INCOME DISTRIBUTION IN LOMBARDY DURING THE PANDEMIC TRANSITION: A TERRITORIAL STUDY[1]

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Abstract. The COVID-19 pandemic has had a disruptive impact not only in terms of health emergency, but also from a social and economic perspective. At least in the short term, the effects in terms of economic fragility on the population seem to be inevitable both as an increase in the incidence of fragility and as an increase in the intensity of fragility. However, these risks are not evenly distributed among different territorial areas. In general, variability at different levels is an important key to interpreting social phenomena, especially for the implementation of effective territorial policies.

The work proposes to analyze the impact of the pandemic crisis on the economic fragility of the Lombardy population at the municipal level, using income data from tax returns provided by the Italian Revenue Agency for the period 2014-2021.

The analysis shows that the municipalities most affected by the crisis triggered by the spread of COVID-19 are those with a constant or positive pre-pandemic economic trend, i.e. those with a more vibrant economy. By contrast, the risk of increased economic fragility is less high in municipalities characterized by a negative trend, i.e. less economic dynamism. Furthermore, the analysis shows that the risk of increased economic fragility is less in small municipalities, characterized by a larger aging population, which seems to play a protective role. The prevailing manufacturing specialization helps to explain the variability observed at territorial level. In particular, heavy manufacturing municipalities seem to be the least affected.

1. Background

In 2020, the COVID-19 pandemic has had a strong impact not only in terms of a health emergency, but also in social terms due to the economic shock triggered by the containment measures. The containment measures taken to limit the spread of the virus, such as lockdowns and imposed closures, led to a contraction of production and employment, resulting in increased poverty and inequality both within and

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[1] The work is the joint responsibility of the authors. Paragraphs 1 and 4 are attributed to Elena Sorba, paragraphs 2.1, 2,2, and 3.2 to Simona Ballabio, paragraphs 3.1 to Alberto Vitalini.

between countries (Palomino *et al.*, 2020). The level reached by absolute poverty in 2021 (7.5%) in Italy is among the highest since the year this indicator began to be measured. In particular, in the North, there has been a sharp increase in households in absolute poverty: 6.7% in 2021 compared to 5.8% in 2018 (Istat, 2022a). Initially, the crisis reproduced pre-existing inequalities, affecting those with precarious jobs, especially women, young people and foreigners, but it also affected many self-employed in traditional activities (Brandolini, 2021; Istat, 2021; Carta and Philippis, 2022).

The long-term consequences are not yet fully foreseeable (Martin *et al.*, 2020) but seem inevitable in terms of an increase in economic and social fragility, with effects especially on lower incomes and with clear territorial and spatial differences (Almeida *et al.*, 2021). Also in consideration of the fact that the effects are triggered on non-homogeneous distribution of economic performance in the pre-pandemic period (Mussida and Parisi, 2020).

The Italian economic and social framework is characterized, also in 2021, by the negative repercussions of the crisis resulting from the health emergency, but also by the outline of the recovery of economic activity (Istat, 2022b). The economic effects produced by the crisis triggered by COVID-19 have not yet been completely reabsorbed: in 2021, Italian GDP grew by 6.6 percent, recovering two-thirds of the exceptional contraction that occurred in 2020 (Bank of Italy, 2022).

Within this framework, the aim of the paper is to explore, with a purely descriptive purpose, the impact of the pandemic crisis in terms of the greater economic fragility of the population at a territorial level in Lombardy. In particular, the focus is on the variations in income between the pre-pandemic period and the period following the outbreak of the pandemic due to COVID-19, keeping track of economic trends in previous years. That is, we examine the impact of the COVID-19 pandemic outbreak on per capita income in both 2020 and 2021 at the municipal level in Lombardy, in terms of income trend change. In essence, we ask whether, at the level of individual municipalities in Lombardy, the impact of COVID-19 on income changes in 2020 was positive, negative or absent. Similarly, we ask whether in 2021 the situation has recovered, worsened or remained unchanged. In order to determine whether any negative effects of COVID-19 also persist in the year following the year of the outbreak of the health emergency, we look at whether the municipalities that were negatively impacted in the first year of the pandemic, that is, in the year most affected by the containment measures, have recovered their pre-pandemic trend in the following year or continue to be characterized by a slower growth trend. Similarly, we assess whether municipalities that were not negatively impacted by COVID-19 in the first year were also spared in 2021 or experienced a delayed negative impact in terms of declared per capita income.

The analysis of per capita income data at territorial level can provide important information for the implementation of public policies aimed at mitigating the economic effects of the pandemic. For example, the municipalities that suffered the greatest negative impact may need targeted interventions to stimulate economic and social recovery. Moreover, the focus on Lombardy's municipalities could be used as a basis for comparative analyzes with other Italian regions or other countries, in order to assess territorial and spatial differences in the impact of the pandemic on the economic fragility of populations.

2. Data and Methods

2.1. *Operationalizing the concept of pandemic crisis impact*

The data used are taken from tax returns provided by the Italian Revenue Agency for the period 2014-2021. These data offer the possibility of analysis at a fine territorial level, the municipal level, but they also have limitations. The use of declared income does not take into account the income support measures provided by the government and does not take into account tax evasion, which is a non-marginal phenomenon in Italy. As context data, some demographic statistics and classifications defined by the Italian National Institute of Statistics (Istat) were used, using the municipalities of Lombardy defined at administrative boundaries referring to 2021 as the unit of analysis.

The impact of COVID-19 is measured in terms of the change in income in 2020 and 2021 compared to the pre-pandemic period. To assess the impact of COVID-19 on income, we could limit ourselves to looking at the 2019/2020 and 2019/2021 change. However, the economic trend that characterized the various territories in the pre-pandemic period is not evenly distributed; some territories are characterized by negative income variation, others by no variation and still others, most of them, by more or less pronounced growth. If only the annual variation is considered, there is a risk that the impact of Covid is not correctly assessed because the annual variation may be in line with the previous trend. For example, if the trend is - 0.5% per year and a similar decrease is observed between 2019 and 2020 and between 2019 and 2021, we cannot automatically attribute this decrease to the effect of the pandemic crisis (because no discontinuity is observed). To control this, we compared the 2019/2020 and 2019/2021 rate of change with the average annual rate of change of the previous five years by simply subtracting the two values. We thus obtain a difference of percentage points. If the difference is positive the impact of Covid is considered positive, if the difference is zero the impact is zero, if the difference is negative the impact is negative. In order to observe the income impact of Covid

during the year in which the Prime Ministerial Decree imposed the containment measures, and in order to observe the impact of the pandemic during the only year for which declared incomes are available after the pandemic but are not subject to economic activity closures imposed to limit the spread of the virus, we separately considered the 2019/2020 variation and the 2019/2021 variation. For the trend, the period following the readjustment after the great recession triggered in 2008 was considered.

For an exploratory analysis and visualization of the spatial distribution of the effects of the pandemic crisis, an impact typology was constructed with essentially heuristic value. As a first step, a two-mode classification was determined for both 2020 and 2021, in both cases with respect to 2019:

1. neutral or positive impact: municipalities with no change in income trend or with positive trend change. For example, municipalities with an average rate of change for 2014-2019 of 0.5% and a 2019/2020 rate of change of 0.5% or more.
2. negative impact: municipalities with a negative trend change. E.g., municipalities with an average rate of change for the period 2014-2019 of 0.5% and a 2019/2020 rate of change of 0.1%, a difference of -0.4 percentage points.

In a second step, by combining the values of the two previous classifications built on the two different years, a typology consisting of four types was determined:

1. no or positive impact: municipalities with no or positive trend change in both 2020 and 2021;
2. negative impact reabsorbed: municipalities with negative trend change in 2020 but no trend change in 2021;
3. lagged negative impact: municipalities with no or positive trend change in 2020 but negative in 2021;
4. negative impact that persists: municipalities with negative trend change in both 2020 and 2021.

2.2. *Analysis tools*

To show the distribution of impact among the municipalities of Lombardy, according to the classifications presented in the previous paragraph, we used choropleth maps. Instead, to describe the characteristics of the municipalities that modulate the probability of being more exposed to a negative impact that either

persists or is delayed, or at the opposite protected, we will use a decision tree strategy (or classification tree). The tree classifies cases into homogeneous groups, based on the values of independent variables (predictors) that predict the values of a dependent variable (target). In particular, we will use SPSS Answer Tree and CHAID (Chi-squared Automatic Interaction Detection) growth methods as statistical tools. At each step, CHAID chooses the independent (predictor) variable that has the strongest interaction with the dependent variable. For each node, the tree shows the number and percentage of members of the target group. The subdivisions of the municipalities are made in order of importance. The categories of each predictor are merged if they are not significantly different from the target variable. The target variable is divided into four modes and corresponds to the impact classification taking into account both 2020 and 2021.

The independent variables, in line with the literature, are:

- province;
- population size class (dummy: 1. up to 5,000 inhabitants, 2. more than 5,000);
- altitude zone (1. mountain, 2. hill, 3. plain);
- prevalent tourist vocation (1. non-tourist, 2. non-lacustrine tourist, 3. lacustrine tourist);
- prevalent manufacturing specialization (1. nonmanufacturing, 2. made-in-Italy, 3. heavy manufacturing;
- per capita income trend in 2014-2019 (1. negative, 2. stable or positive up to 2% (3rd quartile), 3. above 2%);
- per capita income 2019 (1. below I quartile (€14,494) , 2. between I and III quartile (€17,603), 3. above III quartile);
- incidence of foreigners no-eu (1. below I quartile (3.5%), 2. between I and III quartile (8.1%), 3. above III quartile);
- incidence 65 and older (1. below I quartile (21.1%), 2. between I and III quartile (26.6%), 3. above III quartile);
- incidence of self-employed taxpayers (1. below I quartile (11.3%), 2. between I and III quartile (15.6%), 3. above III quartile).

3. Results

3.1. *Municipal distribution*

In Lombardy in 2020, the pandemic due to COVID-19 had a general negative impact on declared per capita income. Approximately 9 out of 10 municipalities were negatively impacted, if only in terms of a slowdown in the growth trend (Fig. 1). In

2021, the geography of the effects of COVID-19 changes profoundly: the percentage of municipalities affected by a negative income trend change compared to the pre-pandemic period drops to around 40% (fig. 2).

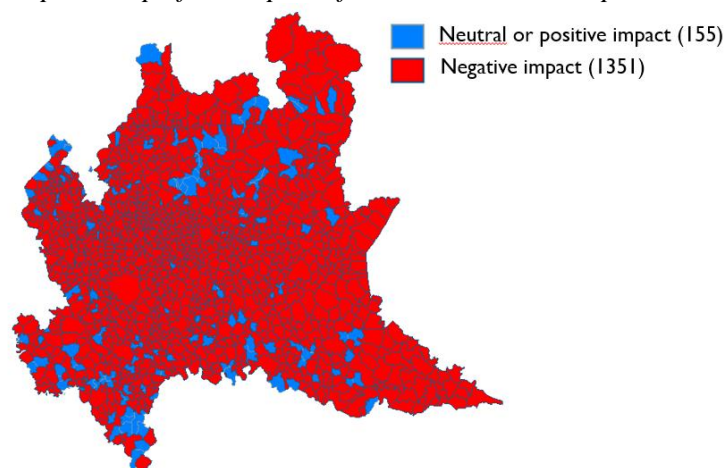**Figure 1 –** *Choropleth map of the impact of COVID-19 at municipal level in 2020.*
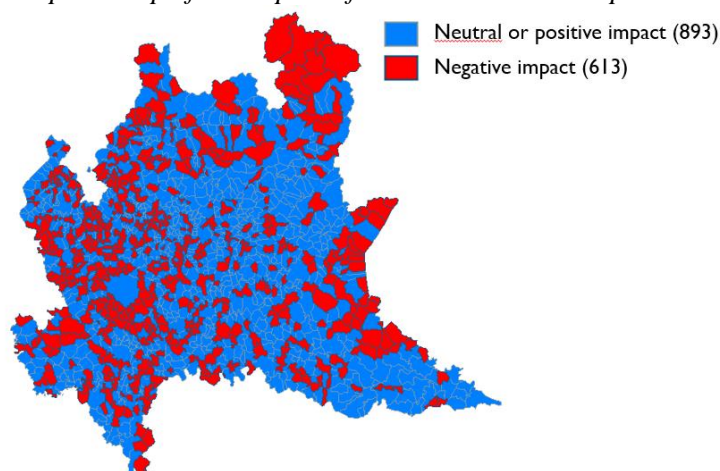

Figure 2 – *Choropleth map of the impact of COVID-19 at municipal level in 2021.*

Considering the two years together, it can be seen that about 9% of the municipalities do not appear to have suffered any negative impact, while half of the Lombardy municipalities, although having suffered a negative impact in the year of the restrictions and closures determined for the containment of the virus, already recovered in 2021 a trend of per capita income in line with or above the pre-pandemic period. Approximately 40% suffer a negative impact in 2020 that persists into 2021,

when the containment measures are relaxed, and very few municipalities (21) suffer a delayed negative impact.

Observation of the choropleth map reveals a territorial trend towards a concentration of negative impact of the COVID-19 pandemic. In particular, a concentration is observed in four distinct areas of the regional context, characterized by specific connotations of the economic structure. Although the relationship between the consequences of Covid-19 on declared income (associated with the municipality of residence) and the economic system is certainly also influenced by the phenomenon of work commuting, which in Lombardy involves a significant share of workers, especially in some areas.

The first area affected by the negative impact is concentrated in the Milan hinterland, with the exclusion of Milan. This area is characterized by the presence of numerous industrial and commercial activities, which have undergone severe contractions due to the containment measures adopted to limit the spread of the virus.

The second area affected by the negative impact of the pandemic concerns the lake municipalities bordering Lake Garda, in the province of Brescia. This area is highly dependent on tourism and the hotel industry, sectors that have suffered heavy losses due to the health crisis.

The other areas affected are the upper Valtellina and, in a widespread manner, the provinces of Varese and especially Como (Fig. 3). Even in these areas, the negative impact of the pandemic has been significant, resulting in increased economic fragility and reduced income.

Figure 3 – *Choropleth map of the impact of COVID-19 of the impact of COVID-19 at municipal level taking both 2020 and 2021.*
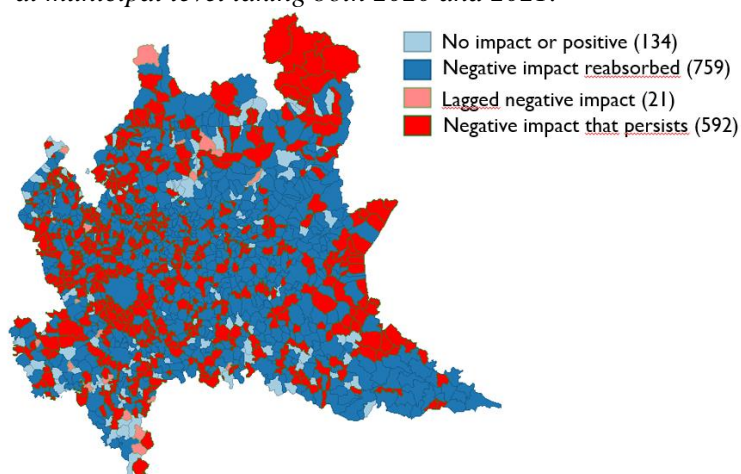
In terms of the percentage of municipalities affected, there seems to be a relationship between the negative impact of the pandemic crisis and the province they belong to, with a rather high incidence of negative impact in the provinces of Milan and Como. This is also confirmed by looking at the number of people affected by province: in the Como area, almost one in two of the people reside in municipalities with a negative impact of the pandemic crisis on income. Moreover, two out of five of the people living in Sondrio, Milan and Pavia reside in municipalities that have been affected by the negative impact of the health crisis on per capita income. In contrast, the municipalities that were spared by the crisis triggered by COVID-19 in terms of income are mainly concentrated in the provinces of Bergamo, Cremona and Brescia: here, about four out of five residents reside in municipalities that were not affected by a negative impact or the negative impact recorded in 2020 was reabsorbed.

Table 1 – *Municipalities with lagged or continuing negative impact by province and population. Absolute values and percentages.*

Provinces	Lagged negative impact		Negative impact that persists		Total population	
	a.v.	%	a.v	%	a.v	%
BERGAMO	4	1.6	68	28.0	273.697	24.8
BRESCIA	0	0.0	63	30.7	336.777	26.8
COMO	1	0.7	74	50.0	290.126	48.7
CREMONA	0	0.0	36	31.9	86.067	24.5
LECCO	0	0.0	33	39.3	118.272	35.5
LODI	1	1.7	26	43.3	79.870	35.1
MANTOVA	0	0.0	23	35.9	111.888	27.6
MILANO	1	0.8	81	60.9	1.297.873	40.2
MONZA E BRIANZA	0	0.0	21	38.2	300.103	34.5
PAVIA	9	4.8	69	37.1	214.380	40.1
SONDRIO	3	3.9	34	44.2	75.080	42.0
VARESE	2	1.4	64	46.4	335.404	38.2
Total	21	1.4	592	39.3	3.519.540	35.3

3.2. Application of the decision tree

The application of the decision tree shows that municipalities with a positive trend in per capita incomes in the pre-pandemic period are more affected, i.e. the probability of having suffered a negative effect is much higher in correspondence with the most lively economic realities. Conversely, the risk of an increase in

economic fragility is less high in municipalities with a negative trend, i.e. municipalities that were already starting from a more difficult economic situation.

Figure 4 – *Decision tree for impact classification: Node 0.*
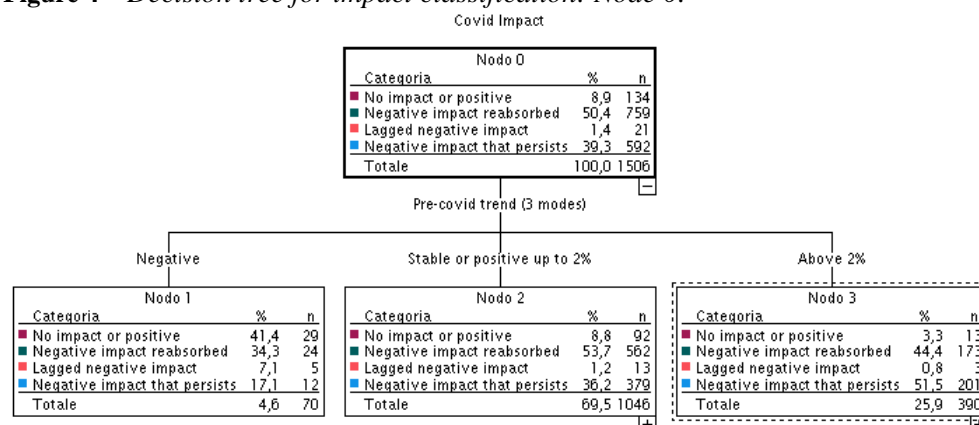
Among municipalities with a constant or positive but less than 2% income growth trend in the pre-pandemic period, the variability of the phenomenon is primarily explained by population size class: the risk of an increase in economic fragility is less high in smaller municipalities (up to 5,000 inhabitants), with the difference depending on the level of population aging. The municipalities with a higher incidence of elderly people are more likely to have suffered a delayed negative impact, in all likelihood the higher incidence of pensions may, at least initially, have helped to stem the negative effects of the economic crisis triggered by the spread of the virus, at least in terms of income reduction.

In municipalities with more than 5,000 inhabitants, the likelihood of having been negatively impacted varies according to the prevailing specialization of the local labour system (LTS) to which the municipality belongs. The least affected municipalities are those in heavy manufacturing, which experienced a less significant negative impact than other sectors of the local economy.

On the other hand, as regards the municipalities with a more lively pre-pandemic economy, with a positive income change of more than 2%, it is mainly the provinces of Bergamo and Brescia that are least affected by a negative impact. Rather, in these provinces most of the municipalities, although affected by a slowdown in income growth in 2020, recovered or improved their previous trend in 2021.

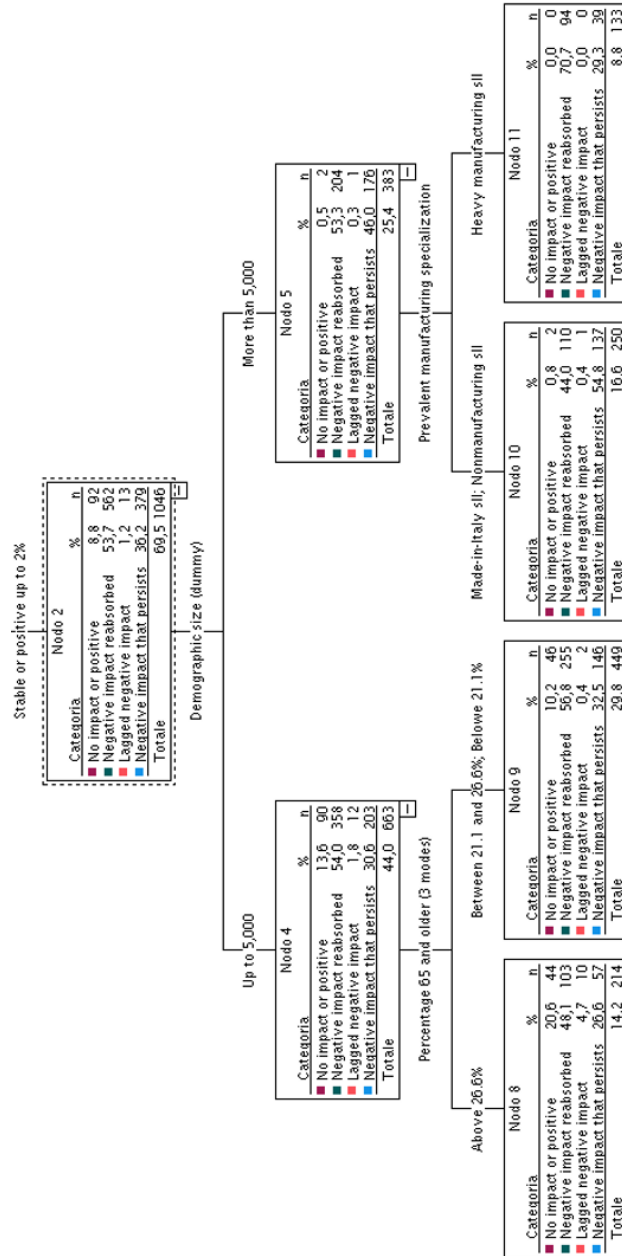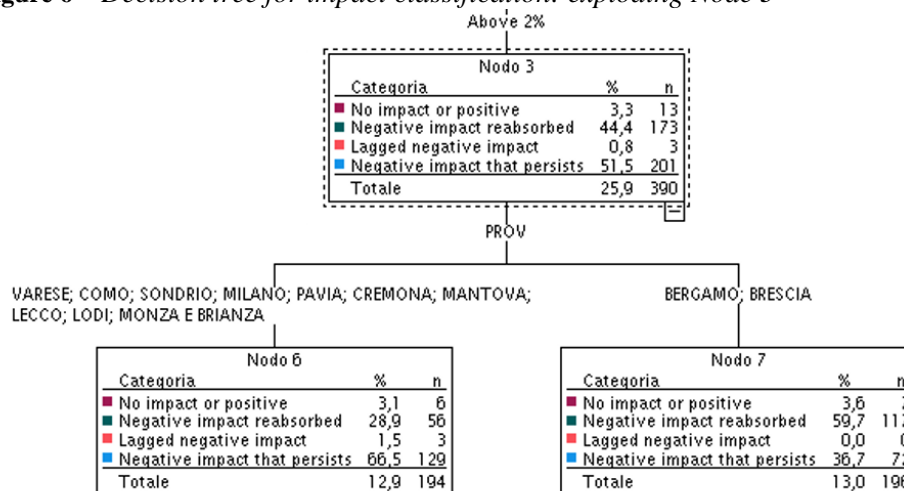**Figure 5 –** *Decision tree for impact classification: exploding Node 2.*

Figure 6 – *Decision tree for impact classification: exploding Node 3*

4. Conclusion and some further developments

Analyzes showed that the impact of the COVID-19 pandemic on income does not seem to have been evenly distributed across the territory. Some provinces were more affected, in particular the province of Como and also that of Milan. Other provinces, however, were less affected, in particular the provinces of Cremona, Bergamo and Brescia.

An important factor that seems to be able to modulate the distribution of the impact seems to be the pre-pandemic period. The most affected areas are those that are economically more vibrant.

A protective factor with respect to impact seems to be, in smaller municipalities, the degree of aging of the population. In all likelihood, at least initially, the high proportion of elderly people receiving retirement income mitigated the income impact of the economic crisis triggered by COVID-19. In municipalities with a population over 5,000 inhabitants, the protective role seems to be played by specialization in heavy manufacturing.

The main limitation of the work, besides the use of declared income that does not take into account the income support measures provided by the government and tax evasion, is not having considered the intensity of the impact. An in-depth study of the dynamics at the territorial level would be desirable, also in explanatory terms, taking into account not only the presence of the impact but also the strength of the effects on the variation of the income trend.

It would also be interesting to relate the impact of COVID-19 on income to some measures of poverty and to investigate the effects of the crisis triggered by COVID-19 on the unequal distribution of income at the municipal level, using measures such as the Gini index.

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