Real-Time Inequalities and Policies during the Pandemic in the US [*]

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Abstract

We investigate the effects of different policies implemented during the Covid-19 pandemic on real-time inequalities in the United States. We use a novel database built using anonymized data from the private sector, which enables us to compute daily measures of consumption inequality at the county level. Using a narrative approach combined with high frequency data to identify the shocks, we evaluate the impact of monetary policy in a VAR framework. Our approach allows us to augment standard Cholesky identification with additional information coming from key policy announcements by the Fed and evaluate their effectiveness. The main findings show that consumption inequality rose during the pandemic, but the effect of monetary policies has been to mitigate such an increase. In particular, we distinguish two kinds of intervention: those regarding federal funds rate, Repo agreements and QE programs ("purely monetary") and those concerning emergency plans for firms to avoid mass layoffs and a sharp decrease in employment ("quasi-fiscal"). Our evidence suggests a greater contribution by the former type in mitigating the rise in inequality.

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1 Introduction

The Covid-19 pandemic has drastically changed our daily life. Aside from the terrible health consequences, it has resulted in an unparalleled economic crisis, which countries all over the world have been attempting to address since March 2020. In the United States, the pandemic led to a large and immediate decline in aggregate spending and a sharp increase in unemployment. The response of the Federal Reserve, through a series of monetary stimulus and emergency lending initiatives has, according to many economists (Fleming et al. 2020, Bullard 2020, Crouzet 2020 among others) prevented the pandemic from causing a financial crisis and a much deeper and more prolonged recession. In this paper we investigate whether the measures that the Fed has taken in response to the pandemic had an effect on inequality. Indeed, although inequalities in the United States have been under attention for the past few decades, during Covid-19 the situation has drammatically worsened: inequality in the US has reached record levels since mid-March 2020, when tens of millions of Americans across the country started losing their jobs as a result of the economic fallout.

Two main streams of the literature are at the basis of this work. The first one is related to the effects of Covid-19 on consumption inequality. Several studies have analysed this aspect using high-frequency data for different countries, finding an increase in consumption inequality during the pandemic. Among others, Aspachs et al. (2021) with Spanish data from bank records, Gathergood et al. (2021) and Chronopoulos et al. (2020) with UK data, Andersen et al. (2021) for Denmark, Bachas et al. (2020) and Cotton et al. (2021) with US credit card data. The second stream concerns the empirical analysis of the effects of monetary policy on inequality. The debate on the topic is still open, and the empirical literature is sometimes ambiguous. Some studies exploit survey data on household income at the quarterly level: the paper of Coibion et al. (2017), for example, uses quarterly data from the US Consumer Expenditure Survey (CEX) in a VAR framework with narrative shocks to estimate the effects of conventional monetary policy on the Gini coefficient for consumption and income. Also for the US, Montecino and Epstein (2015) found that unconventional monetary policy led to rising inequality via raising asset returns. Some other studies perform similar analysis for different countries: Saiki and Frost (2014) look at how unconventional monetary policy affected inequality in Japan after 2008, using micro level data of Japanese households in a VAR framework. Mumtaz and Theophilopoulou (2016) provide similar evidence for the UK using the Family Expenditure Survey (FES), finding that contractionary monetary policy shocks lead to an increase in earnings, income and consumption inequality. For the Euro area, Guerello (2017) constructs measures of income dispersion using data from the European Commission Consumer Survey and evaluates the effects of both types of

monetary policy on income distribution, while Lenza and Slacalek (2018) use the Household Finance and Consumption Survey (HFCS) by the European Central Bank to evaluate the impact of quantitative easing on income and wealth of individual euro area households.

In our analysis, differently from the above mentioned literature, inequality is intended to be across counties, as in Brown and Ravallion (2020), Paarlberg et al. (2017) among others. We consider disparities in the level of consumption spending, using anonymized bank transaction data recently released by Chetty et al. (2020) to evaluate the microeconomic dynamics underlying aggregate data. We first build the dataset by creating daily indices to measure inequality across counties in the US and descrbe the evolution of these indices during the pandemic. Then, we estimate a VAR model augmenting standard Cholesky identication with additional information coming from key policy announcements by the Fed in the last year in order to measure the impact of Fed's measures in mitigating or reinforcing real-time inequalities.

Our main contribution is the use of high-frequency data on consumption spending to study the effect of Fed's policies during Covid-19. In particular, we distinguish between two kinds of intervention in a narrative framework: those regarding the federal funds rate, the Repo agreements and the QE programs, that we call "purely monetary", and those concerning emergency plans for firms to avoid mass layoffs and a sharp decrease in employment, to which we refer to as "quasi-fiscal" policies. As discussed above, many authors have analyzed the development of consumption spending in the US with similar data, but to the best of our knowledge, the empirical literature linking these trends with Fed's monetary and quasi-fiscal policy interventions is very scarce. Our main findings show that consumption inequality rose during the pandemic, and the effect of Fed's policies has been to mitigate such an increase. In particular, when distinguishing between monetary and quasi-fiscal policies, our evidence suggests a greater contribution by the former type of intervention in mitigating inequality.

The paper is articulated as follows: Section 2 presents the data used, explains how daily inequality indices are created and describes our identification strategy for the shocks. Section 3 shows the evolution of consumption inequality during the pandemic, the empirical analysis through the estimation of a VAR model, and presents the results. Section 4 concludes.

2   Data and methodology

Our aim is to assess whether and how inequality in the United States has evolved during the Covid-19 pandemic, and what has been the role of Fed's policies in this sense. For our analysis we use different types of data. We look at inequality in consumption levels across counties.Many authors have analyzed consumption patterns to study inequalities:

according to Blundell and Preston (1998) and Krueger and Perri (2006), the distribution of consumption expenditures gives greater insight into the distribution of household well-being, compared to income distribution. We combine the two measures: first, we look at inequality in consumption spending across all counties. Then, we divide them in four quartiles on the basis of their per capita income, and analyze the response of consumption of counties at different quartiles. Differently from the above mentioned papers, we use high-frequency spending data to provide a real-time dynamic analysis of inequality of consumption spending.

2.1 Real economy data

The database recently released and constantly updated by Chetty et al. (2020) provides daily information on percent changes in consumption expenditure and employment by county in the US. The changes refer to January, 14 2020 and our sample period is from 20th January 2020 to 31st March 2021, with daily data. This database is built using anonymized data from several private companies. In particular, they measure consumer spending changes using data on credit and debit card spending collected by Affinity Solutions Inc, which capture nearly 10% of debit and credit card spending in the US. Since we are working with card spending data, we miss cash transactions in our analysis, as well as other transactions that are made, for example, through other agents such as insurance companies. This dataset, nonetheless, provides satisfactory information about spending on retail, some service expenditures, and some durable goods. In the Affinity data provided by Chetty et al. (2020), daily changes in card spending are available at the county level, and each county is associated to a zip code. In order to be able to divide the counties in four quartiles based on per capita income, we use data on 2019 per capita income by county from the US Bureau of Economic Analysis (BEA).

For employment, Chetty et al. (2020) provide a representative picture of private non-farm employment in the United States by combining different data sources to obtain information on employment and earnings: payroll data from Paychex and Intuit, worker-level data from Earnin, and time sheet data from Kronos. As for consumption data, also data on employment are provided as percent changes with respect to January 14, 2020.

However, we are interested in working with economic data in levels and not in percent changes. To transform percent change data into level data we combine the database by Chetty et al. (2020) on daily percent changes in consumption and employment with annual 2019 data on per capita consumption and employment from the BEA. Our assumption is that annual 2019 data are a good proxy for the situation on 14th January 2020, to which data in percent changes refer to. In this way, we have a measure in levels of daily per capita

consumption and employment thoughout 2020. Finally, we remove weekend days from the sample to be able to merge all data. We end up with a dataset of 310 observations for each variable, for 3,142 counties. To the best of our knowledge, we are the first who perfom an analysis of consumption inequality using this dataset with the described arrangements, to study diparities across US counties and to assess the role of the Fed in the evolution of inequality.

Figure 1: Consumption and employment trends (7-day moving averages)
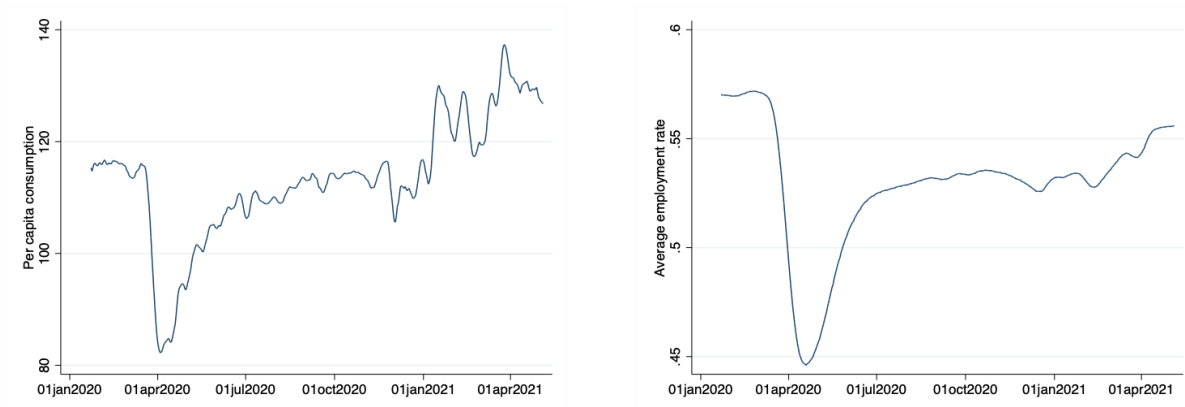
(a) Average per capita consumption spending

(b) Average employment rate

Figure 1 reports the daily average (intended as average across counties) per capita consumption spending and the daily average employment rate in the US during the sample period considered. The correlation between these series constructed by us and the data on per capita consumption and employment from the FRED database is 0.94 for consumption and 0.97 for employment. Looking at the development of the two variables, one can easily notice a similar trend, with the minimum level reached in April 2020 (among others, EarnestResearch 2020 and Alexander and Karger 2020 provide the same evidence). Moreover, while the consumption spending returns to pre-pandemic levels (and also above those) towards the end of 2020, the employment rate remains significanlty lower.

2.2 Consumption inequality indices

As a first step, before looking at the effect of Fed's policies on inequality, we are interested in the evolution of consumption inequality across counties in the US during 2020 and at the beginning of 2021. We thus construct several indices of consumption inequality across counties at daily frequency and compare them. Such measures report the inequality across counties in the level of per capita consumption spending during the sample period considered. The data underlying these indices are given, as explained in Section 2.1, by a combination

of two sources: we applied the daily percent changes in consumption spending at the county level from the database released by Chetty et al. (2020) to annual 2019 data on per capita consumption by county from BEA. We are here considering the US counties as a whole, without looking at the differences in per capita income. Figure 2 reports four of these indices: the difference between the 90th and the 10th percentile in consumption spending (2a), the variance of the logarithm of consumption (2b), the Gini index (6) and the Atkinson index (2d). For all these indicators, a higher value means a higher level of consumption inequality across counties. We can notice a common trend in the four plots: it appears that the Covid-19 pandemic had a large and heterogeneous economic impact leading to a higher consumption inequality across US counties in 2020. In particular, a peak is evident around mid-April, which corresponds to the outbreak of the pandemic, and at the beginning of 2021. Similar results were found by Cotton et al. (2021) with an analogous dataset and by Cox et al. (2020), Baker et al. (2020), Karger and Rajan (2020) using different sources of spending data.

Figure 2: Consumption inequality indices

(a) 90th–10th percentile difference

(b) Variance of log consumption

(c) Gini index

(d) Atkinson index
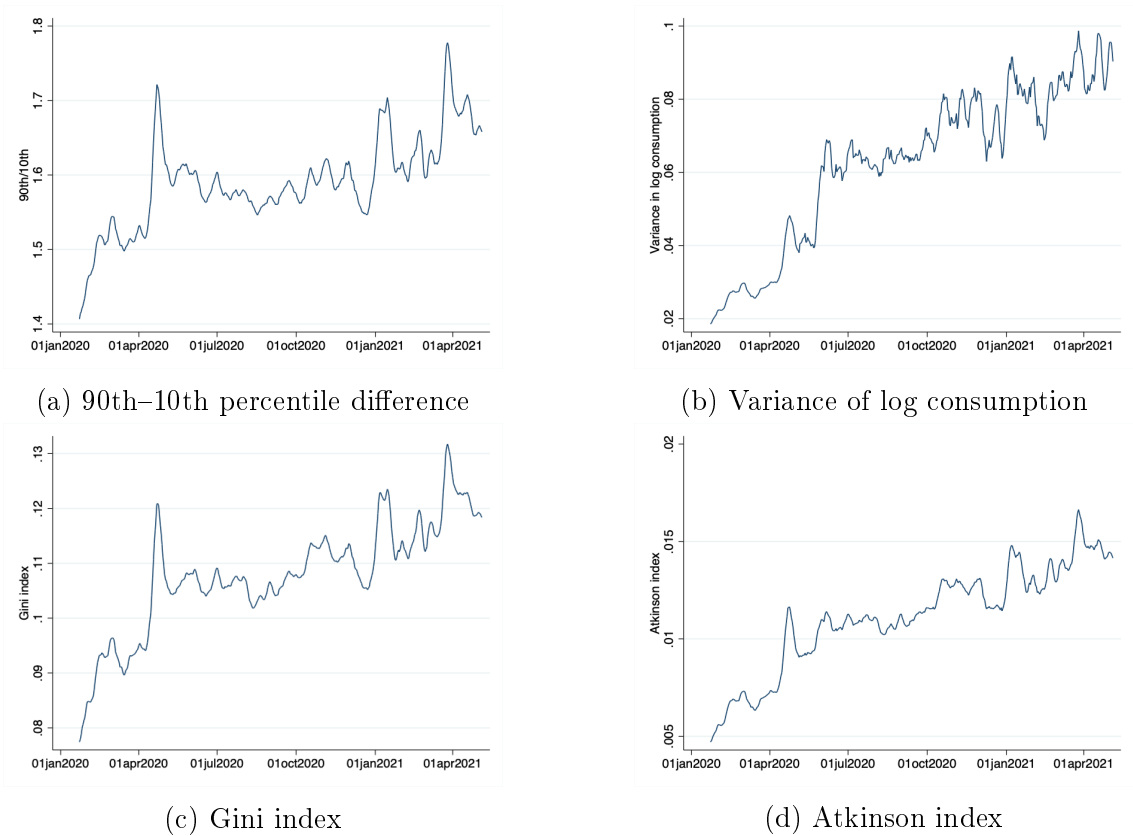
2.3 Monetary policy shock identification and data

As many researchers claim (Labonte 2021, Clarida et al. 2021, Ferrero and Giglioli 2020, among others), the Fed promoted economic and financial stability throughout the Covid-19 emergency by exploiting its monetary policy and lender of last resort functions. Some of these actions aimed to encourage economic activity by lowering interest rates (traditional monetary policy measures), while others aimed to provide liquidity so that businesses could access required funding. In particular, in 2020, differently from the past, the Fed has also acted as a lender for nonbank firms and markets by creating a series of emergency lending facilities.

For the scope of our analysis, we divide Fed's measure announcements in two broad categories. The first, that we call "purely monetary policies", includes those announcements of conventional and unconventional monetary policy actions that the Fed took during the Covid-19 emergency (and that are classified as "Monetary Policy" by the Fed website). These include federal funds rate, Repo agreements and QE programs. The second group, instead, consists of announcements of liquidity and funding operations, subsidized lending, other tools to provide more direct support to credit, such as under-remunerated reserve requirements and other banking initiatives. This second category includes emergency plans for firms to avoid mass layoffs and a sharp decrease in employment: they can be easily seen as complement to fiscal measures and therefore we refer to them as "quasi-fiscal policies". As described by Montanjees (1995), these are operations undertaken for public policy reasons by units outside the government definition, like the Fed. Most of these activities might be carried out by fiscal authorities, rather than being inherent to central banks (Gil Park 2012).

In order to recognize the shocks, we use an innovative setup combining high frequency (HF) data with a narrative approach for the identification of monetary policy shocks, but with some differences from other authors who used similar strategies such as Kuttner (2001), Gurkayanak et al. (2005), Hamilton (2008), Campbell et al. (2021). First, since we have daily data, we don't isolate a 30-minute window around the announcements to guarantee the orthogonality of the shock, but we assume that no other shock occurs in the same day to change the response of the variables [1]. Second, we look at the spread between the long-term and the short-term interest rates on Treasury bills (that is, the change in the slope of the yield curve) in the days of Covid-19 related Fed press conferences as a measure for the shock. Indeed, the great majority of actions in 2020 were not based on interest rate increases, but rather on forward guidance and asset purchases. When a central bank gives forward guidance

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[1] We are aware that we cannot exclude the presence of other contemporaneous (in the same day) shocks that can possibly make our resuts biased (see Miranda-Agripppino and Ricco 2021). We nonetheless try to estimate the impulse response functions, bearing this in mind.

on future monetary policy, it shapes investors' expectations for future policy interest rates, which influence the yield curve. Forward guidance refers to central banks' commitment to keep policy interest rates low for a period of time or until they accomplish a measurable goal (such as an increase in inflation and/or a decrease in unemployment). Hence, the yield curve is predicted to flatten between the short end and the term of the yield curve that corresponds to the guidance's term, and to flatten farther out. Similarly, asset purchases involve the outright purchase of assets by the central bank in the secondary market, including government bonds. By purchasing assets, the central bank adds to demand for them, so their price increases and their yield falls. As a result, asset purchases can change the slope of the yield curve, usually by lowering the additional yield investors require to compensate for the uncertainty that interest rates or inflation could rise in the future (term risk). As a result, we consider a narrowing of the spread between long and short-term rates as an indicator of an unconventional expansionary monetary policy intervention.

As a robustness check, we repeat the analysis using a Cholesky identification strategy without the narrative-HF component, using different variables to detect the two shocks: following Peersman (2011) and Mumtaz & Theophiopoulou (2016), all policy measures that affect the real economy beyond the policy rate, such as operations that change the composition of the central bank's balance sheet, actions that try to guide longer-term interest rate expectations, or measures that expand or reduce the size of the balance sheet or monetary base, are classified as non-standard policy actions. Specifically, such monetary measures have been identified as innovations to the Fed balance sheet and so, as in Guerello (2018), to the Fed total asset growth rate[2].

All the data we use to analyse the effects of monetary policy are taken from the FRED database and have a daily frequency. In particular, we use data on short term (3 month) and log term (10 year) Treasury bill rates. For the robustness check using the Cholesky identification without the narrative-HF component, we use the LIBOR overnight rate as a policy indicator for the conventional monetary policy and the Fed's total asset volume for the

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[2]In our robustness check, the lag length is chosen to be the average of the optimal lag according to AIC and BIC criteria, and it is equal to 18. The ordering of the vector of variables is: consumption, employment, short term interest rate, Fed's assets, stock market variable and Gini index. The implicit restrictions behind this ordering imply that consumption and the employment rate do not contemporaneously respond to innovations in both the short run interest rate and the Fed's balance sheet, while the latter measure responds contemporaneously to innovations in consumption and employment. This scheme allows us to disentangle monetary shocks from demand shocks but not vice-versa. Additionally, the restrictions imposed disentangle the purely monetary shocks from the quasi-fiscal policy measures, by assuming that these latter actions affect directly the Fed's balance sheet and the financial market but their effect is lagged on the short run interest rate. Finally, the inequality index is assumed to be weakly exogenous to the model and, hence, to not affect contemporaneously all the other variables as in Saiki and Frost (2014). Our results are similar to what we find using the narrative-HF approach. Figures are available on request.

unconventional monetary policy. We also include stock market variables in our econometric model, using the NASDAQ 100 Index, which represents the daily index value at market closing. It includes 100 of the largest domestic and international non-financial securities listed on The NASDAQ Stock Market based on market capitalization. Finally, we construct a timeline of the Fed press conferences with Covid-19 related policy announcements, taking data from the Fed's public website. Figures 3 and 4 show the 2020 trend of the Treasury bill rates and the Fed's assets.
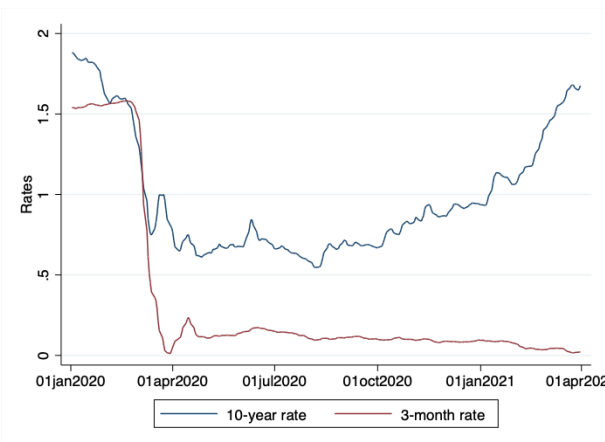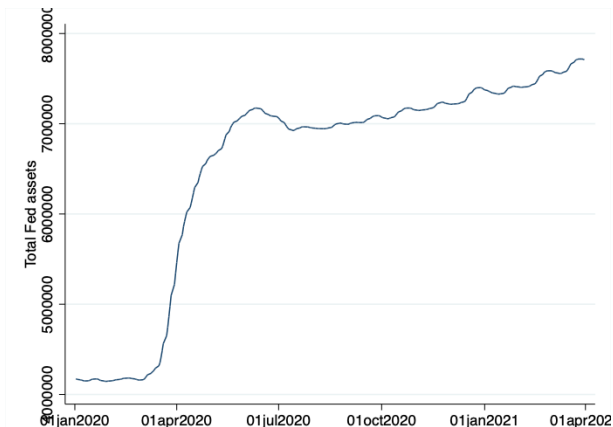
Figure 3: Treasury bill rates	Figure 4: Fed's asset

# 3 Consumption inequality and Fed's policies during the pandemic

Now, we want to see what has been the effect of Fed's policies on consumption inequality in the US from 20th January 2020 to 31st March 2021, and in particular whether there is any difference in the effect of pure monetary policies and quasi-fiscal policies. We do so by constructing a VAR framework that we estimate for the top quarter and the bottom quarter of the income distribution separately, as well as for the two kinds of shock, pure monetary and quasi-fiscal. We then look at the differences in the responses. Moreover, to further assess the effects of the policies on the level of inequality, we build another VAR model in which we include the average level of consumption and the Gini coefficient. Our first VAR is described by the model:

$$Y_t = B_0 + B_1 Y_{t-1} + B_2 Y_{t-2} + \cdots + B_p Y_{t-p} + e_t \qquad e_t \sim \mathcal{N}(0, \Sigma) \tag{1}$$

where Y_t is a vector of variables containing consumption, employment rate, our narrative-HF shock and a stock market variable represented by the NASDAQ 100 index. Consumption

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(in dollars per day) employment rate and the stock market variable (as index) are expressed as deviations from the 20-day centered moving average and are stationary according to the Augmented Dickey–Fuller (ADF) test and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. p is the number of lags computed by averaging the optimal lag lengths according to BIC and AIC criteria and it is equal to 27, Bs are matrices of coefficients and e is a vector of normally distributed errors. Figure 5 reports the cumulative impulse response functions of consumption and employment to a pure monetary policy shock and a quasi-fiscal shock for the top and bottom quartiles of the income distribution of counties, together with the 95% confidence intervals. We look at the cumulative response because we are considering deviations from the centered 20-days moving average: the cumulative IRFs mitigate the variability in the response. Both types of policy intervention had a greater impact on consumption and employment for the bottom quartile than for the top one. However, this difference is greater for the pure monetary policy interventions than for the quasi-fiscal policy, suggesting that the first had a more important role in limiting the increase in inequality than the second.

Figure 5: Consumption and employment responses to shocks

(a) Pure monetary shock

(b) Quasi-fiscal shock
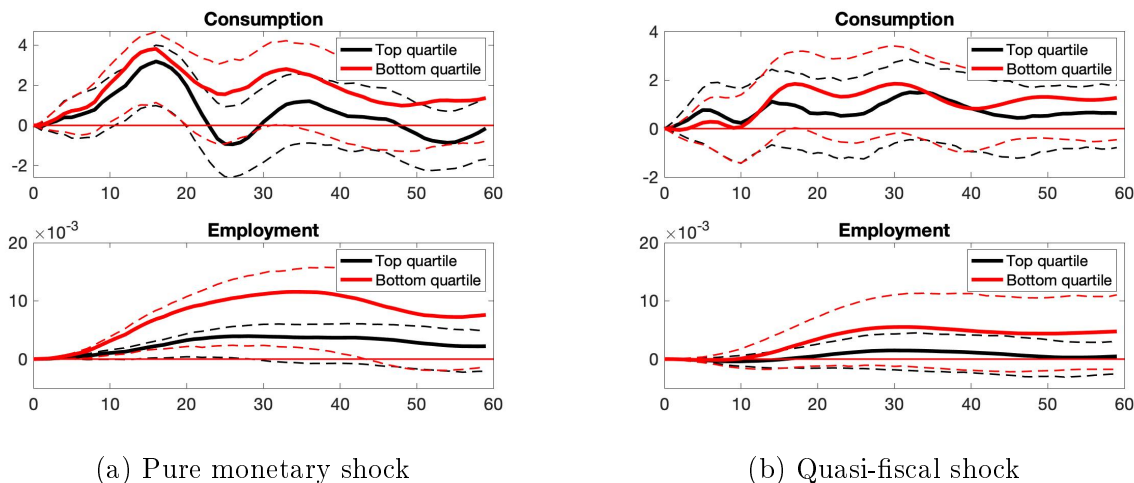
We find similar results if we look at the effect of pure monetary and quasi-fiscal policies on the Gini index [3]. We recall that a higher level of Gini indicates a greater level of inequality, whereas a lower one expresses lower inequality. The specification of the VAR is the same as above, with the vector of variables containing the average consumption spending and the

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[3] As a robustness check, we perform the analysis shown in Figure 6 using different measures of inequality: the variance of the logarithm of consumption, and the difference between the 90th and the 10th percentile of the distribution of consumption. The results, available on request, are similar to our main findings: the inequality index initially grows, and then decreases by more following a pure monetary shock than after a quasi-fiscal shock.

average employment level across countries, the narrative-HF shocks constructed as explained in Section 2.2, the stock market variable and the Gini coefficient. The lag length is again chosen to be the average between the optimal lag according to the AIC and BIC criterion, and it is equal to 10 in this case. Figure 6 shows that in response to the shocks, inequality grows at first, and then decreases, reaching the initial level after 20 days when the shock is of pure monetary policy, and after 30 days when it is a quasi-fiscal shock. Importantly, after a pure monetary shock, the level of inequality decreases below the initial level, before converging again to the equilibrium, whereas this does not happen with a quasi-fiscal stimulus.

Figure 6: Gini coefficient's response to shocks
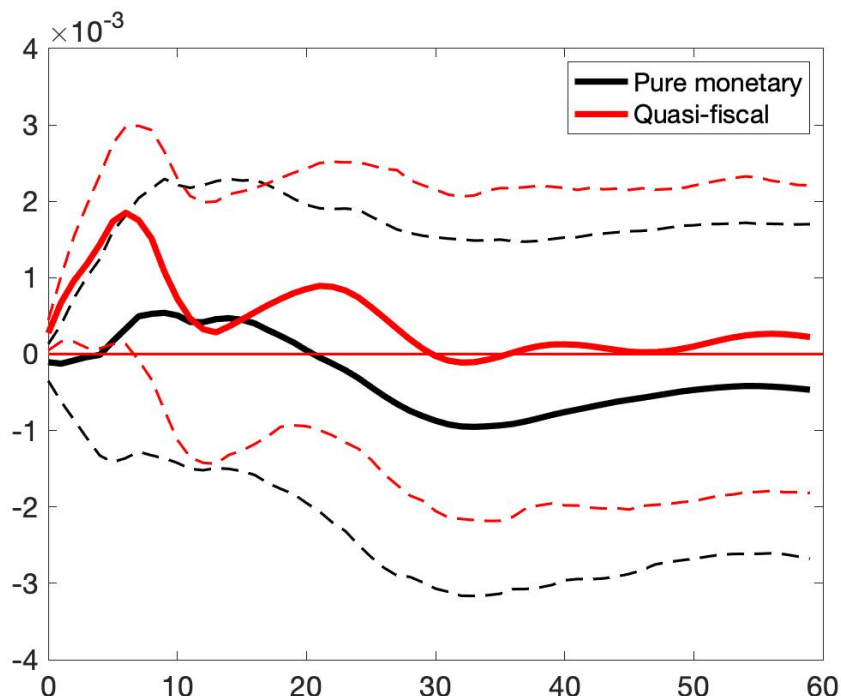
4   Conclusions

In this paper, we investigate the development of consumption inequality in the US during Covid-19 pandemic, and the effect of Fed's policies on such inequality. Our main contribution, relative to previous work on monetary policy and inequality, is the use of recently released high-frequency (daily) data from credit card transactions, that allow us to compute inequality measures at a daily frequency up to a very recent point in time, combined with a narrative approach, to evaluate the impact of monetary and quasi-fiscal policies. We find that inequality in consumption spending has increased during the crisis, but the Fed gave a greater stimulus

to consumption and employment to the bottom quartile of the distribution than to the top quartile, suggesting a mitigating impact of its policies. Moreover, interventions of monetary policy in the form of asset purchases and changes of interest rates seem to have attenuated more the rise in inequality than the quasi-fiscal policies represented by subsidized lending programs and Fed's policies aimed at avoiding mass layoffs.

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