XLI CONFERENZA ITALIANA DI SCIENZE REGIONALI

THE IMPACT OF LOCKDOWN ON THE DECREASE IN STARTUPS IN THE ITALIAN REGIONS: AN ESTIMATION OF THE MISSED NEW EMPLOYMENT OPPORTUNITIES

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ABSTRACT

The COVID-19 pandemic has generated a strong shock for the economies. While there are many studies focused on the effects especially in terms of forecasts, few have investigated the effects on the entrepreneurship. Indeed, the combination of the pandemic and the lockdown measures represents an unprecedented situation that has still not been addressed in the entrepreneurship literature. As widely recognized, startups represent an important driver for economy growth, and positively influence the speed of the recovery. The aim of this paper is twofold: measuring the effect of the lockdown on new startups and the consequences in terms of the missed new employment opportunities; testing the geographically effect of COVID-19 on the missed new employment opportunities due to the startup decrease. We study the case of Italy through an analysis at the regional and provincial level. We found that during the two months of lockdown, new business applications fell by 45%, and we estimated that over 30,000 people missed out on employment opportunities, corresponding to around 50% of a theoretical new employment generated by startup activities in a scenario without the COVID-19 pandemic. Furthermore, through an econometric analysis at the provincial level, we found a significant effect of COVID-19 spread on the missed new employment opportunities, also highlighting a significant effect on the startup decrease and not still on the firm deaths.

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1. Introduction

The discovery of a novel coronavirus in late 2019 (Zhu *et al.*, 2020) which led to the global pandemic of COVID-19 (WHO, 2020) in March 2020 had a massive impact on the world economies (Jordà *et al.*, 2020; Ma *et al.*, 2020; OECD, 2020a), dramatically changing the political and economic environment (Winston, 2020). Since COVID-19 turned out to be a highly infectious virus that can be easily transmitted, and also involving asymptomatic or peri-symptomatic phases (Bai *et al.*, 2020), governments had to adopt lockdown and social distancing measures (Glass *et al.*, 2006) to combat the spread of the virus, in order to also attenuate the pressure on the healthcare system. This has led to a particular shock that has affected up to one third of GDP in the major economies (OECD, 2020b).

Currently, policies have been focusing on protecting the existing industries and employment, with less attention to the future of economic activities, such as startups (Kuckertz *et al.*, 2020). The important role of startups in job creation is widely recognized in the literature (more recently, e.g., Fritsch & Wyrwich, 2017), and the negative economic consequences of a decline in startups during a recession (Sedláček, 2019; Ayres & Raveendranathan, 2016; Gourio *et al.*, 2014).

The combination of the COVID-19 pandemic and the lockdown measures represents an unprecedented situation that has still not been addressed in the entrepreneurship literature. Recently, Sedláček and Sterk (2020) studied the effect of the decline in startups on employment in the United States in view of the COVID-19 crisis; and Kuckertz *et al.* (2020) analyzed the effect of lockdown on the survival of startups.

This paper aims to enrich this new strand of literature by estimating, for Italy, how many employment opportunities have been missed because of the decrease in startups during the two-months of lockdown (March-April 2020) and if there is a geographically relationship with the spread of COVID-19.

Being the first country in Europe to be hit, Italy is one of the countries most affected by COVID-19 and the consequences of the lockdown on the new entrepreneurship were very evident: in the two-months March-April 2020, new business applications fell by 45.1% compared to the same period of the previous year.

This paper aims to shed light on an important issue related to the COVID-19 effect on the economy, considering that the speed of recovery post-crisis also depends on firm entry (Clementi & Palazzo, 2016).

The remainder of the paper is structured as follows. Section 2 reviews the literature. Section 3 presents the background. Section 4 illustrates the data. Section 5 describes the empirical methodology. Section 6 presents the results. Section 7 concludes.

2. Related literature

The positive effect exerted by startups on employment growth is widely recognized in the literature (Fritsch & Wyrwich, 2017; Doran *et al.*, 2016; Fritsch & Schroeter, 2011; Fritsch & Mueller, 2008). Despite new firms undergoing a high failure rate in the short-term, the surviving firms grow faster in the long-run than the average existing firm (e.g., Haltiwanger *et al.*, 2013; Fort *et al.*, 2013).

In the current period of economic recession, the downside is that a decline in startups may have negative effects on employment, as it may lead to a persistent void in aggregate employment (e.g., Gourio *et al.*, 2016; Sedláček, 2019). This is because a lack of new firms today means fewer older firms in the future, which contribute the most to employment levels (Sedláček, 2019). In fact, some scholars have highlighted the relationship between the slow recovery of firm entry and the slow recovery of employment (e.g., Elsby *et al.*, 2011; Jaimovich & Siu, 2014; Haltiwanger *et al.*, 2013).

Many studies have focused on the effects of the decline in startups on employment during the Great Recession in the United States (US). Sedláček (2019) found that if the firm entry had remained constant, the level of unemployment would have been 0.5 percentage points lower over 10 years after the crisis. Gourio *et al.* (2014) underlined the long-run effects of a decline in startups on employment levels, finding that the reduced entry rate resulted in a loss of 1.7 million jobs between March 2006 and March 2011, compared to a loss of only 500,000 between March 2006 and March 2009. Ayres and Raveendranathan (2016) also highlighted the strong relationship between the startup rate and employment, estimating that 22% of the

difference in the employment levels per labor force participant between March 2012 and March 2007 (pre-recession period) was due to the lack of firm entry.

With specific reference to the COVID-19 pandemic and the related lockdown, Sedláček and Sterk (2020) studied the effect of the disruption in startup activity on US employment. Focusing on three margins corresponding to the number of startups, the growth potential, and the survival rate, they estimated that a reduction in these margins for one year to their minimum levels since 1977, would lead to a 1.1% aggregate employment reduction in 2020. More specifically, they developed a calculator to compute the long-term effects on employment caused by different scenarios related to the above three margins.

Lastly, several studies have studied the impact of the COVID-19 and the lockdown on unemployment (e.g., Kong & Prinz, 2020; Gregory *et al.*, 2020), as well as on employment by combining epidemiological and macroeconomic models (e.g., Kaplan *et al.*, 2020; for a literature review, see Bank of Italy, 2020). By territorial perspective, some scholars have studied the effects of COVID-19 under the lens of the economic geography (Ascani *et al.*, 2020).

3. Background

3. 1 The COVID-19 Pandemic in Italy

On 31 December 2019 the World Health Organization (WHO) was informed about cases of pneumonia of an unknown cause in Wuhan (China) and on 7 January 2020 the Chinese authorities informed the World Health Organization about a novel coronavirus (2019-nCov) that had not previously identified in humans, which was subsequently named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by the International Committee on Taxonomy of Viruses on 11 February: the disease caused by SARS-CoV-2 was offically named as coronavirs disease 2019 (COVID-19) by WHO. COVID-19 can cause mild illness, moderate and severe pneumonia, respiratory failure, and death (Centers for Disease Control and Prevention, 2020).

In March 2020 the cases increased outside China, and Europe became the epicentre of the epidemic involving over 40% of globally confirmed cases. On 11 March the WHO announced that the outbreak had become a pandemic (WHO, 2020).

At the end of February cases of COVID-19 started to spread in Italy, and the number of cases increased exponentially. Italy was the first country in Europe to have an outbreak of COVID-19 and is one of the most affected countries. According to WHO data, as of 7 June 2020, with over 200,000 cases, Italy is the seventh country in the world in terms of the number of COVID-19 confirmed cases, after the United States, Brazil, Russian Federation, United Kingdom, India and Spain, and the fourth in terms of the number of deaths (33,846 in Italy), after the United States (109,038), United Kingdom (40,465) and Brazil (35,026).

Within Italy, the COVID-19 outbreak originated in Lombardy, where, as of 7 June 2020, almost 40% of the total number of cases in Italy are concentrated. This amounts to 8.9 cases per 1,000 inhabitants compared to the national average of 3.9 (Table A1 in Appendix). Other northern regions also registered high values in relative terms, such as Piedmont (7.1 cases per 1,000 inhabitants), Trentino-South Tyrol (6.5), Liguria (6.4), Emilia-Romagna (6.2), in addition to the highest value in Aosta Valley (9.5). In central Italy COVID-19 spread especially in Marche (4.4 cases per 1,000 inhabitants); while in southern Italy, all regions recorded a lower number of cases per 1,000 inhabitants than the national average, also in most areas with a value of less than one.

3. 2 Non-Pharmaceutical interventions in Italy

COVID-19 is a highly infectious disease and to date no vaccine exists. In Italy, in the light of its exponential diffusion in March, policymakers were forced to adopt lockdown measures to curb the transmission and attenuate the pressure on the public health system.

On 23 February 2020 Italian Government takes the first emergency policy through a decree introducing a quarantine to the most affected municipalities of the regions of Lombardy and Veneto. In the light of the exponentianl growth of the infections, on 4 March 2020, the Italian government suspends meetings, events (including sporting events), shows (including the cinema and theatre), teaching activities in schools and

universities, in the whole country besides other restrictions, and promotes flexible workplace practices whenever possible. On 8 March with a new decree the Government imposes lockdown measures (e.g., limitations to people's mobility and prohibited gatherings in public places) in the region of Lomabardy, in five provinces of Piedmont, five provinces of Emilia-Romagna, three of Veneto, and one of Marche, involving about one quarter of the Italian population. On 9 March the lockdown measures are extended to the whole country with a decree known as *#Io resto a casa* (*#I stay home*). On 11 March the Government suspends all retail trade activities (except food and primary goods, pharmacies and parapharmacies), bar and restaurant activities (except for deliveries), and personal services (except for laundries and funeral services). On 22 March nearly all economic sectors were temporarily suspended, and this suspension was extended by subsequent decrees until 3 May, with the exception of activities considered "essential" to the survival of the population and to the operation of the healthcare system. Only children's clothing shops, stationaries, book shops, and the forestry and wood industry were allowed to reopen from 14 April.

3. 3 Startups evolution in Italy in the months of lockdownon

We consider March-April 2020 as the period of lockdown in Italy in the light of the following evidence: i) data on startups are monthly; ii) as explained above, the first measure in Italy of the lockdown in 2020 was in early March, and the end of lockdown was between the end of April and the beginning of May.

According to the Business Register data of the Chambers of Commerce, in this period startups decreased by 45.1% compared to the same period in the previous year (UNIONCAMERE, 2020) (Graph A1 in Appendix). This is the highest reduction in the last ten years (since monthly data have been available), and the magnitude indicates the potential risk of losing a generation of firms. It appears that the lockdown affected the setting up of firms more than the closures, as the latter even decreased. However, in terms of closures, the stay-at-home orders might have attenuated the decision to close down a firm, in addition to the government measures implemented to sustain business activities (Restore Liquidity Decree, suspension of tax payments, etc.). The decline in startups affected all regions (the largest administrative unit) in Italy, but particularly those in the centre and north, where COVID-19 spread the most. The region with the greatest decrease in startups was Lombardy (Graph A2 in Appendix), the same region most affected by COVID-19. In fact, we found a significant and negative regional bivartiate correlation between decrease in startups and COVID-19 cases per 1,000 inhabitants ($\rho = -0.4$, p-value<0.10) (Graph A3).

4. Data

To estimate the impact of the decline in startups on missed employment we combine different data sources: the Italian Business Register of the Chambers of Commerce, the Statistical Archive of Active Enterprises, and the Labour force survey of the Italian National Institute of Statistics (ISTAT).

The Italian Business Register, managed by Infocamere (IT Company for the Italian Chambers of Commerce) is an administrative data source which provides data on new business applications and closure of businesses in Italy (https://www.infocamere.it/en/home). The register was established in computerised format from 1993 and it represents a unique case across Europe. This Register is the country's most updated source of business demography since it provides monthly data with a lag of about 15 days from the reference month. Thus, this data source allows us to analyze the evolution of startups during the months of lockdown.

The Statistical Archive of Active Enterprises of ISTAT represents the official statistics for Italy on enterprises and related persons employed (https://www.istat.it/it/archivio/216767), reference for EUROSTAT statistics. This archive is used as information base to reproduce census data since it provides information on enterprises and persons employed integrating administrative and statistics data available in Italy. For this reason the data have a lag time of about a year and a half from the reference year. Data are annual. This archive provides information on persons employed through a Linked Employer-Employees Database (Leed) process. The data are detailed by several structural information including the firm's birth date. Thus, this data source is important to study the employment in the startups.

The Labour force survey is conducted by ISTAT aimed at estimating the main aggregates of the labour supply, employed and unemployed. The survey is continuous since the information are collected every week of the year; it involves each year a sample of over 250,000 households, representing 600,000 individuals who are resident in Italy (ISTAT, 2006). The main features of the survey are harmonised at the European level, and consistent with the International standards defined by the Internaltional Labour Organization (ILO), and are defined by specific regulations of the Council of the European Commission. The survey is inserted in the National Statistical Program and the results are part of EUROSTAT statistics. At the regional level (NUTS-2) data are quarterly and annual. For our purposes, the survey provides detailed information on previous status of the employed people helping us to estimate the new employment generated by the startup entrepreneurs. Finally, concerning data used in the econometric analysis, see Table A3 (in Appendix).

5. Empirical strategy

5. 1 Estimation of missed new employment opportunities

According to the data of the Business Register of the Chambers of commerce, we calculated the change in startups. First, we calculated, for each region *i*, the absolute change in startups ΔS that occurred in the two-months March-April 2020 on the same period of the previous year:

$$\Delta S_i = S_{it_1} - S_{it_o} \quad [1]$$

where t_1 indicates the two-months March-April 2020 and t_0 indicates the two-months March-April 2019.

Second, we calculated, for each region *i*, the theoretical change in startups ΔST that would have occurred in the two-months March-April 2020 on the same period of the previous year assuming a scenario without COVID-19 pandemic. We estimated the regional theoretical values of the startups in March and April 2020 through X-12-ARIMA program (U.S. Census Bureau, 2011, see also Box & Jenkins, 1976) using a time series starting from January 2010. We use a specific SARIMA specification in order to properly model the high level of seasonality of the time series (peak in March and bottom in August). Specifically, SARIMA($p\ d\ q$)($P\ D\ Q$) where: ($p\ d\ q$) refers to the orders of the nonseasonal autoregressive (AR), differencing, and moving average (MA) operators, respectively; and ($P\ D\ Q$) refers to the seasonal autoregressive, differencing, and moving average orders. Each region has a specific seasonal ARIMA specification: the best ARIMA model for each region shows an average forecast error over last year below 10% (in six regions less than 5%); for Italy it is 3%. For consistency, the value of Italy is obtained as the sum of the regional forecasted data; the differences with the series obtained using a direct univariate model for Italy are very low (less than 1%). In all cases we accept the null of no autocorrelation of the residuals using the Ljun-Box Q Statistics (Ljiun-Box Q Statistics not significant at 0.01%).

Once analyzed the change in startups during the months of lockdown (actual and theoretical), we estimated the new employment missed related to the startups decrease.

First, according to the data of the Statistical Archive of Active Enterprises, we calculated at the regional level the average size of enterprises born in the year (startups). We used the average of startups size in the last three years to smooth a possible high data variability from one year to another (nevertheless data showed small changes, since the yearly change in startups' size, in the last three years, among all Italian regions ranged between +1.6 and -1.5 people employed). In Appendix (Table A2) we report the average startups size in the last three years according to data availability of the datasource.

Second, using the Labour force survey we estimated the new employment generated by startups: considering the new employed as entrepreneurs in the year, we calculated the share referred to those having a status of not employed in the previous years (*coeff*) (we considered the average of the shares resulting from the last three Labour force surveys; however the share is revealed quite stable over time ranging from 55.1% and 59.5%). While, concerning the employees in the startups, since we have no information on their previous status, it was assumed that everyone is new employed.

Analitically, the average startup size referred to new employment ($AVSS\_NE_i$) in each region *i*, is calculated according to the following steps.

1) we calculated at a national level the part of the average startup size related to the new employed as entrepreneurs (*AVSS_NEentr*):

$$AVSS\_NEentr = 1 * coeff \quad [2]$$

2) assuming that the part over the value 1 in the average startups size ($AVSS_i$) refers entirely to new employees, we calculated at a regional level the average startups size referred to the total new employment (*AVSS_NE*) as follows:

$$AVSS\_NE_i = AVSS\_NEentr + (AVSS_i - 1) \quad [3]$$

Finally, to estimate at a regional level the absolute value of the Missed New Employment (MNE) by the startups missed in the two months of lockdown in each region *i*, we multiplied the decrease of the startups (ΔS_i) by the average startups size referred to the total new employment ($AVSS\_NE_i$):

$$MNE_i = \Delta S_i * AAVSS\_NE_i \quad [4]$$

from wich we can calculate the share of the new employment missed because of the startups decrease in the two-months March-April 2020 on the theoretical employment (TE_i):

$$Empl\_miss_i = \frac{MNE_i}{TE_i} \quad [5]$$

where TE_i is obtained by multiplying the theoretical number of startups related to a scenario without COVID-19 pandemic (as above explained) by the average startups size referred to the total new employment (*AVSS_NE*).

5.2 Econometric analysis

To test the geographically effect of COVID-19 spread on the missed new employment opportunities we used an OLS (Ordinary Least Squares) method. Analitically:

$$Y_i = \beta_0 + \beta_1 COVID19_i + \beta_2 S_i + u_i \quad [1]$$

where Y_i is the share of the new employment missed because of the startups decrease in the two-months March-April 2020 on the theoretical employment (the employment that would have been generated by a flow of startups between March-April 2020 in a scenario without the COVID-19 pandemic) in the province *i* (for the econometric analysis we estimated the values also at the provincial level). The independent variables are: $COVID\text{-}19_i$ that indicates the number of COVID-19 cases per 1,000 inhabitants; S_i is a vector including the control variables capturing several territorial characteristics related to the presence of small firms, high/medium-high technology manufacturing intensive sectors, knowledge intensive services, graduated population (HC), in addition to R&D expenditure and economic growth. u_i is the error term that captures any other unknown factor affecting the new employment missed.

Regarding the Instrumental Variables (IV) approach, we used the Two Stage Least Squares (2SLS) estimator. Starting from the structural equation [1], we consider a set of instrumental variables Z_i correlated with the endogenous explanatory variable (*COVID-19*), but uncorrelated with the stochastic error u_i in the regression [1]. The effects of the instruments on the endogenous variable are measured by the vector of parameters β_{21} in the auxiliary regression (first-stage):

$$COVID19_i = \beta_0 + \beta_{21} Z_i + S_i + v_i \quad [2]$$

where *COVID-19* is the endogenous explanatory variable in (1), Z_i is the vector of instrumental variables and v_i is the residual.

After estimating the first-stage regression (2), in the second-stage equation [1] *COVID-19* is replaced by its estimated value in the first-stage. To test if *COVID-19* is endogenous we used the Wu-Hausman test: if it is significant we reject the null hypothesis that the variable is exogenous. Concerning the validity of the instruments, we check: i) if they are correlated with the endogenous variable (instruments relevance); ii) if they are exogenous, namely uncorrelated with the structural error term *u* in regression [2] (instruments exogeneity). Regarding instruments' relevance, we used F-test for the joint significance of the instruments' coefficients: a value above 10 means that the instruments are not weak (Stock *et al.*, 2002). Regarding instruments exogeneity, we perform an overidentification restriction check applying the Sargan test: an insignificant value means that we do not reject the null hypothesis that the instruments are exogenous.

6. Results

6. 1 Missed new employment opportunities

Table 1 reports the results, of which first preliminary analyses were published in Pini and Rinaldi (2020). Missed employment refers to the new employment opportunities not created because of the decrease in startups between March-April 2020. Theoretical employment refers to the employment that would have been generated by a flow of startups between March-April 2020 in a scenario without the COVID-19 pandemic. We estimated that 31,400 people had missed out on employment, corresponding to 46.2% of the theoretical employment.

Table 1 - Employment missed for startups decrease in the lockdown period on Italy by region

Regions	*Employment Missed (Thousand)*	*% on Italy*
Piedmont	2.2	7.1
Aosta Valley	0.0	0.1
Lombardy	6.4	20.4
Trentino-South Tyrol	0.5	1.6
Veneto	3.2	10.2
Friuli-Venezia Giulia	0.4	1.3
Liguria	0.7	2.2
Emilia-Romagna	3.6	11.6
Tuscany	2.5	8.1
Umbria	0.3	0.9
Marche	0.9	2.8
Lazio	4.3	13.6
Abruzzo	0.5	1.5
Molise	0.1	0.2
Campania	1.8	5.6
Apulia	1.8	5.6
Basilicata	0.1	0.2
Calabria	0.6	1.9
Siciliy	0.9	3.0
Sardinia	0.6	1.9
Italy	31.4	100.0

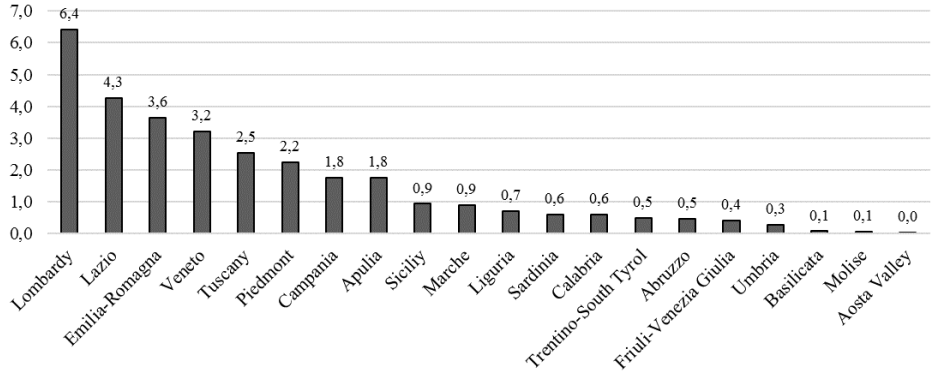
Note: Employment missed refers to the new employment not realized beacause of the startups decrease in the two-months March-April 2020. The data of Aosta Valley is less than 100.
Source: Authors' estimations

Lombardy is the region that lost the most: both in absolute terms with 6,400 people missing out on possible employment (1st region), and in relative terms since this value represents 56.8% of the theoretical employment (1st region) (Fig. 1). More generally, the central-northern regions showed the highest values. The top-four regions by absolute values of employed people missing out on possible employment are all central-northern, as well as in terms of the percentage on theoretical employment: Lombardy, Lazio, Emilia-Romagna and Veneto in the first case; Lombardy, Marche, Tuscany and Lazio in the second case. Thus, the employment potentially missed occurred in the most developed Italian regions, considering that all the above-mentioned regions have a GDP per capita that is above the national average (source: ISTAT). Moreover, the regions displaying the highest values are also those most affected by COVID-19. We found a high regional bivariate correlation between the employment missed and the number of COVID-19 cases ($\rho = 0.8$, p-value<0.01).

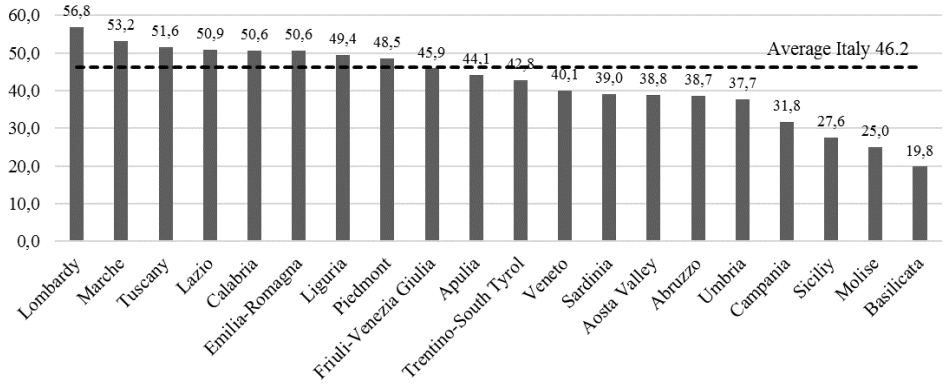
Analyzing this relationship using relative values, we also found a positive and significant regional bivariate correlation between the percentage of employment missed on the theoretical employment, and the number of COVID-19 cases per inhabitants ($\rho = 0.5$, p-value<0.05). Graph 2 shows that most regions (14 out of 20) are situated above or below the national average in both indicators. This is the effect of the COVID-19 pandemic on the decline in startups decline ($\rho = -0.4$, p-value<0.10), as shown in Graph A3 in Appendix.

Graph 1 - Regional ranking for the employment missed for startups decrease in the lockdown period in Italy

(a) Regional ranking on the basis of the absolute values of employment missed

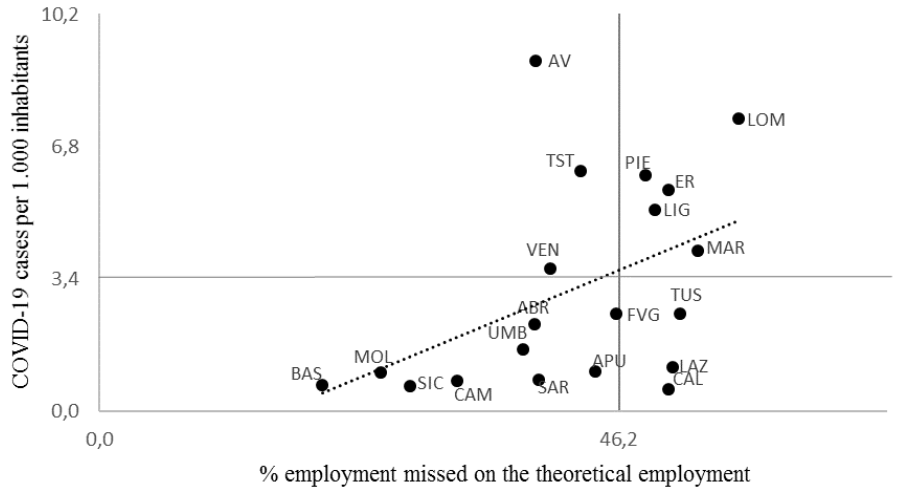


(b) Regional ranking on the basis of the % of employment missed on the theoretical employment



Note: Employment missed refers to the new employment not realized beacause of the startups decrease in the two-months March-April 2020. Theoretical employment refers to employment generate by the flow of startups in the two-months March-April 2020 in a scenario without COVID-19 pandemic.
Source: Authors' estimations

Graph 2 - Employment missed for startups decrease in the lockdown period and COVID-19 cases in Italy by region



Note: (a) Employment missed refers to the new employment not realized beacause of the startups decrease in the two-months March-April 2020. (b) Theoretical employment refers to employment generate by the flow of startup in the two-months March-April 2020 in a scenario without COVID-19 pandemic. (d) COVID-19 cases until 30 April 2020. (d) For each indicator, the horizontal and the vertical line is situated in correspondence to the national average.
Source: Authors' estimations

6. 2 COVID-19 effect on missed new employment opportunities

Table 2 reports the estimates testing the effect of the COVID-19 spread (expressed in cases per 1,000 inhabitants) on the missed new employment opportunities (in terms of share on the theoretical employment) due to the startups decline, at the provincial level. Controlling for several territorial characteristics, we found that there is a positive and significant ($p<0.01$) influence of COVID-19 on the missed new employment opportunities (Column 1). Besides controlling for structural territorial characteristics, such as firms size (*Small*), sector (*HTM* and *HKIS*) and human capital (*HC*) without finding any significant results, we control also for the perfomances including the R&D share on GDP (*R&D*) and the economic growth in the last five years (*Growth*). In this last regard, the results show that the largest shares of the missed new employment opportunities on the theoretical employment occured in the areas more competitive: the coefficient of *R&D* and *Growth* are positive and significant ($p<0.05/0.1$, Columns 2-3).

As robustness check, we analyze the potential endogeneity of the relationship between COVID-19 and the new missed employment opportunities. According to Musolino and Rizzi (2020), several factors may influence the spread of COVID-19, such as the pollution, the commuting and the aging population. The preferred way to address that issue is by using the instrumental variables approach. We used 2SLS regression. Accounting for the endogeneity problem, the effect of COVID-19 always remained positive and significant at the 1% level (Column 4). The Wu–Hausmann test was significant indicating that COVID-19 is an endogenous variable. Concerning the validity of the instruments, the F statistics for the instruments' relevance was over 10 (despite only slightly), indicating that the instruments are not weak. More specifically, according to Stock and Yogo (2005)'s tabulation of the critical values for the weak instruments test, we reject the null of a relatve bias greater than 10%.

In table 2 we reported also the coefficients of the instruments in the first-stage: all three are positive and significant at least at the 5%, confirming the findings found by Musolino and Rizzi (2020). Finally, regarding the exogeneity of the instruments, since the Sargan test was not significant, we can consider them to be exogenous.

Furthermore, as robustness check, we control for the territorial factor including two area fixed effects (Center and South): the coefficient of COVID-19 remains however significant ($p<0.05$) (Table A6 in Appendix). Moreover, we study the role of geographical area by splitting the analysis into three subsamples:

North, Center and South. The results reveal that the significant effect of COVID-19 on the new missed employment opportunities occurred in Northern Italy and not in Center and in Souhern Italy.

Finally, we test if there were differences regarding the influence of COVID-19 spread on the firm births and on the firms deaths. In this case, we used as dependenti variable, on the one hand the percentage change of firm births, and on the other hand the the percentage change of firms deaths (in both cases the decrease are expressed in positive numbers). We found that COVID-19 influenced more significantly the startups decrease ($p<0.01$) but not the the firm deaths, since the coefficient of *DE_decrease* is positive (namely, more Covid cases greater firm deaths decrease, we have to take into account that the effect of lock-down togheter to the Governemt's measures, may have slowed-down/delayed the closure) and less significant (Table A7 in Appendix). This suggests that the crisis, in the short-term, has mainly undermined the startup activity.

Table 2 – Baseline estimates

Variable	*OLS (1)*	*OLS (2)*	*OLS (3)*	*IV-2SLS (4)*
COVID-19	1.384***	1.205***	1.085**	2.652***
	(0.423)	(0.422)	(0.421)	(0.845)
Small	-0.071	-0.018	0.056	0.097
	(0.172)	(0.170)	(0.172)	(0.178)
HTM	0.085	-0.168	-0.422	-0.768
	(0.426)	(0.432)	(0.447)	(0.487)
HKIS	-0.245	-0.161	-0.062	-0.104
	(0.303)	(0.299)	(0.299)	(0.309)
HC	0.271	0.159	0.025	0.286
	(0.474)	(0.467)	(0.466)	(0.494)
R&D		7.260**	6.203*	4.230
		(3.277)	(3.278)	(3.496)
Growth			4.480*	3.178
			(2.346)	(2.489)
Instrumental variables				
Commuting				0.389***
				(0.085)
Old-age DR				0.137**
				(0.065)
PM10				0.121**
				(0.053)
Observations	99	99	99	99
Exogeneity: Wu-Hausmann (F-statistic)				5.158**
Instruments relevants (F-statistic)				10.545***
Overidentification test, Sargan (Chi2)				0.012
R^2	0.166	0.208	0.239	0.123
Adjusted R^2	0.121	0.157	0.180	

Note: Dependent variable *Empl_miss*. Standard errors in parentheses. *** p<0.01, ** p<0.05, p<0.1. We report also the coefficients of the instrumental variables in the first-stage regression. Exogeneity test for the instrumented variable: Wu–Hausmann test, significance means to reject the hypothesis of exogeneity of the instrumented variable. Instruments relevance: *F*-test on first-stage regression, significance, with a *F*-value > 10, means to reject the hypothesis of irrelevance of the instrumental variables. Sargan test for the overidentification restriction, no significance means to not reject the hypothesis of exogeneity of the instrumental variables.
Source: Authors' elaboration

7. Discussion and conclusion

This paper estimates the missed new employment opportunities related to the decline in startups during the months of lockdown in Italy (March and April 2020), and then tests the geographically effect of COVID-19 spread on this estimated aggregate. To the best of our knowledge, to date in the literature there are very few studies on the COVID-19 influence on the economy from the entrepreneurship perspective.

We estimated that 31,400 people missed out on employment opportunities. This corresponds to 46.2% of the theoretical employment that would have been generated by a flow of startups in a scenario without the COVID-19 pandemic. Lombardy shows the highest values in both absolute and relative terms. Moreover, an econometric analysis reveals that there is signifcant effect of the COVID-19 spread on the missed new employment opportunities at the provincial level. Further analysis indicates that COVID-19 spread affected in the short-term only the startups decrease and not the firm deaths increase.

Although we analyzed a short period of only two months, the first message that emerges from the results is the strong effect of the lockdown on the setting up of firms. This highlights the employment opportunities missed as well as the potential threat to the overall level of innovation in the economic system that new firms tend to promote. The missed employment in only two months corresponds to 1.2% of the total Italian unemployment registered at the end of 2019. The second message concerns the evidence that COVID-19 negatively affected the most competitive Italian provinces, in terms of innovation and economic growth registered in the last five years.

One recommendation that we propose to policy makers is the need to also sustain entrepreneurs, especially in the months post-lockdown in order to recover the decline in startups, and to prevent a lost generation of firms. In view of the positive benefits provided by startups to the economy together with Italy's lack of innovation and employment, Italy cannot afford a lost generation of firms.

This analysis represents a first step in a potentially fruitful line of research. The study presents several limitations. First, we assume that firms that might have been started would have had the same employment potential as existing startups. Second, we did not take into account the failure rate of the firms that might have been started, thus negatively influencing the job creation.

Future research could extend the analysis in at least two directions: studying the impact of lockdown and COVID-19 pandemic with particular regard to women entrepreneurship and to youth entrepreneurship; studying the territorial differences in the recovery of startups activity togheter to the firms' resilience (on the basis of the firm deaths), in the post-lockdown months.

8. Acknowledgments

The views expressed in the article are those of the authors and not of the institution they are affiliated with. The Authors thank Carmine Pappalardo and Andrea Ascani for valuable suggestions.

9. Disclosure

The views expressed in the article are those of the authors and not of the institution they are affiliated with.

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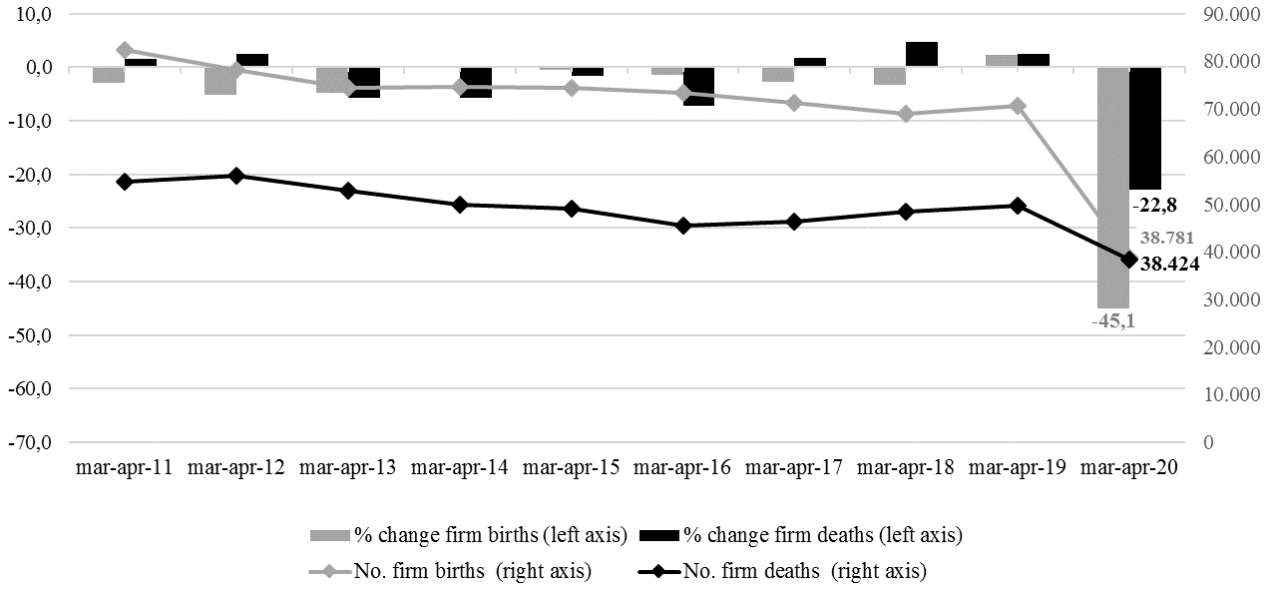
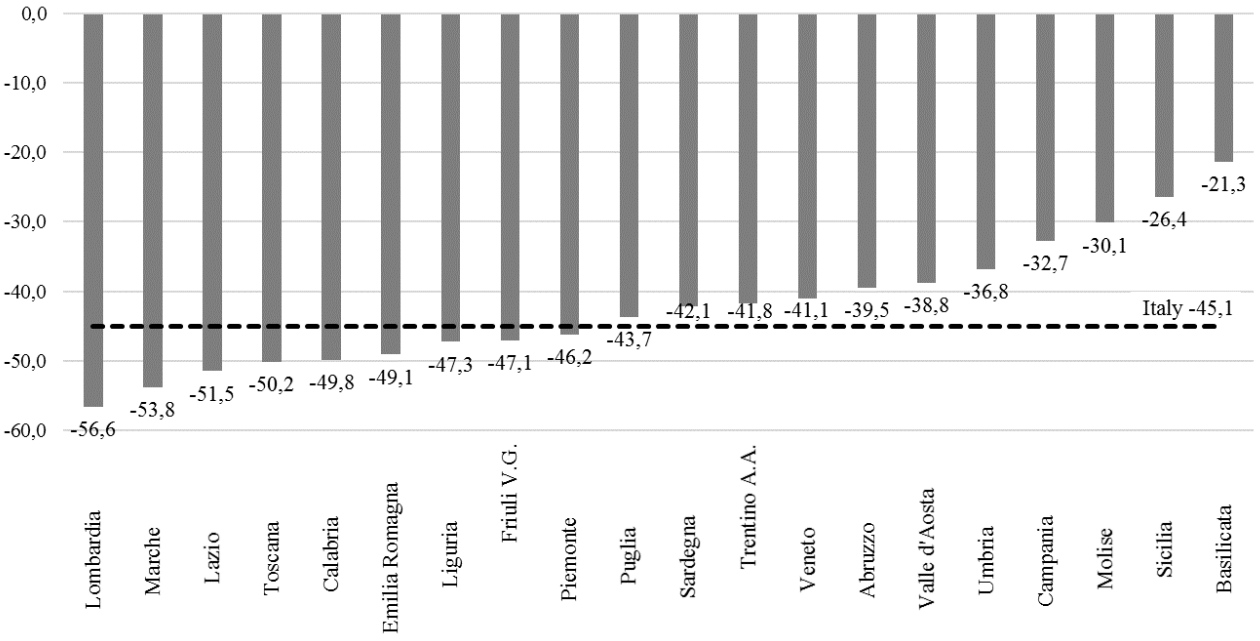
11. Appendix

Graph A1 - Firm births and firm deaths trend in Italy (two months March-April of each year)



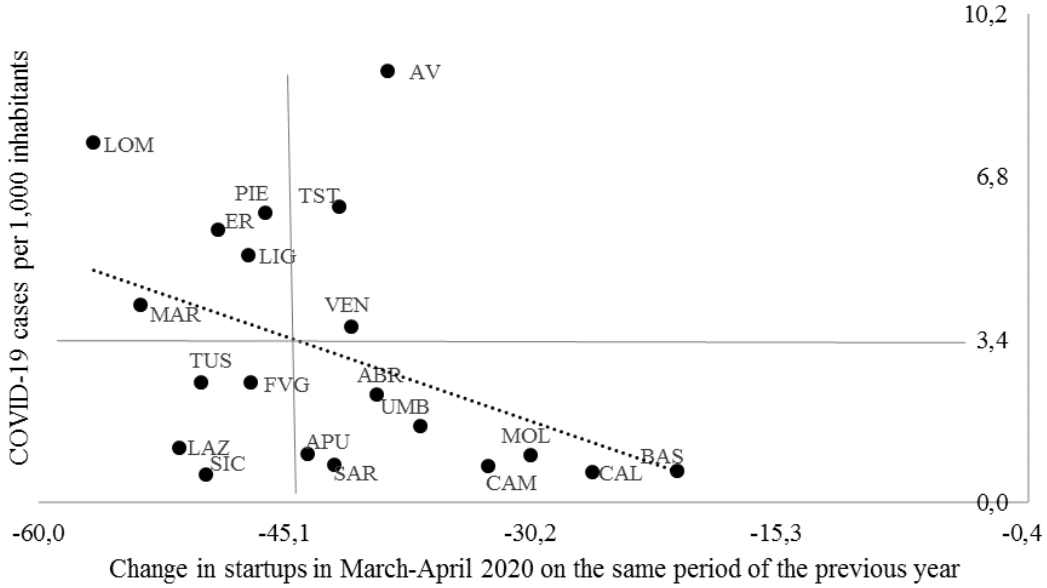
Source: Authors' elaboration on Unioncamere-Infocamere

Graph A2 - Percentage change of firm births in the two months March-April 2020 compared to the two months March-April 2019 in Italy by region



Source: Authors' elaboration on Unioncamere-Infocamere

Graph A3 - COVID-19 and startups decline in the lockdown period in Italy by region



Source: Authors' elaboration on Unioncamere-Infocamere, Italian Civili Protection Department, and ISTAT data

Table A1 - COVID-19 cases in Italy by region (updated to 7 June 2020)

Regions	*No. cases*	*% of the total*	*Per 1,000 inhabitants*
Piedmont	30,855	13.1	7.1
Aosta Valley	1,191	0.5	9.5
Lombardy	90,195	38.4	8.9
Trentino-South Tyrol	7,038	3.0	6.5
Veneto	19,183	8.2	3.9
Friuli-Venezia Giulia	3,283	1.4	2.7
Liguria	9,812	4.2	6.4
Emilia-Romagna	27,908	11.9	6.2
Tuscany	10,135	4.3	2.7
Umbria	1,432	0.6	1.6
Marche	6,745	2.9	4.4
Lazio	7,812	3.3	1.3
Abruzzo	3,265	1.4	2.5
Molise	436	0.2	1.4
Campania	4,826	2.1	0.8
Apulia	4,511	1.9	1.1
Basilicata	399	0.2	0.7
Calabria	1,159	0.5	0.6
Siciliy	3,451	1.5	0.7
Sardinia	1,362	0.6	0.8
Italy	234,998	100.0	3.9

Source: Authors' elaboration on Italian Civili Protection Department and ISTAT data

Table A2 - Average startups size in Italy by region

Regions	*Year 1*	*Year 2*	*Year 3*	*Average*
Piedmont	1,4	1,5	1,2	1,4
Aosta Valley	1,0	1,1	1,1	1,0
Lombardy	1,5	1,4	1,4	1,4
Trentino-South Tyrol	1,5	1,3	1,4	1,4
Veneto	1,5	1,3	2,9	1,9
Friuli-Venezia Giulia	1,4	1,4	1,2	1,3
Liguria	1,2	1,2	1,2	1,2
Emilia-Romagna	1,4	2,8	1,3	1,9
Tuscany	1,4	1,6	1,4	1,5
Umbria	1,2	1,2	1,3	1,2
Marche	1,4	1,3	1,4	1,4
Lazio	2,1	1,2	1,3	1,5
Abruzzo	1,2	1,2	1,2	1,2
Molise	1,1	1,1	1,3	1,2
Campania	1,2	1,2	1,2	1,2
Apulia	1,2	1,2	1,2	1,2
Basilicata	1,0	1,2	1,1	1,1
Calabria	1,0	1,0	1,1	1,1
Siciliy	1,1	1,1	1,1	1,1
Sardinia	1,1	1,2	1,2	1,2
Italy	1,4	1,4	1,4	1,4

Source: Authors' elaboration on Italian Civili Protection Department and ISTAT data

Table A3 – Variables description

Variable	*Description*	*Source*
Dependent vatiables		
Empl_miss	Share of the new employment missed because of the startups decrease in the two-months March-April 2020 on the theoretical employment	Authors' estimation
SU_decrease	Percentage change of firm births in the two months March-April 2020 compared to the two months March-April 2019	Unioncamere-Infocamere
DE_decrease	Percentage change of firm deaths in the two months March-April 2020 compared to the two months March-April 2019	Unioncamere-Infocamere
Independent variables		
COVID-19	COVID-19 cases per 1,000 inhabitants (30 April 2019)	Italian Civili Protection Department and ISTAT
Small	Share of employees in firms <50 employees on total employees (2019)	Unioncamere-Infocamere
HTM	Share of employees in high and medium-high technology intensive manufacturing sectors on total employees (2019)	Unioncamere-Infocamere
HKIS	Share of employees in high knowledge intensive service sectors on total employees (2019)	Unioncamere-Infocamere
HC	Share of population 15 years old and over with a tertiary degree on total population (2019)	ISTAT
R&D	Percentage of R&D expenditure on GDP (2017)	ISTAT

Growth	Value added growth (yearly avarage 2013-2019)	ISTAT and G. Tagliacarne Research Center
North	Dummy: 1 = North	
Center	Dummy: 1 = Center	
South	Dummy: 1 = South	
Instrumental variables		
Commuting	Share of residents commute to work/study on total residents	Musolino & Rizzi (2020)
Old-age DR	Old age dependency ratio: number of individuals aged 65 and over per 100 people of working age (15-64)	Musolino & Rizzi (2020)
PM10	PM_{10} values in μg/mc (yearly average 2011-18)	Musolino & Rizzi (2020)

Note: All variables are at the provincial level except R&D (regional).

Table A4 – Summary statistics

Variable	*Mean*	*S.D.*	*Min*	*Max*
COVID-19	3.6	3.2	0.3	16.8
Small	72.7	12.6	30.0	92.8
HTM	5.4	4.0	0.5	16.1
HKIS	14.2	6.0	8.0	43.5
HC	13.4	3.1	7.6	22.7
R&D	1.3	0.4	0.5	2.1
Growth	24.1	6.5	13.5	48.4
North	0.5	0.5	0	1
Center	0.2	0.4	0	1
South	0.3	0.5	0	1

Source: Authors' elaboration

Table A5 – Correlation matrix

	1	2	3	4	5	6	7
1.COVID-19	1.000						
2.Small	-0.359	1.000					
3.HTM	0.475	-0.544	1.000				
4.HKIS	0.131	-0.686	0.125	1.000			
5.HC	0.155	-0.532	0.410	0.401	1.000		
6.R&D	0.403	-0.397	0.540	0.094	0.313	1.000	
7.Growth	0.545	-0.674	0.584	0.290	0.608	0.493	1.000
VIF	1.42	3.58	2.37	2.41	1.54	1.57	2.07

Source: Authors' elaboration

Table A6 –Geography: robustness check and disentangling

Variable	*Italy* *(1)*	*North* *(2)*	*Center* *(3)*	*South* *(4)*
COVID-19	1.000**	1.206**	-0.702	1.623
	(0.484)	(0.467)	-1.669	-3.496
Small	-0.019	-0.051	-0.504	-0.352
	(0.170)	(0.276)	(0.386)	(0.373)
HTM	-0.261	0.299	-0.269	-2.374
	(0.434)	(0.480)	-1.018	-1.467
HKIS	0.009	-0.032	-0.507	-0.634
	(0.289)	(0.443)	(0.635)	(0.655)
HC	-0.446	0.157	-1.714*	-0.380
	(0.472)	(0.648)	(0.957)	-1.290
R&D	2.094	5.480	-0.254	-12.893
	(3.658)	(3.949)	(8.996)	(12.729)
Growth	2.868	-2.182	10.412**	5.981
	(2.318)	(4.031)	(3.712)	(5.768)
Center	6.131			
	(3.704)			
South	-6.112			
	(4.812)			
Observations	99	47	22	30
R^2	0.317	0.196	0.473	0.156

Note: Dependent variable *Empl_miss*. Standard errors in parentheses. *** p<0.01, ** p<0.05, p<0.1.
Source: Authors' elaboration

Table A7 – Different effect of lockdown on firm births and on firm deaths

Variable	*SU_decrease* *(1)*	*DE_decrease* *(2)*
COVID-19	1.064***	2.148*
	(0.373)	(1.083)
+ controls		
Observations	99	99
R^2	0.267	0.228

Note: Dependent variable is reported at the top of the column. Standard errors in parentheses. *** p<0.01, ** p<0.05, p<0.1.
Controls: *Small, HTM, HKIS, HC, R&D, Growth.*
Source: Authors' elaboration