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More than a She-recession: Long-term feminization and short-term pandemic effects

Linnea Nelli* Maria Enrica Virgillito†

Abstract

The Covid-19 crisis has been defined as a "She-recession" because of its disproportionate impact on female employment by contrast to past recessions defined as "Man-recessions", for the usual disproportionate impact on men. The roots of the She-recession can be however traced back to the persistence of gender asymmetries both intra-household and extra-household in the labour market, a phenomenon known as feminization. This paper aims at measuring and explaining the gender differences in the impact of the Covid-19 crisis on the Italian labour market from a macroeconomic perspective. We measure the duration, depth and diffusion of the Covid-19 crisis on job losses, structural unemployment and inactivity. We find that the impact of the Covid-19 crisis has been more than proportional for women, especially for low educated female workers and working in the South during 2020.

Keywords: feminization, hysteresis, labour markets

JEL Classification: J16, E32, J6

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1 Introduction

During the pandemic crisis, a new concept has spurred into both academic and journalistic literature meant at qualifying from a gender perspective the recessionary impact of the crisis on labour markets, namely, the notion of *She-recession*. The very concept of *She-recession* tries to account for the fact that a crisis might have an asymmetric unfolding with respect to its gendered impacts and takes origin from the comparison between the Great Recession in the US, from 2007 to 2009, vis-à-vis the Covid-19 crisis in 2020. In fact, the literature defines the past economic downturns as "Man-recessions", since the impacts of pre-pandemic crises have usually been harder for male employment rather than for female one. Until the pandemic crisis, economic shocks have been mainly affecting male-prevalent industrial sectors, as manufacturing and construction, subject to a high cyclical volatility (Hoynes et al. (2012); Rubery and Rafferty (2013); Alon et al. (2021)). Differently, the Covid-19 crisis has recorded a major decline in female employment (Shibata, 2020). The origin of the crisis, a global health crisis, and the adopted measures to contain it, in particular social distancing and lockdowns, have largely impacted upon service sectors, the latter involving working activities characterised by inter-personal contacts and which can not be easily executed from home. The sectors are worldwide characterised by predominant shares in female employment. In addition to closures of workplaces, school closures have harshly impacted on motherhood, with female workers having to split their time between homeworking, whenever possible, and childcare, which typically weights on women's shoulders. The interaction between the specificity of the pandemic crisis and the ensuing non-medical containment measures has resulted in what has been now commonly understood as *She-recession*.

According to Del Boca et al. (2020), Italy is an interesting case study on this matter. On the one hand, it is the first European country where the coronavirus has spread and where very strict lockdown measures have been adopted, particularly long school closures. On the other hand, the Italian labour market is characterised by low female labour force participation and long-lasting gender asymmetries. Cetrulo et al. (2020) show that Italian women are mainly employed in essential, low-skilled sectors, service and retail activities, which could not have been executed from home during lockdown phases; largely under temporary contracts or self-employed, many women were not covered by the firing restrictions applied by the Italian government as a response to the Covid-19 related economic crisis. Taken together gender asymmetries in the sectoral distribution of occupations and the precarious working

conditions, female workers in the Italian labour markets have been dramatically exposed to negative side effects of the pandemic, with peaks in unemployment and transition to inactivity at 98% during the last quarter of 2020.[1]

In this contribution we study the unfolding of the She-recession in Italy. We take a macroeconomic-structuralist perspective, identifying its root-causes in the persistent attributes of female employment conditions in the Italian labour market, both in the long and in the short run. We first present a series of structural labour market trends in female employment. We then assess the She-recession looking at *depth, duration and diffusion* of the Covid-19 crisis, according to the NBER methodology of crisis identification, considering the long-term pre-crisis trends. In this respect, we build and refine the statistic developed by Fazzari and Needler (2021), a loss function measuring the unfolding of the crisis in terms of the three above mentioned dimensions. The measure represents a proxy to detect the eventual emergence of hysteresis in labour market patterns, being built upon deviation from long-term trends.

Using quarterly data from the Italian Labour Force Survey, we compute losses functions in employment, structural unemployment and inactivity distinguishing by gender, education level, geographical location. The measure allows to retrieve equal vs unequal outcomes in the distribution of losses among categories for each series of interest. We document a disproportionate impact on female employment and a proportional effect on female inactivity due to previous hysteresis in the labour market. Women from the South and women with lower education levels have been the most exposed categories, recording an impact more than proportional with respect to higher educated women and women from other regions.

The analysis is structured as follows: Section 2 accounts for a theoretical discussion and previous findings on She-recession; Section 3 looks at structural trends and changes in female labour markets, focusing on the role of education, tertiarization, flexibilization of the labour market, and regional asymmetries, in a nutshell, patterns of feminization of labour markets. Section 4 presents the data, Section 5 links structural trends and pandemic effects in female labour markets; Section 6 explains the methodology and results. Our conclusions are laid out in Section 7.

[1] https://www.ISTAT.it/it/files//2021/02/Occupati-e-disoccupati_dicembre_2020.pdf

2 She-recession: why the pandemic crisis is different

2.1 Female labour demand and supply during recessionary periods

In order to understand the specific attributes of the She-recession we need to compare such an event with previous episodes of crises. Event crises are generally understood as being originated from supply or alternatively demand "shocks". Generally speaking, with respect to supply shock crises, the literature refers to energy crises or imported-inflation of intermediate goods that propagate via price-channels, with the oil crisis in the seventies being the textbook case. When coming to demand crises, less acknowledged till the Great Recession in 2008, the literature refers to declines in wage growth and lack of consumption. The pandemic crisis has been classified as both a supply crisis, due to the reduction of working hours and labour supply, and a demand crisis, as far as wage compression and income losses might have constrained demand.

Crises, particularly in labour markets, propagate via industry channels: working hours reduction and employment losses derive from output contraction in industries and sectors more exposed to the shocks. Therefore, both industry composition in terms of gender, and country composition in terms of industry, determine the severity of each given crisis and any eventual disproportionate effect on specific labour market/industry segments. Comparing the pandemic with "ordinary" shocks provides evidence of asymmetric effects in terms of gendered job losses.

Hoynes et al. (2012) compare the financial crisis of 2007 with the economic recession in the 1980s in the United States. The loss in overall employment has been stronger and longer during the Great Recession than in the 1980s recession, mainly because of a higher participation of women to the labour market, but men accounted for the highest share of job loss and they find that unemployment was more cyclical for men than for women both during the 80s and during the financial crisis. Rubery and Rafferty (2013) trace back gender differences in crises outcomes to job segregation, work flexibility and participation, and welfare state capacity. The latter are channels through which there could be propagation of negative shocks leading to unexpected outcomes. Occupational segregation can both protect or expose more women according to the characteristics of the recession and, because of the low pays they receive, they might record an increase in employment during recoveries, acting as a substitute for higher paid male workers; in addition, female labour supply is hugely

dependent from the household role and on the welfare state benefits in kind. These attributes make the female component of labour markets quite distinctively behaving vis-à-vis male ones. In line with this expectation, although highly shock-exposed industries have usually been male-dominated ones, looking at cyclical volatility between the last quarter of 2019 and the second one of 2020, female industries have recorded the highest loss in employment (Alon et al. 2021). The authors compute the cyclical component of GDP as deviation from a Hodrick-Prescott trend. The cyclical volatility is defined as the log deviation from the predicted values of the regression of the HP-residuals of industry employment on the HP-residuals of real GDP, for the period 2008-2019 at quarterly frequency (Alon et al. 2021, p.14).

Therefore, the very nature of the recession in itself is the first reason of gendered effects of crises. However, in addition to asymmetric exposure to shocks because of occupational segregation, resulting from asymmetric labour demand patterns, also female labour supply patterns are quite specific.

Female responses to recessions might be very diverse. During ordinary shocks, a counter-cyclical response of female employment to counterbalance the risk of unemployment of the male partner has been defined by Lundberg (1985) as the "added-worker effect". Lundberg (1985) shows that the added worker effect is significant in white families, acting as an insurance against employment uncertainty, credit constraints and loss in earnings of the male members of the household. Rubery and Rafferty (2013) argue that in past recessions before the Great Recession in 2007, cyclical volatility of female employment was found only in manufacturing, where women mainly occupied buffer positions, with flexible hour arrangements in order to adjust to variations in demand and protect the male positions at the core, while in other sectors they were more protected. Flexible participation to the labour market instead has led to an increase in unemployment and a decrease in inactivity rate for women between 2007 and 2011. Albanesi and Kim (2021a) estimate that the ratio between population and employment according to gender and family status increased by 0.2 percentage points for married women with children during the Great Recession, while employment for married men with children fell by 2.4%, by 6.1% for single men with children vis-à-vis 2.7% for women, for single workers without children 6% and 2% respectively. The added worker effect can explain the lower cyclicity of female labour supply for married individuals.

Remarkably, the Covid-19 crisis did not show these regularities. Because of the magnitude of employment decline during the pandemic (much higher than for the Great Recession, Shibata (2020)), the "discouraged worker effect" (Lundberg (1985)) characterised both female and male employment dynamics. Indeed, according to Albanesi and Kim (2021a), employment decreases by 8.5% for married men with children vis-à-vis 13% for married women with children during the Covid-19 crisis. While the impact on male employment is higher with respect to the Great Recession (-2.4% versus -8.5%), the relationship is reversed for women (-13% in the pandemic crisis versus +0.2% during the Great Recession).

Overall, the impact of the Covid-19 crisis on female employment has been twofold. On the demand side, acting via the *industry composition channel*, social distance measures have impacted female workers more than male ones due to the gender composition of the industries more subject to closures. On the supply side, acting via the *childcare channel*, school closures and gender norms in child and elder care forced working women to reduce their supply of labour also in sectors less hit by the pandemic, with the possibility of remote working, or even to exit the labour market.

2.2 She-recessions across countries

The extant literature shows that there is a large cross-countries variation in the impact of the Covid-19 crisis on female employment. Alon et al. (2021) find that (i) gender gaps in employment effects decrease when controlling for occupations, but gender gaps for parents with school-age children are the largest in the United States and in Canada; (ii) the effect on employment is small in Germany and in the Netherlands but high on working hours, particularly because of furloughs schemes preserving employment but reducing working hours especially for women; (iii) the relative worked hour index for Swedish workers, that is the ratio between worked hours by women and worked hours by men between the last quarter of 2019 and the second quarter of 2020, has increased given that Sweden has adopted softened school closures; (iv) in Spain the industry channel has a decisive impact since the results show a significant decline in hours for women with school-age children when controlling for occupation types, while it was not significant in the regression with no industry channel effects.

Hupkau and Petrongolo (2020) find that the effect of the Covid-19 crisis has been mixed in the United Kingdom: on the one hand, the gender gap has narrowed since the impact

of the recession has been equally distributed on men and women in terms of job losses and resort to furloughs, while on the intensive margin, the reduction in worked hours and in earnings have been even smaller for women and an increase in fathers devoting time to housework and childcare is observed; on the other hand, women have taken care of 60% of the additional childcare hence gender differences in family life have widened. By the same token, for Italy Del Boca et al. (2020) and Del Boca et al. (2021) find that the time devoted by women for childcare is always higher except for those women who kept working where they used to also during the pandemic. At the same time, they find that women's working arrangement does not affect the time their male partners devote to childcare or housework, but males' working arrangement does on their female partners. Biroli et al. (2021) run a similar analysis comparing Italy, the United Kingdom and the United States while Djankov et al. (2020) find that the gender gap in labour force participation has shrunk in Denmark, Norway, Australia and the United Kingdom thanks to ad-hoc policies.

Particularly for Italy, the distribution of occupations by gender together with the housework division of labour are the main channels for which the impact of the pandemic has been so harsh for women. Cetrulo et al. (2020) show that women are mainly employed in essential, low-skilled sectors, such as service and retail activities, largely non teleworkable occupations, with temporary contracts, or self-employed. The pandemic has exerted two consequences on these workers: firstly, they were not covered by the firings' restrictions, thus they were the category of workers for which the highest job losses were recorded; secondly, the impact of the lockdown measures on these sectors has exacerbated the polarization in wages between precarious and protected workers, widening gender gaps. Indeed, only 30% of professions can be executed from home and women represent a low share of them (mainly employed in the administrative sector).

3 Beyond recessions: Long term patterns of feminization of labour markets

The supply-side responses of women to the Covid-19 crisis acknowledged by the literature are particularly driven by gender norms. Fabrizio et al. (2021) find that women without children whose occupation implied inter-personal contact have recovered in terms of employment much faster than mothers having similar occupations. Other than gender association for

women in their role of mothers, the gender gap in earnings justifies the choice to reduce working hours for women who usually earn a lower salary than their male partners (Kleven et al. (2019); Albanesi and Kim (2021a); Albanesi and Kim (2021b); Hupkau and Petrongolo (2020), Sun and Russell (2021)). However, the root causes of such patterns have to be traced back to long term sources of occupational segregation.

The combination of structural changes in job opportunities in new growing sectors and higher level of education have constituted a turning point for female employment. During the seventies, new job opportunities for women were constituted by the access to previously typical male professions as teachers and bank clerks (*resegregation*), by the increase in demand for health and child care, a sector that already was female-dominated, and by technological change particularly in clerical work and telecommunications (Blau et al. (1998)). Technological change, mainly computerisation, has induced a recomposition effect in tasks and functions executed in the workplace, implying a demand for specific skills, partly covered by female administrative jobs.

In parallel, women were increasing their access to education, becoming more skilled to match the demand of the labour market (Goldin (1984); Dolado et al. (2002)). Women start to change the choice in what Akerlof and Kranton (2000) define the *"identity- a person's sense of self"* that for women used to be *gender associated*. The choice that an individual makes of his/her identity implies specific economic decisions and outcomes: *gender association* implied women who identify themselves as housewives not participating to the labour market or not investing in their education. During the *quite and revolutionary phase* (Goldin (2006)) starting in the late seventies, women's identity of themselves and decision making have started to shift from gender association to own individuality, involving a stronger attitude towards economic decisions, participation to the labour market and investments in human capital and career development in a long run horizon.

In the nineties, the tertiarization of the economy drives female employment, providing for new job opportunities in services. Patterns in Italy follow such a trend. In Figure 1, both participation and employment rates are characterised by a positive and increasing trend for women, starting from levels below 40% for both rates in the 1977 and reaching the 50% - 55% in 2020. Nonetheless, both rates are still low compared to EU level averages, and especially lower than male participation and employment rates.

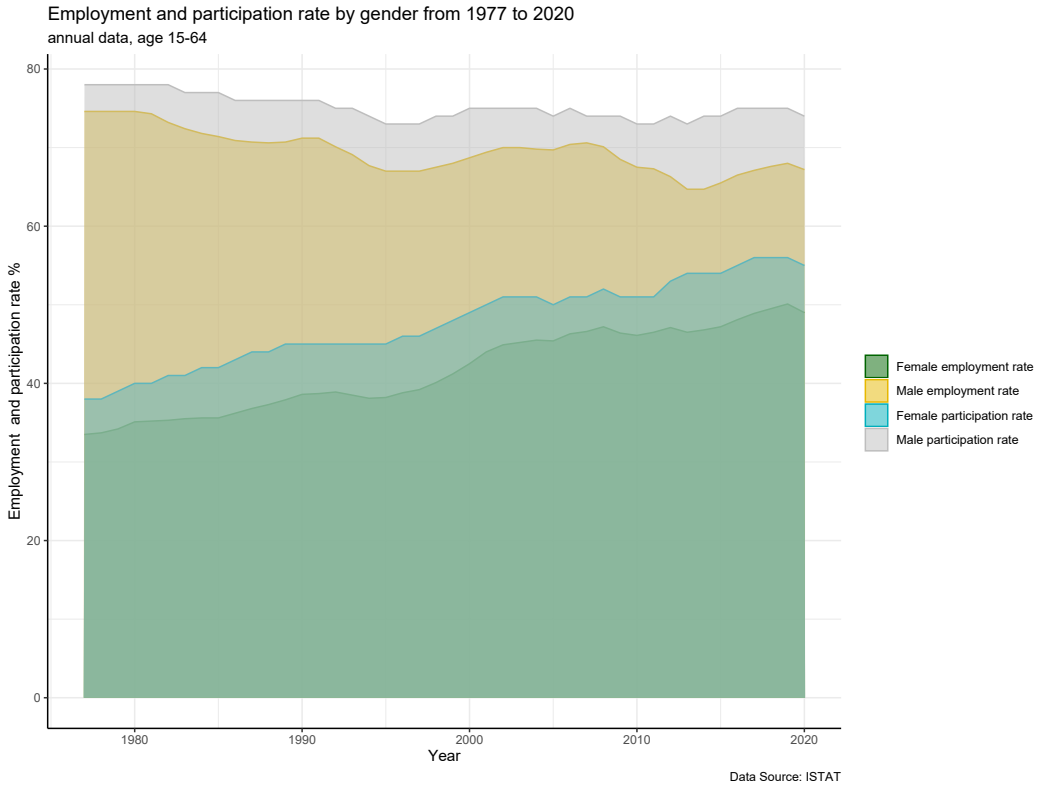


Figure 1: Employment and participation rates by gender between 1977 and 2020 in Italy

Despite the increasing trend in female employment, gender norms keep affecting the decision to participate to the labour market, the level and duration of education and consequently the final occupation and sector of belonging for women, leading both to concentration of female employment in low-value added sectors and/or limited access to high professional status (*horizontal* and *vertical occupational segregation*). Employment discontinuity, because of motherhood periods, is among the sources of segregation (Goldin (1984)). In addition, discontinuity is followed by temporary and part time contracts implying female working conditions to be more precarious.

Although the increase in female education has narrowed the gap with male education level (Altonji and Blank (1999)), thanks to the involvement of women in education fields traditionally male dominated (as STEM disciplines; Charles and Bradley (2002); Mann and DiPrete (2013); Wang and Degol (2013); Sassler et al. (2017)), there is a wide agreement in the literature about the fact that the improvement in females' job experience accounts more

than education in narrowing differences in earnings (O'Neill and Polachek (1993), Wellington (1993), Blau and Kahn (1997), Goldin (2006)). Interacting discontinuity in employment and education choices, Mincer and Polachek (1974) argue that there is a positive relationship between the continuity in participation, mainly observed in single, young women without children, and the initial investment in human capital in the first working experience, more than in later ones, while because of discontinuity of participation both women, usually married with children, and employees do not invest in learning and training skills.

In the next paragraphs, we outline trends in Italian female employment with respect to education, sectors, contracts and geographical distribution, presenting some descriptive evidence of long run trends in feminization.[2]

Figure 2 shows the female participation and employment rates by level of education between 1977 and 2020 in Italy: the higher the level of education, the higher the participation rate. Figure 3 presents the shares by education level within female employment. The improvement in education is straightforward: in 1977, only 4.4% of employed women had a graduation while in 2020 the share is 31.2%; the share of working women with a high level of education follows a similar trend and in 2020 accounts for the highest share of employed women (46.2%). In 1977, primary education level accounted for the category with the highest share in employment, while the share of working women with secondary education level is quite stable over time.

[2]The initial time differs in the discussed trends because of data availability for each category. 2020 is always the last period since we analyse the effect of the Covid-19 crisis during its first year.

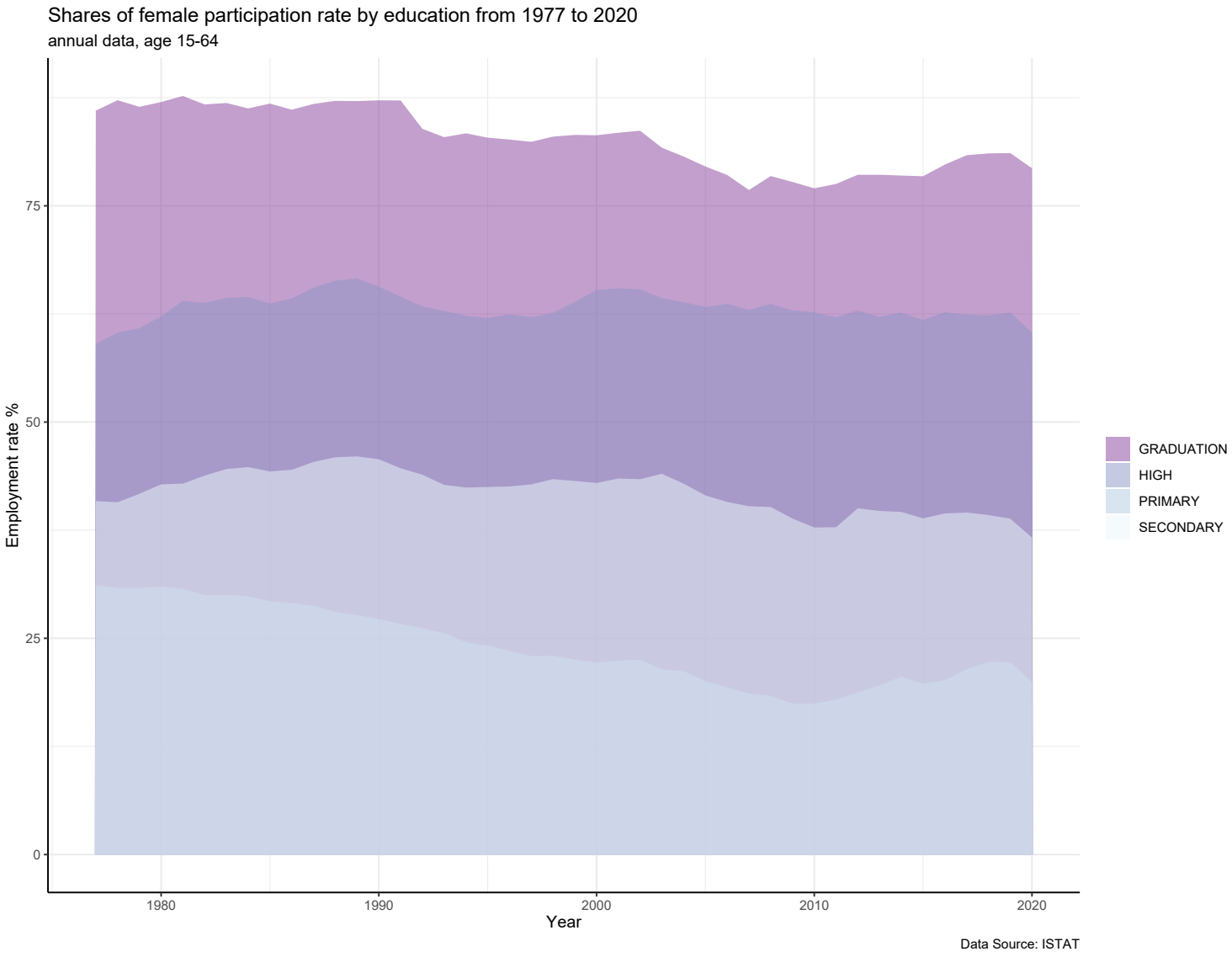


Figure 2: Female employment rate trend by level of education from 1977 to 2020 in Italy

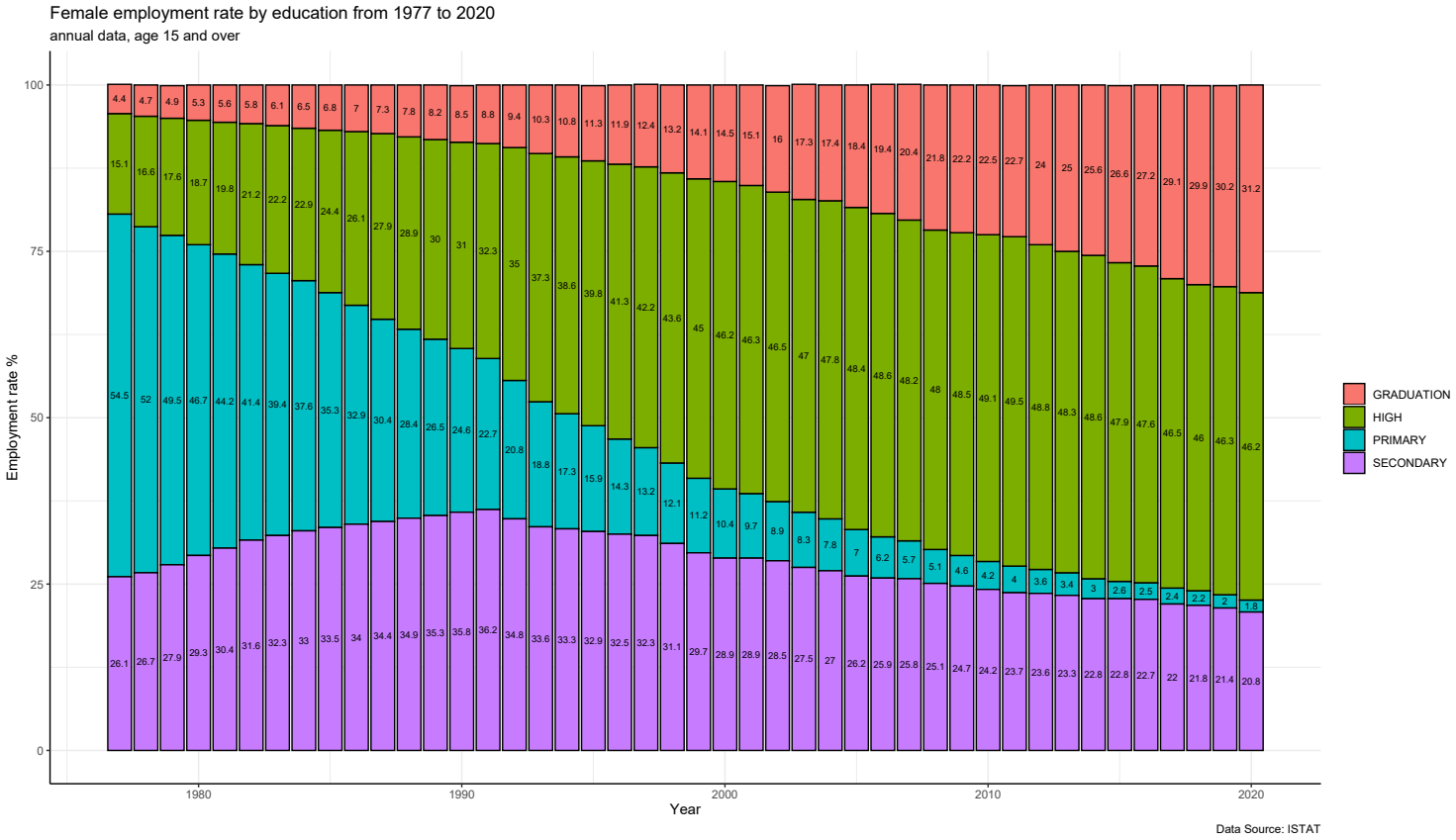


Figure 3: Shares of female employment rate within each level of education from 1977 to 2020 in Italy, annual data

Figure 4 provides for employment shares by gender in macro-sectors, namely agriculture, industry and services in 1977 and in 2020. The NACE specification is the corresponding English translation of the sectors classified under the service macro-sector by ISTAT. Female employment is one third of male one in agriculture in 2020, a stable one fourth share in industry, one third in services in 1977 and almost equal to male employment in 2020. We then look at the percentages of employment by gender in the different service activities, being the latter a female-dominated macro-sector. From Figure 5, adopting a NACE Rev.2 classification, "Education and health" is the sector with the highest share in female employment (72% vis-à-vis 28% of male employment both in 2008 and in 2020) and "Other service activities" (68% via-à-vis 32% for male employment in 2020). "Accommodation and food" and "Administrative and support to firms" shares are quite balanced, while for "Information and communication" and "Transportation and storage" male employment is much higher. This evidence accounts for the pattern of horizontal female occupational segregation, largely concentrated in so called low value added activities. Looking at occupational distribution by professional categories, a proxy for vertical segregation, Figure 6 shows that only 33% of executives are women in 2020, 45% middle managers and 31% self-employed, while they account for 57% of white collars. Shares in professionals, middle management and executives increase between 2004 and 2020. However, the bulk of female jobs being concentrated in "Other services" and in "Education and Health" are less subject to vertical mobility. In fact, among sectors, equally defined occupations are not equally remunerated, and horizontal segregation is not neutral and exacerbates vertical disparities. Typically, in low value-added sectors, where female employment is concentrated, the possibility of professional upgrading and vertical mobility are lower than in so called high value-added sectors. Therefore, any potential amelioration in vertical mobility has to compared with stagnant horizontal segregation.

Figure 7 shows that women account for the highest shares both in temporary and part-time contracts. According to Petrongolo (2004), the high shares of part-time contracts for women in Southern Europe is due to the gender discrimination affecting such countries rather than for voluntary women choices as in Northern countries. By the same token, Buckingham et al. (2021) argue that sectors as hospitality, cleaning, education, care, personal and social services happen to be both characterised by part-time and temporary working arrangements and female dominated, since women are considered as "more appropriate".

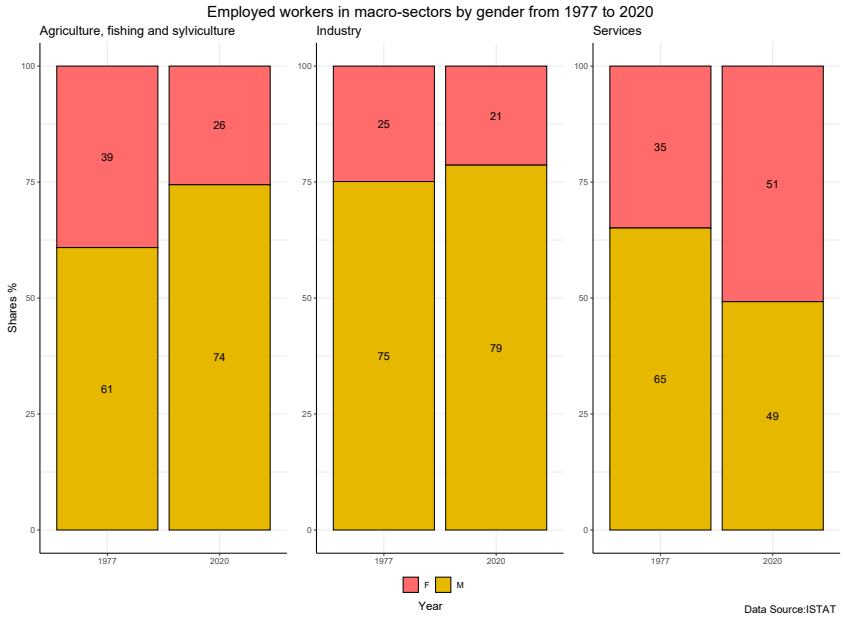


Figure 4: Percentage share in employment by gender in macrosectors in 1977 and in 2020 in Italy, annual data

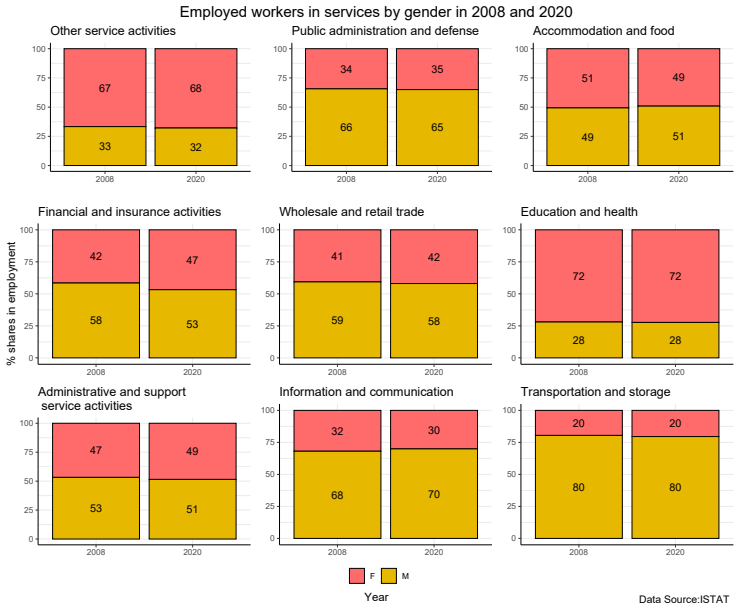


Figure 5: Percentage share in employment by gender in the service sectors in Italy in 2008 and 2020, annual data

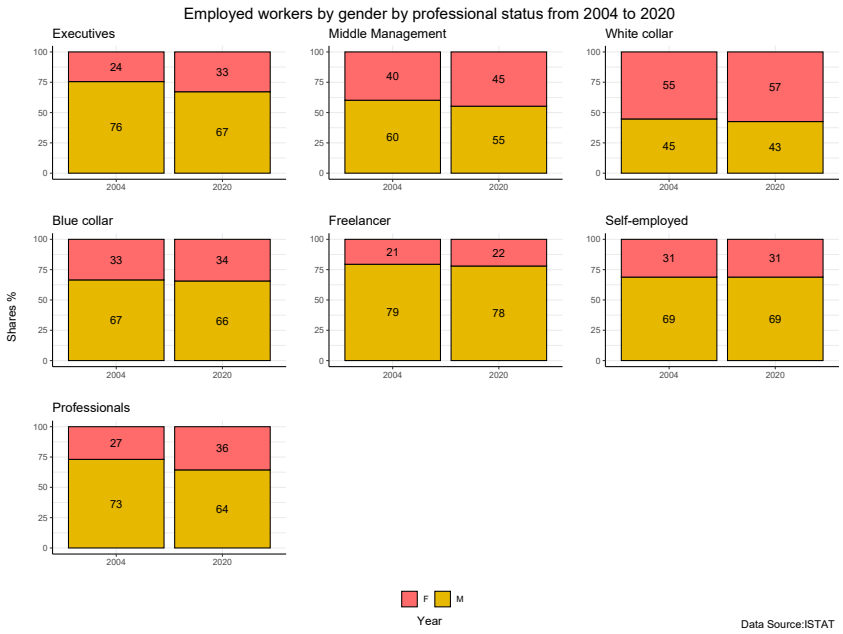


Figure 6: Percentage shares in employment by gender and by professional status in 2004 and in 2020 in Italy, annual data

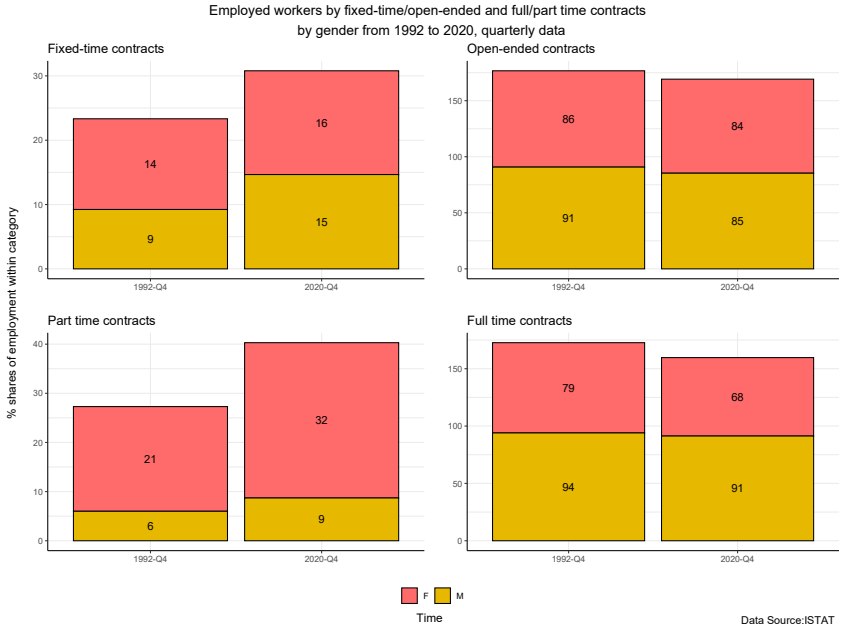


Figure 7: Percentage shares in employment by gender by type of contract in the last quarter of 1992 and in the last quarter of 2020 in Italy, quarterly data.

Italy is characterised by a persistent asymmetry between Northern and Southern regions in gender labour market outcomes. Among the many territorial divides, gender divides are quite striking. Figure 8 reports the female structural unemployment rate (unemployed status for more than 12 months) by region. Structural unemployment is higher more than twice for women in the South with respect to more virtuous regions in the Centre and in the North of Italy. Notably, the South of the country is also characterised by strong familistic orientations of the division of labour, with women still subject to the male breadwinner archetype, with gender norms, at the very least, discouraging female participation in formal labour markets and women emancipation from family ties. In addition, from the demand side of the labour market, the structural weakness of the southern productive structure hampers employment opportunities, and particularly good ones.

The documented patterns highlight the process of feminization of the labour market starting since the seventies. Such process can be expressed by the following trends: (i) female occupational segregation in low value-added sectors, (ii) unmatched increases of educational attainments with professional upgrading and in general wage remuneration for female workers, (iii) female disproportionate exposure to unstable and flexible contractual regulations, (iv) persistence of gender norms reproducing intra-household asymmetric division of labour and extra-household labour market participation.

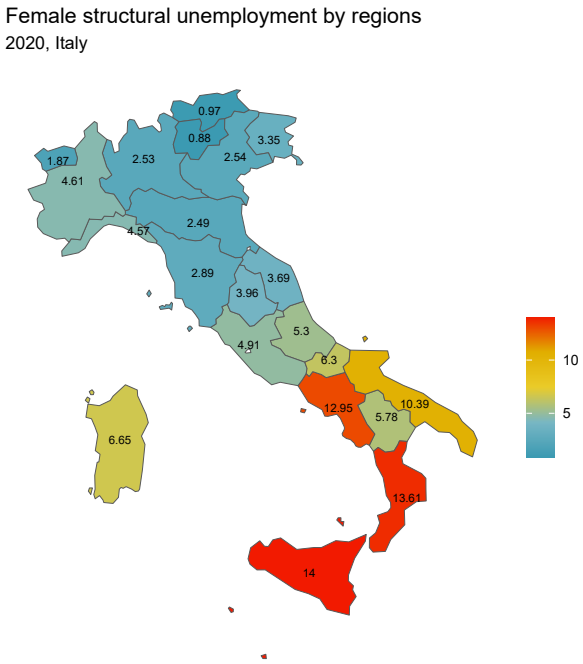


Figure 8: Female structural unemployment rate in Italy: regions in comparison. Data source: ISTAT

4 Data

Having documented such long term patterns, we now intend to focus on the specific effects on female workers due to the pandemic unfolding. In particular, we are interested in capturing hysteresis effects due to long-run trends in feminization as potential amplifiers of the pandemic crisis.

In order to accomplish the task, we analyse quarterly data from the Labour Force Survey of the Italian National Institute of Statistics (ISTAT) of employment, structural unemployment, inactivity for women and men between 15 and over years old, accounting for a long-term period, from 1993 to 2020. Table 1 shows the main descriptive statistics about these key variables. t is the number of observations namely the number of quarters of the time series. For each of the three variables, Figure 9 shows the quarterly data, annual average, the mean and the median computed over the entire quarterly time series by gender to identify

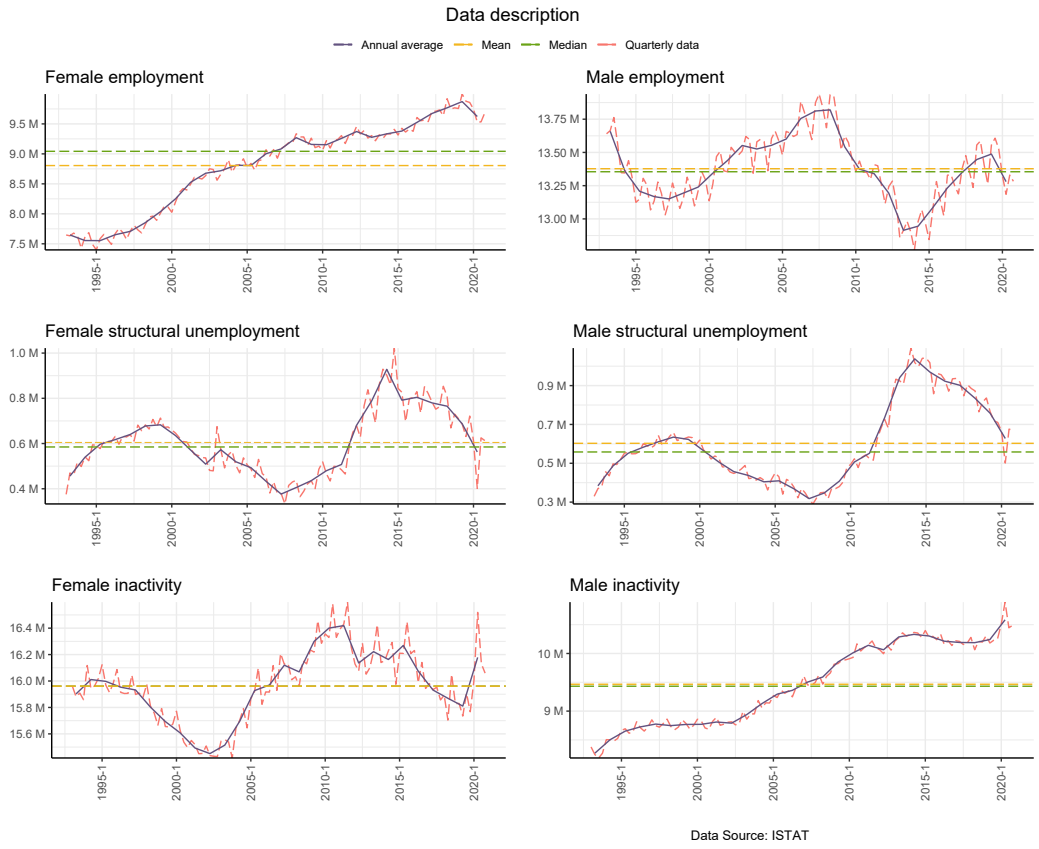


Figure 9: Data description: quarterly data, annual average, mean and median.

the reference years. The mean value for female employment refers to the period between 2004 and 2005 and the median for the period between 2006 and 2007; male employment oscillates more around mean and median values and reference years are 1995, 2000, 2012, 2017 and 2020, the same for male and female structural unemployment for which the reference years are 1995, 2001 and 2012 and 2020 and for female inactivity with the reference years between 1995 and 1998, 2005, 2017 and 2019; for male inactivity, mean and median values are between 2006 and 2007. Going further into geographical and educational distributions, Table 2 and 3 and Figures 10 and 11 provide the respective information for female regional employment and female employment by education.

Table 1: Descriptive summary of the data. Data Source: ISTAT

Employment			
Statistic	Female	Male	Total
t: 1993-Q1/2020-Q1	t=112	t=112	t=112
Mean	8,804,935	13,377,585	22,182,520
Median	9,065,017	13,353,464	22,405,984
St. Dev.	736,713.400	253,506.200	802,131.100
Min	7,398,284	12,766,801	20,522,766
Max	9,997,537	13,939,058	23,553,667

Structural unemployment			
Statistic	Female	Male	Total
t: 1993-Q1/2020-Q1	t=112	t=112	t=112
Mean	604,888.900	602,806.400	1,207,695
Median	608,514	550,275	1,161,076
St. Dev.	144,883.100	209,565.500	349,337.600
Min	332,883	290,625	623,508
Max	1,022,043	1,093,141	2,062,632

Inactivity			
Statistic	Female	Male	Total
t: 1993-Q1/2020-Q1	t=112	t=112	t=112
Mean	15,961,169	9,465,930	25,427,099
Median	15,960,906	9,440,054	25,483,066
St. Dev.	275,743.700	705,876.000	898,781.700
Min	15,417,757	8,186,644	24,095,277
Max	16,596,764	10,891,029	27,410,160

Table 2: Descriptive statistics of the data: female regional employment

Female regional employment			
Statistic	North	Centre	South
t: 2000-Q1/2020-Q4	t=84	t=84	t=84
Mean	4,986,625	2,004,683	2,177,057
Median	5,027,856	2,020,519	2,169,161
St. Dev.	219,108.200	152,710.800	70,179.390
Min	4,433,069	1,633,726	1,959,192
Max	5,391,286	2,252,968	2,353,283

Table 3: Descriptive statistics of the data: female employment by education level. Data source: ISTAT

Female employment by education				
Statistic	Primary	Secondary	High-school	Graduation
t: 2000-Q1/2020-Q4	t=84	t=84	t=84	t=84
Mean	449,410.400	2,250,118	4,367,995	2,100,842
Median	388,812	2,244,788	4,453,724	2,079,064
St. Dev.	217,706.200	132,796.800	221,956.800	557,931
Min	164,703	1,930,380	3,704,025	1,175,015
Max	877,990	2,551,847	4,642,923	3,106,937

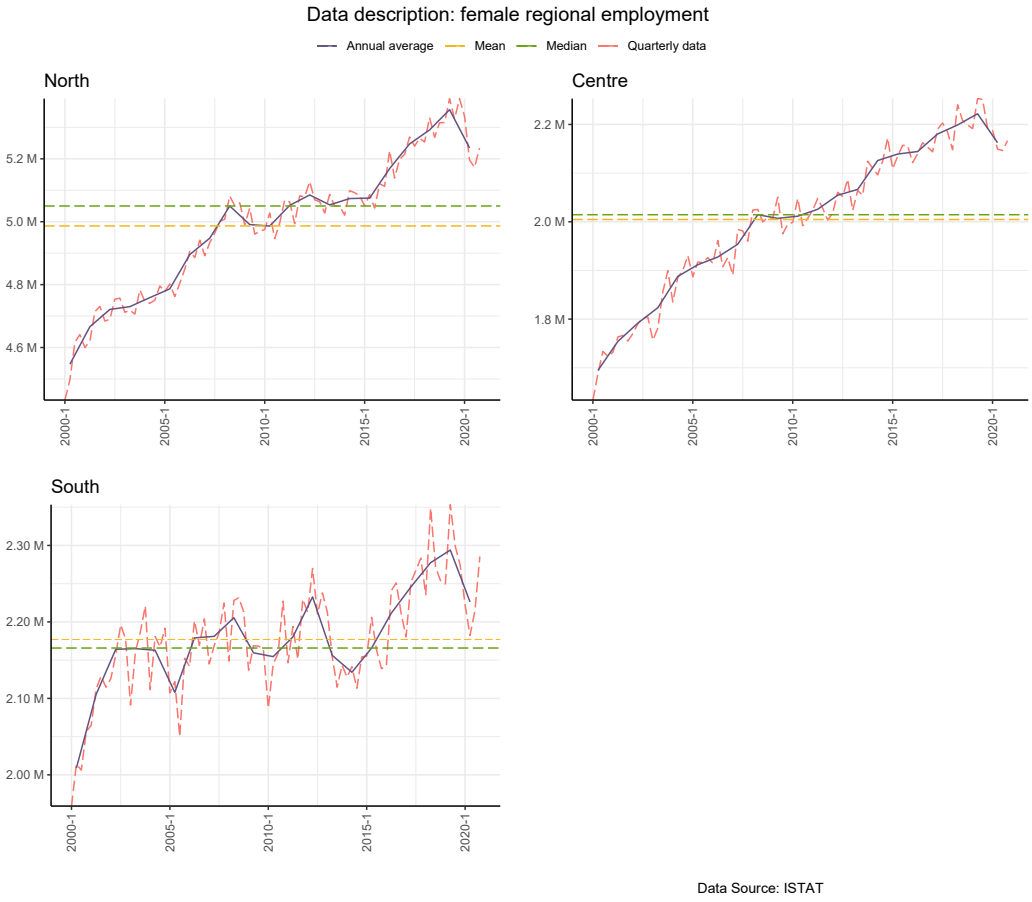


Figure 10: Data description: quarterly data, annual average, mean and median of female regional employment

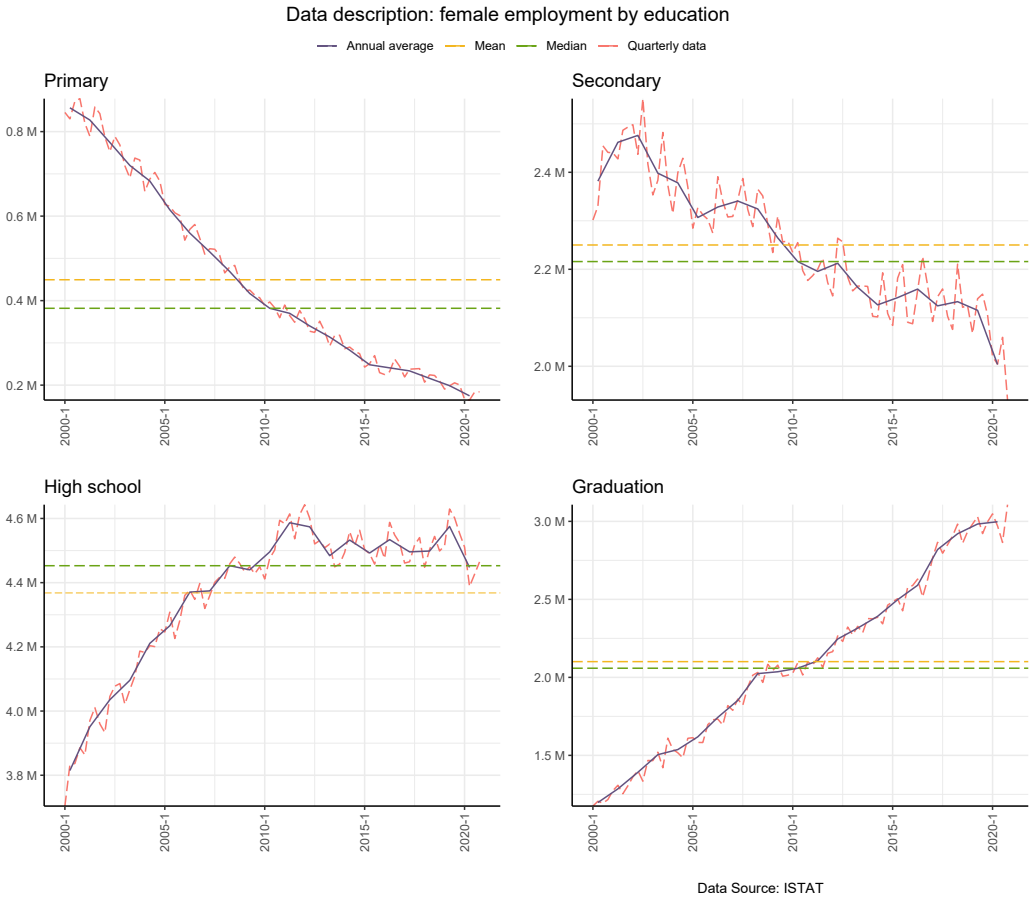


Figure 11: Data description: quarterly data, annual average, mean and median of female employment by education

5 From long-term feminization to hysteresis

Economic shocks, as the Covid-19 crisis, may induce hysteresis effects, impacting structural unemployment in particular. Dosi et al. (2018) identify three main channels of recessions inducing hysteresis in unemployment and output growth: decrease in productivity, skills deterioration and in entry dynamics. In relation to unemployment, during recessions firms fire workers and unemployment rises. If recessions are deep, recovery will be slower and less powerful, causing an increase in the duration of unemployment which, in turns, implies skills deterioration: long-term unemployed workers stop learning by doing processes, miss to acquire new techniques of production, are less probable to find a job, and whenever it occurred, their skills are deteriorated and their productivity will be lower. Two important side effects emerge. First of all, an increase in the duration of unemployment raises structural unemployment, typically hysteretic via skills' deterioration which induces further lengthening of unemployment duration. At the same time, structural unemployment largely characterises female labour market status. In Italy, female structural unemployment, with a duration longer than 12 months, has always been higher than the male one, and, on the contrary, employment and participation rates have always been much lower for women than for men [3], and below EU average.[4]

As a consequence, long-term unemployed people may exit the labour market, because of the strong feeling of discouragement and transiting into inactivity. Discouragement has particularly characterized the labour market dynamics during the Covid-19 crisis both for men and women: already in March 2020, ISTAT counts an increase of 7.7% of inactive workers, corresponding to 1 million 25 thousand units. The increase in inactive workers during the pandemic can be interpreted as a consequence of the persistence of precariousness and high unemployment in the Italian labour market.

In fact, occupational segregation, access to education and precariousness of female labour market participation present strong persistence over the long run, and in that have affected the labour market dynamics during the pandemic phase. In Figure 12, the autocorrelation functions for structural unemployment, activity and employment rate, and inactivity for

[3] see Table 1

[4] For instance, in 2019 before the pandemic, female employment in Italy was 53.8% vis-à-vis 67.5% as average in the European Union, 27 members, Eurostat (Figure B.1 in the Appendix)

both genders are shown. All variables, both male and female, are strongly correlated with their past values, although with a decaying memory. Activity and inactivity rates present distinct gender dynamics. The time lasting memory of the variables provides for a first evidence about how individual current status in employment, unemployment, inactivity is deeply affected by past outcomes.

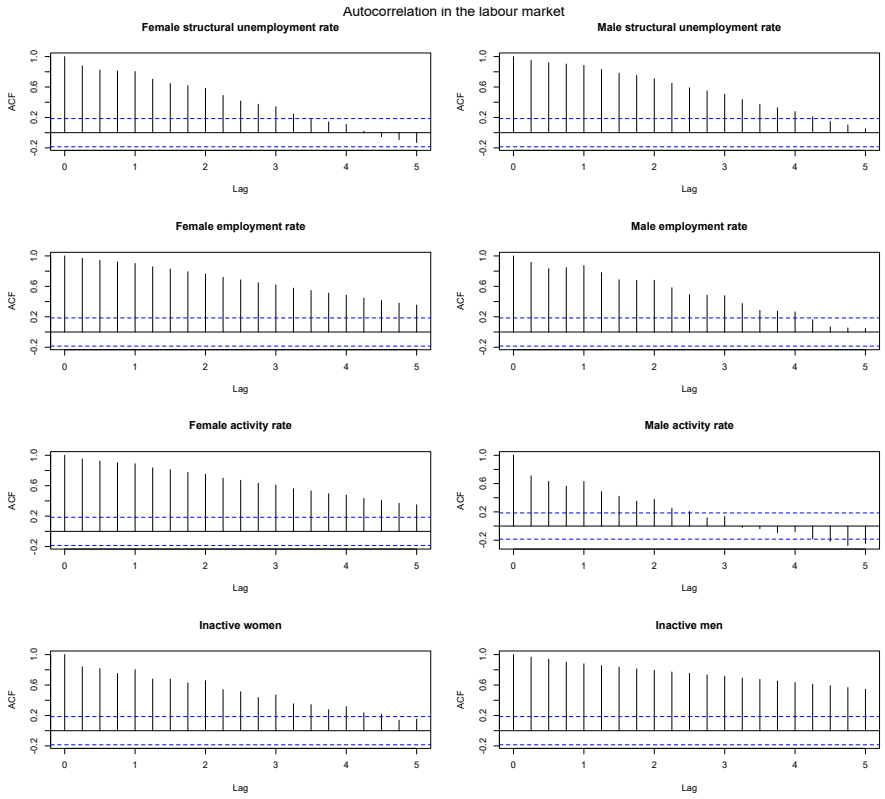


Figure 12: Autocorrelation in the Italian Labour market by gender, quarter lags. Data Source: ISTAT

Figure 13 shows the change in the employment, structural unemployment and inactivity rate in total and by gender from the last quarter of 2019 to the last quarter of 2020. The strong increase in the inactivity rate between the first and the second quarter of 2020 is evident both for men and women. In parallel, both the employment and the unemployment rate decrease, the latter being higher for women than for men. These trends give evidence of the strong discouragement effect impacting the Italian workers during the Covid-19 crisis.

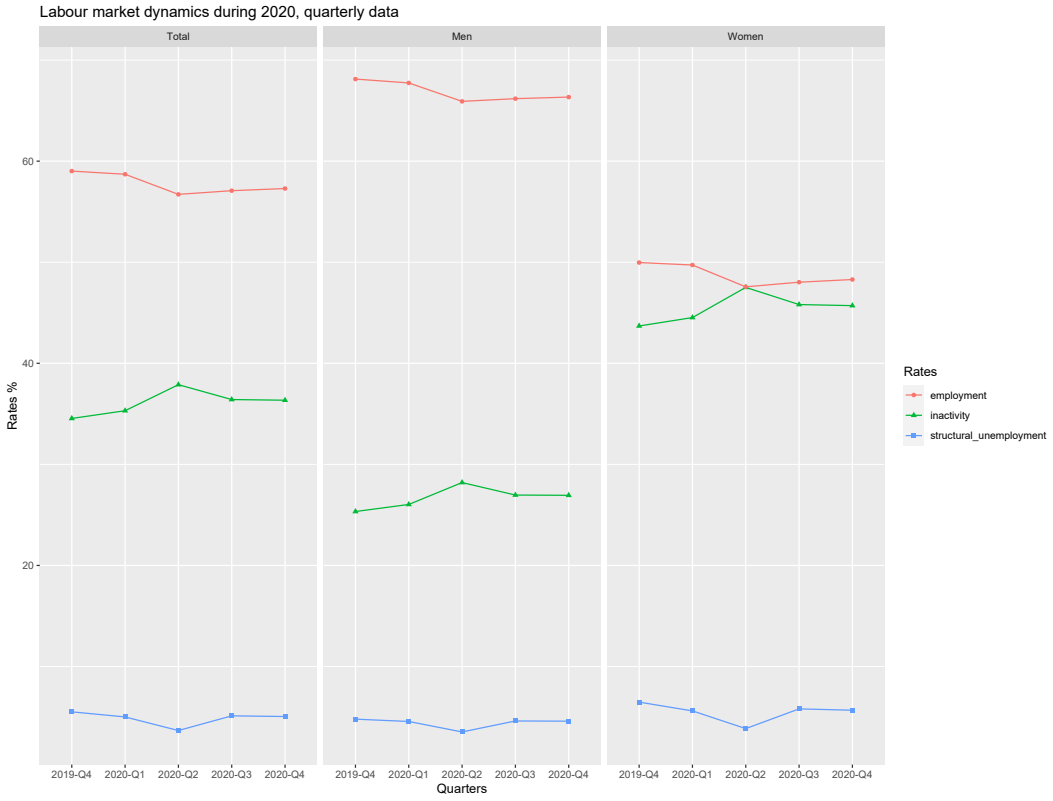


Figure 13: Employment, unemployment and inactivity rates by gender in Italy during 2020. Data source: ISTAT

Figure 14 shows the level in employment by gender during 2020 and the percentage changes from quarter to quarter. The decrease is stronger for women only during the second quarter of 2020 (-2.24% vis-à-vis -1.04% for men), despite male employment increases during the third quarter, it decreases during the last one while female employment increases.

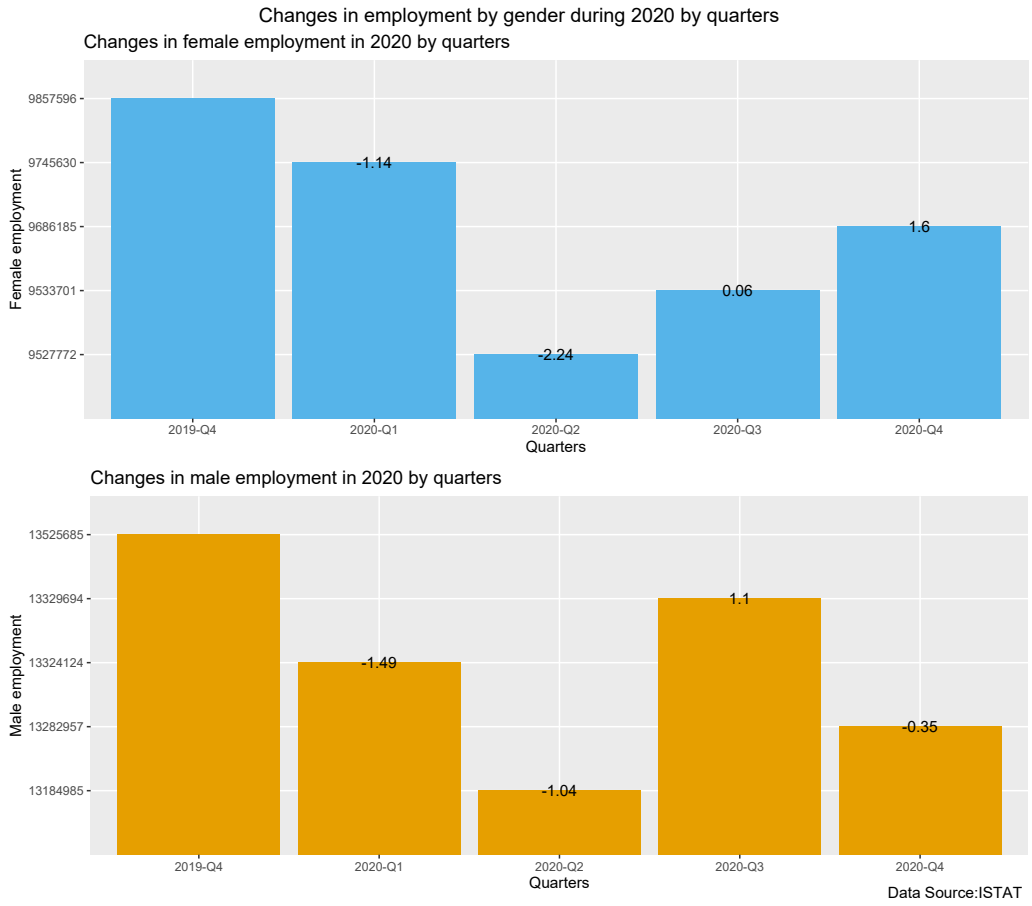


Figure 14: Employment changes by gender in Italy during 2020.

Looking at the impact on employment by gender in macrosectors (Figure 15), it is evident the decline in employment in the wholesale and retail trade, accommodation and food sectors. Within the service sector (Figure 16), accommodation and food, wholesale and retail trade, other services which include arts, entertainment and recreation, other service activities, including the activities of membership organisations, the repair of computers and personal and household goods and a variety of personal service activities, activities of households as employers, undifferentiated goods and services producing activities of households for own use, have been the most affected. The fall in employment in these activities is evident for the total, for men but with a deeper incidence for women in wholesale and retail trade and accommodation and food and other services. These are indeed the sectors in which female employment is concentrated, as evident from the macro-sectors values as well.

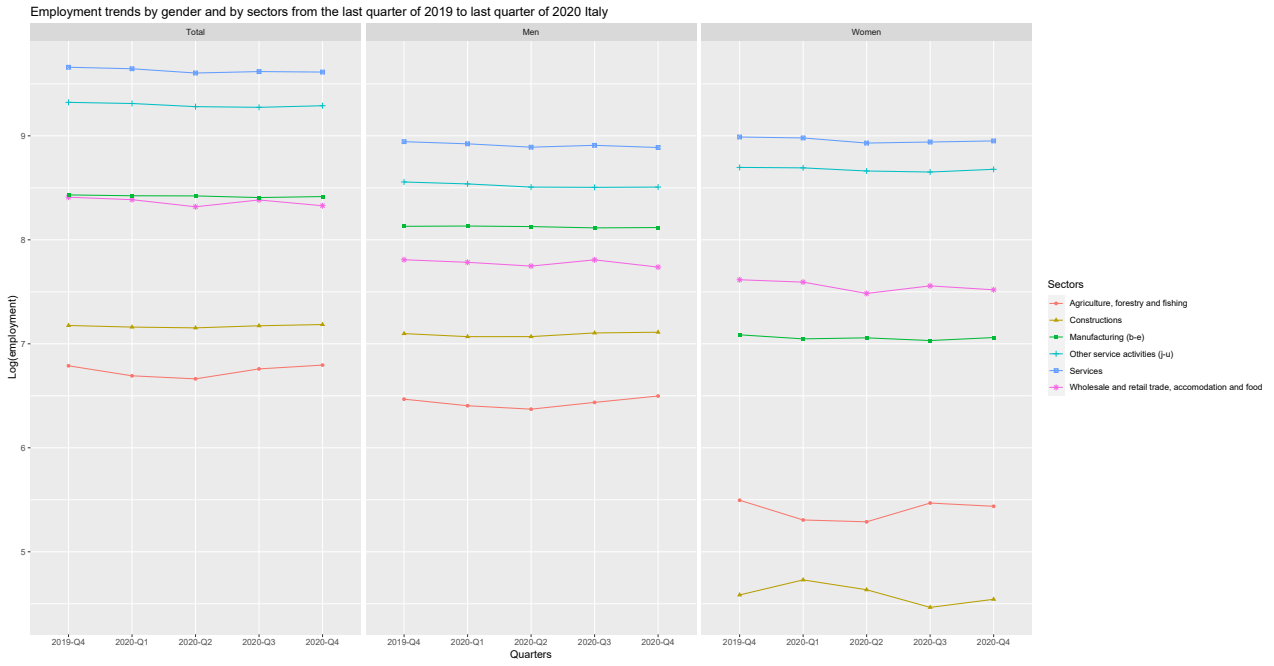


Figure 15: Employment trends by sectors and by gender during 2020. Data Source: ISTAT

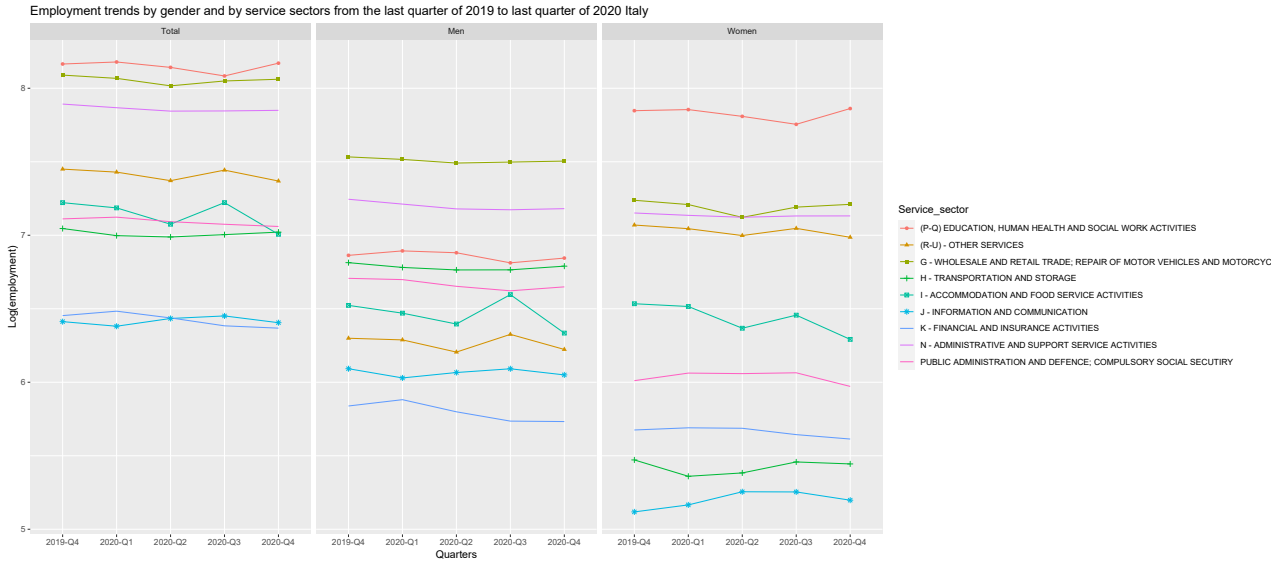


Figure 16: Employment trends in the service sector and by gender during 2020. Data Source: ISTAT

While exhibiting long-term memory patterns, typical of unit root variables, the analysis of autocorrelation functions is not enough to actually measure persistence in duration of negative shocks for labour market outcomes. In the next section, we are going to focus on the measurement of hysteresis in labour market outcomes for female workers and the extent to which a She-recession has occurred.

6 Detecting She-recession: loss functions and their distribution

6.1 Methodology

The evidence presented so far, although accounting for structural patterns and pandemic labour market effects, is still not conclusive of the extent to which a She-recession has occurred. We advance therefore with a direct measurement of losses in line with the methodology proposed by Fazzari and Needler (2021). The indicator measures whether the impact of the Covid-19 crisis has been disproportionate for a given gender category. We compute such statistics for employment losses, structural unemployment and inactivity with respect to the pre-recession trends. Focusing on the female employment impact, we then analyse heterogeneity across levels of education and regional distribution. Our statistics, being loss functions, assess the *depth, duration and diffusion* of the Covid-19 crisis, and in that allow to account for the severity of the event in a hysteresis type of framework, measuring deviations and duration of such deviations from the pre-crisis trend. In addition, we look for differentiated impacts by regional and educational distributions.

We improve the methodology of Fazzari and Needler (2021) by (i) capturing hysteresis on the Italian labour market by considering structural unemployment and inactivity other than employment; by (ii) adopting a long run perspective filtering the data with a trend starting in 1993 in order to account for long-run deviations from existing trends, while Fazzari and Needler (2021) apply a short run trend; (iii) by adopting the Christiano-Fitzgerald filter instead of a linear trend. The Hodrick Prescott filter is applied as a robustness check.

In order to compute the key statistic, we follow six main steps:

1. *prior-recession peak and trough identification.* We firstly define the recession period

following the three main criteria adopted by the NBER[5]: *depth, duration and diffusion.*

As cited by Claessens et al. (2009), *"a recession begins just after the economy reaches a peak of activity and ends as the economy reaches its trough"*. In terms of *depth*, a recession can be defined as severe when output declines more than 3.15%; its *duration* is defined between the first peak and the first trough, namely by the time span between the first decrease of -3.15% (or more) and the first increase grater or equal to +3.15% (Claessens et al. (2009)). To address *depth* and *duration*, we identify the prior-recession peak and the first trough looking at GDP growth, following NBER Business Cycle Dating Committee guidelines.

Figure 17a shows the *annual trend variation* of GDP growth (grey line) and of total employment (dashed line) between the last quarter of 2019 and the second quarter of 2021 with respect to the correspondent quarter of the previous year. In addition, we also show the cumulative variation of GDP in order to give an account of the persistent negative dynamics of the variable. The prior-recession peak is the last quarter of 2019 since the first drop is lower than -3.15% (-6.36%) and occurs during the second quarter of 2020. The trough is the last quarter of 2020, since the first trend variation over +3.15% is the first quarter of 2021. The end of the recession is then the last quarter of 2020 (2020-Q4). Total employment follows the annual trend variation of GDP.

Figure 17b shows the cyclical variation of GDP growth (grey line) and employment (dashed line), namely the percentage change with respect to the previous quarter, together with the cumulative GDP variation (red bars). Despite the cumulative cyclical variation is still negative, the GDP growth increases by about 14% during the third quarter of 2020, thus the trough is the second quarter of 2020 (2020-Q2).

Therefore, we identify the last quarter of 2019 as the pre-recession peak and the last quarter of 2020 as trough with respect to the trend, while the second quarter of 2020 with respect to the cyclical variation. Estimates are pursued using both time spans.

As a result, (i) the identification of the peak and the trough explains the *duration* of the recession, to define the time span of the impact of the Covid-19 crisis on the Italian labour market (longer for annual trend with respect to cyclical variations);

[5]NBER Business Cycle Dating Committee guidelines

(ii) the identification of the peak and the trough with respect to the severity of GDP growth variation explains the *depth* of the recession, while actual data of the variables of interest at the peak signal the proportionality of the impact for the category of worker we are considering; (iii) comparing employment, structural unemployment, inactivity and female employment by education and by regions explains the *diffusion* of the recession.

2. *Isolation of trend and cyclic data components.* To capture the impact of the Covid-19 crisis, we look at the differences between actual and filtered data over the defined recession period. In particular, the filter captures the state of the economy in the previous phase. However, the trend is calculated over a long-run horizon, starting in 1993 in order to account for any hysteretic patterns in the series analysed, in line with the evidence presented in Section 3.

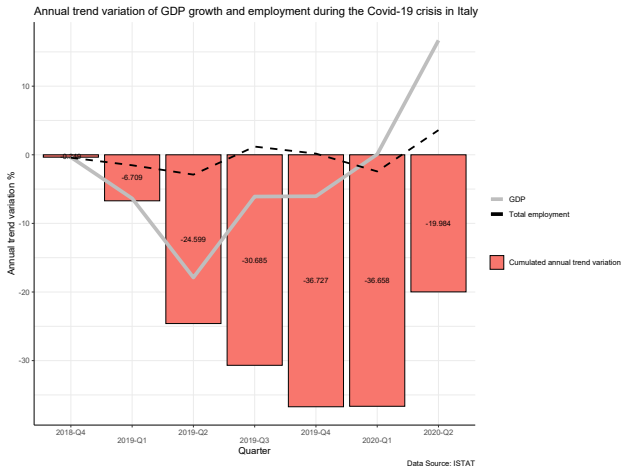
   Each time series is filtered by the Christiano-Fitzegerald filter (CF from now on), to detach the trend from the cycle, namely the variation from trend as a consequence of shocks. The Hodrick-Prescott filter (HP from now on) is applied as a robustness check (description and estimates are provided in the Appendix), since the HP extracts a trend that is comparable to the linear trend adopted by Fazzari and Needler (2021) in our case, so it allows us to make a comparison and robustness checks.[6]

   The CF filter decomposes a time series $\{x_t\}_{t=1}^{T}$ into its trend and cyclical components. Assume we have a stochastic process

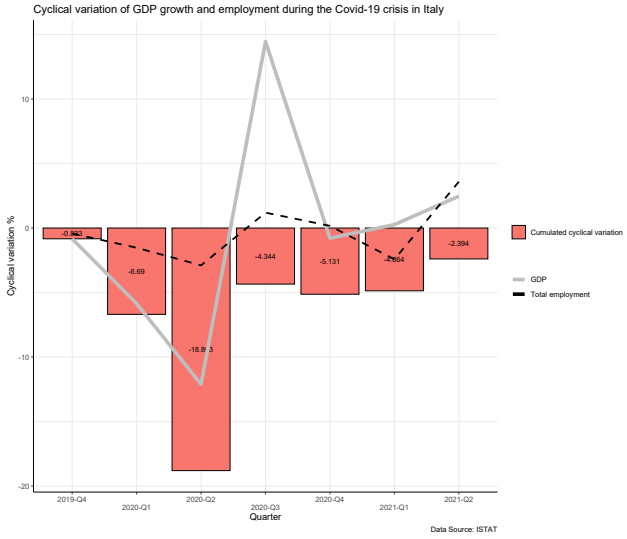
$$x_t = y_t + \bar{x}_t \tag{1}$$

   where y_t is a process oscillating between $2 < p_l < p_u < \infty$ and the frequencies for which y_t has power are limited to $\{(a, b) \bigcup (-a, -b)\} \in (-\pi, \pi)$ where $a = \frac{2\pi}{p_u}$ and $b = \frac{2\pi}{p_l}$. For what concerns our analysis, $p_l = 6$ and $p_u = 32$, since cyclical components in a

[6] According to Christiano and Fitzgerald (2003), for what concerns the analysis of business cycles with quarterly data, there are no big differences between their method and the HP filter, which is widely used in the literature to analyse economic phenomena with quarterly data (Christiano and Fitzgerald (2003), Baxter and King (1999)). We did not use the Baxter-King filter since it dropped some observations at the beginning and at the end of the sample and given that in our time series the end of the sample corresponds to the Covid-19 crisis we can't drop these observations.



(a) Pre-recession peak identification: trend variation of GDP growth and employment with respect to correspondent quarter of previous year (from 2019-Q4 to 2021-Q2 with respect to 2018-Q4 and 2020-Q2)



(b) Pre-recession peak identification: cyclical variation of GDP growth and employment with respect to previous quarter between 2019-Q4 and 2021-Q2

Figure 17

business cycle last from a minimum of six quarters (18 months with monthly data, 1.5 years with annual data) and a maximum of 32 (96 months, 8 years) hence $a = \frac{2\pi}{32}$ and $b = \frac{2\pi}{6}$ (Baxter and King (1999), Christiano and Fitzgerald (2003), Hodrick and Prescott (1997)). $\bar{x}_t$ is a process oscillating in the complement interval in $(-\pi; \pi)$ (Fitzgerald and Christiano (1999)). The CF filter approximate y_t with $\hat{y}_t$, a filter that is a linear function, a projection of y_t onto x_t of the raw data x_t: for $t = 1, ..., T$

$$\bar{y}_t = P[y|x] = \sum_{j=-f}^{p} \hat{B}_i^{p,f} x_{t-j} \tag{2}$$

where $f = T - t$ and $p = t - 1$. The weights are chosen to minimise the mean square error between y_t and $\hat{y}_t$, that is $\hat{B}_j^{p,f}$ solves

$$\min_{\hat{B}_i^{p,f}} \underset{j=-f,..,p}{E[(y_t - \hat{y}_t)^2|x]} \tag{3}$$

x_t is represented as a moving average of order q to avoid the filter to depend on time and non-stationarity of the series. As a result, we get two time series: a trend and a cycle, representing the deviations from the trend.

3. *Loss function definition.* We compute a loss function $\mathcal{L}$ comprehending the loss in employment, increase in structural unemployment and inactivity by gender and loss in female regional employment and by level of education as the cumulative sum of the CF cycle values:

$$\mathcal{L}_{x_{i_j}} = \sum_{t=Q1_{2020}}^{T} c_{x_{t,i_j}} \tag{4}$$

where $x = \epsilon, u, i$ is the labour market variable (employment, structural unemployment and inactivity), $i = g, e, r$ is the type of individuals we are analysing by gender, female education and female regional employment respectively, j is the category for each type namely $j = f, m$ for female or male for $i = g$ gender; $j = p, s, h, g$ primary, secondary, high or graduation level for $i = e$ female education; $j = n, c, s$ North, South or Centre of Italy for $i = r$ female regional employment. T is either the last quarter of 2020[7] or the second quarter of 2020.[8]

[7] 2020-Q4, if considering the trend variation of GDP to define the recession period (see step 1)
[8] 2020-Q2, if considering the cyclical variation to define the recession period, (see step 1).

4. *Share of each category over the total loss function.* We compute the percentage of the loss $\mathcal{L}_{x_{i,j}}$ for each j on total loss function for category i, $\mathcal{L}_{x_i} = \sum_{j=1}^{J} \mathcal{L}_{x_{i_j}}$

$$l_{x_j} = \frac{\mathcal{L}_{x_{i_j}}}{\mathcal{L}_{x_i}}\% \tag{5}$$

5. *Share of each category of total data at prior-recession peak.* We compute the share of each category j of type of individuals i for each variable over time x_t of actual data at the prior-recession peak $t = p$, the first quarter of 2019 (2019-Q4):

$$s_{x_{i_j}} = \frac{x_{p,i_j}}{x_{p,i}}\% \tag{6}$$

6. *Quarter loss (QL) indicator*[9]. We take the ratio between the share of losses l_{x_j} over the share of actual data of variable 2019-Q4 $s_{x_{i_j}}$:

$$QL_{x,i_j} = \frac{l_{x_{i_j}}}{s_{x_{i_j}}} \tag{7}$$

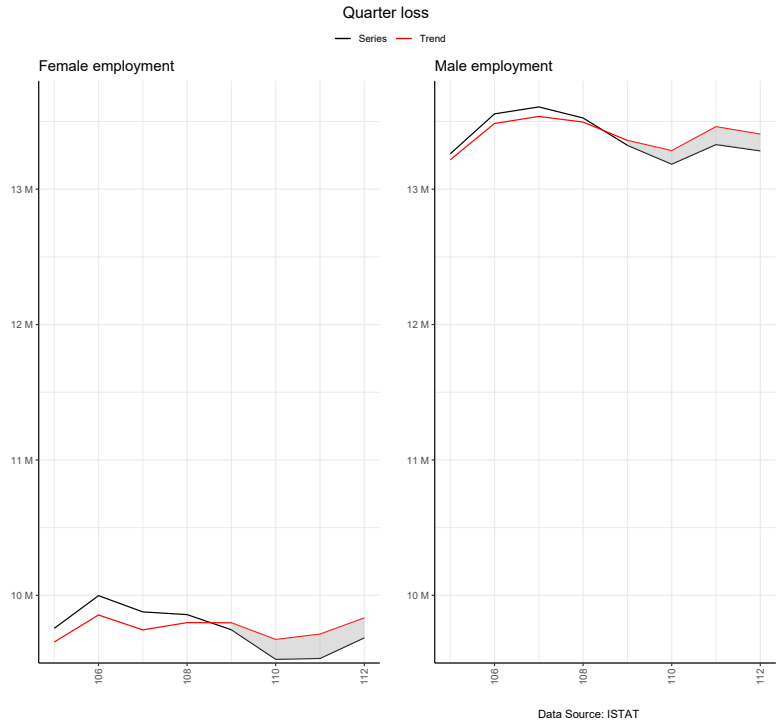
where the denominator captures the persistence in gender, educational and geographical inequality over time. The *quarter loss* is interpreted as follows:

$$\begin{cases} QL_{x,i_j} \in [0,1] & \text{impact of the crisis less than proportional} \\ QL_{x,i_j} > 1 & \text{impact of the crisis more than proportional} \end{cases} \tag{8}$$

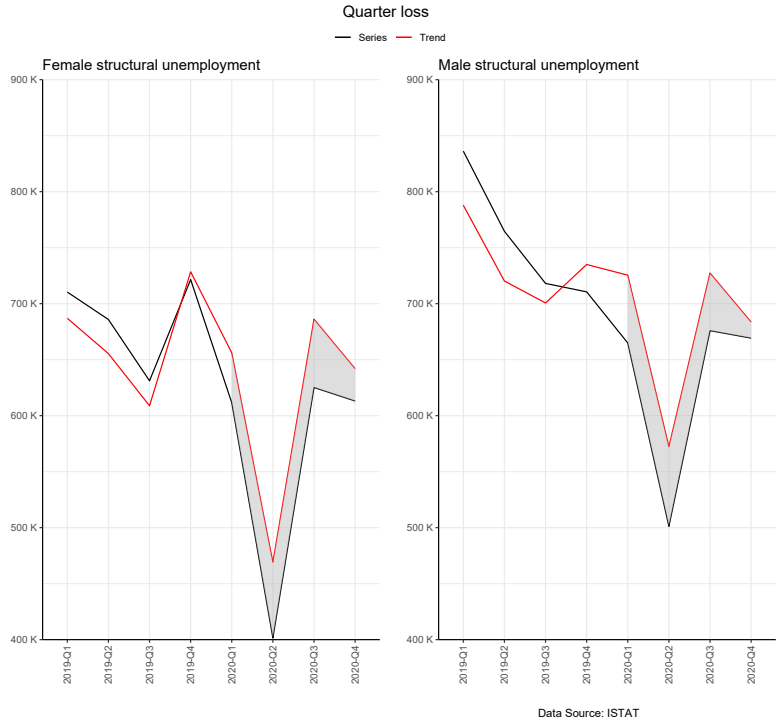
6.2 Results

In what follows, we provide the results of our estimation of loss functions. Figure 18 shows the female and male losses in employment, structural unemployment and inactivity, corresponding to the area in grey during the recession period between the prior-recession peak (2019-Q4) and the last quarter of 2020 (2020-Q4). Figures B.3, B.4 and B.5 in the Appendix show the quarter loss areas with respect to the 2020-Q2 trend. The area in female employment appears wider than for men, while for structural unemployment and inactivity there is no evident gender difference.

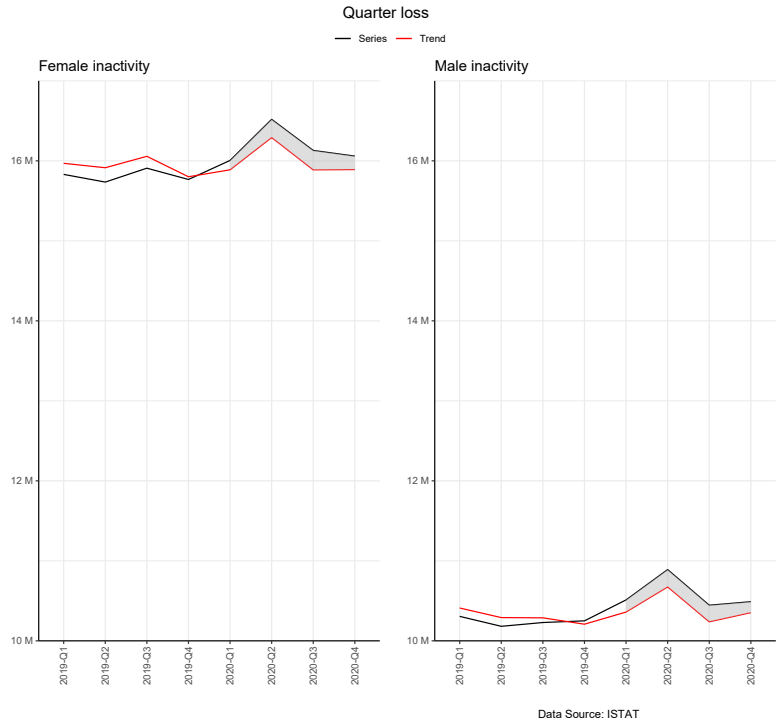
[9] Fazzari and Needler (2021) define their measure as *job monthly loss.*



(a) Filtered employment data by gender by the Christiano-Fitzgerald filter, *quarter loss* in grey.



(b) Filtered structural unemployment data by gender by the Christiano-Fitzgerald filter, *quarter loss* in grey.



(c) Filtered inactivity data by gender by the Christiano-Fitzgerald filter, *quarter loss* in grey

Figure 18

Table 4 reports the *quarter loss* (QL) indicator and the shares behind it. Column 1 highlights the trough of the recession period, 2020-Q2 or 2020-Q4, column 2 and 3 show the percentage by gender of the deviation from trend for women and men $l_{i,j}$ where $i = g$ corresponds to gender and $j = f, m$ f for female and m for male, the numerator of the QL indicator; Column 4 and 5 show the share by gender in actual data at the prior-recession peak $s_{i,j}$ which captures the persistence of gender differences in the Italian labour market over time being the denominator of the QL indicator. Column 6 and 7 report the QL indicator for female and male workers respectively.

According to our estimates, the Covid-19 crisis has an impact that is more than proportional for female employment, while less than proportional for men considering both recession periods. The job losses for women account for 42.905% when considering only the first two quarters of 2020 and 57.28% when considering all quarters of 2020 as recession duration. Being actual employment at the prior-recession peak 42.16% for women, the QL

ratio is slightly above 1 in the first case (1.018) and quite consistently above 1 (1.36) in the second case, signalling that with respect to the share of employment before the recession the job losses have been disproportionate for women. Results for structural unemployment are less straightforward: both female and male structural unemployment decrease and are lower than the trend values (see Figure 18b and Figure B.4 in the Appendix). The decrease has a higher impact on men considering the 2020-Q2 recession period, while both indicators are close to unity considering the 2020-Q4 recession period. Overall, it looks like that there are no relevant gender differences in the impact of the Covid-19 crisis on structural unemployment. The decrease in structural unemployment is mirrored in the increase in inactivity, especially for men. The indicators suggest that the impact is more than proportional for men, especially considering the first time span (see Figure 18c), while it is less than proportional for women. This is given by the high hysteresis in female inactivity: considering the second estimate, the loss function is higher for women, as the share at the prior-recession peak is 60.60% for women vis-à-vis 39.40% for men. The Hodrick-Prescott filter confirms the results (Table C1 in the Appendix).

Overall, considering (i) the disproportionate effect for female employment given the low pre-recession employment rate, (ii) the proportionate effect on women in inactivity given the high pre-recession inactivity rates, and (iii) similar losses in structural unemployment, the influence of the past and persistent gender asymmetries on the impact of the Covid-19 crisis actually represent an amplifier of the She-recession. The more than proportionate effect on male inactivity seems to support the evidence of high increase in male inactivity observed during the Covid-19 crisis (see Section 5.2).

6.3 By region and by education

Now, we present some evidence of the impact on female employment by region and by education level. Table 5 shows the job quarter loss for women in the North (n), Centre (c) and South (s) of Italy. Women from the South have suffered an impact more than proportional with respect to employed women in other regions, considering both time spans, during the first quarters of 2020 the impact has been more than proportional for women from the centre of Italy as well. Figure 19 shows the quarter loss areas.

Employment						
T	$l_{x_{g,f}}$	$l_{x_{g,m}}$	$s_{x_{g,f}}$	$s_{x_{g,m}}$	QL_f	QL_m
2020-Q2	42.905	57.095	42.157	57.843	1.018	0.987
2020-Q4	57.289	42.711	42.157	57.843	1.359	0.738
Structural unemployment						
T	$l_{x_{g,f}}$	$l_{x_{g,m}}$	$s_{x_{g,f}}$	$s_{x_{g,m}}$	QL_f	QL_m
2020-Q2	20.171	79.829	50.382	49.618	0.400	1.609
2020-Q4	50.564	49.436	50.382	49.618	1.004	0.996
Inactivity						
T	$l_{x_{g,f}}$	$l_{x_{g,m}}$	$s_{x_{g,f}}$	$s_{x_{g,m}}$	QL_f	QL_m
2020-Q2	35.214	64.786	60.603	39.397	0.581	1.644
2020-Q4	51.459	48.541	60.603	39.397	0.849	1.232

Table 4: Quarter loss in employment, structural unemployment and inactivity by gender considering both the second and the last quarter of 2020 as trough of the recession

Regional female employment									
T	$l_{x_{r,n}}$	$l_{x_{r,c}}$	$l_{x_{r,s}}$	$s_{x_{r,n}}$	$s_{x_{r,c}}$	$s_{x_{r,s}}$	QL_n	QL_c	QL_s
2020-Q2	12.21	24.73	24.73	54.69	22.24	23.07	0.22	1.11	2.73
2020-Q4	39.04	17.93	17.93	54.69	22.24	23.07	0.71	0.81	1.87

Table 5: Quarter loss for female employment in different macro regions of Italy

Figure 19: Regional female employment data filtered up to 2020-Q4 *quarter loss* in grey.

Table 6 shows the quarter loss in female employment with respect to education. Considering only the first two quarters of 2020 as recession period, the impact is more than proportional for women with primary and secondary education, with a QL indicator much higher than 1 (11.24 and 3.07 respectively). Women with graduation seem to gain jobs instead. On the other hand, the quarter loss is more than proportional for graduated women considering the entire time span, as for women with primary education. Results are shown in Figure 20 as well. The Hodrick-Prescott filter confirms the results (Table C2 and C3 in the Appendix) except for education patterns, showing the different sensitivity of the filters.

Female employment by education												
T	$l_{x_{r,p}}$	$l_{x_{r,s}}$	$l_{x_{r,h}}$	$l_{x_{r,g}}$	$s_{x_{r,p}}$	$s_{x_{r,s}}$	$s_{x_{r,h}}$	$s_{x_{r,g}}$	QL_p	QL_s	QL_h	QL_g
2020-Q2	22.87	65.48	19.47	-7.82	2.03	21.36	46.20	30.40	11.24	3.07	0.42	-0.26
2020-Q4	9.24	11.27	37.66	41.83	2.03	21.36	46.20	30.40	4.54	0.53	0.82	1.38

Table 6: Quarter loss in female employment by education level

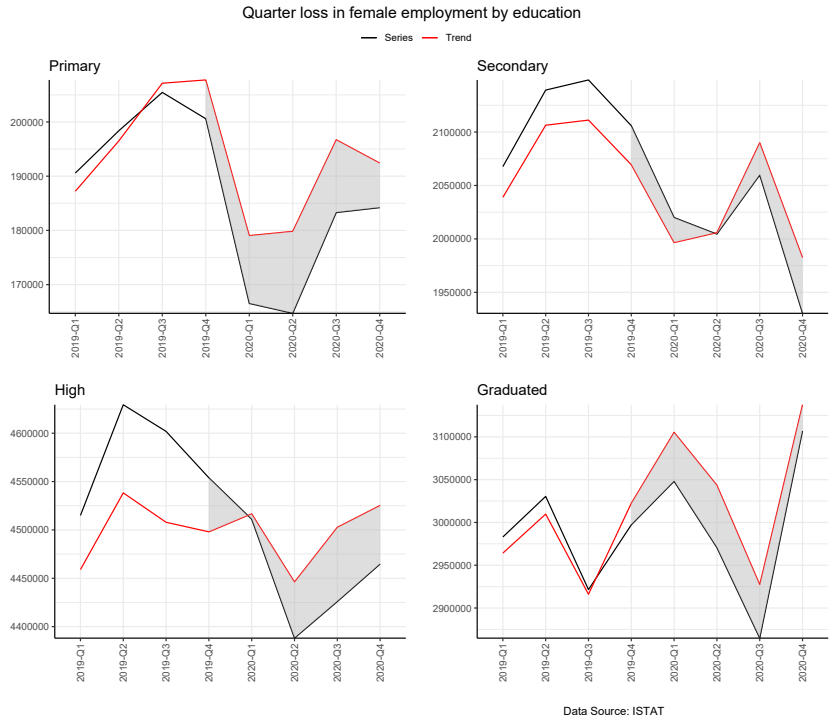


Figure 20: Female employment by education level, data filtered up to 2020-Q4 *quarter loss* in grey

6.4 Distribution of disproportionate effects

Lastly, we provide for the distribution of the QL indicator, checking how often it takes values above or below the unity in order to have a complete assessment of the range of its dispersion among different tests of disproportionality. Figure 21 shows the distribution of the indicator when considering the second quarter of 2020 as last quarter of the recession period (T=2020-Q2, on the left) vis-à-vis the last quarter of 2020 (T=2020-Q4 on the right),

and the distribution of all indicators as a third graph. Not surprisingly, the longest recession reports far larger extreme values than the short one. The distribution of all indicators is concentrated between 0.8 and 1.3. Disproportional values (larger than unity) are present but are also balanced by less than proportional ones, considering that we are including the all range of values of the indicator.

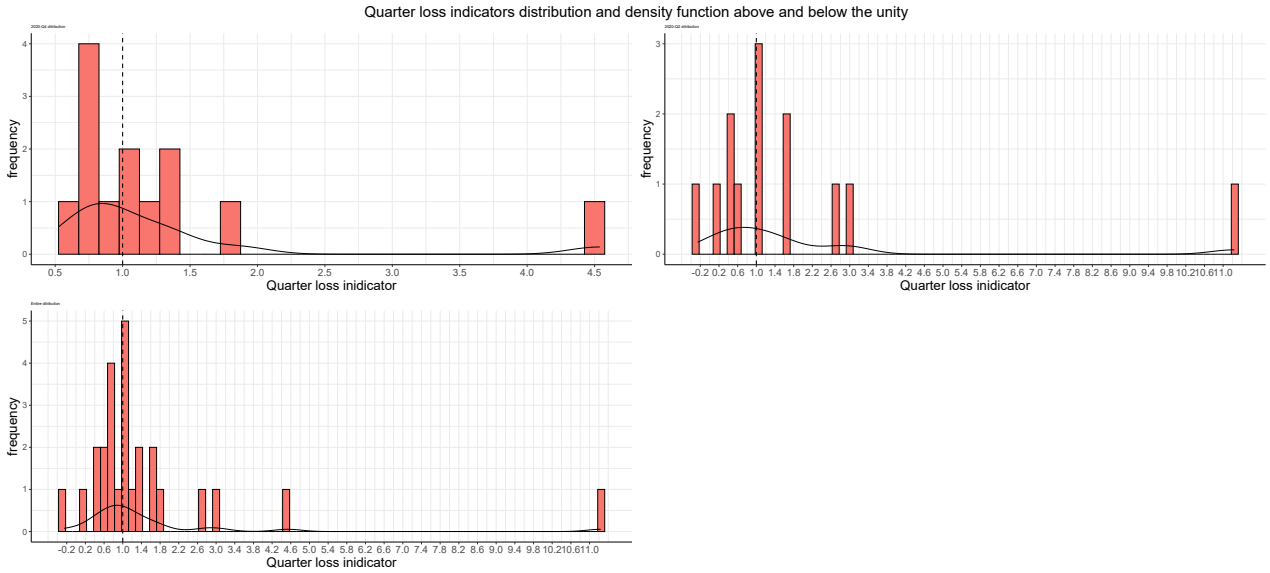


Figure 21: Quarter loss indicators distribution and density function above and below the unity

7 Conclusions

Since the Covid-19 economic crisis has been prompted by an unprecedented health emergency, it has impacted on the economic system in a complete different manner when compared to standard downturns: in particular, for the first time a stronger impact on female employment has been recorded, while during past recessions, male employment has shown much higher cyclicality (Man-recession). For this reason, the Covid-19 crisis has been defined as a She-recession, because of (i) the industry channel, for which the sectors hit the hardest by social distancing measures are characterised by high shares of female employment, and (ii) the childcare channel, i.e., school closures have increased the childcare burden especially on women because of gender norms, triggering transition to inactivity.

However, considering the impact of the recession in an isolated manner, without ac-

counting for pre-pandemic structural asymmetries in gender, geographical distribution and education, risks to undervalue the root causes of the recorded patterns during the pandemic. While the literature has widely documented gender imbalances in labour market outcomes, as the gender-pay gap and the lower female participation rate, matters of feminization of the labour markets have been less considered (Cetrulo et al. (2023)). Feminization of the labour market implies occupational segregation in low-paid activities, contractual segregation in temporary and fixed contracts, fragmentation of jobs. Intra-household, feminization implies gendered division of unpaid and care work and gendered norms, the latter reflected into high inactivity and low labour market female participation. In addition, although internationally a wide coverage has been devoted to document the She-recession, less evidence is available for Italy, and particularly with a perspective drawing upon long-term memory processes and hysteresis as fuelling amplifiers of "temporary" shocks.

This paper aims at measuring and explaining the gender differences in the impact of the Covid-19 crisis on the Italian labour market from a macroeconomic perspective by assessing the depth, duration and diffusion of the recession. In particular, we trace back to pre-existing and persistent gender asymmetries the roots of the She-recession. Our main findings suggest that hysteresis in gender asymmetries amplifies and affects the She-recession manifestation of the Covid-19 crisis, given the disproportionate impact on female employment and proportionate effect on female inactivity. In line with hysteresis in labour markets, women from the South and with lower education levels suffer an impact more than proportionate with respect to higher educated women, despite the impact on graduated women is more than proportional when considering all the quarters of 2020 as recession period. On the one hand, the impact on low educated women can be explained by the industry channel, since they are mostly employed in low value added activities mainly hit by the pandemic restrictions. A similar reasoning applies for women working in the South, being their activities concentrated in sectors subject to closures. For graduated women, the children channel could be an explanation. This is out of the scope of this paper, but worthy for further investigation.

Industry level, cross-country comparative analyses and measurement of long-lasting She-recession effects are further avenues of research together with a deeper accounting of the impact of feminization, largely intended both as a process occurring extra-household in the labour market, but even intra-household, with reference to gendered division of unpaid labour and effects of gender norms into participation to labour markets.

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Appendix

A The Hodrick-Prescott filter

Assume we have a time series

$$x_t = y_t + \bar{x}_t \tag{9}$$

Spectral analysis provides as instrument to obtain the component y_t, an *ideal bandpass filter*:

$$y_t = B(L)x_t \tag{10}$$

where $B(L) = \sum_{j=-\infty}^{\infty} B_j L^j$ is the filter, L is the lag operator and $B_j = \frac{sin(jb)-sin(ja)}{\pi j}$, $B_0 = \frac{b-a}{\pi}$ are the weights. However, the *the ideal bandpass filter* can be applied only if data are infinite. The implementation of the Christian-Fitzgerald and the Hodrick-Prescott (CF and HP from now on) starts from the necessity to have an instrument able to make this decomposition when data are finite. As a result, these filters apply an approximation of the ideal one (Fitzgerald and Christiano (1999)).

The HP filter has the aim to explain fluctuations of aggregate macroeconomic variables over the business cycle, from the long run path of growth (Hodrick and Prescott (1997)). Time series are represented as the sum of a growth and a cyclical component

$$x_t = g_t + c_t \qquad t = 1, ..., T \tag{11}$$

where growth changes smoothly and the cycle component is defined as the deviation form growth path. The aim is to minimise the smoothness of growth, that is:

$$\min_{\{g_t\}_{t=-1}^{T}} \left\{ \sum_{t=1}^{T} c_t^2 + \lambda \sum_{t=1}^{T} [(g_t - g_{t-1}) - (g_{t-1} - g_{t-2})]^2 \right\} \tag{12}$$

where λ is a penalty parameter, that is a positive number that the higher the variations in growth component the higher the penalty. Assuming the cycle component and the second difference of the growth component with zero mean and constant variances σ_1^2 and σ_2^2, the penalty parameter is defined as $\sqrt{\lambda} = \frac{\sigma_1}{\sigma_2}$. For quarterly data, Hodrick and Prescott consider a 5 percent cyclical component and $\frac{1}{8}$ of one percent change in growth rate in a quarter as moderately large, hence $\sqrt{\lambda} = \frac{5}{d\frac{1}{8}=40}$, that is $\lambda = 1,600$.

B Figures

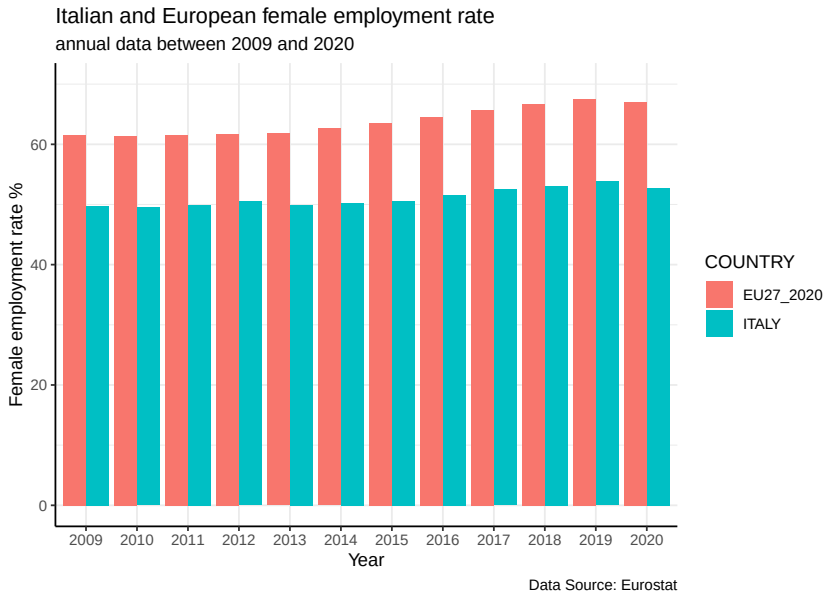

Figure B.1: Female employment rate, age 15 and over, comparison between EU-2020 (27 members) average and Italy. Data Source: Eurostat

Figure B.2: Cyclical and trend variation of the Italian GDP by quarters from 1996 to 2020

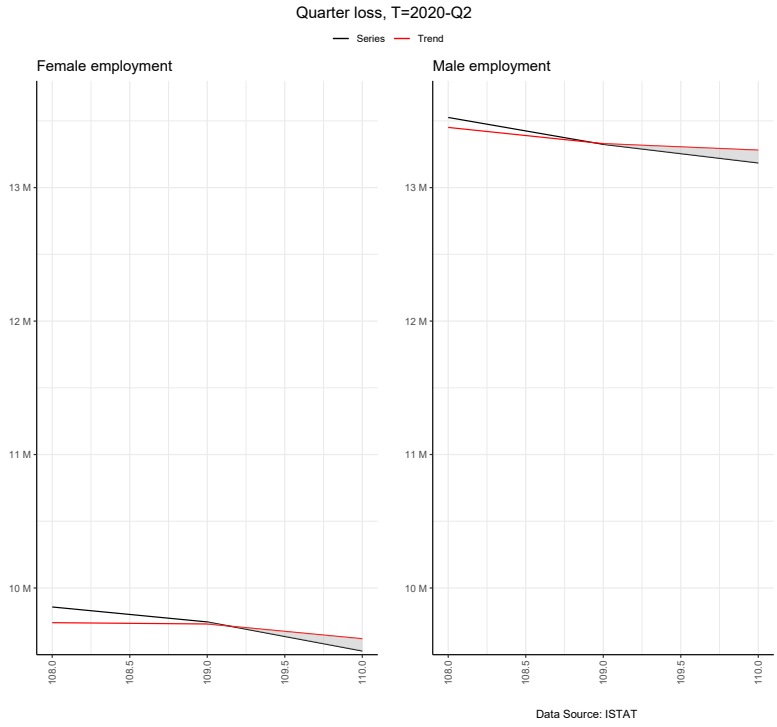

Figure B.3: Filtered employment data up to the quarter 2020-Q2 by gender by the Christiano-Fitzgerald filters, *quarter loss* in grey.

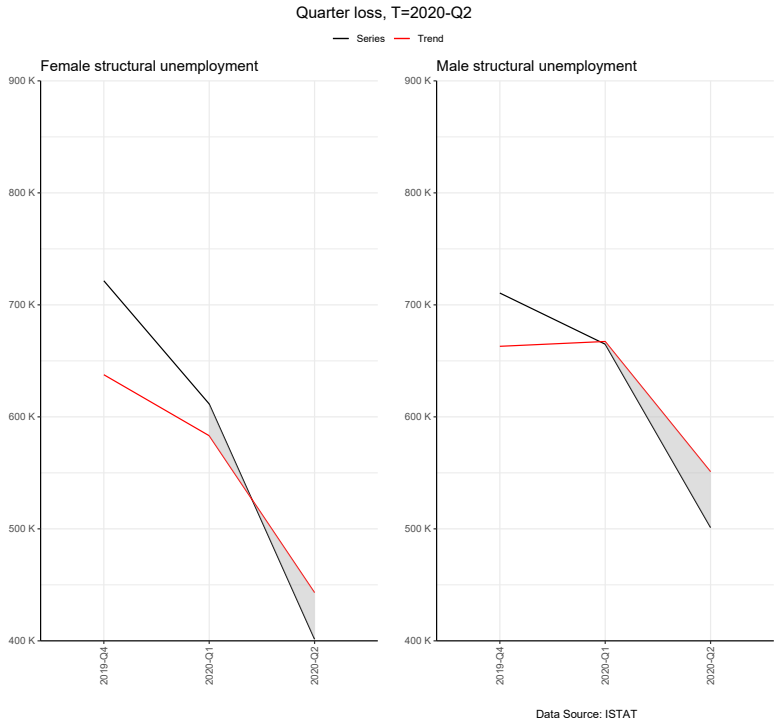

Figure B.4: Filtered structural unemployment data up to the quarter 2020-Q2 by gender by Christiano-Fitzgerald filter, *quarter loss* in grey.

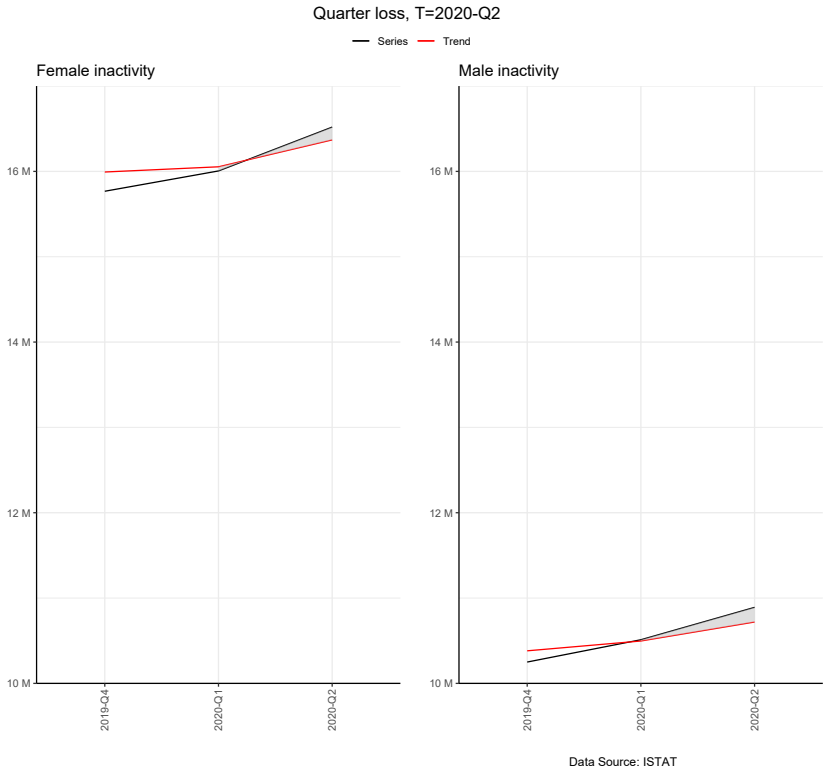

Figure B.5: Filtered inactivity data up to the quarter 2020-Q2 by gender by the Christiano-Fitzgerald filter, *quarter loss* in grey

C Tables

Table C.1: Quarter loss with respect to the Hodrick-Prescott filter in employment, structural unemployment and inactivity.

Employment

T	$l_{x_{g,f}}$	$l_{x_{g,m}}$	$s_{x_{g,f}}$	$s_{x_{g,m}}$	QL_f	QL_m
2020-Q2	47.878	52.122	42.157	57.843	1.136	0.901
2020-Q4	50.723	49.277	42.157	57.843	1.203	0.852

Structural unemployment

T	$l_{x_{g,f}}$	$l_{x_{g,m}}$	$s_{x_{g,f}}$	$s_{x_{g,m}}$	QL_f	QL_m
2020-Q2	52.880	47.120	50.382	49.618	1.050	0.950
2020-Q4	53.053	46.947	50.382	49.618	1.053	0.946

Inactivity

T	$l_{x_{g,f}}$	$l_{x_{g,m}}$	$s_{x_{g,f}}$	$s_{x_{g,m}}$	QL_f	QL_m
2020-Q2	50.840	49.160	60.603	39.397	0.839	1.248
2020-Q4	53.649	46.351	60.603	39.397	0.885	1.177

Table C.2: Quarter loss by Hodrick-Prescott filter for female employment in different macro regions of Italy

Regional female employment

T	$l_{x_{r,n}}$	$l_{x_{r,c}}$	$l_{x_{r,s}}$	$s_{x_{r,n}}$	$s_{x_{r,c}}$	$s_{x_{r,s}}$	QL_n	QL_c	QL_s
2020-Q2	40.696	22.715	22.715	54.691	22.239	23.070	0.744	1.021	1.586
2020-Q4	47.948	23.169	23.169	54.691	22.239	23.070	0.877	1.042	1.252

Table C.3: Quarter loss with respect to the Hodrick-Prescott filter in female employment by education level

Female employment by education

T	$l_{x_{r,p}}$	$l_{x_{r,s}}$	$l_{x_{r,h}}$	$l_{x_{r,g}}$	$s_{x_{r,p}}$	$s_{x_{r,s}}$	$s_{x_{r,h}}$	$s_{x_{r,g}}$	QL_p	QL_s	QL_h	QL_g
2020-Q2	7.639	33.874	33.360	25.127	2.035	21.363	46.197	30.405	3.754	1.586	0.722	0.826
2020-Q4	3.765	31.349	31.365	33.521	2.035	21.363	46.197	30.405	1.850	1.467	0.679	1.102