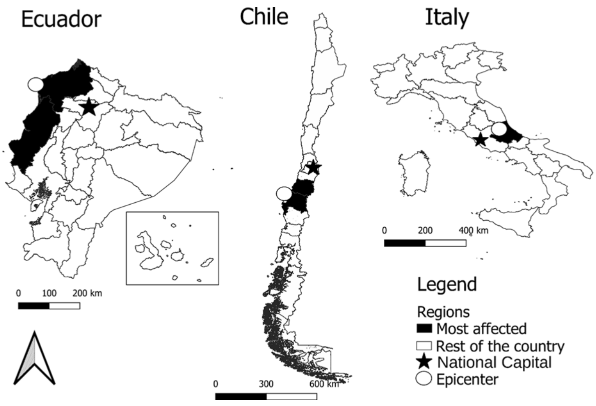

Fig. 1 Most affected regions by country. (Own elaboration)

[6] The peculiarities of the Italian dataset forced us to identify pre-earthquake panel variables for wages and working hours using a quasi-panel joining (Bruno and Stampini 2009), where the Istat LFS 2008 was matched with the 2009 one.

[7] Five classes: 1 Agriculture, livestock, forestry and fishing (reference category); 2 Construction; 3 Manufacturing, mining and electricity; 4 Wholesale and retail trade, hotels and restaurants, transport and storage; 5 Other activities.

Short term labor market changes are assessed through different econometric models: Mincerian wage regressions, difference in difference (DD) models to estimate shifts in wages and working hours, and logistic regressions implemented as a non-linear DD to look for changes in the probability of being employed.

In order to understand gender dynamics in a post-earthquake scenario, the regressions for labor income and worked hours will be estimated for men and women altogether, and then as separate estimations[8]. We estimate them separately because men and women could have different reasons to decide to participate in labor markets, so their reserve salary could be determined by different variables.

Brown et al. (2011) analyzed the differential in reserve salaries between men and women, finding that the presence of children at home increases the reserve salary more for women than for men, this would be explained because women would experience higher opportunity cost for taking a job outside the home. Caliendo et al. (2017) found that the wage gap between men and women is reduced once the reserve salary was incorporated as a control variable, this would indicate that the gender differences in reserve salaries would determine the observed differences in the wage.

First, we use wage Mincerian equations (Mincer 1974) to identify changes in labor income and working hours (data panel regressions), our coefficient of interest is the one associated with the natural disaster (d.earthquake1, see Eqs. 1.1 and 1.2):

Equation 1.1 Minçerian regression, labor income

$$\begin{aligned}\ln(wage)_{it} =& \alpha + \beta_1 d.\text{earthquake1}_i + \beta_2 \text{schooling}_{it} + \beta_3 \text{potencial\_experience}_{it} + \\ & \beta_4 \text{potencial\_experience}_{it}{}^2 + \beta_5 d.\text{sex}_i + \beta_{6.kt} d.\text{ecomic\_sector}_{ik,t} + \\ & \beta_7 d.\text{selfemployment}_{it} + \beta_{8.\text{skt}} \left(d.\text{ecomic\_sector}_{ik,t} x d.\text{sex}_i\right) + \\ & \beta_{9.\text{sft}} \left(d.\text{selfemployment}_{it} x d.\text{sex}_i\right) + \beta_{10} d.\text{time}_t + \\ & \beta_{11} \ln(worked\_hours)_{it} + \beta_{12} d.\text{stability}_{it} + \varepsilon_{it}\end{aligned}$$

Equation 1.2 Mincerian regression, worked hours

$$\begin{aligned}\ln(worked\_hours)_{it} =& \alpha + \beta_1 d.\text{earthquake1}_i + \beta_2 \text{schooling}_{it} + \\ & \beta_3 \text{potencial\_experience}_{it} + \beta_4 \text{potencial\_experience}_{it}{}^2 + \\ & \beta_5 d.\text{sex}_i + \beta_{6.kt} d.\text{ecomic\_sector}_{ik,t} + \\ & \beta_7 d.\text{selfemployment}_{it} + \beta_{8.\text{skt}} \left(d.\text{ecomic\_sector}_{ik,t} x d.\text{sex}_i\right) + \\ & \beta_{9.\text{sft}} \left(d.\text{selfemployment}_{it} x d.\text{sex}_i\right) + \beta_{10} d.\text{time}_t + \\ & \beta_{11} d.\text{stability}_{it} + \varepsilon_{it}\end{aligned}$$

Second, we apply a difference in difference (DD) approach to find whether the earthquake had a robust effect on labor income and worked hours. In this case, our coefficient of interest was the one associated with the interaction between the treatment (*d.earthquake2*) and time:

[8] We also tried specifications that included interactions for men and women for robustness.

Equation 2.1 DD approach, labor income

$$\begin{aligned}\ln(wage)_i =& \alpha + \beta_1 d.\text{earthquake2}_i + \beta_2 d.\text{time} + \beta_3 d.\text{earthquake2}_i x d.\text{time} + \beta_4 \\ & \text{schooling}_i + \beta_5 \text{potencial\_experience}_i + \beta_6 \text{potencial\_experience}_i{}^2 + \\ & \beta_7 d.\text{sex}_i + \beta_{8.k} d.\text{ecomic\_sector}_{ik} + \beta_9 d.\text{selfemployment}_i + \\ & \beta_{10.sk}\left(d.\text{ecomic}_{\text{sector}ik} x d.\text{sex}_i\right) + \beta_{11.sf}\left(d.\text{selfemployment}_i x d.\text{sex}_i\right) \\ & + \beta_{12}\ln(worked\_hours)_i + \beta_{13} d.\text{stability}_i + \varepsilon_{it}\end{aligned}$$

Equation 2.2 DD approach, worked hours

$$\begin{aligned}\ln(worked\_hours)_i =& \alpha + \beta_1 d.\text{earthquake2}_i + \beta_2 d.\text{time} + \\ & \beta_3 d.\text{earthquake2}_i x d.\text{time} + \beta_4 \text{schooling}_i + \\ & \beta_5 \text{potencial\_experience}_i + \beta_6 \text{potencial\_experience}_i{}^2 + \\ & \beta_7 d.\text{sex}_i + \beta_{8.k} d.\text{ecomic\_sector}_{ik} + \beta_9 d.\text{selfemployment}_i + \\ & \beta_{10.sk}\left(d.\text{ecomic}_{\text{sector}ik} x d.\text{sex}_i\right) + \\ & \beta_{11.sf}\left(d.\text{selfemployment}_i x d.\text{sex}_i\right) + \beta_{12} d.\text{stability}_i + \varepsilon_{it}\end{aligned}$$

Third, we estimate logistic regressions models (nonlinear DD) for each country in order to explore the probability of being employed after the earthquake (see Eqs. 3.1 and 3.2):

$$Prob\left(x_i = 1|z_i\right) = \frac{e^{\beta_i z_i}}{1 + e^{\beta_i z_i}}$$

Equation 3.1 Logistic model

Where x_i represents the condition of being employed (variable employment equal to 1) and z_i is the vector of explanatory variables for each individual i. The vector of the explanatory variables that we use in our nonlinear DD estimations is:

$$\begin{aligned}z_i =& d.\text{earthquake2}_i, d.\text{time}, d.\text{earthquake2}_i x d.\text{time}, \text{schooling}_i, \\ & \text{potential\_experience}_i, \text{potential\_experience}_i^2, d.\text{sex}_i, d.\text{selfemployment}_i\end{aligned}$$

Equation 3.2 vector of explanatory variables, nonlinear DD for employment

The label descriptions for the variables in our models are:

ln(wage)	is the natural logarithm of individual monthly labor income.
ln(worked_hours)	is the natural logarithm of the individual monthly worked hours.
employment	is a dummy variable taking the value of 1 if the individual is employed, 0 otherwise[9].

[9] We consider the working age population in each country.

d.time	is a dummy time variable (1 post disaster, 0 pre disaster). Pre disaster periods are December 2015 for Ecuador, 2008 for Italy and the year 2009 for Chile. Post disaster periods are December 2016 for Ecuador, the year 2009 for Italy and 2010 for Chile.
d.earthquake1	is a dummy variable taking the value of 1 if the individual is located in the seismic areas in the post-earthquake year, otherwise 0.
d.earthquake2	is a dummy variable taking the value of 1 if the individual is located in the seismic areas, otherwise 0.
schooling	is the individual's years of education.
potential_experience	was calculated as age—schooling—six.
d.sex	is a dummy variable for sex[10] (1 female).
d.economic_sector	are dummy variables for "k" economic activities (see footnote 7).
d.selfemployment	is a dummy variable that takes the value of 1 if the individual was an employer or self-employment, otherwise 0.
d.stability	is a dummy variable which takes 1 if the individual has work stability (permanent contract or job appointment), 0 otherwise.

4 Case studies: Abruzzo (Italy), Biobío and Maule (Chile), and Manabí and Esmeraldas (Ecuador)

Jowell (1998) and Maddison (2005) explained the issues about the selection of case studies in cross country comparison for social sciences: The cases should present a right mix of similarities and differences, their number should be not too large but possibly more than two, in order to be able to describe them in depth and to prevent possible syncrasies. Finally, the authors should not be completely alien from their context.

The similarities identified in advance are: all three countries are earthquake-vulnerable across the whole country (no feasible self-selection in earthquake-free areas); they have comparable size and population (the biggest one is no more than three times the smallest) and morphology. They also had a similar independent State history (independence in 1800s, liberal and authoritarian regimes, democratic transitions and a slow ongoing process from a centralized to a decentralized State in the late decades), same majority religion, similar languages, legal systems (civil law), and relative currency stability.

Their main differences are their geopolitical role, their gross and per capita GDP (Italy 2009: 2.391 trillion USD—40,640 per capita. Chile 2010 172.4 billion—10,243 per capita. Ecuador 2015 99.29 billion—6150 per capita, according

[10] It is important to note that the separate regressions for males and females do not include the sex dummy, the interaction between economic sector and sex, and the interaction between self-employed dummy and sex.

to the World Bank). They also experienced very different macroeconomic trends before and after the disaster in study: Italy was at its peak, and since the earthquake struck it has experienced a severe crisis, mainly due to the European financial turmoil in 2008–2011. In Chile the reverse was happening, since 2009 was the middle of a rapid, yet volatile growth cycle. Ecuador was at the end of a sustained growth period that was becoming flatter after the earthquake hit. Their economic models of growth are also different, the Chilean one had more merits to be called neoliberal at the time, while the Italian and Ecuadorian ones were more balanced. Indexes of economic freedom show this: Chile (18th), Italy (80th) and Ecuador (170th). Most of these differences are given by government spending[11] (UN 2018). Ecuador and Italy present similar characteristics with respect to Chile when workers' rights are the center of analysis. Starting from a fundamental rights point of view, the Chilean Constitution recognizes to workers the fundamental rights given by human nature and the "freedom of work and its protection" (art 5 and 19). The Ecuadorian Constitution explicitly considers work as a "right and a social duty" (art 33), deeply articulated in its right and subject to State intervention (art. 34, 37, 38, 39, 47, 66, 276, 284, 319–333). Italian Constitution is even more explicit, starting with a clear "Italy is a democratic Republic founded on Labor" (Art. 1), with a clear stand on workers' rights, the right to work and the role of the State actively promoting these (art. 4, 35–40, 46). All three States have their own Worker Statute Law, comprehending contract norms, workers securities and union's rights.

Regarding the role of the State in case of disaster, the Constitutional framework is different: the Italian text ignores the issue, mentioning only in a note the possibility of exceeding the national budget (art. 81), forwarding to lower rank laws any protection from disaster hazards. The Chilean Constitution explicitly introduces the state of catastrophe (art. 32, 40, 41) where the Government can exceed its normal powers, also restricting workers freedom, but there is no mention of any risk management. In the Ecuadorian Constitution the concept of risk reduction is widely introduced, with rights in case of disaster and the possibility of a state of exception (art. 35, 38, 46, 164, 261, 389, 397).

In all three nations, norms about risk reduction and disaster management are numerous and prone to change after each occurring disaster (especially in Italy) so it is not easy to predetermine precisely how each state could have reacted to such disastrous events presented hereafter.

4.1 Brief description of the earthquakes

4.1.1 2016 April 16th: Ecuadorian Earthquake

The Ecuadorian coast was shaken by a 7.8 Mw earthquake on April 16, 2016 (20 km deep), its hypocenter was located off the coast of *Manabí*, a province which also suffered the highest casualty rate. The provinces of *Manabí* and *Esmeraldas* were the most affected regions in terms of infrastructure damages. The disaster left a total of

[11] This is negatively counted in the Index, which is very low for Chile at 25% of GDP, higher and similar for Italy and Ecuador (respectively, 50% and 44% of each GDP).

671 human lives lost, 113 individuals were rescued alive, and in the three days after the earthquake almost 4859 people received health care. The areas most affected by the disaster were vulnerable areas, both physically and socio-economically. In general, the estimated reconstruction costs reached the amount of 3344 million USD: 1369 million in the social sector, 862 million in the infrastructure sector, 1032 million in the productive sector, and 81 million in other costs (IG-EPN 2018; Committee for Reconstruction and Productive Reactivation 2016).

The national government quickly developed actions and regulations for the recovery of the affected areas. On May 20[12], 2016, the Ecuadorian government passed a law stipulating solidarity contributions to be collected on remunerations, wealth, utilities, property and representative rights of capital existing in Ecuador. The value added tax was temporarily increased by 2 percentage points[13] throughout the country, except for the provinces of *Manabí* and *Esmeraldas*. Incentives were established for new productive investments in these two provinces.

By May 30, 2018, 2876 million USD were allocated, which were distributed as follows: 2100.8 million for reconstruction, 412.6 for productive reactivation and 362.6 for emergency. As of April 14th, 2017, the Productive Reactivation Committee indicates that more than 44,000 direct and indirect jobs have been generated (80% identified as local unskilled labor). Finally, the Technical Secretariat of the Committee of Reconstruction and Productive Reactivation (2019), reported that by October 2018 Public Banking had placed 689 million dollars in the provinces of *Manabí* and *Esmeraldas*.

4.1.2 2010 February 27th: Chile earthquake

On the night of February 27th 2010, an earthquake of 8.8 moment magnitude (Mw) shook the central part of Chile for four minutes long. The epicenter was located 17 km from the coastal town of *Cobquecura*, the magnitude and the distance induced a tsunami wave that hit the Chilean coast 35 min after the seismic shake. The event left 525 official losses, of whom 100 perished because of the tsunami, about 500,000 people were immediately displaced, and more than 200,000 buildings reported damages. The earthquake mainly affected six Chilean regions (*Biobío, Maule, O'Higgins, Valparaiso, Metropolitana and Araucanía*). But, while in the regions away from the epicenter most of the damages were due to a scattered single building vulnerability, the catastrophic outcome emerged mainly in the two regions close to the epicenter: *Biobío* and *Maule*.

The two regions most affected by the 2010 earthquake were both poorer in terms of GDP than the national average, but *Biobío* was slightly richer than *Maule*. Their economy is mainly based on forestry, fishery, other agricultural activities and energy production. The 2010 earthquake affected highly dense areas and the two coastal cities of *Concepción* (*Biobío*) and *Constitución* (*Maule*), where the signs of the earthquake are still persistent almost ten years later.

12 Official Register (2016).

13 VAT was raised from 12–14% This increase was a solidarity contribution for seismic areas.

In April 16th, 2010, the Presidency released a reconstruction plan where almost 30 billion USD were estimated as the overall cost of the catastrophe. To boost reconstruction, the government engaged 8.4 billion USD for the 2010–2014 period, mostly earmarked for public infrastructure projects (Government of Chile 2010). The remaining part was supposed to be covered by 6.2 billion USD from private insurance companies, but most of these funds were never disbursed because of insolvency (Brain and Mora 2012). The last half of the remaining costs have not been explicitly covered. No explicit post-disaster policies have been enacted for the creation jobs or local development initiatives. In 2010, only 16,634 workers got unemployment subsidies.

4.1.3 2009 April 6th: Italy earthquake

At 3:32 am on April 6th, 2009, the city of *L'Aquila* (Italy) was hit by a 6.3 Mw earthquake, the highest of a long seismic swarm. 309 inhabitants died, 1600 were injured and about 100,000 were evacuated from *L'Aquila* and the surrounding municipalities during the following weeks. Differently from the South American earthquakes, European and especially Italian seismic events are characterized by lower, yet highly concentrated energy releases in smaller areas prone to devastation, either because of shorter fault lines, complicated geology or older construction techniques (Lam et al. 1996; Viti 2019). The *Abruzzo* region, where *L'Aquila* is the capital, has always been one of the most vulnerable regions of Italy, both in terms of socio-economic and seismic vulnerability. Besides the cost in human lives and livelihoods, the capital losses were also enormous and remarkable since more than 22,000 private houses were damaged, 2000 firms suspended their business and the total cost from the earthquake is estimated at 11.2 billion USD.

On April 28th, the government approved the emergency law *Decreto Abruzzo* (L 77-2009) as well as the first reconstruction norms, which described no-tax areas and social securities for the affected population, including unemployment subsidies for

Table 1 Summary information for the case studies. (Own elaboration)

	ECUADOR	CHILE	ITALY
Date of peak shake	April 16, 2016	February 26, 2010	April 6, 2009
Magnitude	7.8 Mmw	8.8 Mmw	6.3 Mmw
Mercalli Scale	VIII–IX	VIII–IX	IX–X
Victims	671 (+ 9 missing)	525 (+ 23 missing)	309
Tsunami	No	Yes	No
Displaced inhabitants	80,000	500,000(est)	80,000
Damage estimated (at the moment[a])	USD 3.3 bln	USD 30 bln	USD 11.2 bln
Public expenditure (total)	USD 2.9 bln	USD 8.4 bln	USD 12.7 bln
Public expenditure for local development	USD 412 mln	–	USD 530 mln
Unemployment rate change (national)	+0.4%	–1.6%	+1.4%
Unemployment rate change (affected regions)	–2.0%	–0.1%	+1.4%

[a]Initial cost estimations are made just days or weeks after the events. The actual figures tend to differ

self-employed workers and employers. In 2012, this effort was followed by a larger law for overall reconstruction (L 83-2012), bringing the total public reconstruction expenditure at almost 13 billion USD, more than the original cost. This huge amount of public funds should have been used mainly for private housing reconstruction subsidies, but a relevant quota (530 million USD) ended up going instead for local development projects. Table 1 summarizes the most important information for the three earthquakes.

An important point about these three earthquakes is that both emigration and immigration represented a very limited phenomenon, at least in the short term time period we are examining here. This is important to note, as attrition, representativeness and biases could have increased if these disasters had also triggered flows of people across geographic areas.

5 Results

5.1 Labor income distributional differences

To describe how labor income shifts developed in each country we first performed a quantile comparison of labor income[14] between two years, first for affected areas and then for unaffected areas of each country using the Harrell and Davis (1982) quantile estimator for robust tests for two independent groups[15].

In the Ecuadorian case (see Table 2), there was a positive and significant difference in labor income only for the first wage quintile in the affected areas in 2016, but

Table 2 Ecuadorian labor income quantile difference (natural logarithm). (Source: National Survey on Employment, Unemployment and Underemployment (ENEMDU). Own elaboration)

Quantile	*N* 2016	*N* 2015	Average 2016	Average 2015	Difference	CI low	CI up	*p*.crit	*p*.value
Ecuadorian Wage (logarithm) Quantile Difference: affected Areas									
0.2	2524	2426	5.05	4.85	0.20	0.05	0.31	0.01	–
0.4	2524	2426	5.60	5.52	0.08	–0.02	0.16	0.01	0.05
0.6	2524	2426	6.00	5.99	0.01	–0.02	0.05	0.03	0.33
0.8	2524	2426	6.44	6.42	0.02	–0.04	0.08	0.05	0.45
1	2524	2426	9.24	10.82	–1.58	–2.30	0.81	0.02	0.21
Ecuadorian Wage (logarithm) Quantile Difference: unaffected Areas									
0.2	25,405	24,797	4.84	5.02	–0.18	–0.22	–0.14	0.01	–
0.4	25,405	24,797	5.58	5.71	–0.12	–0.16	–0.09	0.01	–
0.6	25,405	24,797	6.03	6.04	–0.01	–0.03	0.01	0.03	0.29
0.8	25,405	24,797	6.47	6.48	–0.02	–0.05	0.02	0.02	0.20
1.0	25,405	24,797	11.51	10.56	0.95	–0.82	1.39	0.05	0.74

[14] We only took wages >0. We use labor income in current values during the present research.

[15] According with Mair and Wilcox (2019) we reject the null hypothesis (no quantile difference) if *p*-value ≤ *p*-critic.

Table 3 Chilean labor income quantile difference (natural logarithm). (Source: National Socioeconomic Characterization Survey (CASEN, post-earthquake). Own elaboration)

Quantile	*N* 2010	*N* 2009	Average 2010	Average 2009	Difference	CI low	CI up	*p*.crit	*p*.value
Chilean Wage (logarithm) Quantile Difference: Affected Areas									
0.2	6097	6333	11.51	11.51	–0.001	–0.06	0.00	0.01	0.04
0.4	6097	6333	11.92	11.92	0.000	–0.00	0.00	0.05	0.74
0.6	6097	6333	12.03	12.04	–0.014	–0.04	0.02	0.01	0.29
0.8	6097	6333	12.43	12.43	–0.000	–0.02	0.01	0.03	0.65
1.0	6097	6333	15.42	14.91	0.511	–0.18	0.52	0.02	0.50
Chilean Wage (logarithm) Quantile Difference: Unaffected Areas									
0.2	14,279	14,931	11.70	11.71	–0.013	–0.07	–0.00	0.01	–
0.4	14,279	14,931	12.01	12.01	0.000	–0.00	0.00	0.05	0.45
0.6	14,279	14,931	12.15	12.18	–0.038	–0.07	–0.00	0.02	0.01
0.8	14,279	14,931	12.45	12.51	–0.065	–0.11	–0.00	0.01	0.004
1.0	14,279	14,931	15.61	15.76	–0.154	–0.34	0.02	0.03	0.22

Table 4 Italian labor income quantile difference (natural logarithm). (Source: Rilevazione sulle Forze di Lavoro. Own elaboration)

Quantile	*N* 2009	*N* 2008	Average 2009	Average 2008	Difference	CI low	CI up	*p*.crit	*p*.value
Italian Wage (logarithm) Quantile Difference: Affected Areas									
0.2	855	1022	6.73	6.46	0.27	0.20	0.36	0.03	–
0.4	855	1022	6.98	6.89	0.09	0.04	0.15	0.02	–
0.6	855	1022	7.11	7.05	0.06	0.02	0.12	0.01	–
0.8	855	1022	7.28	7.21	0.06	0.02	0.11	0.01	–
1.0	855	1022	8.01	8.01	–	–	–	0.05	1.00
Italian Wage (logarithm) Quantile Difference: Unaffected Areas									
0.2	5634	7206	6.73	6.48	0.25	0.20	0.28	0.03	–
0.4	5634	7206	7.00	6.91	0.10	0.09	0.11	0.02	–
0.6	5634	7206	7.15	7.07	0.08	0.06	0.10	0.01	–
0.8	5634	7206	7.32	7.24	0.07	0.06	0.10	0.01	–
1.0	5634	7206	8.01	8.01	–	–	0.04	0.05	0.95

for unaffected areas there was a negative difference in 2016 for the first and second quintile.

In Chile no wage differences were found for the affected areas, only for unaffected areas there was a negative and significant wage difference for the first, third and fourth quintiles (Table 3).

In Italy there were positive and significant wage differences in 2016 for the affected areas in the first to fourth quintiles, both in affected and unaffected zones (see Table 4).

In summary, we found heterogeneous wage differences between years for some quantiles. In Ecuador only the first income quintile in the affected zones showed statistically significant wage increases, while unaffected areas in the first two quantiles showed income decreases. For Italy, both seismic and not seismic areas had wage increases (quintile 1–4), only for the first quintile is higher for affected locations. Finally, in Chile no significant differences were found for affected territories. In the final section we discuss how future research could explore deeper questions about the distribution of wages in post-disaster labor markets.

5.2 Wage regressions

For the panel regression and the difference in difference estimates, we performed separate regressions for men and women, we also made joint regressions with interactions for robustness. Differences in the reserve salaries could due to gaps in productivity and expectations of both groups, since men and women have very different reasons for deciding whether or not to participate in the labor market (Brown et al. 2011; Caliendo et al. 2017).

For data panel models we performed a Hausman test, which suggests that the more appropriate models were fixed effect estimations, so we report only these models for all three countries. In Ecuador we found a positive association between the earthquake, labor income and working hours (11.6% and 6.5% respectively for males and females jointly, Table 5). The earthquake labor income coefficient for males was greater in magnitude than for females, but the coefficient of worked hours

Table 5 Mincerian Regressions[a] (data panel). (Source: ENEMDU, CASEN, ISTAT. Own elaboration)

Dependent Variable	Males and Females Jointly		Males		Females	
	Ln(wage)	Ln (worked_hours)	Ln(wage)	Ln (worked_hours)	Ln(wage)	Ln (worked_hours)
Ecuador						
d.earthquake1	0.116***	0.0645***	0.129***	0.0474***	0.0860**	0.104***
S.E.	(0.0184)	(0.0114)	(0.0214)	(0.0128)	(0.0356)	(0.0227)
N	55029	67043	34062	38457	20967	28586
Sigma_u	0.781	0.528	0.723	0.446	0.845	0.600
Rho	0.663	0.661	0.636	0.614	0.683	0.677
Italy						
d.earthquake1	0.0132	0.0378*	0.00837	0.00453	0.0167	0.0975**
S.E.	(0.0186)	(0.0209)	(0.0327)	(0.0403)	(0.0215)	(0.0232)
N	8429	10854	3558	4264	4871	6590
Sigma_u	0.352	0.562	0.590	0.816	0.577	0.451
Rho	0.664	0.748	0.820	0.824	0.868	0.708
Chile						
d.earthquake1	0.0238	–0.0149	0.0126	–0.00772	0.0509	–0.0325
S.E.	(0.0253)	(0.0422)	(0.0294)	(0.0486)	(0.0493)	(0.0832)
N	24864	26116	16048	16783	8816	9333
Sigma_u	0.684	0.694	0.634	0.656	0.730	0.743
Rho	0.712	0.450	0.688	0.440	0.718	0.446

Standard errors in parentheses

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

[a]See Table 8 in the Appendix for complete regressions results

Table 6 Double Difference Estimations[a]. (Source: ENEMDU, CASEN, ISTAT. Own elaboration.)

Dependent Variable	Males and Females Jointly		Males		Females	
	Ln(wage)	Ln (worked_hours)	Ln(wage)	Ln (worked_hours)	Ln(wage)	Ln (worked_hours)
Ecuador						
Interaction Term (d.earthquake2 × d.time)	0.112***	0.0591***	0.116***	0.0506***	0.105***	0.0772***
S.E.	(0.0217)	(0.0143)	(0.0259)	(0.0160)	(0.0393)	(0.0268)
N	55029	67043	34062	38457	20967	28586
Italy						
Interaction Term (d.earthquake2 × d.time)	0.00231	0.0466**	0.00110	0.0131	–0.00183	0.103**
S.E.	(0.0197)	(0.0215)	(0.0238)	(0.0234)	(0.0326)	(0.0415)
N	8429	10854	3558	4264	4871	6590
Chile						
Interaction Term (d.earthquake2 × d.time)	–0.0311	0.0395	–0.0380	0.0332	–0.0206	0.0509
S.E.	(0.0218)	(0.0254)	(0.0257)	(0.0305)	(0.0394)	(0.0450)
N	24864	26116	16048	16783	8816	9333

Standard errors in parentheses

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

[a]See Table 8 in the Appendix for complete regressions results

was higher for females. In Italy, we found an increase in worked hours (3.8% for men and women jointly, 9.8% for females), but not for male workers. Surprisingly, in Chile we did not observe statistically significant associations between the earthquake, wage changes and working hours.

5.3 Difference in difference (DD) approach

The double difference estimations were coherent with the Mincerian wage regressions. We found a positive earthquake effect in wages and worked hours in Ecuador (11% and 6% respectively, joint regressions, Table 6). Also, we found that the wage coefficient was higher for men and the working hours coefficient was greater for women. It seems that, in the short term, the Ecuadorian labor markets in the regions affected by the earthquake improved their performance in these two dimensions. For Italy, we found an effect only in working hours but not in labor income, and we also found a gender effect, since only women experienced an increase in their working hours. It is possible that reserve salaries for women might have decreased due to the earthquake in some affected regions. In Chile there was no significant effect, neither in labor income nor in worked hours.

Table 7 Logistic regressions for employment dummy (average marginal effects, nonlinear DD)[a]. (Source: ENEMDU, CASEN, ISTAT. Own elaboration)

Dependent Variable: Employment	ECUADOR	CHILE	ITALY
Interaction Term (d.earthquake2 × d.time)	0.0028	–0.0067	0.0019
S.E.	0.0037	0.0076	0.0116
N	68,924	121,294	12,050

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[a] See Table 9 in the Appendix for complete regressions results

5.4 Employment status logistic regressions

We performed a regression analysis to compute how the three earthquakes are associated with the probability of being employed in the immediate post-disaster months using a nonlinear DD. As in previous regressions, comparable samples (most affected regions and the rest of the territories) were included in the regression analysis for all three countries.

The parameter of interest is the interaction term between time (post-earthquake) and being in one of the most affected regions (*Manabí* and *Esmeraldas* for Ecuador, *Maule* and *Biobío* for Chile and *Abruzzo* for Italy). Controlling for other variables, we did not observe statistically significant parameters for interaction terms in any of the three countries (see Table 7).

6 Discussion and conclusions

6.1 Discussion

Understanding the effects of an earthquake on the workforce during the first months after the event is not a linear process. After having identified changes in working hours and wage parameters, the first distinction to adopt in this discussion is between the most affected regions and the surrounding[16] population, starting from a simple comparison of employed, unemployed or inactive people before and after the earthquake.

In Ecuador there was a reduction in the share of unemployed and inactive citizens in the most affected areas (defined in our research). This trend of rising labor indicators could have been caused by a young demographic structure and general State interventions to boost the local economy in the short run. In Ecuador, the most vulnerable workers (lower quintile) faced a significant increase in wages[17], while in unaffected areas we observed the opposite (negative difference in 2016 for the first and second quintile).

[16] Except for Ecuador, where the unaffected individuals were in provinces different from Manabí or Esmeraldas.

[17] We refer to yearly descriptive quantile comparisons between affected and unaffected zones. We do not refer to regressions in which is possible to include a variable to capture the earthquake influence in our outcomes.

Despite the magnitude of the earthquake and the relatively low levels of social protection, Chile faced the earthquake with good resistance, both in the most affected regions, as well as the rest of the country, showing only a slight transition from unemployment to inactivity. We observed that wages did not face significant changes in the different quintiles. The Italian case is very peculiar, an old population in the year of an economic crisis made the Abruzzo region more likely to increase unemployment, even considering that there were no subsidies for workers passing from inactivity to unemployment. Note that the most affected regions in the three nations are very similar under a profile of peripherality[18] with respect to the national economic flows. Our regression analysis shows that the earthquake seemed to improve wages and working hours in Ecuador, while in Chile the disaster did not seem to influence labor income, nor working hours. In Italy, only an increase of working hours was found.

The gender gap is multidimensional and strongly persistent in the three cases, where women have lower probability of being employed (see sex dummy in Table 9 in the Appendix). The heterogeneity of each case is relevant, in Ecuador both men and women earn and work more due to the earthquake, in Italy only women increased their worked hours, but labor income did not increase overall. In Chile no significant effects were found.

It is important to mention that all three labor markets are different from each other. In Ecuador, a large proportion of the workforce (nearly 50%) is employed in the informal sector, the percentage is even higher if we use informal employment definition (Mendoza and Jara 2020). This has implications for the provision of public services, as the Ecuadorian Social Security Institute only guarantees formal workers access to health and retirement pensions. The Chilean market has a legal workday of 45 h, while in Ecuador and Italy the legal workday is 40 h. In many ways, Chile is also a country that has focused its economy on market liberalization for the last decades, yet it has not guaranteed some social protection benefits for workers (i.e. low retirement pensions). The Italian labor market at the time (2009) was mainly made up of formal workers, it is these workers who have access to social security.

6.2 Conclusions

This brief study of short run effects of earthquakes on local labor markets shows different scenarios where responses and impacts had differences and similarities across all three countries. The speed of recovery could depend both on intrinsic characteristics of the regions and the capabilities of policy makers to help these processes, as the Ecuadorian dynamism, Chilean resistance, and Italian support has shown. The amount of public money spent for reconstruction and local development could have played an important role on short term labor market reactions, although

[18] In Chile the most populated and economically important area is the Metropolitan region (Santiago, the country capital is here). In Ecuador three cities are the most important in terms of population and economic flows: the capital Quito (Pichincha province), Guayaquil (Guayas province) and Cuenca (Azuay province). In Italy the most important cities are the capital (Rome) and those located in the northern side of the country.

some of these funds might have also exacerbated expectations from local economic agents. We saw how a smaller and poorer, but younger and more dynamic economy such as the Ecuadorian was able to react in a decisive way to the disaster shock. The case of Chile, a mature economy with a more liberalized system, did not seem to suffer considerable short run effects, as the Chilean labor market reacted well due to increased economic activity in the years following the earthquake. At the same time, an older economic system such as the Italian one, seemed to experiment short run effects in working hours, but not in workers' salaries in affected areas. However, an increased State role during catastrophic events appears to be necessary in order to maintain social cohesion and securities.

In conclusion, this paper remarks the importance of institutions, the economy and public support have after a disaster in the short run. In that moment, when the attention is mainly paid to basic needs such as food or shelter, affected households function with relevant changes in their working conditions: some families can be forced to find other sources of income and women are often at a disadvantage when gender equality policies are not considered in these scenarios. Investigating previous short-term responses is important for policymakers to adjust disaster responses to the needs of societies and avoid some pitfalls that other countries experienced (such as the compounding effect the financial crisis had in Italian labor markets).

Work is not only important in the mid-run from a disaster, in order to assess the economic development of an affected area, it is also crucial to give proper attention to post-disaster employment conditions in the first months. An integrated system of workforce protection may help affected households to avoid a second personal disaster after the collective one.

There are many challenges for future research in this topic, we show a first distributional approach with the salary comparisons per quintile in our manuscript. According to our results, Ecuador is a special case in which there was an average salary increase for the first quintile in seismic areas, but there was an average wage decrease for unaffected areas in the first and second quintiles between the pre and post-earthquake periods. In this article there is not enough evidence to conclude that an existing distributional effect was found. For this reason, causal distributional approaches are among the future challenges in order to reveal whether earthquakes affect local labor markets homogeneously (or not) across the wage distribution. This could be a crucial part in designing good mechanisms in public policy to minimize potential damages that earthquakes could cause to workers, and the labor markets they comprise.

Further research directions in this area can be both plentiful and offer a lot of insight, especially when comparing multiple countries that have suffered similar disasters. Ohtake et al. (2012) suggest to study changes in industrial structure, which could help policy makers to identify economic sectors in need, and guide the post-disaster economy with better tools. Ewing et al. (2005) suggest that new research questions might focus in determining which characteristics make resilient regions, a very broad concept that has been explored in depth in this literature, but rarely using cross-country comparisons with microdata. Xiao and Feser (2014) also point out that future research could focus on determining the influence of pre-disaster economic conditions (sectoral structure, urban and rural composition, employment and unemployment), on the labor market reaction and adjustment over long periods.

Appendix

Table 8 Minцerian regressions and Difference in difference regressions. (Sources: ECUADOR: ENEMDU. Own elaboration, CHILE: CASEN. Own elaboration, ITALY: Source: ISTAT. Own elaboration)

	Levels						Difference in difference					
	Men and women		Males		Females		Men and women		Males		Females	
Variables	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)
ECUADOR												
d.earthquake1	0.116***	0.0645***	0.129***	0.0474***	0.0860**	0.104***	–	–	–	–	–	–
	(0.0184)	(0.0114)	(0.0214)	(0.0128)	(0.0356)	(0.0227)						
Schooling years	0.0144***	0.00234	0.0113*	0.00469	0.0210**	–0.00142	0.0613***	0.00429***	0.0565***	–0.00149**	0.0671***	0.0119***
	(0.00487)	(0.00292)	(0.00589)	(0.00350)	(0.00866)	(0.00513)	(0.000928)	(0.000603)	(0.00117)	(0.000719)	(0.00152)	(0.00103)
Pot.Experience	0.00896	0.00270	0.00222	0.00783*	0.0237**	–0.00584	0.0267***	0.0206***	0.0304***	0.0211***	0.0210***	0.0202***
	(0.00625)	(0.00371)	(0.00754)	(0.00440)	(0.0112)	(0.00660)	(0.000630)	(0.000379)	(0.000776)	(0.000445)	(0.00107)	(0.000656)
Pot.Experience (sq)	–0.0000962	–0.0000738*	–0.0000162	–0.000112**	–0.000284**	–0.00000587	–0.000353***	–0.000300***	–0.000414***	–0.000327***	–0.000263***	–0.000265***
	(0.0000673)	(0.0000391)	(0.0000791)	(0.0000459)	(0.000127)	(0.0000706)	(0.00000921)	(0.00000555)	(0.0000114)	(0.00000653)	(0.0000157)	(0.00000958)
d.sex	–	–	–	–	–	–	–0.247***	–0.193***	–	–	–	–
							(0.0157)	(0.00781)				
Construction	0.334***	0.165***	0.334***	0.165***	0.414***	0.227***	0.338***	0.144***	0.339***	0.142***	0.547***	0.233***
	(0.0292)	(0.0176)	(0.0287)	(0.0165)	(0.111)	(0.0695)	(0.0140)	(0.00940)	(0.0137)	(0.00843)	(0.0701)	(0.0499)
Manufacturing, mining and electricity	0.324***	0.176***	0.324***	0.177***	0.189***	0.195***	0.320***	0.118***	0.340***	0.128***	0.173***	0.161***
	(0.0297)	(0.0181)	(0.0292)	(0.0169)	(0.0548)	(0.0297)	(0.0136)	(0.00903)	(0.0135)	(0.00822)	(0.0212)	(0.0135)

Table 8 (Continued)

Variables	Levels						Difference in difference					
	Men and women		Males		Females		Men and women		Males		Females	
	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)
Wholesale and retail trade, hotels and restaurants, transport and storage	0.255*** (0.0272)	0.125*** (0.0162)	0.255*** (0.0267)	0.126*** (0.0152)	0.219*** (0.0465)	0.154*** (0.0250)	0.297*** (0.0110)	0.129*** (0.00711)	0.317*** (0.0109)	0.138*** (0.00650)	0.376*** (0.0153)	0.227*** (0.00935)
Other activities	0.348*** (0.0328)	0.157*** (0.0199)	0.348*** (0.0322)	0.158*** (0.0186)	0.258*** (0.0489)	0.168*** (0.0266)	0.423*** (0.0131)	0.0460*** (0.00867)	0.457*** (0.0136)	0.0754*** (0.00833)	0.444*** (0.0172)	0.103*** (0.0109)
d.self_employment	–0.230*** (0.0171)	–0.0213** (0.0101)	–0.228*** (0.0170)	–0.0228** (0.00954)	–0.402*** (0.0289)	–0.136*** (0.0138)	–0.240*** (0.00976)	0.0361*** (0.00634)	–0.252*** (0.0101)	0.0422*** (0.00609)	–0.442*** (0.0147)	–0.186*** (0.00826)
Interaction sex (F) and Construction	0.0761 (0.112)	0.0640 (0.0659)	–	–	–	–	0.248*** (0.0687)	0.116** (0.0452)	–	–	–	–
Interaction sex (F) and Manufacturing (...)	–0.135** (0.0607)	0.0200 (0.0326)	–	–	–	–	–0.125*** (0.0240)	0.0521*** (0.0146)	–	–	–	–
Interaction sex (F) and Trade services (...)	–0.0359 (0.0525)	0.0295 (0.0280)	–	–	–	–	0.104*** (0.0176)	0.109*** (0.0104)	–	–	–	–
Interaction sex (F) and Other activities	–0.0888 (0.0575)	0.0121 (0.0314)	–	–	–	–	0.0554*** (0.0190)	0.0845*** (0.0112)	–	–	–	–
Interaction sex (F) and d.self_employment	–0.167*** (0.0317)	–0.117*** (0.0159)	–	–	–	–	–0.238*** (0.0144)	–0.223*** (0.00868)	–	–	–	–
d.time	–0.0220*** (0.00670)	–0.0208*** (0.00399)	–0.0246*** (0.00814)	–0.0218*** (0.00481)	–0.0176 (0.0118)	–0.0192*** (0.00690)	–0.0329*** (0.00652)	–0.0462*** (0.00415)	–0.0357*** (0.00809)	–0.0388*** (0.00491)	–0.0291*** (0.0109)	–0.0567*** (0.00710)
Ln(worked_hours)	0.419*** (0.0107)	–	0.415*** (0.0137)	–	0.425*** (0.0173)	–	0.675*** (0.00667)	–	0.634*** (0.00940)	–	0.704*** (0.00962)	–
d.stability	0.0817*** (0.0135)	0.0694*** (0.00871)	0.0912*** (0.0166)	0.0619*** (0.0103)	0.0645*** (0.0232)	0.0818*** (0.0155)	0.304*** (0.00919)	0.215*** (0.00602)	0.292*** (0.0114)	0.204*** (0.00705)	0.324*** (0.0154)	0.221*** (0.0105)
d.earthquake2	–	–	–	–	–	–	–0.0737*** (0.0156)	–0.0833*** (0.0103)	–0.0652*** (0.0185)	–0.0378*** (0.0114)	–0.0912*** (0.0283)	–0.170*** (0.0195)

Table 8 (Continued)

	Levels						Difference in difference					
	Men and women		Males		Females		Men and women		Males		Females	
Variables	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)
Interaction d.earthquake2 and d.time	–	–	–	–	–	–	0.112*** (0.0217)	0.0591*** (0.0143)	0.116*** (0.0259)	0.0506*** (0.0160)	0.105*** (0.0393)	0.0772*** (0.0268)
Constant	3.249*** (0.168)	4.791*** (0.0934)	3.458*** (0.205)	4.757*** (0.112)	2.848*** (0.294)	4.868*** (0.164)	1.316*** (0.0357)	4.603*** (0.00936)	1.520*** (0.0492)	4.655*** (0.0103)	0.930*** (0.0514)	4.336*** (0.0155)
N	55029	67043	34062	38457	20967	28586	55029	67043	34062	38457	20967	28586
Sigma u	0.781	0.528	0.723	0.446	0.845	0.600	–	–	–	–	–	–
Rho	0.663	0.661	0.636	0.614	0.683	0.677	–	–	–	–	–	–
CHILE												
d.earthquake1	0.0238 (0.0253)	–0.0150 (0.0422)	0.0126 (0.0294)	–0.00772 (0.0486)	0.0509 (0.0493)	–0.0325 (0.0832)	–	–	–	–	–	–
Schooling years	–	–	–	–	–	–	0.0769*** (0.00128)	0.00709*** (0.00151)	0.0702*** (0.00151)	0.00470*** (0.00182)	0.0870*** (0.00233)	0.0113*** (0.00271)
Pot.Experience	–	–	–	–	–	–	0.0162*** (0.000781)	0.00685*** (0.000912)	0.0218*** (0.000925)	0.00880*** (0.00110)	0.00847*** (0.00141)	0.00356** (0.00163)
Pot.Experience (sq)	–	–	–	–	–	–	–0.000151*** (0.0000135)	–0.000109*** (0.0000157)	–0.000233*** (0.0000156)	–0.000145*** (0.0000184)	–0.0000491* (0.0000257)	–0.0000403 (0.0000296)
d.sex	–	–	–	–	–	–	–0.147*** (0.0193)	–0.0711*** (0.0225)	–	–	–	–
Construction	0.0823* (0.0424)	–0.0845 (0.0715)	0.0798* (0.0417)	–0.0864 (0.0693)	0.884*** (0.255)	0.675 (0.410)	0.170*** (0.0153)	0.00816 (0.0181)	0.179*** (0.0146)	0.00490 (0.0175)	0.277*** (0.0776)	–0.0221 (0.0892)
Manufacturing, mining and electricity	0.0997** (0.0424)	–0.105 (0.0719)	0.0984** (0.0416)	–0.105 (0.0694)	–0.0466 (0.102)	0.0949 (0.174)	0.207*** (0.0152)	–0.0128 (0.0181)	0.230*** (0.0146)	–0.00472 (0.0177)	–0.116*** (0.0316)	–0.109*** (0.0367)
Wholesale and retail trade, hotels and restaurants, transport and storage	–0.0132 (0.0413)	0.0471 (0.0685)	–0.0139 (0.0405)	0.0461 (0.0662)	0.0263 (0.0769)	–0.0742 (0.128)	0.0634*** (0.0135)	0.0244 (0.0160)	0.0911*** (0.0130)	0.0327** (0.0156)	–0.0849*** (0.0234)	–0.0563** (0.0268)

Table 8 (Continued)

	Levels						Difference in difference					
	Men and women		Males		Females		Men and women		Males		Females	
Variables	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)
Other activities	0.0358 (0.0437)	–0.0698 (0.0741)	0.0339 (0.0429)	–0.0707 (0.0716)	0.0977 (0.0821)	0.0580 (0.137)	0.139*** (0.0143)	–0.0965*** (0.0170)	0.167*** (0.0139)	–0.0842*** (0.0168)	–0.0463** (0.0219)	–0.190*** (0.0253)
d.self_employment	–0.260*** (0.0370)	–0.0857 (0.0609)	–0.260*** (0.0362)	–0.0854 (0.0588)	–0.207** (0.0832)	0.129 (0.128)	–0.132*** (0.0127)	–0.0133 (0.0149)	–0.158*** (0.0127)	–0.0272* (0.0151)	–0.276*** (0.0211)	–0.115*** (0.0241)
Interaction sex (F) and Construction	0.801*** (0.245)	0.745* (0.384)	–	–	–	–	0.153** (0.0740)	–0.0199 (0.0857)	–	–	–	–
Interaction sex (F) and Manufacturing (...)	–0.150 (0.106)	0.197 (0.176)	–	–	–	–	–0.290*** (0.0326)	–0.0736* (0.0383)	–	–	–	–
Interaction sex (F) and Trade services (...)	0.0363 (0.0838)	–0.124 (0.136)	–	–	–	–	–0.105*** (0.0247)	–0.0563* (0.0288)	–	–	–	–
Interaction sex (F) and Other activities	0.0566 (0.0887)	0.124 (0.146)	–	–	–	–	–0.162*** (0.0235)	–0.0681** (0.0276)	–	–	–	–
Interaction sex (F) and d.self_employment	0.0520 (0.0873)	0.214 (0.134)	–	–	–	–	–0.207*** (0.0202)	–0.126*** (0.0235)	–	–	–	–
d.time	–0.0302* (0.0163)	0.0155 (0.0272)	–0.0312* (0.0189)	0.0235 (0.0313)	–0.0273 (0.0319)	–0.00352 (0.0540)	–0.0708*** (0.0139)	–0.00945 (0.0162)	–0.0514*** (0.0164)	0.0121 (0.0196)	–0.0936*** (0.0249)	–0.0435 (0.0284)
Ln(worked_hours)	0.0551*** (0.0117)	–	0.0516*** (0.0140)	–	0.0619*** (0.0213)	–	0.176*** (0.00536)	–	0.120*** (0.00657)	–	0.254*** (0.00905)	–
d.stability	–	–	–	–	–	–	0.197*** (0.00906)	0.0650*** (0.0107)	0.179*** (0.0107)	0.0377*** (0.0129)	0.213*** (0.0163)	0.110*** (0.0191)
d.earthquake2	–	–	–	–	–	–	–0.0662*** (0.00888)	–0.0260** (0.0105)	–0.0697*** (0.0105)	–0.0359*** (0.0126)	–0.0695*** (0.0160)	–0.0108 (0.0187)
Interaction d.earthquake2 and d.time	–	–	–	–	–	–	–0.0311 (0.0218)	0.0395 (0.0254)	–0.0380 (0.0257)	0.0332 (0.0305)	–0.0206 (0.0394)	0.0509 (0.0450)
Constant	5.482*** (0.0670)	5.171*** (0.0466)	5.610*** (0.0786)	5.262*** (0.0434)	5.244*** (0.126)	5.008*** (0.111)	3.792*** (0.0335)	5.065*** (0.0230)	4.072*** (0.0401)	5.081*** (0.0264)	3.254*** (0.0579)	4.969*** (0.0424)

Table 8 (Continued)

	Levels						Difference in difference					
	Men and women		Males		Females		Men and women		Males		Females	
Variables	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)
N	24864	26116	16048	16783	8816	9333	24864	26116	16048	16783	8816	9333
Sigma u	0.686	0.701	0.634	0.656	0.730	0.743	–	–	–	–	–	–
Rho	0.713	0.454	0.688	0.440	0.718	0.446	–	–	–	–	–	–
ITALY												
d.earthquake1	0.0132 (0.0186)	0.0378* (0.0209)	0.00837 (0.0215)	0.00453 (0.0232)	0.0167 (0.0327)	0.0975** (0.0403)	–	–	–	–	–	–
Schooling years	–	–	–	–	–	–	0.194*** (0.00476)	0.00879* (0.00514)	0.137*** (0.00604)	–0.00914 (0.00584)	0.257*** (0.00743)	0.0361*** (0.00936)
Pot.Experience	–0.00390 (0.0211)	–0.0524** (0.0239)	0.0188 (0.0244)	–0.00918 (0.0268)	–0.0356 (0.0379)	–0.111** (0.0456)	0.00241*** (0.000819)	0.00183** (0.000825)	0.00424*** (0.000960)	0.00290*** (0.000876)	0.0000199 (0.00143)	–0.00109 (0.00170)
Pot.Experience (sq)	0.000387 (0.000293)	0.000500 (0.000330)	0.000450 (0.000343)	–0.000199 (0.000369)	0.000116 (0.000508)	0.00154** (0.000634)	0.0000870*** (0.0000207)	–0.0000601*** (0.0000199)	0.0000149 (0.0000239)	–0.000104*** (0.0000207)	0.000182*** (0.0000371)	0.0000535 (0.0000429)
d.sex	–	–	–	–	–	–	–0.141** (0.0559)	–0.202*** (0.0457)	–	–	–	–
Construction	–0.0691 (0.126)	–0.0673 (0.143)	–0.110 (0.114)	–0.0862 (0.127)	–0.0890 (0.397)	–0.457 (0.464)	0.170*** (0.0331)	–0.0879*** (0.0285)	0.165*** (0.0309)	–0.0862*** (0.0247)	0.132 (0.0928)	–0.0809 (0.104)
Manufacturing, mining and electricity	0.0391 (0.113)	0.0652 (0.126)	0.0468 (0.102)	0.0547 (0.112)	0.153 (0.300)	–0.325 (0.402)	0.159*** (0.0322)	–0.0575** (0.0279)	0.172*** (0.0301)	–0.0501** (0.0242)	0.0965* (0.0512)	0.0106 (0.0471)
Wholesale and retail trade, hotels and restaurants, transport and storage	–0.0322 (0.113)	0.0346 (0.125)	–0.0449 (0.102)	0.0218 (0.111)	0.0751 (0.279)	–0.185 (0.380)	0.154*** (0.0325)	0.0155 (0.0276)	0.172*** (0.0303)	0.0214 (0.0240)	–0.0266 (0.0506)	–0.0235 (0.0451)
Other activities	–0.0255 (0.106)	–0.111 (0.119)	–0.00761 (0.0952)	–0.104 (0.106)	–0.0239 (0.280)	–0.479 (0.380)	0.204*** (0.0324)	–0.130*** (0.0279)	0.241*** (0.0304)	–0.112*** (0.0244)	0.0860* (0.0500)	–0.187*** (0.0448)

Table 8 (Continued)

	Levels						Difference in difference					
	Men and women		Males		Females		Men and women		Males		Females	
Variables	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)
d.self_employment	–0.869*** (0.251)	0.204*** (0.0657)	0 (.)	0.204*** (0.0583)	–0.821*** (0.278)	0.252*** (0.0924)	–0.0966** (0.0415)	0.187*** (0.0148)	–0.0539 (0.0395)	0.164*** (0.0154)	–0.238*** (0.0568)	0.213*** (0.0246)
Interaction sex (F) and Construction	–0.0448 (0.380)	–0.371 (0.426)	–	–	–	–	0.00410 (0.0939)	0.0275 (0.0932)	–	–	–	–
Interaction sex (F) and Manufacturing (...)	0.0723 (0.294)	–0.400 (0.370)	–	–	–	–	–0.0552 (0.0579)	0.0807* (0.0486)	–	–	–	–
Interaction sex (F) and Trade services (...)	0.104 (0.277)	–0.211 (0.351)	–	–	–	–	–0.167*** (0.0576)	–0.0278 (0.0470)	–	–	–	–
Interaction sex (F) and Other activities	–0.0102 (0.274)	–0.328 (0.350)	–	–	–	–	–0.0963* (0.0567)	–0.0355 (0.0465)	–	–	–	–
Interaction sex (F) and d.self_employment	–	0.0347 (0.103)	–	–	–	–	–0.117* (0.0661)	–0.000634 (0.0185)	–	–	–	–
d.time	–0.0408** (0.0160)	–0.00818 (0.0178)	–0.0537*** (0.0178)	–0.00543 (0.0194)	–0.0116 (0.0300)	–0.0132 (0.0353)	–0.0434*** (0.00674)	–0.0429*** (0.00742)	–0.0335*** (0.00828)	–0.0246*** (0.00826)	–0.0523*** (0.0109)	–0.0716*** (0.0139)
Ln(worked_hours)	0.293*** (0.0136)	–	0.170*** (0.0196)	–	0.369*** (0.0192)	–	0.347*** (0.00974)	–	0.227*** (0.0147)	–	0.409*** (0.0131)	–
d.stability	–0.0174 (0.0915)	0.296*** (0.112)	0.759*** (0.187)	0.677*** (0.186)	–0.198* (0.113)	0.170 (0.153)	0.141*** (0.00978)	0.105*** (0.0119)	0.167*** (0.0126)	0.0736*** (0.0142)	0.112*** (0.0150)	0.139*** (0.0203)
d.earthquake2	–	–	–	–	–	–	0.0133 (0.0141)	–0.0672*** (0.0156)	0.00142 (0.0169)	–0.0523*** (0.0169)	0.0188 (0.0236)	–0.0940*** (0.0305)
Interaction d.earthquake2 and d.time	–	–	–	–	–	–	0.00231 (0.0197)	0.0466** (0.0215)	0.00110 (0.0238)	0.0131 (0.0234)	–0.00183 (0.0326)	0.103** (0.0415)

Table 8 (Continued)

	Levels						Difference in difference					
	Men and women		Males		Females		Men and women		Males		Females	
Variables	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)	Wage (ln)	Hours (ln)
Constant	5.919***	4.183***	5.313***	3.471***	6.365***	4.901***	4.816***	3.585***	5.420***	3.663***	4.270***	3.280***
	(0.351)	(0.398)	(0.414)	(0.442)	(0.650)	(0.782)	(0.0498)	(0.0334)	(0.0651)	(0.0324)	(0.0707)	(0.0563)
N	8429	10854	4871	6590	3558	4264	8429	10854	4871	6590	3558	4264
Sigma u	0.350	0.545	0.577	0.451	0.590	0.816	–	–	–	–	–	–
Rho	0.662	0.736	0.868	0.708	0.820	0.824	–	–	–	–	–	–

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9 Logistic regressions for employment (nonlinear DD). (Source: ISTAT. Own elaboration)

Dependent Variable: Employment	ECUADOR	CHILE	ITALY
d.earthquake2	–0.572*** (0.101)	–0.171*** (0.0414)	–0.149 (0.189)
d.time	–0.0568 (0.0504)	–0.0478 (0.0406)	0.997*** (0.145)
Interaction d.earthquake2 and d.time	0.105 (0.142)	–0.0523 (0.0595)	0.0579 (0.373)
Schooling years	–0.0435*** (0.00608)	0.177*** (0.00499)	0.259*** (0.0742)
Pot. Experience	0.0315*** (0.00435)	0.195*** (0.00351)	0.0988*** (0.0135)
Pot. Experience (sq)	–0.000300*** (0.0000785)	–0.00344*** (0.0000722)	–0.00183*** (0.000339)
d.sex	–0.0905* (0.0476)	–1.373*** (0.0367)	–0.334*** (0.125)
d.self_employment	1.160*** (0.0715)	10.30*** (0.723)	1.422*** (0.234)
Constant	3.389*** (0.0958)	–2.942*** (0.0531)	1.163*** (0.269)
N	68924	121294	12050
chi2	900.7	5538.6	172.3
Rank	9	9	9
Ll	–8178.6	–10389833.4	–727053.7

Standard errors in parentheses
* $p<0.10$, ** $p<0.05$, *** $p<0.01$.

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