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THE EFFECTS OF THE PANDEMIC ON HOUSEHOLDS' FINANCIAL SAVINGS: A BAYESIAN STRUCTURAL VAR ANALYSIS

by Luigi Infante, Francesca Lilla and Francesco Vercelli*

Abstract

Following the outbreak of the COVID-19 pandemic, Italian households' financial savings reached exceptionally high levels. Using a time-varying coefficients VAR model with stochastic volatility, the paper aims to identify the impact of the COVID-19 pandemic on households' financial savings and other macroeconomic variables, distinguishing between a containment shock, a fear-of-infection shock, and an uncertainty shock. We find that the impact of the containment shock on financial savings is positive and high, whereas the impacts of the fear-of-infection and the uncertainty shocks are lower. Based on our counterfactual exercises, in the absence of the three identified shocks, from March to December 2020, financial savings would have been much lower than the value observed (€67 billion instead of €110 billion).

JEL Classification: C32, E21, E44.
Keywords: households' financial savings, COVID-19, outliers, time-varying VAR.
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Contents

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* Bank of Italy, Economic Research and International Relations.

1 Introduction[1]

The onset of the COVID-19 pandemic was followed by the introduction of severe actions to contain the contagion and by an increased perception of uncertainty about the future. The Italian government, in response to the rapid expansion of the pandemic, decided to curb the diffusion of the virus initially through a lockdown involving the whole Italian territory and later through the introduction of restrictions differentiated by regions. The measures limited the circulation of people and required the closure of a wide range of economic activities. Against this background, households accumulated an impressive amount of savings, in line with what has been observed in other developed countries (Attinasi et al., 2021; Lilla et al., 2021). The annual financial savings of Italian households exceeded €100 billion in 2020, about four times the average value of the previous 5 years.

A significant number of recent papers have focused on household consumption and saving patterns during and after the pandemic. Using transaction-level data, Hacioglu et al. (2020) for the UK, Baker et al. (2020) for the US, Carvalho et al. (2020) for Spain and Bounie et al. (2020) for France, identify a significant drop in consumption, following the outbreak of the COVID-19 pandemic. Finck and Tillmann (2020) find that the fall of household spending in the US is related to the unexpected component of the COVID-19 pandemic, measured as the difference between the actual and the expected number of deaths. The faster the increase in the number of infections, the stronger the drop in consumption. With respect to the excess savings due to COVID-19, Bilbiie et al. (2021) discuss the possible side effects of the huge amount of savings piled up during the pandemic, such as the pressure on the aggregate demand deriving from a too rapid spending of the accumulated savings in the post-pandemic.

The evaluation of the macroeconomic impact of the pandemic has been handled in different ways. Caggiano et al. (2020), in a VAR framework, predict that the peak of global uncertainty (measured by the VIX) in March 2020 implied a cumulative loss in the world industrial production of 14 per cent over one year. Carriero et al. (2021a), using a large and heteroskedastic VAR, find marked increases in macroeconomic and financial uncertainty throughout the COVID-19 period, although the contribution of uncertainty to the economic downturn is small compared to that

[1]We thank S. Fabiani, R. Giordano, A. Rosolia and two anonymous referees for very helpful comments on a previous version of the paper.

of several macroeconomic and financial indicators. According to the authors, this evidence suggests that the downturn could be mainly driven by COVID-related supply and demand shocks, other than aggregate uncertainty shocks. Assuming that the pandemic has many of the attributes of a natural disaster and that the model parameters are invariant to the nature of disasters, instead, Ludvigson et al. (2021) analyse the economic effects of COVID-19 constructing a costly disaster time series from the pecuniary costs of previous disasters and calibrate the economic cost of COVID-19 to obtain aggregate predictions. Guglielminetti and Rondinelli (2021) estimate a consumption equation on income, wealth, interest rates and expectations up to 2019 for Italy. By comparing the actual evolution of consumption in 2020 with predicted values from the estimates, they conclude that the unexplained difference is attributed to pandemic factors.

COVID-19 also raised challenges in modelling economic time series, due to the appearance of extreme observations in many key macroeconomic variables. For instance, Primiceri and Tambalotti (2020) assume that COVID-19 is a one-period shock that propagates differently from a typical macroeconomic shock and approximate its trajectory by a polynomial. Dynamic responses are obtained by calibrating the polynomial to formulate alternative scenarios on the development of the pandemic. Ludvigson et al. (2021) obtain predictions on the impact of COVID-19 by estimating a VAR model with pre-COVID monthly data (until February 2020). Ng (2021) suggests to add COVID-19 indicators to a VAR as exogenous controls to recover impulse responses to economic shocks similar to the ones estimated in the pre-pandemic period. Lenza and Primiceri (2020), in the context of a constant-variance VAR, propose to re-scale the standard deviation of shocks since March 2020, while Carriero et al. (2021a) allow for temporary volatility outliers. Carriero et al. (2021b) use a VAR with stochastic volatility and improve its forecast performances by incorporating outliers in the model. Prüser (2021) instead replaces the conventional priors distributions used to estimate a stochastic volatility VAR model with an alternative one to take into account extreme observations due to COVID-19.

Our paper provides empirical evidence of the effects of the COVID-19 on Italian household financial savings (surplus)[2], consumption and employment by using a VAR model with time-varying parameters and stochastic volatility. This is a flexible model that allows to track possible

[2]The residual income that is available for increasing financial wealth is defined as net lending/net borrowing. It is called net lending when it is positive and net borrowing when it is negative. For the household sector it is generally positive. In this paper, we might use the expressions net lending, financial surplus or financial savings interchangeably.

changes in the underlying structure of the economy, in particular in the presence of large shocks. Time-varying coefficients are useful to take into account the presence of breaks or shifts in the time series, for instance due to policy measures (i.e. monetary policy), which in turn introduce nonlinearities in the relationships among the time series (Cogley and Sargent, 2005).[3] The time variation of the variance covariance matrix reflects the heteroskedasticity of the innovations and consequently any change in the size of the shocks (Primiceri, 2005).

As for the identification, we follow Gambetti and Musso (2020), who measure the unexpected component of the ECB expanded asset purchase programme (APP) shock, which took place in January 2015. In their model, they include a proxy variable to capture the difference between the announced and the expected amounts of assets purchased by the ECB, that is different from zero only in few periods. In a similar vein, we augment the information set with the containment index, based on information collected by the Oxford COVID-19 Government Response Tracker, which is strongly informative about the pandemic evolution and the restrictive measures adopted in Italy by the government. Since the COVID-19 outbreak, the containment index is non-zero only after March 2020. In order to include a variable that is non-zero in few periods into a VAR, the time-varying structure of the variance covariance matrix that we adopt in our model is essential (Gambetti and Musso, 2020).

We study the excess savings observed in the aftermath of the COVID-19 pandemic taking into account three aspects. First, the social and physical distancing measures introduced by the government limited the chance of consuming, generating forced savings. Second, due to the fear of infection, households may have decided autonomously to reduce the consumption of goods or services requiring social interactions (e.g. restaurant services, cinema, travels), adding to the level of savings. Third, precautionary motives may have contributed to savings, in order to offset potential uncertainty in the future level of consumption due to the risk of future income losses. We attempt to disentangle two COVID-19 specific shocks, which we define as the containment shock and the fear-of-infection shock, along with a macroeconomic uncertainty shock, i.e. a shock that arises when the economy becomes less predictable with respect to the available information.

[3] Lubik and Matthes (2015) also suggest that some macroeconomic variables (i.e. unemployment rate) may record different growth rates at the beginning of a recession, compared to what observed at the onset of the recovery. This nonlinear behaviour may be addressed through time-varying parameters. Specifically on the Covid-19 shock, Carriero et al. (2021b) argue that the extreme realizations due to the pandemic can have strong effects on parameter estimates and forecasts generated by conventional constant-parameter VARs.

To separate the impact of the restrictive measures from the fear of infection, we add to the model a variable that measures the number of Italian travellers, in Italy and abroad, to catch the propensity to consume goods and services that may require some contacts with other people, like in the case of tourism (Guglielminetti et al., 2023). Finally, to capture precautionary savings, we use a measure of macroeconomic uncertainty computed according to the methodology proposed by Jurado et al. (2015), which quantifies the accuracy of economic predictions based on available information.

The contribution of our paper to the existing literature is threefold. We study the effect of the COVID-19 pandemic on the financial savings of Italian households, together with other macroeconomic variables. Furthermore, we propose a methodological approach to identify COVID-19 specific shocks, dealing with extreme observations. Lastly, we make an attempt to disentangle the observed excess of financial surplus into three components: one related to forced savings due to the containment measures; another one that may be attributed to the voluntary choice of households to decrease the consumption of goods and services involving social interactions; and the last one capturing the uncertainty about the future evolution of the economic conditions.

We find that the containment shock has a positive and significant impact on the household financial surplus, which is stronger in the short-run and is absorbed in about twelve months. Instead, consumption and full-time equivalent employment react negatively to the containment shock. With respect to the other identified shocks, their impact on financial surplus, consumption and employment is statistically significant, although with a lower size. Based on our counterfactual exercises, from March to December 2020 the financial surplus would have been equal to €67 billion in the absence of the three identified shocks, while it actually amounted to €110.3 billion.

The paper is organised as follows. In Section 2 we present the dataset, the empirical model, and the identification strategy. In Section 3 we discuss the main findings, including counterfactual analyses and robustness checks. Finally, Section 4 concludes.

2 The empirical methodology

2.1 Data

The database we use includes six variables spanning the period from April 1999 to December 2020: the containment index, the number of Italian tourists, the macroeconomic uncertainty indicator proposed by Jurado et al. (2015), the households' financial surplus, consumption and full-time equivalent employment (Figure 1). These variables are available with different frequencies (quarterly, monthly and daily). However quarterly data may not completely capture the shocks created by COVID-19, since month to month variations tend to average out (Ng, 2021). Therefore, we obtain monthly estimates of quarterly variables (financial surplus, consumption and full-time equivalent employment) through a Chow-Lin disaggregation. We also add to the Chow-Lin regression a dummy term for the months from March to September 2020, given that the amount of data variation due to COVID-19 was substantially different in the first, second and third quarters of 2020 (see Lenza and Primiceri, 2020 and Carriero et al., 2021b).

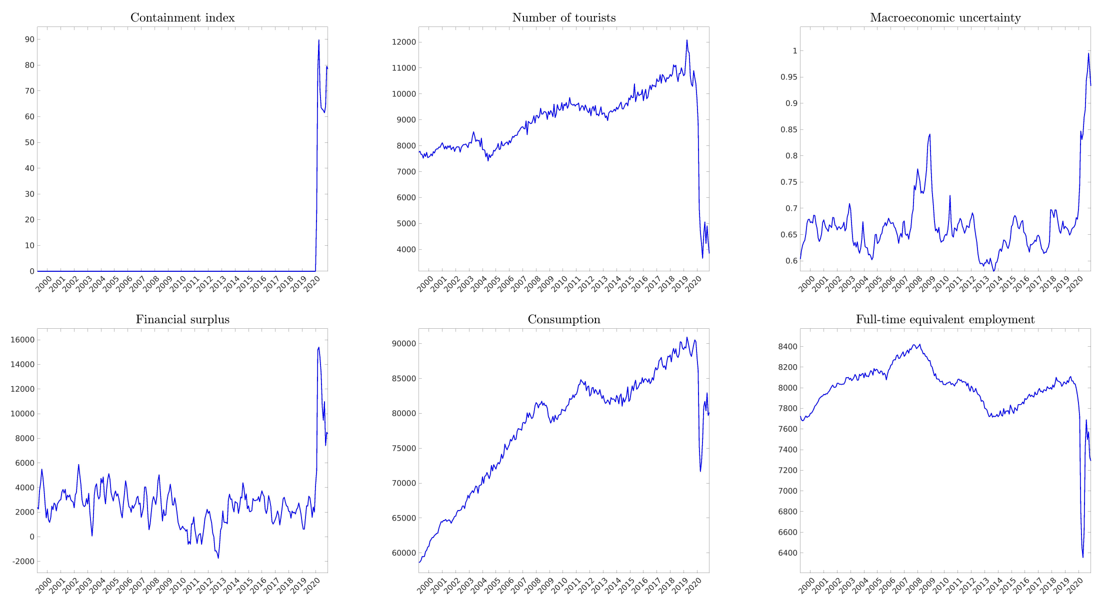

Figure 1: **Data.** Evolution of the variables included in the model. Vertical axes refer to percentage (containment index), thousands (number of tourists, number of full-time employed persons), million of euro (consumption and financial surplus).

The containment index is based on the containment and closure policies indicators collected by the Oxford COVID-19 Government Response Tracker (OxCGRT). We combine the indicators according to the methodology used by the OxCGRT (Hale et al., 2021).[4] Data, available at daily frequency, are aggregated on a monthly basis. The restrictions were strict (and the index was high) in March and April 2020 in response to the first outbreak of COVID-19 contagion, and began to ease at the beginning of May (phase 2). In autumn the Italian government introduced new restrictions to limit the spread of COVID-19 infections (i.e. second wave). The decision to strengthen the measures aimed at restricting the rapid spread of the disease and it was based on the number of infected people, hospitalized or patients in the intensive care units. The containment measures had a direct impact on the economy limiting important areas of the economic activity. Dreger and Gros (2020) argue that the stringency index is strongly correlated with the economic activity and is able to capture recession and recovery across the European countries, compared with other mobility indicators (i.e. Google indicator). News about the unfolding of the infections (i.e. the number of infected people) seems to have an unclear effect on consumer confidence and demand.[5]

The database includes the number of Italian travellers, in Italy (published by Istat) and abroad (published by the Bank of Italy). The overall number gradually increased from 2013 until the end of 2019, when peaked at 10.3 million. Instead, during the COVID-19 period, the number of tourists dropped by more than 50%. As reported in the Special Survey of Italian Households, launched by the Bank of Italy during the pandemic, households limited consumption of non-essential goods and services in order to reduce the risk of contracting infection. Among households who cancelled their plans to go on holidays during the 2020 summer, half declared that their choice was due to the fear of COVID-19 (Rondinelli and Zanichelli, 2020).

We also compute the macroeconomic uncertainty indicator proposed by Jurado et al. (2015). This measure of uncertainty quantifies the magnitude of unpredictability about the future with respect to the available information. Therefore, macroeconomic uncertainty occurs only when the lack of economic predictability is broad-based. The index is based on the implied forecast errors for real economic activity derived from a factor model that uses around a hundred of Italian economic and financial series. As discussed above, the impact of pandemic changed the time series properties of the data determining problems both in the computation of factors and fore-

[4]The OxCGRT provides indicators conceptually close to our containment index, such as the stringency and the containment and health indexes. Conversely to these two indexes, we do not consider the health system policies indicators, since they are not directly related to containment measures and restrictions.

[5]Finck and Tillmann (2020) use instead the difference between the actual and the expected number of deaths to measure the surprise component of the COVID-19 shock.

casting. In order to account for these issues, we refine the uncertainty index following Ng (2021), as explained in Appendix A. The obtained macroeconomic uncertainty measure rises during the COVID-19 period by 31%, reaching its peak in October 2020.

With regard to household saving behaviours, we consider financial surplus and consumption published by Istat.[6] The increase of household savings is impressive during the pandemic, like in other developed countries (Attinasi et al., 2021; Lilla et al., 2021). The drop in consumption from January to December 2020 is remarkable too (-11%), so that in a few months the series returns to the level observed in 2009. Finally, the full-time equivalent employment, based on Istat data, is also characterised by a sharp fall during the same period (-10%), reaching the minimum level in the entire sample period.

All the details on definitions, treatments and sources of the variables used in the paper are reported in Appendix A.

2.2 The approach to COVID-19

To assess the effect of the COVID-19 disease over household savings we rely on the following VAR(p) model with time-varying parameters and stochastic volatility as Primiceri (2005):

$$y_t = B_{0,t} + B_{1,t} y_{t-1} + \cdots + B_{p,t} y_{t-p} + e_t \qquad t = 1, \ldots, T \tag{1}$$

where y_t denote a $K \times 1$ vector of variables of interest, $B_{0,t}$ is a vector of time-varying intercepts, $B_{i,t}$ are matrices of time-varying coefficients for $i = 1, \ldots, p$ lags. Let e_t be the corresponding $K \times 1$ vector of reduced-form shocks to the endogeneous variables with mean zero and variance covariance matrix equal to Σ_t. These errors e_t are mapped to a $K \times 1$ vector of primitive shocks u_t via a matrix S_t:

$$u_t = S_t e_t \tag{2}$$

where u_t is usually assumed to have zero mean and be mutually and serially uncorrelated. Starting from the relation (2) and imposing identification assumptions on S_t, we can derive the dynamic responses to the economic shocks of interest.

[6] We disaggregate the original quarterly series at the monthly level, as explained at the beginning of the section, and we deflate them by using the harmonised index of consumer prices.

In this framework, predicting the macroeconomic impact of the COVID-19 pandemic is not obvious, since a pandemic of this proportion was never observed in recent history. To deal with this issue, the approach proposed in our paper considers the effects of the COVID-19 disease as a sequence of (new) shocks that hit the economy from March to December 2020. These COVID-19 specific shocks add up to the economic shocks that affect the economy in other periods. Following Gambetti and Musso (2020), in the y_t vector of equation (1) we include a COVID-19 variable which is non-zero only after March 2020. Formally, we can define this variable as:

$$y_{c,t} = \begin{cases} 0 & \text{if } t \neq \{2020:3 \ldots 2020:12\} \\ \sigma_{c,t} c_t & \text{if } t = \{2020:3 \ldots 2020:12\} \end{cases} \tag{3}$$

where $c_t \sim WN(0,1)$ is the COVID-19 shock and $\sigma_{c,t}$ is the standard deviation of $y_{c,t}$. This representation of the COVID-19 variable is very flexible, allowing for time-varying variance. For simplicity, in the formula above $y_{c,t}$ is exogenous, i.e. it does not depend on other variables, but this assumptions will be relaxed in the analysis.

The model used is able to account for the transition of the macroeconomic variables towards a regime characterised by the presence of new shocks due to the pandemic. In particular, the time-varying variance is a key feature of the model to correctly analyze the effects of these shocks. This is because the volatility of the COVID-19 variable changes across time, which is justified by the observation that COVID-19 shock is non-zero only after March 2020.[7] Furthermore, assuming a time-varying residuals covariance matrix allows to take into account the exceptional large macroeconomic volatility induced by COVID-19, relative to historical levels and, in turn, to properly estimate the effects of the COVID-19 shocks.[8] Variations in the VAR parameters are allowed to capture nonlinearities and other potential changes in the model dynamics, in the form of breaks or shifts in the time series, that might follow the occurence of the shocks. Appendix B provides further standard details on the specification and estimation of the model.

[7] As an alternative, we could have employed a two-state Markov switching model, where volatilities change across regimes. However, a Markov switching model would have required to specify and impose the number of regimes, that in our framework are captured in a flexible way by the stochastic volatility.

[8] Since Covid-19 is a multi-period event, the time-varying variances and covariances matrix allow us to study the dynamic response to a sequence of shocks, through a period by period identification.

2.3 Identification

We identify two COVID-19 specific shocks, which we define as the containment shock and the fear-of-infection shock, along with an uncertainty shock by means of a combination of zero and sign restrictions. We therefore try to assess to what extent the response of the financial surplus to the COVID-19 pandemic is enforced (due to the containment measures), voluntary (due to the fear of infection) or precautionary. Our model includes six monthly endogeneous variables spanning the period from April 1999 to December 2020: the containment index, the number of tourists, the macroeconomic uncertainty (Jurado et al., 2015), the households' financial surplus, the consumption and the full-time equivalent employment. The first three variables are needed for the identification.

The containment shock can be associated with all the restrictive measures that the Italian government has adopted from March 2020, starting from the lockdown period. Intuitively, the containment restrictions have limited the possibility to consume essential or primary goods and services, so that it affected the households' financial surplus.

The fear-of-infection shock captures concerns of households to contract the COVID-19 disease and, consequently, it influences the consumption of goods and services that involve social interactions. The choice of limiting the expenditures that required social interactions, even if such consumption was not forbidden, might have also contributed to the increase of financial surplus. Since this shock reflects voluntary choices, we do not identify this shock in March and April 2020, namely when government restrictions prevented social interactions.

Finally, the uncertainty shock accounts for an increase in household uncertainty about the future economic conditions, due to the ongoing pandemic. The intuition is that households might have decided to save more than usual, as a precautionary measure, given the great uncertainty about the recovery of the economy in the future.

To identify the containment shock, we compute the containment index based on the restriction and closure policies information collected by the Oxford COVID-19 Government Response Tracker, as described in Section 2.1 and Appendix A. Clearly, this index is available only during the pandemic period. Unfortunately, in contrast with the containment shock, it is virtually impossible to find variables that are effective in recovering the underlying fear-of-infection and uncertainty shocks exclusively during the 2020. Moreover, even if these variables were available, it could be difficult to choose a recursive order for all the three variables that ensures the identification. As a consequence, we add to the model two variables, namely the number of Italian tourists and the macroeconomic uncertainty indicator, and we achieve the identification by means of a combination of zero and sign restrictions imposed on impulse response functions. The identifying sign restrictions do not hinge on a specific model but we argue for their plausibility because they directly reflect researchers' embraceable expectations about the effects of COVID-19 induced shocks. At the same time, the imposed sign restrictions must be mutually exclusive to uniquely identify the structural shocks, as summarized in Table 1.

Table 1: Identification restrictions

Period	Shock	Containment index	Number of tourists	Macroeconomic uncertainty	Financial surplus	Consumption	Full-time equivalent employment
Mar-Apr	Containment	+	-	unrestricted	+	-	-
	Uncertainty	0	unrestricted	+	+	-	-
May-Dec	Containment	+	-	unrestricted	+	-	-
	Fear-of-infection	0	-	0	+	-	-
	Uncertainty	0	unrestricted	+	+	-	-

Note: Zero and sign imposed on the impulse responses on impact for a positive containment shock, a positive fear-of-infection shock and a positive adverse uncertainty shock.

In particular, the containment shock drives the containment index and the number of tourists in opposite directions. The fear-of-infection shock is set to have zero impact on the containment index, which clearly is not determined by the fear of households to contract COVID-19. The sign is negative for the number of tourists, because tourism represents a non-essential good that can be excluded from household consumption choices in order to reduce the risk of contracting COVID-19 (Rondinelli and Zanichelli, 2020). Moreover, we assume that the households decision of limiting consumption, that involve social interaction, does not change, at least on impact, the common component in uncertainty fluctuations. In our idea, fear of infection may represent a sentiment about the current and future evolution of the pandemic. As such, changes in this sentiment (the fear-of-infection shock) generate a change in the risk aversion of households that affects the conditional volatility of the economy but not the uncertainty, namely the common variation in the unforecastable component of a large number of economic indicators (Jurado et al., 2015). Therefore, we impose a zero restriction on the macroeconomic uncertainty variable in correspondence to the fear-of-infection shock. The uncertainty shock leads to an increase in the macroeconomic uncertainty and on impact has no direct effect on the containment measures.

All the three shocks produce an increase in households' financial surplus and a reduction in consumption, as well as a decline in the full-time equivalent employment.[9] Intuitively, the containment shock reduces the consumption bundle of goods and services that households can buy. We assume that substitute goods, like those bought through online shopping, cannot entirely compensate the reduction of consumption. The fear of contracting COVID-19 shock has the same effect of the containment shock because it limits the consumption bundle, even if on a voluntary basis. Instead, the uncertainty about future income streams induces households to reduce consumption in order to create a buffer of savings (Carroll, 1997). The containment shock is expected to reduce employment because it drastically reduces the labour demand of the firms whose activity is affected by the containment policies. The negative sign of both the fear-of-infection and the uncertainty shocks on employment comes from the reduced household demand for goods and services, which translates into a lower labour demand. From a practical point of view, the time-varying impulse response functions are

$$C_t(L) = \sum_{k=0}^{\infty} C_{k,t} L^k$$

with $C_{0,t} = I_n$ and $C_{k,t} = S_{n,n}(\boldsymbol{\mathcal{B}_t}^k)$, where

$$\boldsymbol{\mathcal{B}_t} = \begin{pmatrix} & \boldsymbol{B_t} & \\ I_{n(p-1)} & & O_{n(p-1),n} \end{pmatrix},$$

$\boldsymbol{B_t} = [B_{0,t}, B_{1,t}, \ldots, B_{p,t}]$ and $S_{n,n}(X)$ is a function which selects the first n rows and n columns of the matrix X. In order to appropriately combine the zero and sign restrictions and obtain the structural impulse response functions, we use the "state-of-the-art" algorithm recently introduced by Arias et al. (2018), which extends the sign restrictions methodology developed by Rubio-Ramirez et al. (2010) to allow for zero restrictions. The structural impulse response functions are obtained as follows. For a given realization of $\boldsymbol{B_t}$ and of the lower triangular matrix $P_t = chol(\Sigma_t)$ with positive diagonal elements, we construct a candidate orthonormal matrix Q_t following the algorith

[9] The reduction of consumption may also translates into higher real estate investments. However, these investments generally require more time to be settled. Therefore, it is plausible that on impact the reduced consumption only determines an increase in financial assets, i.e. a rise in financial surplus.

proposed by Arias et al. (2018) which ensures that the transformed impulse responses satisfies the sign and zero restrictions imposed.[10] Then, a candidate solution for S_t in equation (2) is $Q_t^{'} P_t^{-1}$, since $Q_t Q_t^{'} = I_K$. We use each of these candidate solutions in conjunction with $\boldsymbol{B_t}$ to construct the candidate structural models and their structural impulse responses, $C_t(L) P_t Q_t$. This procedure is repeated until we retain 1000 Q_t satisfying the identifying restrictions discussed in Table 1. The restrictions are imposed only upon impact.

3 Results

3.1 Evidence of time variation in variance

Before showing the main results of the model, we validate our econometric approach by analysing the evolution of the residual time-varying variances. During 2020 the variance of the residuals for the six variables in our model displays substantial time variation (Figure 2), since extraordinary shocks hit all the variables. The variance of the residuals from the containment index equation is zero until 2020, displays a peak in correspondence to March 2020 and continues to be positive for the rest of the year. For the other variables, there is evidence of a significant increase in the residual variances in 2020, in conjunction with the COVID-19 pandemic spread.

Overall, the variance of the innovations displays major fluctuations during the pandemic period. This variation over time cannot be captured by estimating a VAR with fixed parameters and constant volatility and supports the use of stochastic volatility specifications, in combination with the containment index which provides information about the evolution of the pandemic.

3.2 The impulse response analysis

The impacts of the containment, the fear-of-infection and the uncertainty shocks are assessed based on the impulse response functions. The model is estimated using variables in first difference or growth rates (where needed to achieve stationarity), but we show the impulse response of the variables in levels. In the figures, the dashed lines indicate the standard 68 percent confidence band.

[10] The imposition of zero restrictions on S_t renders invalid the standard algorithm based on the QR decomposition proposed by Rubio-Ramirez et al. (2010) for generating draws from sign identified VAR models.

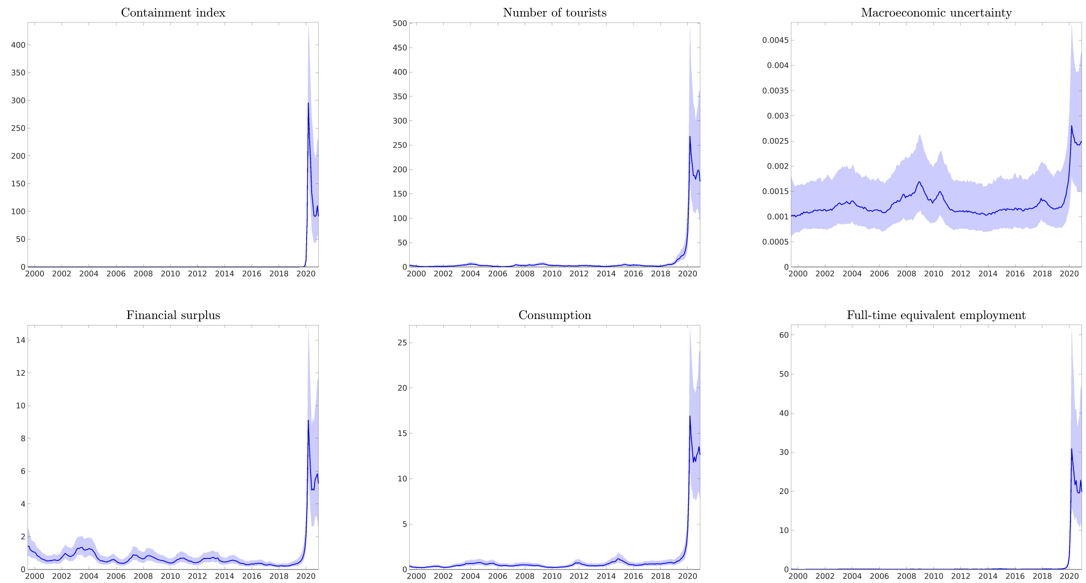

Figure 2: **Estimated stochastic volatility.** Residual time-varying variances of the variables considered in the analysis. Blue lines are the posterior median. Lighter blue areas delimit the space between the 16th and 84th percentiles.

One of the main advantages of modelling time-variation is the possibility to track the effects of structural shocks over time. In figure 3, for each month in 2020 starting from March, we compute the impulse response to shocks on impact, so that we can analyse the short-term effect of the three identified shocks over time.

For the financial surplus, the effect on impact of the containment shock was strong and significant in March 2020 and then decreased gradually over the year, at a faster pace during the summer. The effect on impact of the uncertainty shock was significant in March 2020 and then decreased. The impact of the fear-of-infection shock, which is not identified before May 2020, was strong and significant in each month. The responses of the financial surplus to the uncertainty shock, and particularly to the fear-of-infection shock, seem to have a lower degree of time variation, with respect to the response to the containment shock.

In line with the previous results, the effect on impact of the containment shock on consumption was significantly negative in each month. The response decreased in absolute value throughout the entire year, but more rapidly in the first months of the pandemic. With regards to the uncertainty and the fear-of-infection shocks the response of consumption was similar but with a slower evolution.

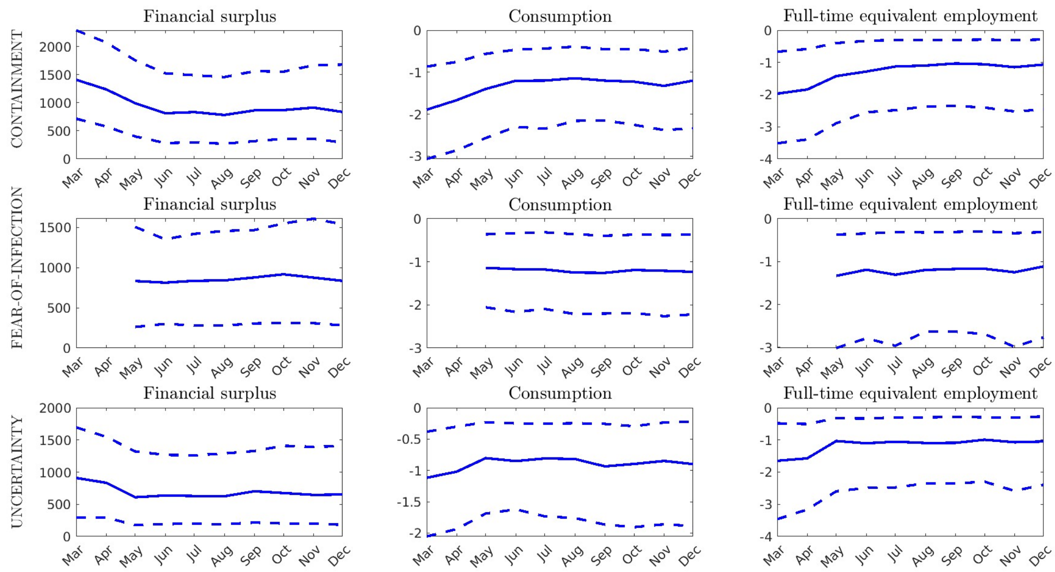

Figure 3: **Evolution of impulse response functions of key variables to a positive containment shock, to a positive fear-of-infection shock and to a positive adverse uncertainty shock at impact.** Full lines are the median impact impulse response functions from March to December 2020. Dashed lines indicates the 16th and 84th percentiles. Horizontal axes refer to number of months. Vertical axes refer to percentage (consumption and full-time equivalent employment) and million of euro for financial surplus.

Similarly to consumption, the impulse response of the full-time equivalent employment to the containment shock is negative and gradually increased over time. The responses to the fear-of-infection and the uncertainty shocks were negative and statistically significant, but more stable over time.

We take a longer perspective by observing the impact of the three shocks over 20 months. For each shock and for each month from March to December 2020 we compute the impulse response function with a 20-month horizon. Figure 4 reports, for each shock and forecast horizon, the average of the ten impulse response functions obtained.

Looking first at the financial surplus, a (positive) containment shock has a large positive impact and peaks at around three months, when it amounts to €1.5 billion. This suggests that, after three months since the shock hits the economy, households' financial savings would have been about €1.5 billion higher than in the absence of the shock. The impact decreases and becomes

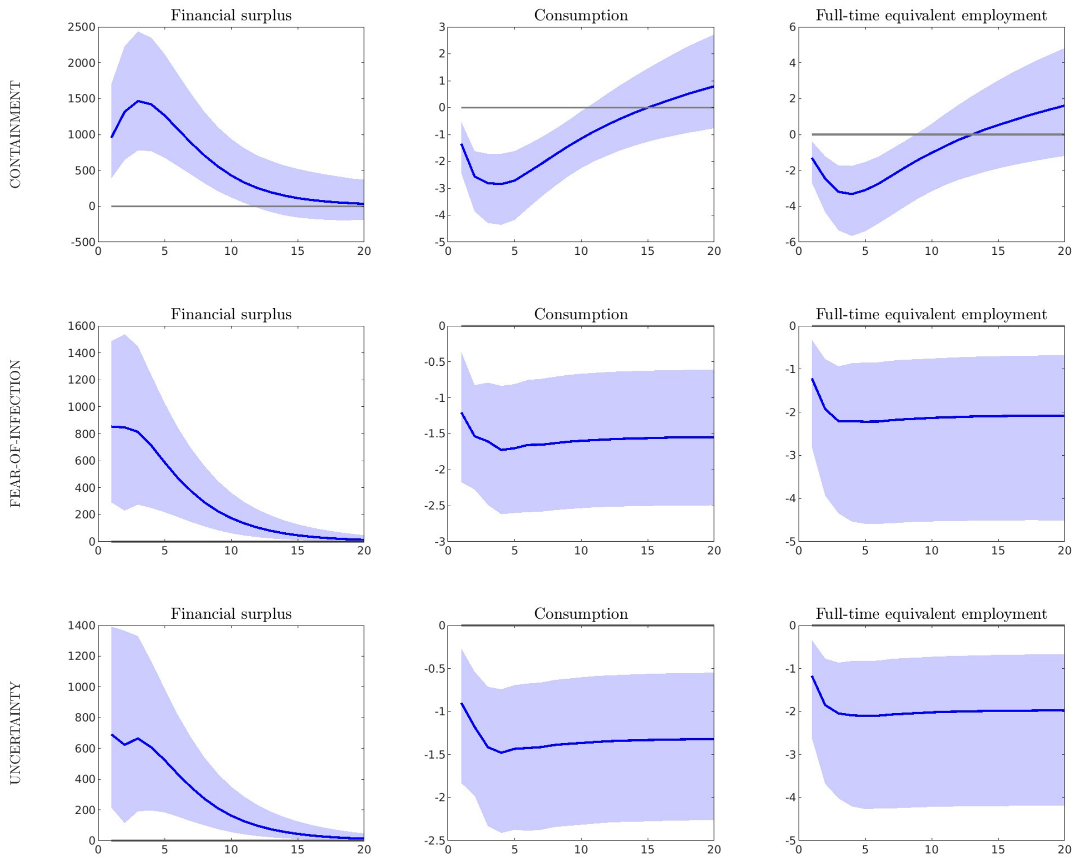

Figure 4: **Impulse response functions to a positive containment shock, to a positive fear-of-infection shock and to a positive adverse uncertainty shock.** Blue lines are the average impulse response functions over the period from March 2020 to December 2020 (averages of the median responses). Lighter blue areas delimit the space between the 16th and 84th percentiles. Horizontal axes refer to number of months. Vertical axes refer to percentage (consumption and full-time equivalent employment) and million of euro for financial surplus.

insignificant after 12 months.[11] The effects of the fear-of-infection and the uncertainty shocks are positive and long-lasting (€853 and €691 million on impact, respectively), albeit more limited than the containment shock.

Concerning consumption, the effect of the containment shock is negative on impact by about

[11] The transitory impact of the shock on financial savings may translate into a permanent shock on financial wealth. However, the total effect on wealth also relies on how the valuation effects (asset prices) respond to the shock.

1.3%, and it achieves the minimum value after three months (-2.8%) and finally turns positive at longer horizons. This estimated impact is somewhat stronger than the estimates of the fear-of-infection and uncertainty shocks (-1.2% and -1% on impact, respectively), which become more negative and remain markedly significant. The former becomes stable at around 1.6% after five months while the impact of uncertainty shocks stabilizes after seven months, at 1.3%.

The strongest impact on full-time equivalent employment is recorded in the case of the containment shock (-1.3% on impact and -3.3% after three months). Employment declines persistently as a result of the uncertainty shock and the average impact stabilizes at about -2% after two months.[12] The fear-of-infection shock causes a reduction of the full-time equivalent employment, stabilising at around -2.1% after eight months.

3.3 The variance decomposition

The relative importance of each structural shock to the variation of our key variables is provided in figure 5, where we report the monthly variance decomposition during 2020 (starting from March) and for different time horizons (1, 4, 8 and 12 months).

With respect to financial surplus, the fraction explained by the containment shock increases at higher horizons (from 30% at a horizon of 1 month to 47% at a horizon of 1 year, on average), while the fraction explained by the uncertainty and the fear-of-infection shocks is more pronounced at lower horizons (on average from 20% and 22% at a horizon of 1 month to 11% and 13% at a horizon of 1 year, respectively).

By contrast, even if the containment shock is the most important at all horizons, an increasing fraction of the variance of consumption is explained by the fear-of-infection shock except for the last four months of the year (from about 14% in May to almost 20% in August 2020, on average). The fraction explained by the uncertainty shock peaks in March 2020 for all horizons.

Concerning full-time equivalent employment, the fraction of variance explained by the containment shock gradually decreases over time (from 46% at the beginning of the pandemic to about 22% in the last part of 2020, on average) while the relative importance of uncertainty and

[12] The consumption and the full-time equivalent employment are not stationary variables, contrarly to the financial surplus. This implies that the shocks identified may have a permanent effect, shifting the variables to a new equilibrium. For instance, in response to the fear-of-infection shock, the consumption has approximately reached a new equilibrium after five months, suggesting a possible change of household consumption habits.

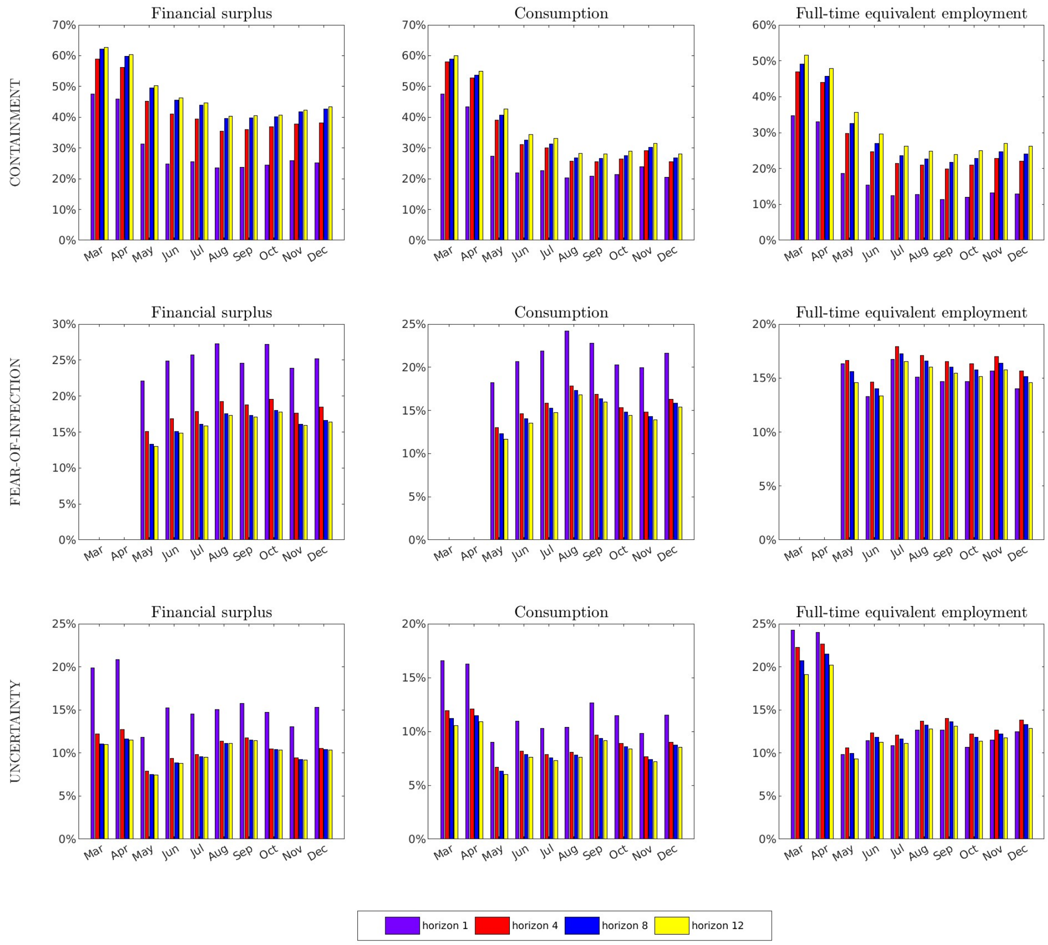

Figure 5: **Evolution of fractions of variances of key variables.** Evolution of fractions of variances explained by containment, fear-of-infection and uncertainty shocks at specific horizons over time (median).

fear-of-infection shocks increases during the summer at all horizons.

To sum up, the containment shock explains the largest fraction of the variance of all the three variables. However, the fraction explained by the containment shock decreases over time (especially at horizon of 1 month), while the relative importance of both fear-of-infection and uncertainty shocks increases in the second half of 2020.

3.4 Counterfactual analysis

An alternative way to assess the impact of the COVID-19 pandemic is through counterfactuals, which indicate how the variables of interest would have evolved in the absence of the identified COVID-19 induced shocks.

Figure 6 shows the evolution of the key variables (solid lines) and their counterfactual values (dashed lines), along with the contribution of each structural shock (coloured bars) to all variables at each point in time. The vertical distance between the actual realization of a variable and the counterfactual value tells us how much the identified shocks affected the variable at a certain point in time.

In March 2020, when the infection started to spread, financial savings amounted to €14.7 billion, but they would have been €7.7 billion in the absence of the three identified COVID-19 induced shocks; the gap between actual and the counterfactual data remained high and quite stable until June. During the first pandemic wave (from March to June), financial savings amounted to €56.7 billion and they would have been €32 billion in the absence of the three identified shocks. Since July 2020, the difference with respect to the counterfactual decreased, even if it remained remarkable. The containment shock played a relevant role in driving up financial savings during the entire period. Indeed, considering the period between March and December, financial savings would have been €67 billion, while the observed value amounted to €110.3 billion.[13] The fear-of-infection shock was relevant in May, June and September 2020 while in the other periods its contribution was lower. The uncertainty shock contributed to the increase in financial savings especially in the first part of 2020 (from March to June) as well as in September.

The most pronounced differences between the counterfactual and the observed consumption growth emerged in the first part of the pandemic period (from March to July). For example, in March 2020 the observed consumption decreased by 14% while the reduction would have been 5% in the absence of COVID-induced shocks, with a remarkable negative contribution of the containment shock. During September and October the fear-of-infection shock provided the largest contribution. In the last months of 2020 there was a low contributions of the three shocks, so that

[13] In a recent work Colabella et al. (2023), assuming that the saving rate remained stable at its average value in the five years preceding the outbreak of the pandemic, estimate that additional savings accumulated by households in financial assets exceeded 130 billion euros up to the first quarter of 2023.

the vertical distance between the realized and the counterfactual is very small.

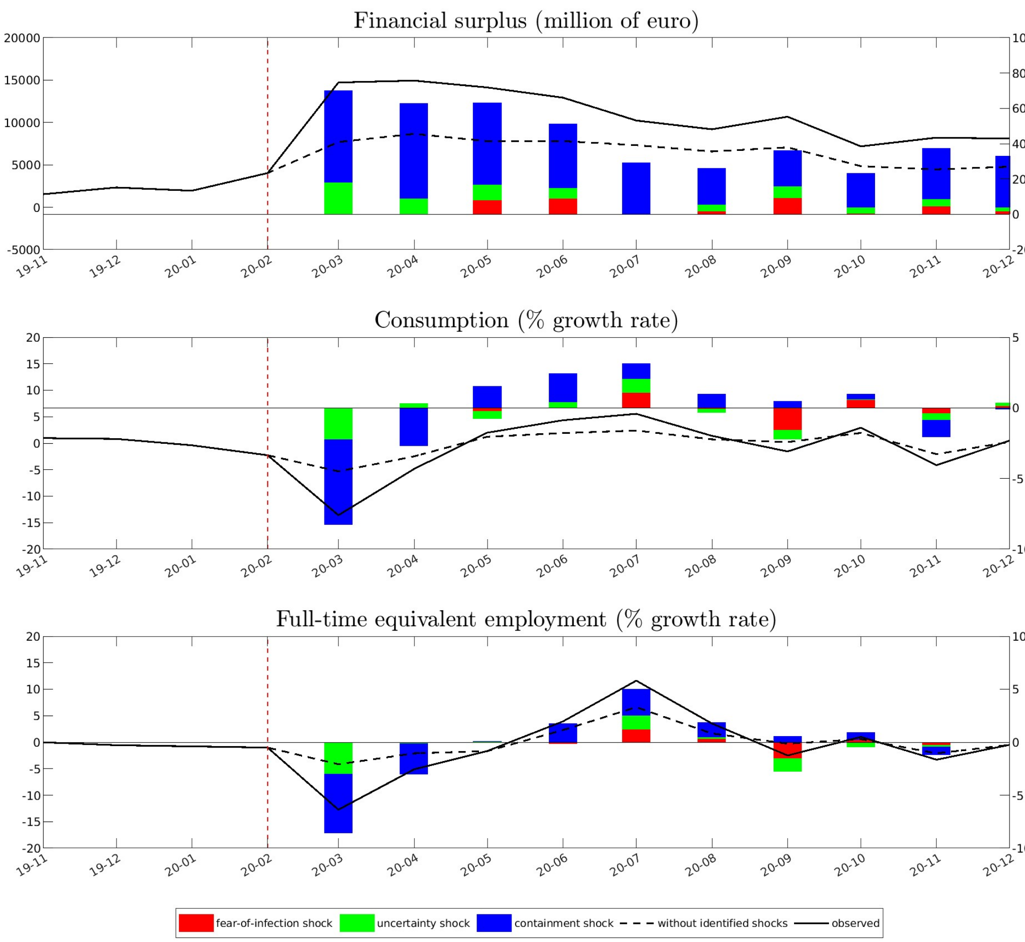

Figure 6: **Counterfactual path of key variables.** Evolution of variables in the absence of containment, fear-of-infection and uncertainty shocks (median). Vertical dashed line denotes the start of the COVID-19 pandemic. The coloured bars indicate the contribution of identified shocks to key variables (right axis).

The full-time equivalent employment growth rate shows a pattern similar to consumption. The drop observed in March 2020 (about -12.7%) would have been less than half if the COVID-19 induced shocks had not taken place (-4%). Also in this case, the containment shock played an important role in reducing the employment growth, followed by the uncertainty shock. The fear-of-infection shock largely contributed to the dynamics of employment in September.

3.5 Robustness exercises

As discussed, in our identification strategy we assume that the containment shock reduces the number of tourists in both March-April and May-December (Table 1). To assess the robustness of our results, we consider an alternative identification scheme that leaves unrestricted the impact of the containment shock on the number of tourists from May 2020 onwards. All the other restrictions, along with the identified shocks, remain consistent with those reported in Table 1. The estimated impulse-response functions are shown in red in Figure 7, and coincide almost exactly for all variables and identified shocks with the baseline results, which are reproduced as blue lines in the same figure.

We further check the robustness of our results by considering the same variables and shocks as in the baseline specification, except for the inclusion of the restaurant services turnover index as an alternative to the number of tourists.[14] This alternative reduces the length of our time series, since the turnover index is only available from January 2010 onwards.[15] Although the reduced sample period used, the impulse response functions, shown in Figure 8, are very similar in all cases and do not have any impact on the conclusions of the paper.

As a further robustness check, we substitute the containment index based on the data collected by the OxCGRT with the Italian stringency index (ItSI) proposed by Conteduca and Borin (2022). In contrast with the containment index, the ItSI is not constructed as a nationwide unweighted indicator, but it traces non-pharmaceutical interventions enforced at the local level (regions, provinces, and municipalities) and aggregates them at the national level, weighing by targeted populations. This is particularly valuable for studying the impact of COVID-19 in Italy, because public intervention displayed significant heterogeneity at the geographical level, especially since the end of 2020.[16] Results on the effects of all three COVID-19 induced shocks across

[14] We consider this alternative specification to deal with the argument that people may decide to avoid travelling not because of infection concerns but due to the limitations lifted by a foreign country to restrain tourism from abroad. Nevertheless, this issue can be addressed also in the identification scheme in Section 2.3, arguing that it is likely that the tourists not affected by the fear of being infected rescheduled their travels looking for alternative destinations, including domestic ones.

[15] Since the restaurant services turnover index is available at a quarterly frequency, we apply the Chow-Lin disaggregation method also in this case. We use the business confidence index, which is published at a monthly frequency, as the indicator variable and we add a dummy term for the treatment of the COVID-19 extremes. Both variables come from the Istat database.

[16] Note that, as explained by Conteduca and Borin (2022), the two indexes are very close during the first phase of the pandemic, which corresponds to our period of analysis, whereas the indicators diverge in 2021, when restrictions were

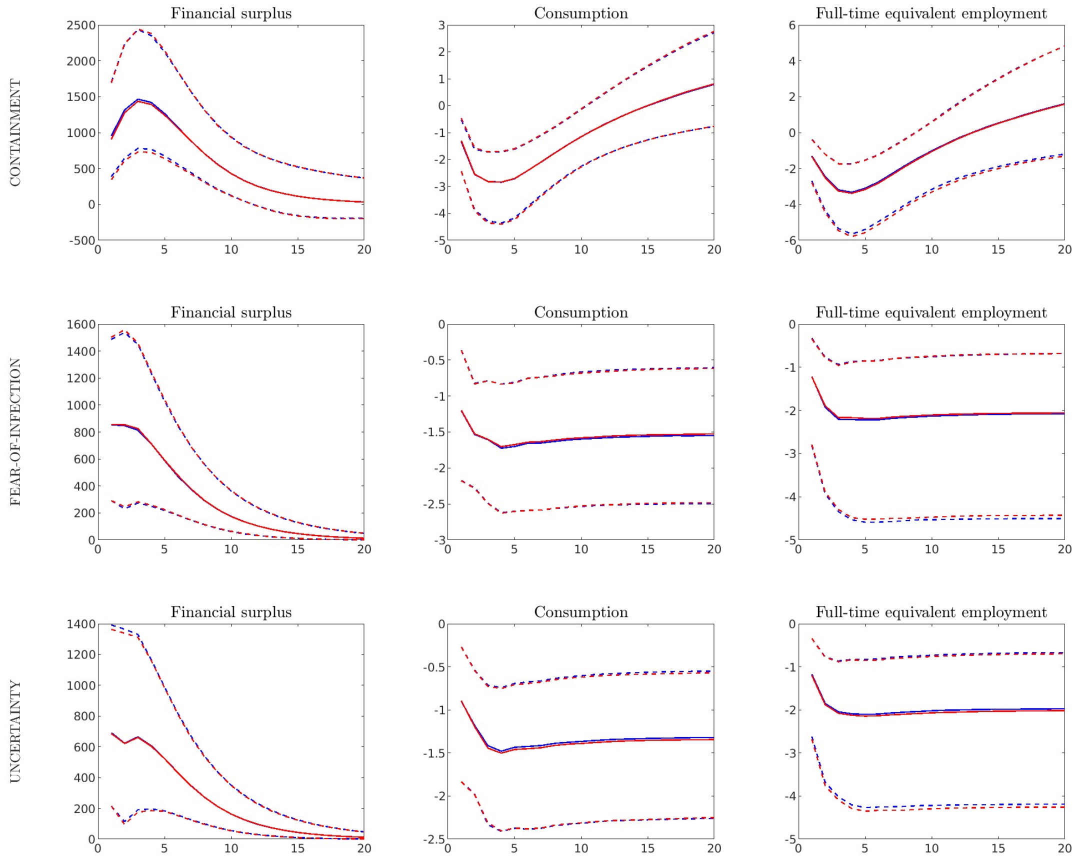

Figure 7: **Impulse response functions to a positive containment shock, to a positive fear-of-infection shock and to a positive adverse uncertainty shock with an alternative identification scheme.** Blue lines refers to baseline model while red lines leave unrestricted the impact of the containment shock on the number of tourists from May 2020 onwards. Full lines are the average of the median responses, dashed lines are 16th and 84th percentiles. Vertical axes refer to percentage (consumption and full-time equivalent employment) and million of euro for financial surplus.

these two models are very similar both qualitatively and quantitatively. For example, looking at Figure 9, the median impulse response functions to containment shocks over the whole sample period appear to be very close for all variables.

Overall, all these sensitivity exercises suggests that the containment shock has a positive and significant impact on households' financial savings and a negative impact on consumption and

implemented only in some local red zones and/or to unvaccinated individuals.

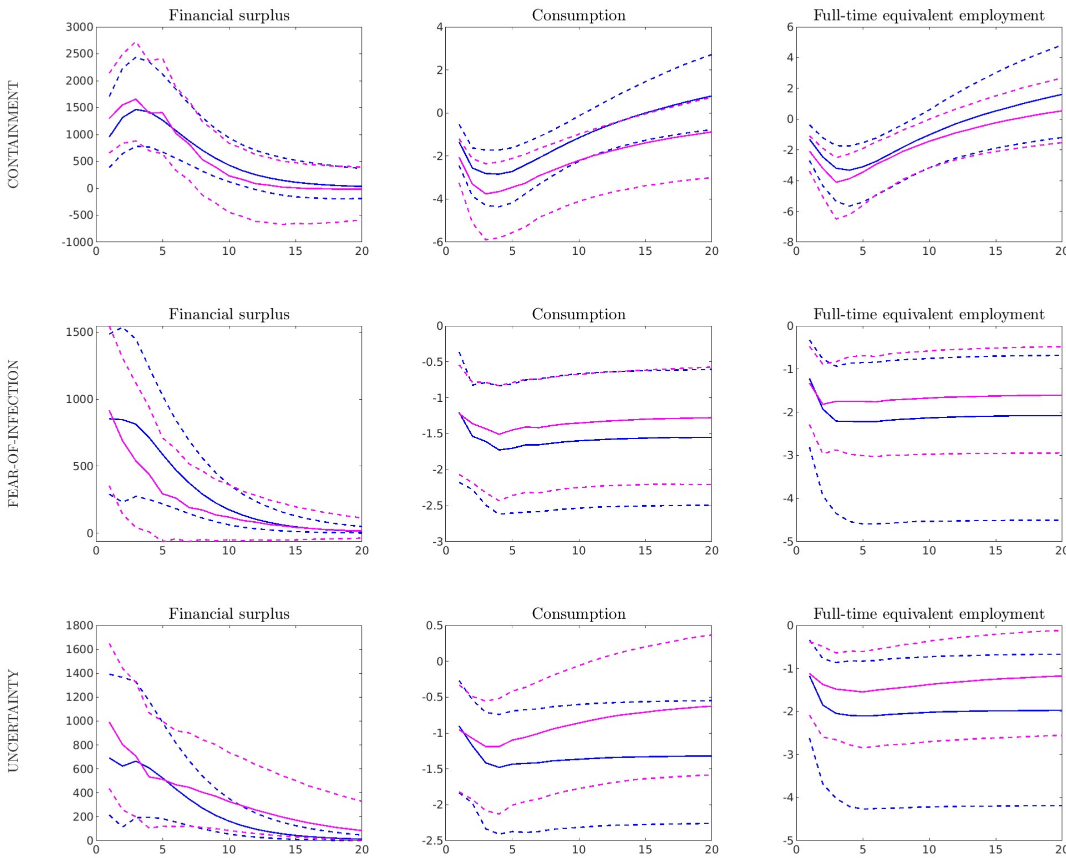

Figure 8: **Impulse response functions to a positive containment shock, to a positive fear-of-infection shock and to a positive adverse uncertainty shock the use of the restaurant services turnover index.** Blue lines refers to baseline model while magenta lines indicates the inclusion of the restaurant services turnover index as an alternative to the number of tourists. Full lines are the average of the median responses, dashed lines are 16th and 84th percentiles. Vertical axes refer to percentage (consumption and full-time equivalent employment) and million of euro for financial surplus.

full-time equivalent employment. Moreover, all variables respond to the fear-of-infection and the uncertainty shocks, even if the impact is lower in size. These conclusions are valid for the baseline model or whether the COVID-19 induced shocks are identified with alternative identification scheme or variables.[17]

[17]Other results that we checked confirmed the similarity of results across the four models (baseline versus three alternatives), including the average variance decompositions and the counterfactual exercise. These additional results

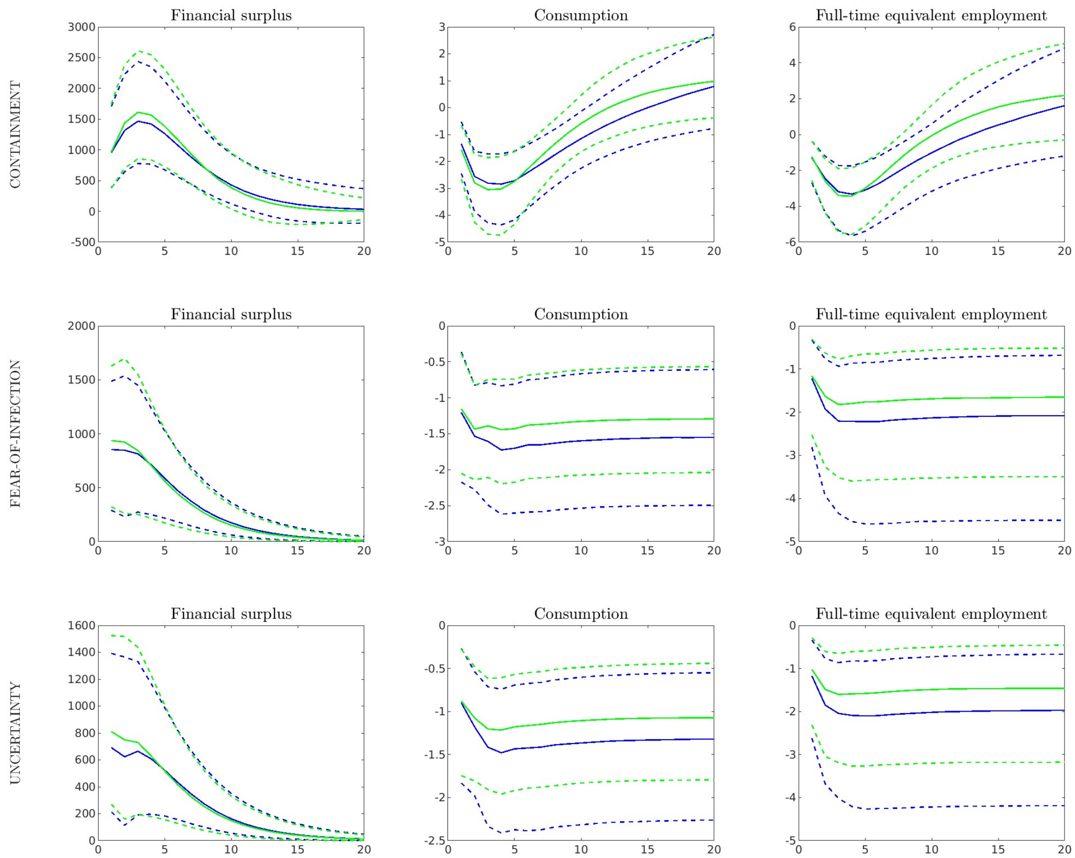

Figure 9: **Impulse response functions to a positive containment shock, to a positive fear-of-infection shock and to a positive adverse uncertainty shock: the use of the Italian stringency index (Conteduca and Borin, 2022).** Blue lines refers to baseline model while green lines indicates the inclusion of the Italian stringency index as an alternative to the containment index. Full lines are the average of the median responses, dashed lines are 16th and 84th percentiles. Vertical axes refer to percentage (consumption and full-time equivalent employment) and million of euro for financial surplus.

4 Conclusions

Following the pandemic, households' financial surplus grew in many countries, including Italy, recording unprecedented values. Part of the observed growth derived from the containment measures (e.g. lockdown) imposed by governments, that prevented people from circulating

are available upon request from the authors.

and, in turn, limited the possibility of consuming. Furthermore, due to the spread of the contagion part of households deliberately reduced the consumption of goods and services that, requiring social interactions, could have increased the probability to be infected. Finally, the long-lasting pandemic period generated uncertainty about economic conditions, which worsened the expectations about future incomes and affected household spending. This paper provides empirical evidence on the effects of the COVID-19 disease on the Italian households' financial surplus through the three mentioned channels.

To this aim, we exploit a VAR with time-varying parameters and stochastic volatility, identified with a minimum set of zero and sign restrictions. The time-varying variance is a key component of the model in order to capture the extreme values observed in many macroeconomic aggregates due to COVID-19.

To achieve the identification, our VAR model is augmented with the containment index, based on information collected by the Oxford COVID-19 Government Response Tracker, tourism flows (in Italy and abroad) to capture the impact of the fear of infection, and the macroeconomic uncertainty to assess the role of precautionary motives.

Overall, the analysis points to a significant macroeconomic impact of the three identified shocks. In particular, the containment shock has a positive and significant impact on household financial savings, which is stronger at lower horizons and is absorbed in about twelve months, whereas it has a negative impact on consumption and full-time equivalent employment. Surplus, consumption and employment also respond to the fear-of-infection and the uncertainty shocks, although the impact is lower in size. Based on our counterfactual exercises, between March and December the financial surplus would have been equal to €67 billion in the absence of the three identified shocks, while it actually amounted to €110.3 billion. The containment shock explains almost entirely the increase of the surplus.

Our model can be used to assess the impact of the pandemic on other macroeconomic indicators. In particular, it would be interesting to study the effect on wealth inequality, since the observed increase of savings might have been concentrated in a fraction of the population. This is left for future analysis.

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A Data definition and treatment

To estimate the time-varying coefficients VAR with stochastic volatility we use data covering the period from April 1999 to December 2020. The variables used are available with different frequencies. As explained in Section 2.1, since quarterly data are less affected by spikes created by COVID-19, we estimate monthly time series through a Chow-Lin disaggregation[18], taking into account COVID-19 extremes. In particular, we add a dummy for the period that goes from March to September 2020, when the amount of data variation was substantially different (Carriero et al., 2021b, Lenza and Primiceri, 2020). Variables that are available with higher frequency are aggregated on a monthly basis. The definition, treatment and sources for each variable work as follows.

The contaiment index is based on information of government measures to contain the spread of COVID-19 obtained from the Oxford Coronavirus Government Response Tracker (OxCGRT). The OxCGRT reports publicly available information on 24 policy indicators organised into four groups: “C - containment and closure policies” (8 indicators), “H - health system policies” (7 indicators), “E - economic policies” (4 indicators) and “V - vaccination policies” (4 indicators). Our containment measure is based on all the C - containment and closure policies indicators which include: school closures, workplace closures, cancellation of public events, restrictions on gathering, public transport closures, stay-at-home requirements, restrictions on internal movement, and international travel controls. These indicators are captured on an ordinal scale to describe the strength of the government response in terms of containment and closure policies.[19]

To construct our containment index we follow the methodology used by the OxCGRT (Hale et al., 2021), which briefly consists in creating a score by taking the ordinal value of each C - indicator and subtracting half a point if the policy is targeted to a specific geographical area rather than being general across the whole jurisdiction. Then, each of these scores is rescaled by their maximum value to be bounded between 0 and 100, with a missing value contributing zero. Lastly, these scores are averaged to obtain the final index. Therefore, the containment index, reporting a

[18] The Chow-Lin method is a technique used for temporal disaggregation, namely the process of deriving high frequency data from lower frequency data. The Chow-Lin method uses high frequency indicators which are deemed to behave like the target variable. Indeed, this method derives a new time series that is consistent with the low frequency data whilst preserving the shortterm movements in the higher frequency indicator series. The indicators used in this exercise are judged to be correlated with the target variables at the higher frequency level.

[19] Detailed information is available on: https://github.com/OxCGRT/covid-policy-dataset/blob/main/documentation_and_codebook.md

number between 0 and 100, reflects the overall containment of the government response. A higher index indicates a higher overall response level.

The number of tourists contains both domestic and international travellers. Concerning domestic tourism, the National Institute of Statistics (Istat) publishes the number of Italian residents who are registered at any Italian touristic accommodation. The number of Italian tourists who choose a foreign destination is obtained from the Bank of Italy survey on international tourism, based on interviews of resident and non-resident travellers at the Italian borders. These data are available quarterly while the domestic ones are at monthly frequency. We obtain the monthly time series on international tourists through the Chow-Lin disaggregation based on the number of resident tourists in Italy. The series have been seasonally adjusted through the X-13ARIMA-SEATS procedure of the US Census Bureau.

We construct the macroeconomic uncertainty following the methodology developed in Jurado et al. (2015) which is based on different steps. We first collected monthly macroeconomic variables (95 time series) and financial variables (around 50 time series) related to the Italian economy, ranging from 1998 to 2020. Macroeconomic variables cover: nominal and real effective exchange rates; industrial production index (referred to manufacturing, mining and quarrying, electricity and gas, consumer and capital goods, non-durable and intermediate goods); production index on construction sector; loans to private sector; deposits collected by banks; bonds issued by banks; long-term interest rate; 3-month interbank rate; business indicators about manufacturing production tendency and future tendency; manufacturing orders, employment and selling prices; construction business tendency; retail trade and service business tendency; international trade export and import indicators; sales retail trade volume indicator; retail trade on car registrations; unemployment rate; labour compensation; consumer prices; stock exchange share price index; stock exchange market value index; average coupon index on bond securities; GDP leading indicator; confidence indicators; orders indicators. The financial variables are indicators measuring a broad cross-section of asset returns and other financial indicators not included in the macroeconomic variables. Following Fama and French (1992) and using around 300 Italian listed firms, we built 5 portfolios based on market value quintiles and 5 portfolio categories based on book equity/market equity quintiles. Furthermore, we computed differences in returns across portfolios built on size deciles and book-to-market deciles. We also divided firms according to the economic sector (manufacturing, services, finance, software, resources) and computed price growth and total return by sectors. Market excess return, built as a difference between market return and the interest rate, is also employed. All macro and financial variables are transformed (in logs or differences) in order to achieve stationarity. Uncertainty is constructed using a factor-augmented vector autoregression (FAVAR) model. Both macro and financial variables are used to compute factors, through a static principal component analysis. In a nutshell, first, latent factors from a large data set that includes monthly macroeconomic and financial variables are obtained by using the method of principal components. Second, forecast errors for each of the factors and for each macroeconomic series are obtained, by estimating an autoregressive model and a factor augmented vector autoregression, respectively. Then, a parametric stochastic volatility model is estimated for both the one-step-ahead prediction errors in the variables and the analogous forecast errors for the factors, obtaining the h-period-ahead forecast error variance of each variable. Finally, the individual uncertainties (the square roots of the forecast error variances) at different forecast horizons are aggregated by equal weighting to compute the monthly macroeconomic uncertainty index. We make some refinements to the described procedure to account for the statistical issues determined by the COVID-19 pandemic on macroeconomic and financial variables, that in turn affect the estimation of economic factors and forecasting. We then follow the approach suggested by Ng (2021). In particular, we estimate the economic factors from ”de-COVID” data obtained by subtracting a consistent estimate of the mean of each series over the sample up to March 2020 and after it. In other words, the ”de-COVID” data are the residuals of a regression of each variable on the current and past values of hospitalizations number and an additional dummy that equals one after March 2020 (Model 4 in Ng, 2021). Once these data are available, we estimate the factors. Then we include COVID-19 indicators (number of hospitalizations and number of cases in Italy), as predictors in the factor-augmented regression. Therefore, the monthly macroeconomic uncertainty index is obtained as described before.

The financial surplus comes from quarterly sectoral non-financial accounts in the Istat database. The series have been seasonally adjusted through the X-13ARIMA-SEATS procedure of the US Census Bureau. The monthly time series is obtained through a Chow-Lin disaggregation exploiting monthly transactions of household deposits from Bank of Italy statistics. The real financial surplus is obtained by applying the harmonised index of consumer prices (HICP).

The consumption comes also from quarterly sectoral non-financial accounts. It has been seasonally adjusted through the X-13ARIMA-SEATS procedure. The monthly time series is obtained by applying the Chow-Lin disaggregation based on information about the inflation and rate of unemployment. To transform the consumption in real terms, the nominal consumption is divided by the HICP.

Finally, the seasonally adjusted full-time equivalent employment is obtained from the quarterly sectoral non-financial accounts database provided by Istat. The monthly variable is obtained via the Chow-Lin disaggregation method based on the unemployment rate.

B Model specification and estimation

We assume that y_t follows

$$y_t = B_{0,t} + B_{1,t}y_{t-1} + \cdots + B_{p,t}y_{t-p} + e_t \qquad t = 1, \ldots, T \tag{4}$$

where $B_{0,t}$ is a vector of time-varying intercepts, $B_{i,t}$ are matrices of time-varying coefficients, for $i = 1, \ldots, p$. Let e_t be the corresponding $K \times 1$ vector of reduced-form shocks to the endogeneous variables.

Let $\theta_t = vec(B_t^{'})$ where $B_t = \left[B_{0,t}, B_{1,t}, \ldots, B_{p,t}\right]$ and $vec(\cdot)$ is the column stacking operator. The VAR coefficients evolve as a random walk:

$$\theta_t = \theta_{t-1} + \omega_t \tag{5}$$

where ω_t is a Gaussian white noise vector with mean zero and costant covariance Ω. In order to model the time-variation of the covariance matrix of the unobservable innovations, let $\Sigma_t = F_t D_t F_t^{'}$ where F_t is a lower triangular matrix with ones on the main diagonal and D_t is a diagonal matrix. Let σ_t be a vector containing the diagonal elements of $D_t^{1/2}$ and $\phi_{i,t}$ a column vector with the nonzero elements of the $(i+1)$-th row of F_t^{-1} with $i = 1, \ldots, n$. The dynamics of those parameters is specified as follows:

$$\log \sigma_t = \log \sigma_{t-1} + \xi_t \tag{6}$$

$$\phi_{i,t} = \phi_{i,t-1} + \psi_{i,t} \tag{7}$$

where ξ_t and $\psi_{i,t}$ are Gaussian white noise processes with zero mean and constant variance Ξ and Ψ_i, respectively. Moreover, we assume that $\psi_{i,t}$ and $\psi_{j,t}$ are uncorrelated for $i \neq j$ and ω_t, ϵ_t, ξ_t and $\psi_{i,t}$ (for $i = 1, \ldots n$) are mutually uncorrelated at all leads and lags.

The VAR is estimated with two lags. Estimation is conducted using Bayesian methods, which are particularly efficient in treating the high dimensionality of the parameter space and the non-linearities of the model. More specifically, the prior distributions are specified consistently with Primiceri (2005) and the Gibbs sampler is used to obtain the posterior distribution of the parameters. The priors for the initial states of the time-varying coefficients $B_{i,t}$, simultaneous relations F_t and log volatilities D_t are assumed to be normally distributed. The priors for the hyperparameters are assumed to be distributed as independent inverse Wishart. Technical details on the Gibbs sampling algorithm used can be found in Galí and Gambetti (2015).

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