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Food purchasing behavior during the COVID-19 pandemic: Evidence from Italian household scanner data

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Abstract

This study analyses food and drink purchasing patterns of the Italian population after the onset of COVID-19 pandemic. Based on governmental restrictions at national and regional level, we explore changes in consumption behavior due to enacted restrictions. Several phenomena may have affected food and drink purchases: (i) closure of restaurants and bars, schools and workplaces necessary implies a shift towards home consumption of meals, hence a higher quantity of food and drink purchased for consumption at-home, due to substitution; (ii) fewer visits to stores because of stay at home restrictions and anticipation of potential food shortages may induce stockpiling and online shopping; (iii) the quality (as proxied by unit values) of purchased food may change because of fewer promotions and increased propensity to save money; (iv) increased time availability because of abridging commuting time and cancelling out-of-home leisure activities may cause a shift towards purchases of raw ingredients, and a decrease in purchases of ready meal and convenience foods; (v) increased psychological distress caused by imposed restrictions and negative news may increase emotional consumption of some food and drinks.
In order to test for the relevance of these factors, we use household scanner data on food and drink purchases in Italy, covering food weekly purchases and soft-drinks daily purchases for a panel of nearly ten thousand households over the years 2019 and 2020.

Keywords: Household scanner data, COVID-19, food consumption

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1 Introduction

The spread of COVID-19 disease has impacted people lives all over the world in many different ways. In 2020 only, the new coronavirus caused more than 1.8 million deaths, with over 83.5 millions registered infections worldwide (Dong et al., 2020).

Restrictions imposed by governments to cease the spread of the virus go from mild social distancing measures and obligation to wear a mask to full lockdowns, meaning closures of workplaces, schools and non-essential stores, and enaction of stay at home restrictions. Italy was the first country in Europe to enact strict public health measures following the surge of clusters of COVID-19 cases in northern regions. The Italian government imposed national lockdown on March 11, 2020[1], the very same day the Director General of the WHO declared COVID-19 a global pandemic. The strict lockdown in Italy lasted for ten weeks, until May 18. The second wave of COVID-19 cases started in October, leading to the establishment of targeted regional restrictions with different degree of severity expressed by a colour-coded system (yellow, orange and red with increasing severity of measures) based on a variety of indicators, such as basic reproduction ratio and rate of occupied beds in intensive care units. The colour-coded system was enacted on November 6, 2020; indicators were constantly monitored and targeted regions were reviewed every week.

During lockdown, the containment measures in place (e.g. stay at home restrictions, closure of schools, workplaces and restaurants) changed the lifestyle of the entire population. Among other behaviors, dietary habits and food and drink consumption were adjusted to the new situation. Therefore, the question

[1] See https://www.ecdc.europa.eu/en/covid-19/timeline-ecdc-response for a timeline of European responses to COVID-19.

arises as to how people adapt and change their food and drink consumption due to imposed restrictions. The aim of the present study is to explore whether and how restrictions for COVID-19 containment affected food and drink at-home consumption.

There are several issues that concur to changing food consumption. The first and perhaps most sizeable one – at least for some socio-economic groups – is substitution for out-of-home consumption. Food and drink stores are considered essential business and therefore remained open during lockdown. This does not apply to restaurants and bars, where on site and collective food and drink consumption are considered as riskier for the spread of the virus. Thus, restaurants and bars remained closed to the public or open with major restrictions for nearly half of the year in 2020. During these periods, potential eating out occasions had to be replaced by home meals, hence generating a non-trivial additional amount of food and drink purchases for at-home consumption. To appreciate the potential magnitude of this effect in Italy, one should consider that 48.7 percent of people aged 25-34 usually had lunch out of home in 2019 (ISTAT, 2019), that many children usually eat lunch in school canteens, and the curbing of tourism and leisure eating out occasions.

A second phenomenon that may have changed food consumption during lockdown is related to stay at home restriction and governmental recommendations, which advised to reduce visits to stores, recommending at most one shopping trip per week[2]. People were encouraged to purchase sufficient food and drink for seven days, therefore inducing a preference for durable foods and stockpiling. Moreover, news about potential food shortages may have triggered hoarding

[2]Italian Ministry of Health https://www.salute.gov.it/portale/news/p3_2_1_1_1.jsp?lingua=italiano&menu=notizie&p=dalministero&id=4299

behaviors and panic buying for some consumers (Lehberger et al., 2021). At the same time, stay at home restriction and fear of the virus may have caused a shift towards shopping for groceries online, to cut down social interactions.

Thirdly, food may have become relatively more expensive during lockdown, due to fewer promotions (i.e. unit values paid for food and drink may have increased), but at the same time, feelings of uncertainty about the future, job insecurity, economic instability and general pessimistic views might have boosted the propensity towards precautionary savings, which translates in attempts to lower food budgets. In Italy, the goal of extra savings represents the second most often cited reason for reducing consumption as a consequence of COVID-19 (Hodbod et al., 2020). One study conducted on a convenience sample found that COVID-19 pandemic increased the propensity to diminish consumption (Chirumbolo and Callea, 2021). Considering food and drink expenditures, savings may be generated by lower overall consumption, but also by lowering the quality of the products purchased, i.e. decreasing the unit value of food bought.

As a fourth issue, closure of workplaces and incentives to work from home led to abridge commuting times; similarly, stay-at-home orders and cancellation of public events, together with closures of gyms, theatres and other entertainment venues, increased free time availability. Some of the extra-time was employed in cooking activities, as captured by the boom of Google searches for the term "receipt" (Google Trends) and by supermarkets running out of flour and yeast stocks. Therefore, the lockdown periods have potentially caused a shift towards purchases of raw ingredients, and a decrease in purchases of ready meals and convenience food.

Lastly, imposition of public health restrictions concerning social distancing and

stay-at-home may have led to isolation and perceived limitation on personal freedom; exposition to worrying news and fear of COVID-19 potential adverse health effects, coupled with insecurity about the future economic and job conditions, are major contributors of psychological distress (Pfefferbaum and North, 2020). Coping with psychological distress may induce unhealthy behaviors, such as overeating, undereating or emotional consumption of foods and drinks, e.g. foods high in sugar and fats, alcoholic and sugary drinks (Garg et al., 2007).

We focus on food and drink consumption in 2020 and analyse changes in purchases contextually to imposed COVID-19 restrictions. We also analyse purchase patterns for sub-groups of the population, as the – perceived and actual – economic effects of the pandemic vary by income, age and geography (Remes, 2021).

Available studies about COVID-19 pandemic effect on food consumption in Italy are mostly based on sample surveys and self-reported behaviors, or highly aggregated secondary data. For instance, Prete et al. (2021) studied changes in dietary habits due to COVID-19 lockdown and found that nearly half of respondents increased their consumption of foods containing added sugars and saturated fats. Castellini et al. (2021) explored how psychological reactions to COVID-19 emergency affected intention to purchase sustainable food products and found evidence that the pandemic has increased interest in animal and environmental issues and human health. On the other hand, Bonaccio et al. (2021) analyzed changes in ultra-processed food intakes during lockdown and found increased consumption for more than one third of the population. Studies from Di Renzo et al. (2020) and Russo et al. (2021) focused on the psychological dimension of food habits, Cavallo et al. (2020). provide a descriptive overview

of main consumption patterns during COVID-19 pandemic in Italy using aggregate secondary data. To the best of our knowledge, there are no studies for Italy providing a comprehensive overview of changes in food-related behaviors based on household-level (scanner) data. The study from O'Connell et al. (2020) examines food spending dynamics in the pre-lockdown period in the UK, based on household scanner data. We partially follow their approach for our descriptive analysis by food categories.

2 Data

Our analyses is based on household-scanner recorded purchases of all packaged food and drink purchases made by a representative sample of households in Italy over a period of two years, 2019 and 2020. The data were acquired from The Nielsen Company (Italy). The sample includes around 9,400 unique households; each household in the Nielsen panel records all food and drink purchases brought home through an hand-held scanner and answer a questionnaire about socio-demographic characteristics once a year. Panellists receive vouchers for their continued participation.

The raw data are organized into two different datasets: dataset A contains aggregated weekly purchases for all food and drink product categories (i.e. total weekly amount purchased by each household, for each food category); dataset B contains non-alcoholic drink purchases only (except water) at the transaction level.

Each row in dataset A contains information about amount (in kg or litres), expenditure in Euros, number of items purchased, purchase channel (e.g. hy-

permarket, supermarket, local store), and indication of whether the purchase was made online. In dataset B, we have additional information concerning the specific product, such as price, brand, package size, material of the packaging (i.e. glass, tin, plastic, paper box), indication of whether the product is a multi-pack, and a binary variable indicating whether the product was on promotion. For each household, a selection of socio-demographic information is available: household size; number of children under fifteen years old; Italian region of residence; per-capita class of income; age class of the main person in charge of food purchases. Descriptive statistics of the sample, for each of the two years and for each dataset, are displayed in Table 1.

Nielsen household scanner data include only purchases of food and drinks brought home. The share of food and drink consumption made out of home (e.g. in restaurants and bars, snacks from vending machines) is not recorded.

2.1 Food and drink categories

Food and drink products are classified into 360 categories ("ecr3" level, Dataset A). Two higher aggregation level exist, by sector (ecr2, 58 different sectors) and by area (ecr1, 7 levels: ambient food, chilled food, frozen food, drinks, fruit and vegetables, meat, and fish). We define storable goods as comprising ambient and frozen foods, which have a relatively long expiration date, e.g. canned products, rice and pasta, cookies, flour, sauces, bread, frozen vegetables. Perishable foods are fresh and chilled foods, with a shorter expiration date, like fruit and vegetables, dairy, meat, fish, refrigerated ready meals[3]. We aggregate the original ecr3 categories based on the European Classification of Individual

[3]However, only packaged products are included in the dataset, e.g. fruit and vegetables purchased in bulk, or meat purchased from the butcher shop are not included.

Table 1. Descriptive statistics.

	Dataset A		Dataset B	
	2019	2020	2019	2020
Age				
$<= 34$	9.67%	9.83%	9.45%	9.74%
$35 - 49$	32.30%	32.24%	32.78%	32.64%
$50 - 64$	31.96%	32.06%	32.37%	32.39%
$>= 65$	26.07%	25.86%	25.40%	25.24%
Income (per capita €/month)				
1^{st} Quartile ($<= 683$)	21.99%	21.64%	22.07%	21.59%
2^{st} Quartile ($684 - 1141$)	31.28%	31.42%	31.67%	31.73%
3^{st} Quartile ($1142 - 1670$)	29.49%	28.67%	29.48%	28.70%
4^{st} Quartile (> 1670)	17.24%	18.26%	16.78%	17.97%
Area of residence				
North-west	28.64%	28.57%	28.52%	28.56%
North-east	20.03%	19.97%	20.10%	20.01%
Centre	22.61%	22.51%	22.59%	22.45%
South and islands	28.72%	28.95%	28.79%	28.99%
Household members	2.56	2.55	2.59	2.58
	(1.16)	(1.17)	(1.16)	(1.16)
Number of children	0.25	0.25	0.26	0.26
	(0.44)	(0.44)	(0.44)	(0.44)
Average unit value/price* (€/Kg / €/L))	3.96	3.88	1.40	1.45
	(39.87)	(7.81)	(1.01)	(1.13)
Volume (per capita kg/L / week)	6.88	7.73	0.60	0.64
(all weeks)	(10.29)	(10.97)	(1.64)	(1.72)
Expenditure (per capita €/week)	16.77	19.29	0.67	0.74
(all weeks)	(18.98)	(21.43)	(1.68)	(1.81)
Av. number of weeks per household	40.22	41.20	16.07	16.85
(weeks with effective purchases)	(11.07)	(11.65)	(11.51)	(11.77)
Volume (per capita kg/L / week)	9.30	10.38	2.05	2.12
(only weeks of effective purchases)	(10.99)	(11.58)	(2.50)	(2.58)
Expenditure (per capita €/week)	22.66	25.90	2.30	2.42
(only weeks of effective purchases)	(18.80)	(21.11)	(2.45)	(2.58)
Number of households	9,340	9,357	8,963	9,007

Standard deviations in parentheses. Per capita volumes and expenditures are obtained using the OECD modified equivalence scale (Hagenaars et al., 1994)
* Unit value for dataset A, shelf product price for dataset B

Consumption according to Purpose - ECOICOP[4]. We consider two levels of aggregation, the first level has six categories, while a second, more disaggregated level, has eighteen categories. Correspondence between our classification and ECOICOP codes is displayed in Table 2. Throughout the article, we will use these classifications alternatively, depending on the specific purpose of analysis;

[4]Available at: https://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_CLS_DLD&StrLanguageCode=EN&StrNom=COICOP_5&StrLayoutCode=HIERARCHIC#

Table 2. Food category classification - correspondence with ECOICOP.

1st level aggregation	2nd level aggregation	ECOICOP
	Food	
Cereals, bread and pasta	Cereals, bread and pasta	1.1.1
Meat & fish	Meat	1.1.2 except 1.1.2.7
	Cold cuts	1.1.2.7
	Fish	1.1.3
Dairy, eggs and fats	Milk and yogurt	1.1.4.1 – 1.1.4.4, 1.1.4.6
	Cheese	1.1.4.5
	Eggs	1.1.4.7
	Oils, butter and fats	1.1.5
Fruit & vegetables	Fruit	1.1.6.1, 1.1.6.2, 1.1.6.4
	Snacks, dried fruits, nuts and crisps	1.1.6.3, 1.1.7.5
	Vegetables	1.1.7.1 – 1.1.7.3, 1.1.7.6
	Potatoes	1.1.7.4
Confectionery & N.E.C.	Sugar, chocolate and confectionery	1.1.8
	N.E.C.	1.1.9
	Coffe and tea powder	1.2.1
	Drinks	
Drinks	Water	1.2.2.1
	Softdrinks and juices	1.2.2.2, 1.2.2.3
	Alcoholic drinks	2.1

we will also focus on specific ecr3 food categories[5].

2.2 Non-alcoholic drink data

Only for the sub-set of non-alcoholic drinks except water (Dataset B) data are available at the barcode and transaction level, i.e. the maximum possible disaggregation, together with information on day and time of the purchase for each household.

2.3 COVID-19 pandemic evolution

Italy was the first European country to enact a national lockdown, communicated by the Prime Minister on March 9, 2020, and effective from the subsequent day. Prior to this, local lockdowns were enacted in selected municipalities and

[5]The full list of ecr3 categories, and correspondence with our classification and ECOICOP is available upon request to the corresponding author.

regions, based on the spread of the disease[6], starting February, 23. Table 3 displays COVID-19 main regulations enacted in 2020.

The definition of lockdown comprehends: stay-at-home requirement and restriction on movements, quarantine for people tested positive and close contacts, closure of non-essential commercial activities and workplaces, school closure, people gathering not allowed. The lockdown in Italy was gradually lifted starting May 4, when "phase two" begun and the stay-at-home requirement was loosened. From May 18, the main restrictions were lifted and non-essential shops, restaurants and bars opened. Contagions during summer 2020 remained low, but started to increase again in October. Therefore, new restrictions came into place in October; on November 6, a colour-coded zoning system was adopted, this allowed to enact regionally targeted restrictions based on local health indicators.

Table 3. COVID-19 main regulations timeline in 2020.

Date	Regulation
January, 31	First public information campaign, start of testing and contact tracing for suspected cases
February, 21	Mandatory quarantine for COVID-19 tested positive
February, 23	Lockdown in eleven municipalities of northern Italy
March, 4	National school closure
March, 8	Lockdown in 26 provinces of northern Italy
March, 10	National lockdown
May, 4	Gathering small number of people allowed, stay at home requirement loosened, parks opened
May, 18	Shops, restaurants and museum opened, no restriction on gatherings
May, 25	Gyms, swimming pools opened
June, 3	No restriction on movements
June, 15	Theatres and movie theatres opened
October, 14	Restrictions on bars and restaurants
October, 23	Targeted restrictions on gatherings, shops, schools, gyms and theatres, and curfew
November, 6	National curfew at 10pm and regional colour zoning system implemented
December, 24-27,31	Italy red zone

[6]List of COVID-19 related regulation available here: http://www.salute.gov.it/portale/nuovocoronavirus/archivioNormativaNuovoCoronavirus.jsp?lingua=italiano&area=213&testo=&tipologia=DECRETO%20DEL%20PRESIDENTE%20DEL%20CONSIGLIO%20DEI%20MINISTRI&giorno=&mese=&anno=&btnCerca=cerca&iPageNo=3

For the purpose of this study, we link purchase data at the weekly (dataset A) or daily (dataset B) level with variables referring to restrictions in place in each region and day, exploiting variation over time and among households living in different areas. We consider stay at home requirements and restaurants and bars closure, under the assumption that these measures have the higher impact on food and drink consumption. Table 4 shows the levels of restrictions that we consider in our analysis; level zero for restaurants and bar closure coincides with the pre-pandemic period, as visits to bars and restaurants never returned to pre-pandemic conditions. Even during the summer there were mild restrictions in action, such as the requirement to wear a mask when leaving the table, while level zero for stay-at-home requirements is also observed post-pandemic.

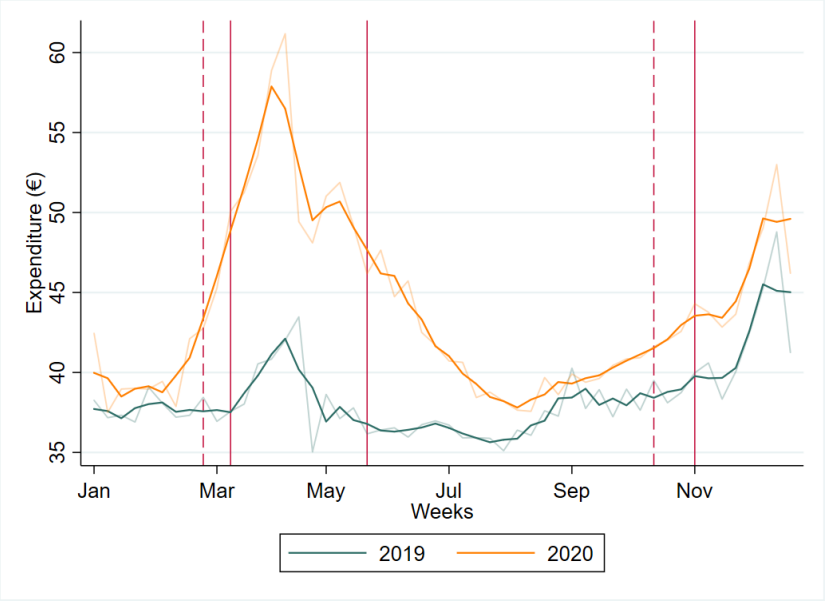
Table 4. COVID-19 regulations: variables used.

Regulation	Levels
Restaurants and bars	0= no measures; 1= open with sanitary measures (mask/hand disinfection); 2= open with strong restrictions (opening time/maximum number of people per table/only eat outside); 3= open only for take away/delivery.
Stay at home	0= no measures; 1= recommend not leaving house; 2= require not leaving house with exceptions for daily exercise, grocery shopping, and 'essential' trips; 3= require not leaving house with minimal exceptions (eg allowed to leave once a week, or only one person can leave at a time, etc).

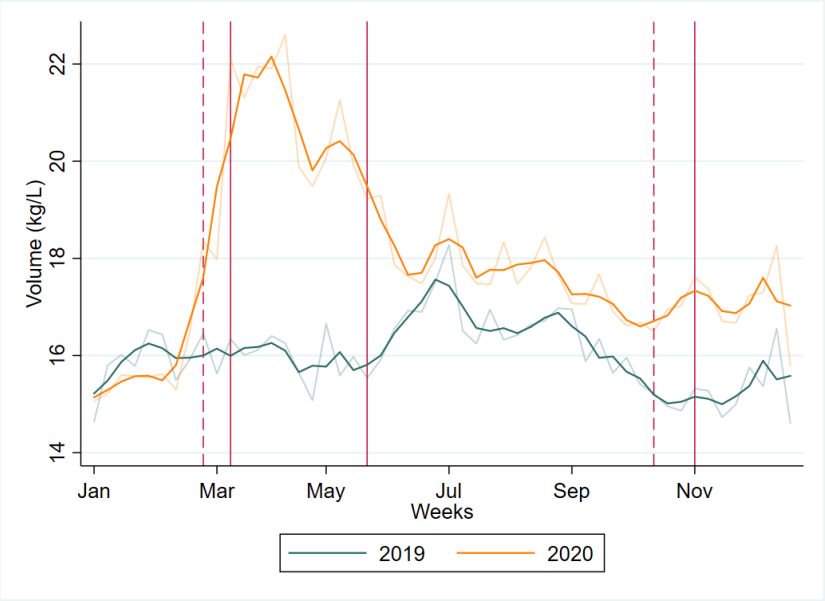
3 Purchase dynamics

This section displays and compares purchase dynamics across the two years: we observe expenditures, purchase volumes and unit values paid in 2020 and compare them with those in the pre-pandemic year 2019, also exploring how they vary by socio-economic group and food category. We focus on the first national lockdown, from March 9, 2020 to May 18, 2020.

Figure 1 displays average household weekly food and drink expenditure (a), and average purchase volumes (b); both expenditure and volumes were considerably higher during the first lockdown, relative to the same period in 2019. Since mid-February 2020, expenditures and volumes remained consistently higher than their levels over the corresponding week in 2019, even after the end of the lockdown period. Therefore, the pandemic – and related restrictions – has increased the amount of, and expenditure for, food and drinks for at-home consumption.



(a) Average household weekly food and drink expenditure by year.

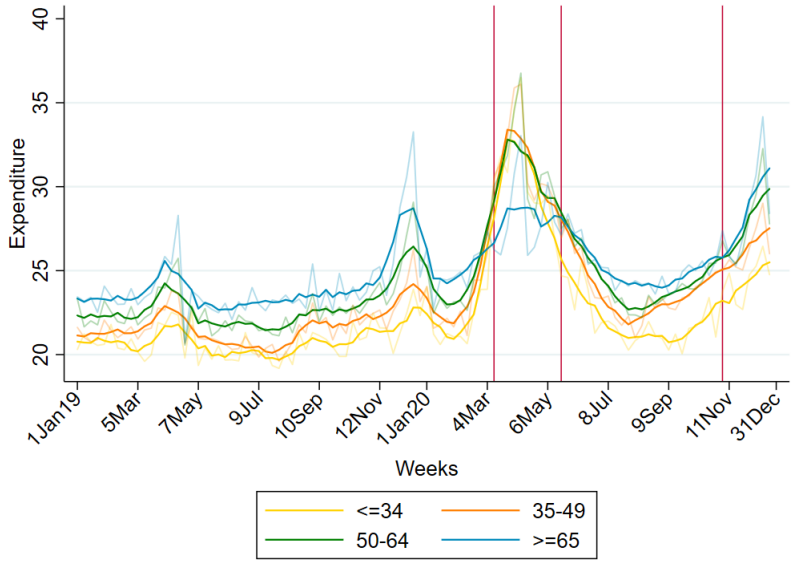


(b) Average household weekly food and drink consumption by year.

Figure 1: (a) Average household weekly food and drink expenditure by year. (b) Average household weekly food and drink consumption by year. For (a) and (b): Thick lines: Running-mean smoothed weekly values (bandwidth 5%). Faded lines: weekly values, non-smoothed. The period between solid vertical red lines corresponds to the national lockdown, from Monday, March 9 until Sunday, May 17. The solid red line in November indicates the beginning of the colour-coded zoning system. Dashed lines refer to the beginning of some imposed restrictions: February, 24 and October, 12.

Although this finding holds at the aggregate level, it may conceal differences by socio-economic groups. We compare expenditures over the two-year period by household income, presence of children and geographical area of residence; graphs are displayed in Appendix A and display a similar increase in expenditure by geographical area of residence and income, and a relatively higher increase in per capita expenditure for households with children, compared to households without children. The expenditure pattern by age of the main shopper, displayed in Figure 2, is particularly interesting. We observe a uneven increase in per capita expenditure by age class during the national lockdown, particularly between households led by under 34 and over 65 years old individuals. The latter group increased expenditure to a lesser extent, when compared with other groups. The average increase in weekly expenditures during the lockdown period in 2020, compared to the same period in 2019, was 89% for those households whose person responsible for food purchases is aged under 34, 74% for ages between 35 and 49, 57% for ages between 50 and 64, and 29% for those aged over 65. Therefore, younger families and young singles show the greatest increase in expenditure, meaning that the lockdown profoundly changed their eating patterns.

Figure 2: Average per capita weekly food and drink expenditure by age.



Thick lines: Running-mean smoothed weekly expenditure (bandwidth 5%).

Faded lines: weekly expenditure, non-smoothed

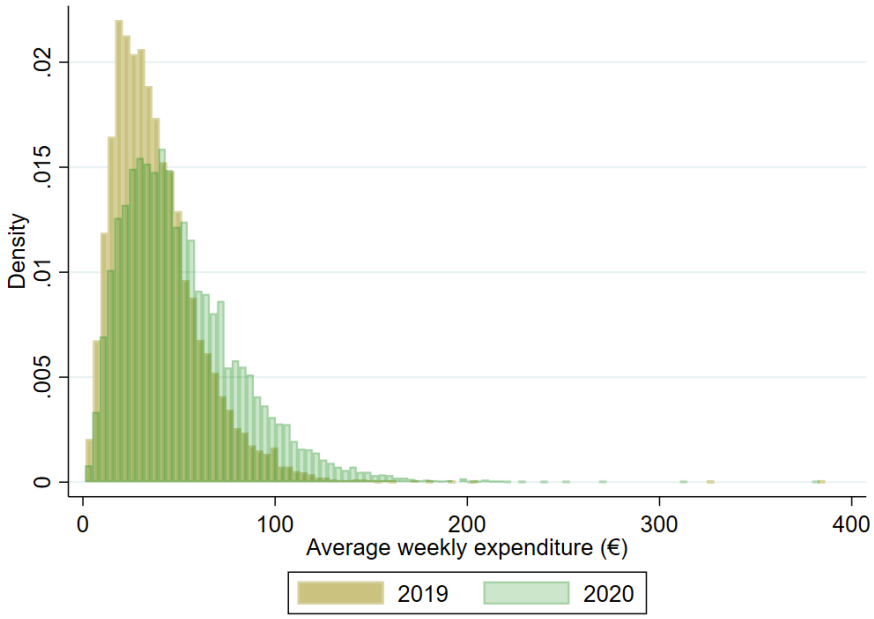
The period between solid vertical red lines corresponds to the national lockdown, from Monday March 9 until Sunday May 17, 2020. The solid red line in November indicates the beginning of colour-coded zoning system.

Next, we disaggregate purchase volumes by food group. Figure 3 compares household consumption between 2019 and 2020 by food category. All food categories experienced a growth corresponding to the period of national lockdown, but trends are different, also because of seasonal factors. The increase in purchase volumes during the lockdown period in 2020, compared to the same period in 2019, was higher for cereals, bread and pasta (+39%); fruit and vegetables increased by 36%; confectionery, dairy, eggs, fats and other foods increased by 30%; the smallest increase is observed for drinks, which still increased by 23%. Following O'Connell et al. (2020), we provide evidence on the distribution of

Figure 3: Average household weekly food and drink consumption by year.

Thick lines: Running-mean smoothed weekly volumes purchased (bandwidth 5%).
Faded lines: weekly volumes, non-smoothed
The period between solid vertical red lines corresponds to the national lockdown, from Monday March 9 until Sunday May 17. Solid red line in November indicates the beginning of colour-coded zoning system.

Figure 4: Distribution of expenditure by year.



Household average weekly expenditure in the ten weeks of national lockdown, from Monday March 9 until Sunday May 17.

household food and drink expenditure during the national lockdown, compared to the expenditure distribution during the same period in 2019. Figure 4 shows the average household weekly expenditure on food and drink in the ten weeks of lockdown, and it reveals a flattening and a rightward shift of the curve in 2020. Similarly to the case of UK pre-lockdown – and even more sizeable – we found that the increase in expenditure and volumes purchased, shown previously, was driven by a moderate increase in demand by many households, rather than a sharp increase by few households.

4 Changing food behaviors

We now provide evidence to support (or controvert) our initial hypotheses on the effect of COVID-19 restrictions on food consumption behavior. The first hypothesis regards substitution with eating-out, more formally, we assume that expenditure for food and drink for at-home consumption has increased primarily as a consequence of restaurants and bars closure. To test this hypothesis, we estimate a fixed-effect panel regression:

$$Exp_{rt} = \alpha_r + \omega_s + \sum_{j=1}^{3} \beta_j R_{jrt} + \epsilon_{rt} \tag{1}$$

where Exp_{rt} is the average household weekly expenditure in region r at time t (with $t = 1, \ldots, 104$) , R_{jrt} is the three-levels region/week specific indicator of type of restriction on bars and restaurants in place, with respect to the pre-pandemic state (see Table 4), ω_s are weekly within-year seasonal effects (with $s = 1, \ldots, 52$) and α_r are fixed regional effects (with $r = 1, \ldots, 20$).

The estimates of the three β_j coefficients are displayed in Table 5: expenditures for at-home food ad drinks were higher post-pandemic with respect to pre-pandemic period, and they grow with increasing restrictions. When restaurants and bars were closed to the public (open only for delivery and take-away) the average weekly household expenditure was 9.48 Euros higher; food and drink expenditure was €4.32 higher when bars and restaurants were open with low restrictions.

Hypothesis 2 refers to potential hoarding behavior and increase in online shopping. To test this hypotheses, we check whether storable goods and fresh foods have different purchase patterns. Figure 5 shows the share of storable

Table 5. Food and drink expenditure depending on restaurants and bar closure - Model results.

	Coeff.	Std error
Bars & restaurants=1	4.32***	0.29
Bars & restaurants=2	4.56***	0.48
Bars & restaurants=3	9.48***	0.34

Weekly seasonal coefficients not shown
* p< 0.1; ** p< 0.05; *** p< 0.01

foods on total food purchases in 2019 and 2020. There is a moderate increase in the proportion of storable food purchased coinciding with the weeks before the beginning of lockdown, but the absolute difference is low (around 2%).

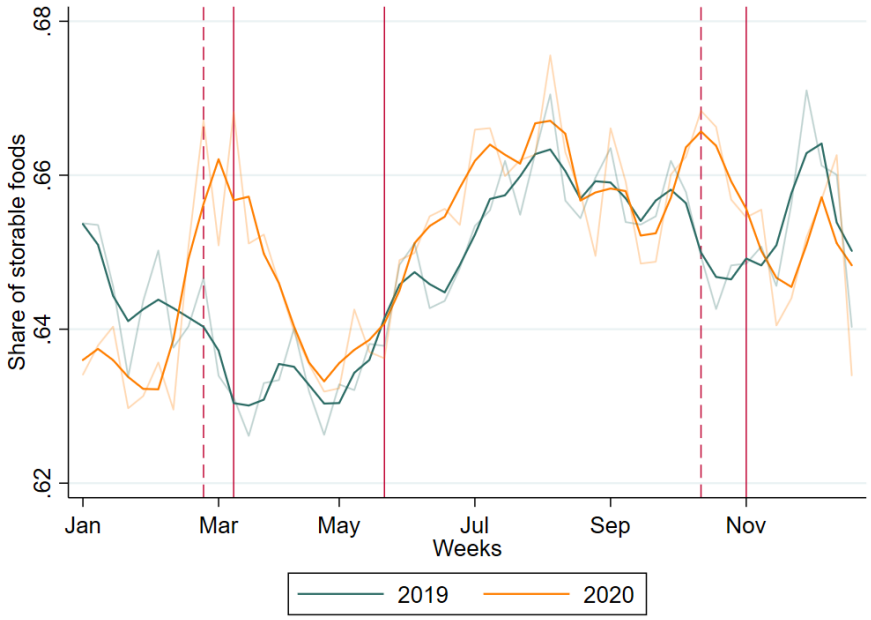
Concerning online shopping behavior during COVID-19 restrictions, Figure 6 shows the proportion of shopping made online on total number of weekly shopping: the adoption of online shopping increases during the first national lockdown, and maintains higher levels throughout 2020.

We estimate a logit model on the probability to purchase online:

$$P(Online_{nt}) = \alpha + \sum_{j=1}^{3} \beta_j S_{jrt} + \gamma Age_{nt} + \delta Income_{nt} + \rho Child_{nt} + \theta Year_n t + \epsilon_{nt} \tag{2}$$

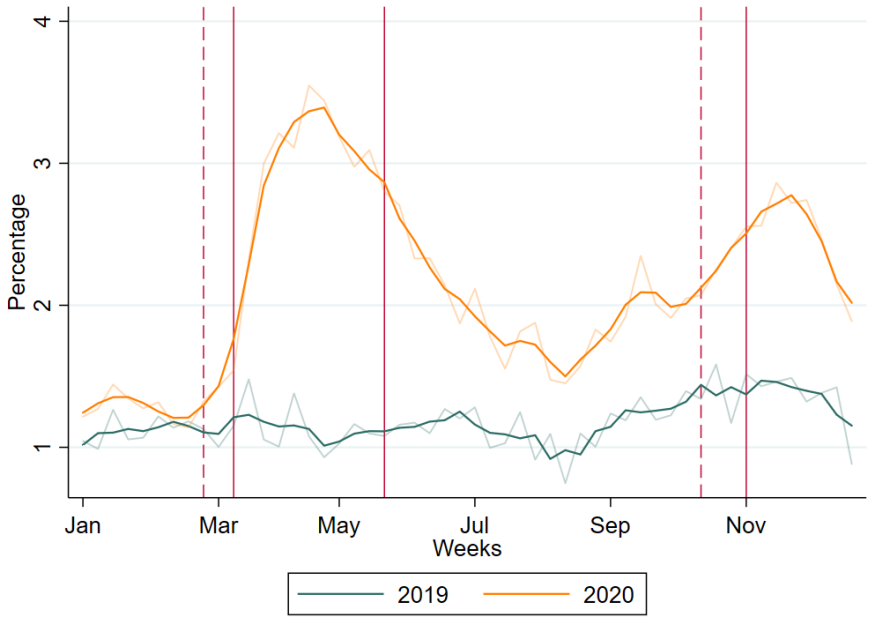
where $Online_{nt}$ equals one when the household n purchases from online store in week t, and zero otherwise; S_{rt} is the three-levels week/region specific indicator of type of stay-at-home requirement in place (see Table 4), with respect to the no-requirement state. Age class of the main responsible for food purchases in the household, income class and presence of children are included in the model as covariates, together with a binary variable indicating the year of purchase. Table 6 displays the estimated coefficients β_j: the probability to purchase food online increases with increasing restriction level of stay at home requirement,

Figure 5: Share of purchases of storable foods on total food purchases by year (drinks excluded).



Thick lines: Running-mean smoothed values (bandwidth 5%).
Faded lines: weekly values, non-smoothed.
The period between solid vertical red lines corresponds to the national lockdown, from Monday March 9 until Sunday May 17. The solid red line in November indicates the beginning of colour-coded zoning system. Dashed lines refer to the beginning of some imposed restrictions: February 24 and October 12.

Figure 6: Share of food and drink online shopping by year.



Thick lines: Running-mean smoothed values (bandwidth 5%).
Faded lines: weekly values, non-smoothed.
The period between solid vertical red lines corresponds to the national lockdown, from Monday March 9 until Sunday May 17. The solid red line in November indicates the beginning of colour-coded zoning system. Dashed lines refer to the beginning of some imposed restrictions: February 24 and October 12.
If a household purchases both online and in traditional stores in the same week, we retain the shopping with the higher expenditure.

ceteris paribus. Socio-demographic characteristics also influence the probability to shop online: individuals aged 35-49 are the most likely to purchase online, while over 65 are the less likely; the higher the income, the higher the probability to purchase online; individuals living in Southern region are the less likely to purchase online and in the year 2020 the probability to purchase online was significantly higher, compared to the previous year.

Table 6. Probability to purchase online - Model results.

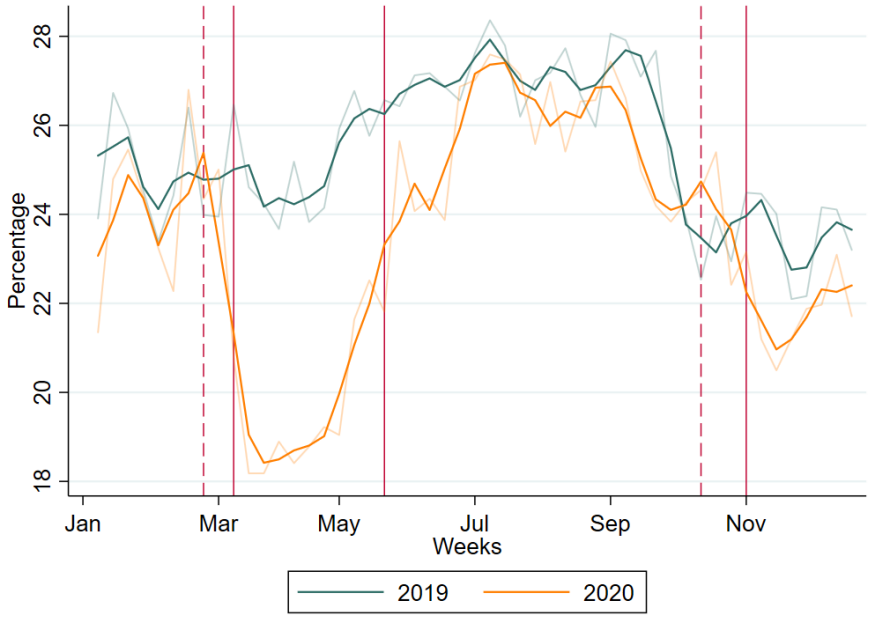
	Coeff	Std error
Stay at home=1	0.35***	0.03
Stay at home=2	0.44***	0.03
Stay at home=3	0.66***	0.04
Age $35-49$	0.09***	0.03
Age $50-64$	-0.45***	0.03
Age $>= 65$	-0.74***	0.04
Income $<= 683$	-0.43***	0.03
Income $684-1141$	-0.11***	0.03
Income $1142-1670$	-0.05*	0.03
Hh with children	0.27***	0.02
North-west	1.86***	0.03
North-east	0.96***	0.04
Centre	1.02***	0.04
Year 2020	0.34***	0.02
Constant	-5.30***	0.05

* p< 0.1; ** p< 0.05; *** p< 0.01

Our third research question concerns prices and promotions, and how they vary during the pandemic. Firstly, we are interested in the rate of promotions; since we only have information on the promotion status of drink purchases, we analyze the share of purchases made on promotion over time for drinks. Figure 7 shows that the share of purchases made on promotion drops from early March until July, when it comes back to the 2019 level.

We are also interested in whether prices and unit values of food and drinks changed, signalling an adjustment of quality choices. To retrieve prices from unit values, we adopt the approach described in Capacci and Mazzocchi (2011)

Figure 7: Weekly share of drink purchases on promotion by year.



Thick lines: Running-mean smoothed values (bandwidth 5%).
Faded lines: weekly values, non-smoothed.
The period between solid vertical red lines corresponds to the national lockdown, from Monday 9th March until Sunday May 17. The solid red line in November indicates the beginning of colour-coded zoning system. Dashed lines refer to the beginning of some imposed restrictions: February 24 and October 12.

and drawing from Deaton (1988). Thus, we assume that (1) households in the same region and week face the same prices; (2) quality choices depend on observed characteristics (demographics) and individual unobserved characteristics. By averaging unit values by region and week, and adjusting by the difference in average demographic characteristics, it is possible to obtain price indices for each good. For each ecoicop i and region r, we calculate price and unit value index for 2019 and 2020 (index base= first week of the year), we call these indexes $P^y_{i,r,w}$ and $UV^y_{i,r,w}$, the indexes vary by week w. We then average them over the period of lockdown in 2020 and the corresponding period in 2019 (week 11-21), obtaining $\overline{P}^y_{i,r,w\in l}$ and $\overline{UV}^y_{i,r,w\in l}$, with $y = 2019, 2020$. Finally, we calculate variation in 2020 with respect to the previous year as $P^{var}_{i,r,w\in l} = \overline{P}^{20}_{i,r,w\in l}/\overline{P}^{19}_{i,r,w\in l}$ and $UV^{var}_{i,r,w\in l} = \overline{UV}^{20}_{i,r,w\in l}/\overline{UV}^{19}_{i,r,w\in l}$. For price variation, we are interested in regions and ecoicop which had higher values of $P^{var}_{i,r,w\in l}$. For unit values, our interest is on regions and ecoicop with the highest values of $Savings_{i,r,w\in l} = P^{var}_{i,r,w\in l} - UV^{var}_{i,r,w\in l}$.

Table 7 shows national average value of indexes for each food group. Food categories that had lower prices during COVID19 lockdown are cereals, bread and pasta, and sugar, chocolate and confectionery, whose estimated price decreased by more than ten percent compared to the same period of 2019. On the other hand, cold cuts and coffee and tea powder prices rose during lockdown, by more than 7 percent.

Graphs showing food and drink groups and regions with the highest increase in price during lockdown, and food and drink groups and regions with the highest relative decrease in unit values during lockdown are displayed in Appendix[7].

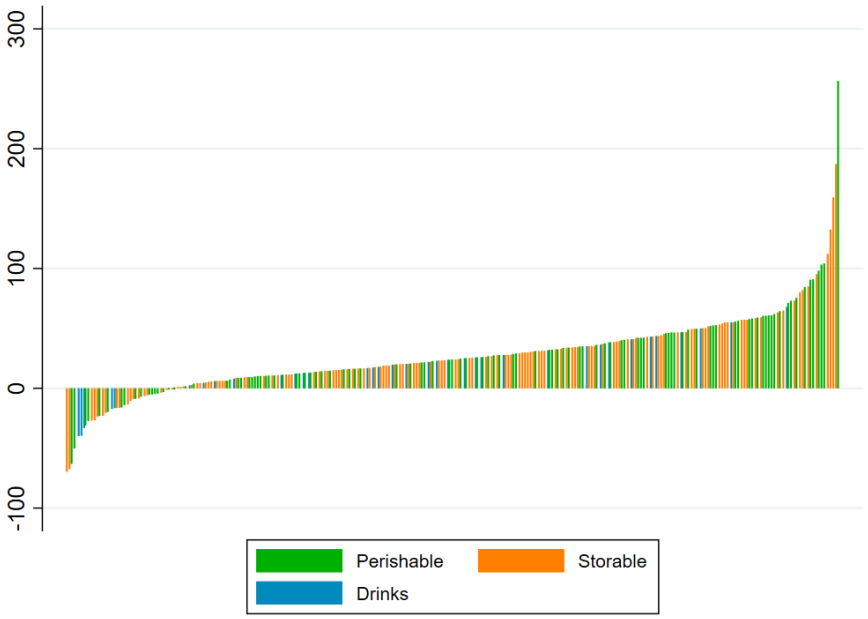
[7]We take the tenth decile for the two indexes, and show the three food groups that appear in most of the regions.

Table 7. Price and Unit value indexes.

	Average $P^{var}_{i,r,w\in l}$	Average $UV^{var}_{i,r,w\in l}$
Cereals, bread and pasta	-11.8%	-13.3%
Meat	0.7%	0.5%
Cold cuts	7.5%	7.2%
Fish	4.3%	4.4%
Milk and yogurt	-2.3%	-4.7%
Cheese	1.5%	1.1%
Eggs	4.2%	3.6%
Oils, butter and fats	-1.3%	-4.0%
Fruit	-2.2%	-2.2%
Snacks, dried fruits, nuts and crisps	4.2%	3.9%
Vegetables	-2.3%	-4.8%
Potatoes	-3.7%	-5.1%
Sugar, chocolate and confectionery	-11.8%	-13.3%
N.E.C.	-1.7%	-3.6%
Coffe and tea powder	7.1%	7.4%
Water	-0.8%	-3.3%
Softdrinks and juices	0.4%	0.5%
Alcoholic drinks	-6.1%	-7.1%

Hypothesis four and five focus on single food categories, in particular raw ingredients – as opposite to ready meals and convenience food – and unhealthy food, high in sugar and fats. Prior to analyze these food categories in detail, we give an overview of purchase patterns at the highest disaggregation level, considering all foods and drinks. Through this analysis, it is possible to gain knowledge on which foods drove the observed increase in demand. For each ecr3 category, we calculate the percentage increase in weekly volumes purchased over the ten-week period of lockdown, relative to the same period in 2019. Figure 8 displays the distribution of percent changes in purchased volumes for each food category, grouped by area (storable and perishable foods, and drinks). Nineteen categories increased sales by more than 70% in 2020, while 40 (out of 279) products experienced a decrease in consumption. The product with the highest increase was brewer's yeast (+256%), followed by flour (+187%) and condensed and powder milk (+159%). The three products experiencing the highest decrease were all ready-for-consumption snacks kit (more than 50% de-

Figure 8: Percentage increases in purchased volumes across food categories.

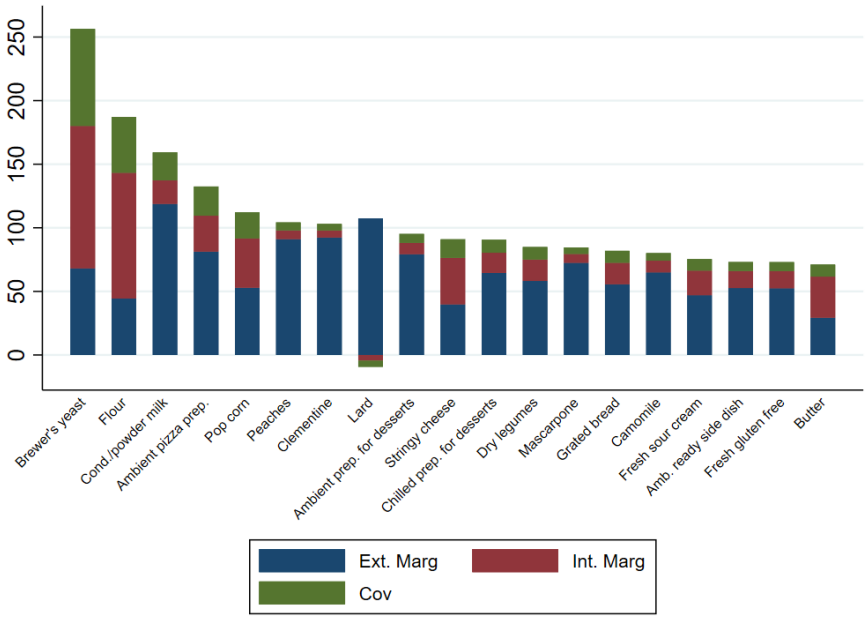


Percentage increases in purchased volumes by ecr3 categories in 2020 compared to 2019, from Monday March 9 until Sunday May 17 (calculation on total volumes purchased in the two years by households in the sample – categories aggregated for fish and meat, 40 categories excluded due to few purchases, resulting in 279 categories).

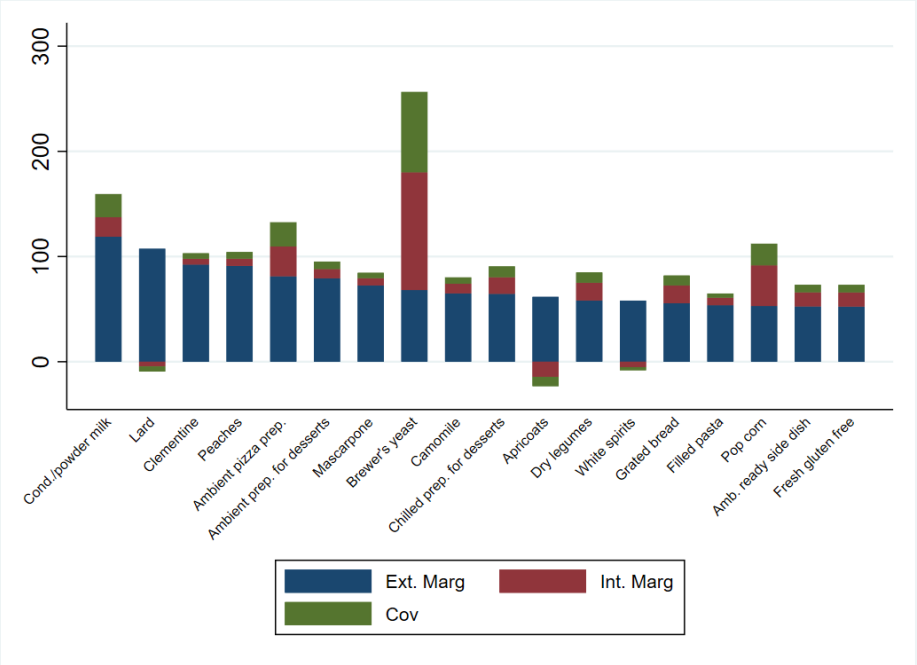
crease). This descriptive results corroborate our hypothesis in (iv), highlighting the increase in raw ingredients and the parallel decrease in ready meals.

Focusing on the food categories with higher increases, we calculate changes in extensive and intensive margin. This two components allow to understand whether the increase in demand was driven by a relatively higher share of households/week purchasing the product (more households purchasing or households purchasing more often – extensive margin), or by an increase in purchased quantities, conditional on purchasing (intensive margin). We follow the same approach as O'Connell et al., where the percent change is expressed as a sum of intensive margin, extensive margin and covariance between these two quantities (O'Connell et al., 2020, pag. 11). Figure 9 displays the decomposition for

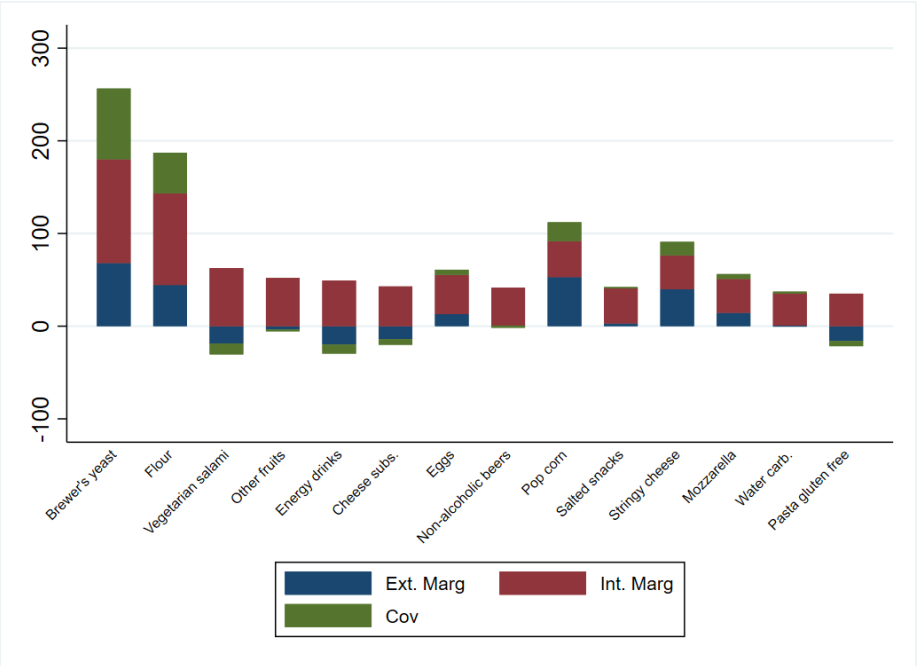
Figure 9: Decomposition in extensive and intensive margin, and covariance – Food categories with 70% increase and higher.



categories with the higher increase in demand: for most of these categories, the increase was driven by the extensive margin, i.e. households purchasing more frequently and an increased proportion of purchasing households. However, for some categories, the intensive margin also played a role in driving demand spikes, for example brewer's yeast, flour and butter. This means that for these categories, conditional on purchasing, larger volumes are purchased. We show two additional graphs, that display categories with higher extensive margin (above 50%, Fig. 8a) and higher intensive margin (above 35%, Fig. 8b).



(a)



(b)

Figure 8 - Decomposition in extensive and intensive margin, and covariance: (a) Food categories with highest extensive margin (b) Food categories with highest intensive margin.

5 Discussion & Conclusion

The purchasing habits of young households were the most affected by the lockdown and restrictions. This could be explained by their pre-pandemic lifestyle, including a higher frequency of meals consumed out of home, in the workplace and/or in bars and restaurants (61.3% of people aged 25-34 had lunch at home in 2019, compared to 94.4% of people aged over 65 according to the ISTAT Multipurpose Survey).

We also find that trends in purchased volumes for storable and perishable foods in 2020 were similar, differently from what has been observed in the UK, where storable products had a spike just before lockdown, as consequence of panic behavior and hoarding (O'Connell et al., 2020). This difference could be driven by several causes: a different perception of the severity of the COVID-19 situation and anticipation of the future lockdown, also given that the timing was different and the magnitude of the crisis was more uncertain when Italy was first affected; a different perception of the probability of food shortages; a different food culture, as Mediterranean diet relies more on fresh foods; or a different government strategy. In fact, in Italy the lockdown was communicated to the population only one day in advance, while in the UK the coronavirus Action Plan was communicated early, and lockdown imposed three weeks later.

Interestingly, food and drink expenditure for at-home consumption remained higher relative to the pre-pandemic level when bars and restaurants were reopened with low restrictions (mainly during summer 2020). This could anticipate a structural change in meal eating habits, i.e. people eating more at home because of distrust in the effectiveness of regulations and concerns about crowded places, even when the spread of the COVID-19 is low.

Some evidence of stockpiling behavior emerge at the beginning of lockdown, but it appears to be modest (+2% in the share of storable food purchased), much lower than what has been observed in the UK. Online shopping increased because of the pandemic situation, and remained higher throughout 2020. We found evidence of persistence in changes of shopping behavior. This can be explained by longer term changes arising from the COVID-19 experience (Hodbod et al., 2020).

With reference to promotion and price variations, we found a lower share of drinks on promotion during lockdown, which returned to the pre-pandemic level short after lockdown ended. Some variations in prices were also observed; in particular, the increase in price of cold cuts in 2020 might be linked to the fact that we only have packaged products in the dataset; during the initial lockdown, butchers inside supermarkets – which sell cold cuts with variable weight (not packaged) – remained close, therefore consumer had to switch towards pre-packaged cold cuts. Also, pre-packaged cold cuts might feel "safer" from virus contamination and consumers might prefer this option to the unpackaged cold cuts sold from butcher shops.

We found some evidence of emotional consumption during lockdown, among food products with higher increase in purchase we found mixture for desserts. Moreover, butter, mascarpone and lard are foods high in fats, for which purchases increased. Purchases of chamomile were also higher, indicating a potential need for relaxation or trouble sleeping during lockdown (also, it is unlikely that higher consumption of this good stems from substitution for out of home consumption). These data also point towards changes in cooking habits during lockdown, in fact, purchase of raw ingredients such as flour, brewer's yeast and

mixture for pizza were among products with highest increase in consumption.

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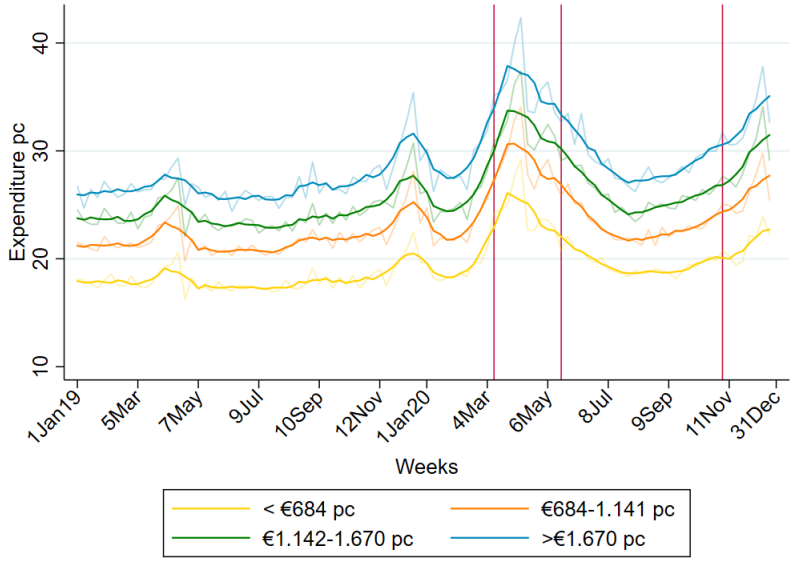
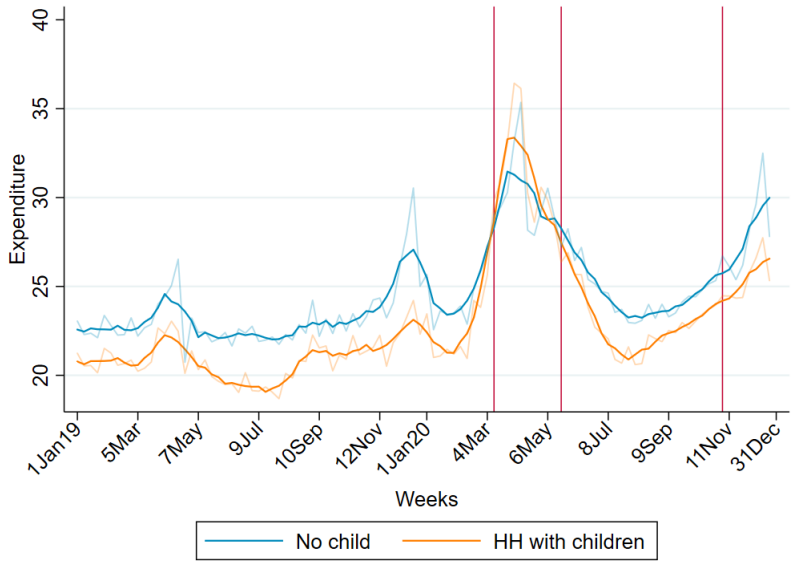
A Appendix

Figure 11: Average per capita weekly food and drink expenditure by per capita monthly income.



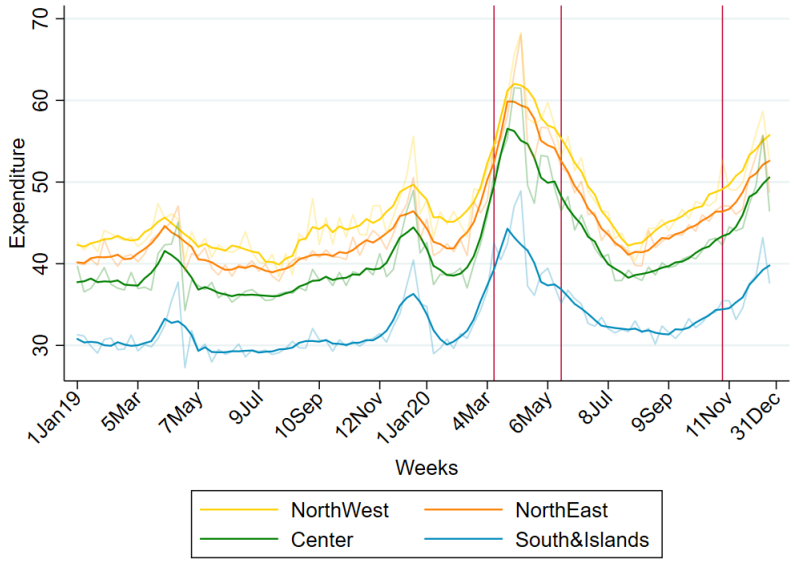
Thick lines: Running-mean smoothed weekly expenditure (bandwidth 5%).
Faded lines: weekly expenditure, non-smoothed

Figure 12: Average per capita weekly food and drink expenditure for households with and without children.



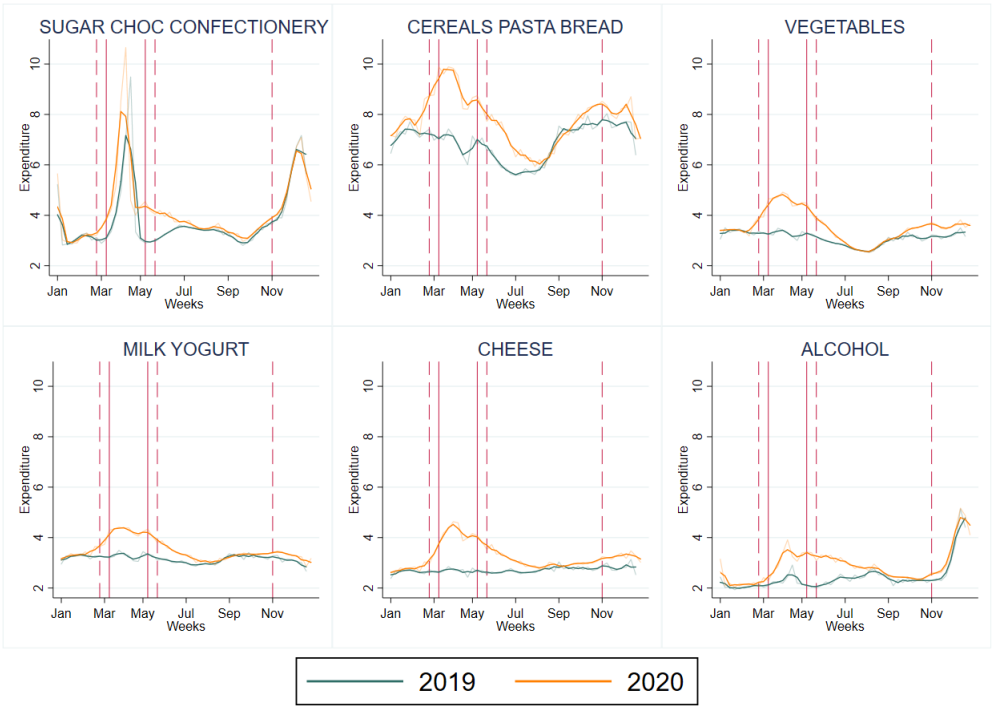
Thick lines: Running-mean smoothed weekly expenditure (bandwidth 5%).
Faded lines: weekly expenditure, non-smoothed

Figure 13: Average household weekly food and drink expenditure by geographical area of residence.



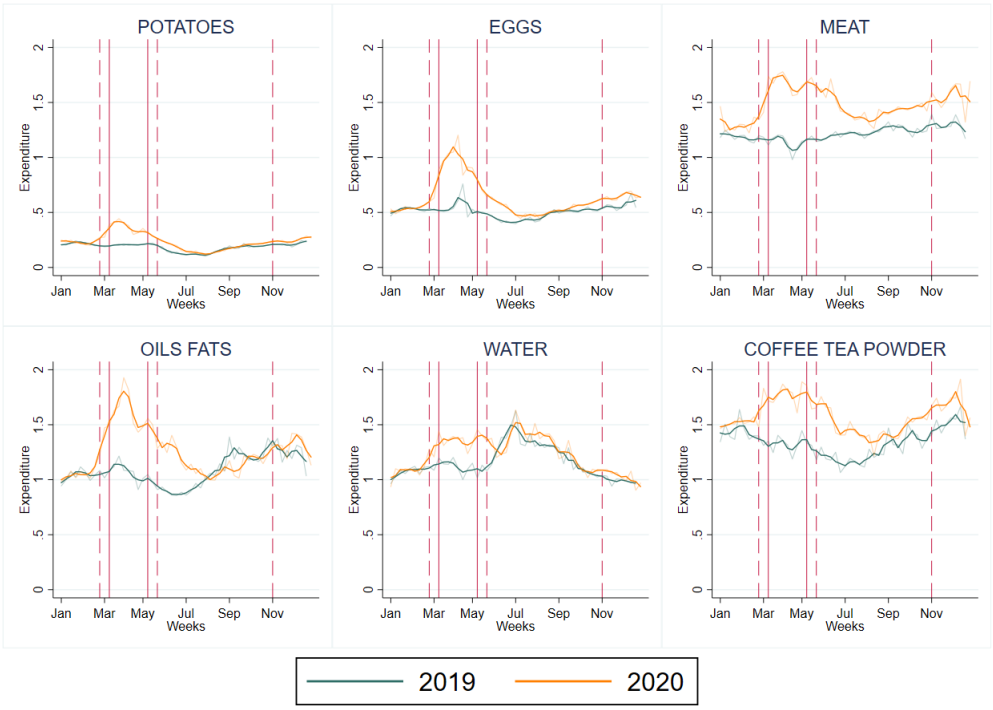
Thick lines: Running-mean smoothed weekly expenditure (bandwidth 5%).
Faded lines: weekly expenditure, non-smoothed

Figure 14: Average household weekly food and drink expenditure by food category (1).



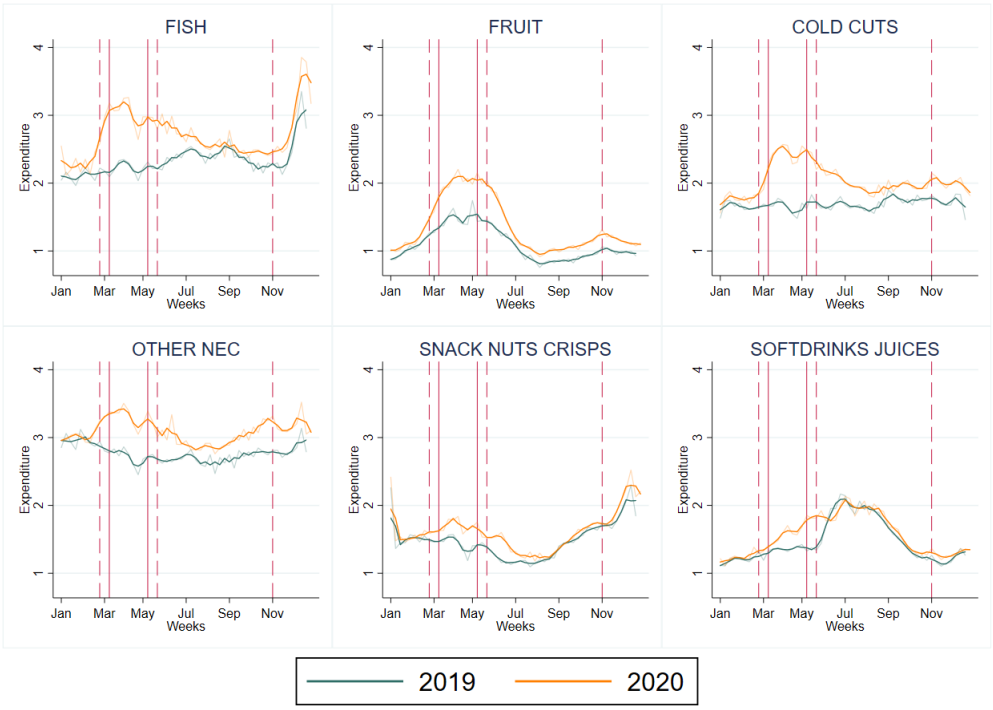
Thick lines: Running-mean smoothed weekly expenditure (bandwidth 5%).
Faded lines: weekly expenditure, non-smoothed

Figure 15: Average household weekly food and drink expenditure by food category (2).



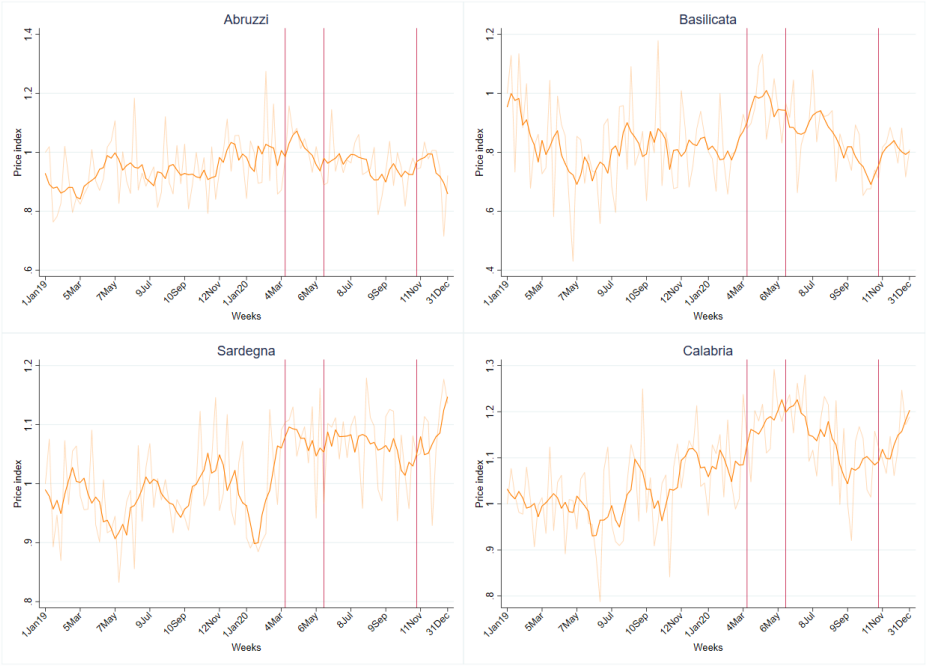
Thick lines: Running-mean smoothed weekly expenditure (bandwidth 5%).
Faded lines: weekly expenditure, non-smoothed

Figure 16: Average household weekly food and drink expenditure by food category (3).



Thick lines: Running-mean smoothed weekly expenditure (bandwidth 5%).
Faded lines: weekly expenditure, non-smoothed

Figure 17: Price index of cold cuts.



Index base= first week of 2019; only region with index values in the tenth decile shown.
Thick lines: Running-mean smoothed weekly index (bandwidth 5%).
Faded lines: weekly index, non-smoothed

Figure 18: Price index of coffee and tea powder.

Index base= first week of 2019; only region with index values in the tenth decile shown.
Thick lines: Running-mean smoothed weekly index (bandwidth 5%).
Faded lines: weekly index, non-smoothed

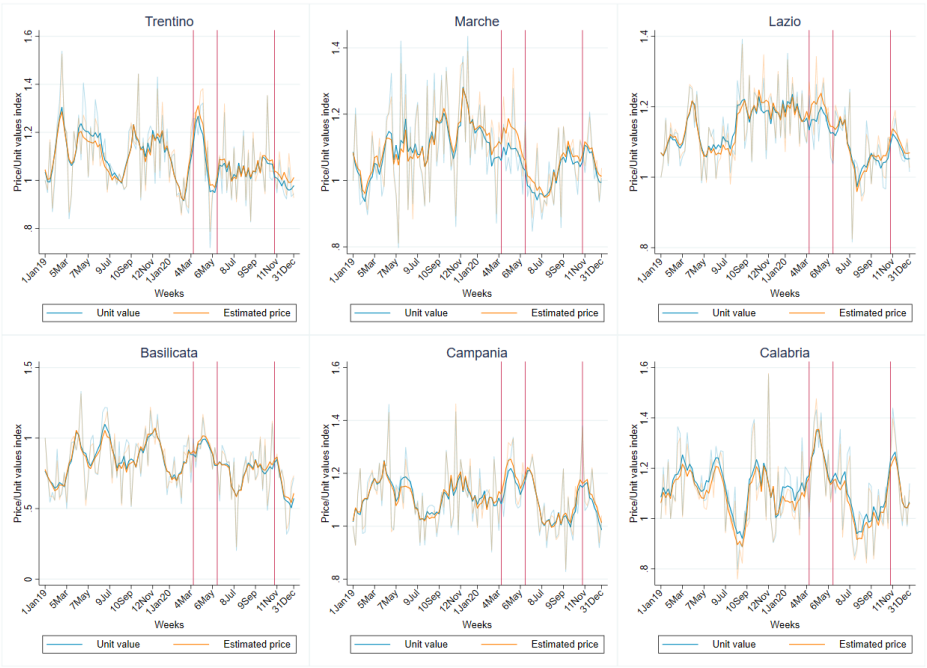
Figure 19: Price index of meat.

Index base= first week of 2019; only region with index values in the tenth decile shown.
Thick lines: Running-mean smoothed weekly index (bandwidth 5%).
Faded lines: weekly index, non-smoothed

Figure 20: Price and unit value indexes of coffe and tea powder.

Index base= first week of 2019; only region with index values in the tenth decile shown.
Thick lines: Running-mean smoothed weekly index (bandwidth 5%).
Faded lines: weekly index, non-smoothed

Figure 21: Price and unit value indexes of oils, butter and fats.



Index base= first week of 2019; only region with index values in the tenth decile shown.
Thick lines: Running-mean smoothed weekly index (bandwidth 5%).
Faded lines: weekly index, non-smoothed

Figure 22: Price and unit value indexes of water.

Index base= first week of 2019; only region with index values in the tenth decile shown.
Thick lines: Running-mean smoothed weekly index (bandwidth 5%).
Faded lines: weekly index, non-smoothed