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Modelling inequality in aggregate consumption function: a policy evaluation for Italy

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Modelling inequality in aggregate consumption function: a policy evaluation for Italy.*

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Abstract

This work explores the interaction of the inequality in the aggregate consumption function for the Italian economy. Measures of inequality are derived by exploiting the rich information in the EU-SILC survey available from 2003 up to 2018 matched with the World Inequality Database (WID) to span a larger sample. According to these measures, Italian income inequality rose substantially along with economic crisis, when credit constraints were strict and consumption smoothing less feasible. We use the specification in the macro-econometric model for the Italian economy developed by Istat (Memo-It) to test different indicators for inequality versus the aggregate consumption function. The results suggest that the P90/P10 index is statistically significant and negatively related. The augmented consumption function promises to assess better the impact of redistributive policies recently launched by the Italian government. Particularly, the impact of the Italian "Reddito di Cittadinanza - *Citizens' income*" (RdC) has been evaluated in aggregate consumption and GDP. Using the new equation, we find that the RdC in 2020 will increase GDP by 0.4 percentage points and aggregate consumption by 1.1 pp. compared to the baseline scenario wherein the consumption function does not include the inequality index.

Keywords: Income inequality, Survey data, Consumption function, Structural macroeconomic model, Policy evaluation.

JEL classification codes: C53, D31, E62

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1 Introduction

Inequality is rising back at the forefront of the public debate, enforced by the consequences of the COVID-19 crisis. Inequality also plays a crucial role in the framework defined to capture well-being and sustainability that are currently available for almost European countries providing strong support for the so-called *beyond-GDP* approach (see for example Stiglitz et al. (2018), UN (2020) and Sachs et al. (2021) ; with reference to Italy Istat (2020b), Istat (2020a), Bacchini et al. (2021)). Particularly in Italy, an inequality index based on the microdata drawn front EU-SILC survey on income, is included in a set of 12 well-being indicators that the Government uses to measure the impact of the Budget Law.

Despite the importance of inequality, as well as the ones of other indicators related to well-being and sustainability, its use both within the traditional boundaries of National accounts and in the Macroeconometric models is scant.

Recently, a strand of literature explores how the traditional System of National Accounts (SNA), which is the pillar for the GDP measurement, could be extended to account for some of the main themes related to well-being and sustainability (see among others Jorgenson and Schreyer (2017) and Van De Ven (2019)). Particularly Törmälehto et al. (2019) aimed to reconcile the main conceptual differences between the indicators drawn from EU-SILC and the national accounts income aggregates, and compared the estimated total sums based on the adjusted concepts[1].

Concerning the macroeconomic debate, most of the analyses have been related to exploring the relationship between income inequality and consumption inequality (see for example Jappelli and Pistaferri (2010),Krueger and Perri (2006), Crespo Cuaresma et al. (2018) and Attanasio and Pistaferri (2016)) but, at least to our knowledge, using inequality measures inside the macroeconometric models as DSGEs, is not so common.

This work aims to spread out this debate using the Italian economy as a benchmark. Italy is a remarkable example for at least two reasons. Firstly, inequality has increased in the last years as a consequence of the global financial crisis and the sovereign debt crisis. Secondly, new policy measures have been put in place to fight for inequality.

We face this issue using the macroeconometric model for the Italian economy (MeMo-It), which is traditionally used for forecasting and policy evaluation (Bacchini et al. (2018)) at Istat, the Italian National Institute of Statistics. In detail, we extend the present consumption function in MeMo-It, introducing an inequality measure based on the traditional micro data related to the EU-SILC survey on households income. In doing so, we compute aggregate measures of inequality exploiting the rich information in the EU-SILC survey available from 2003 up to 2018 together with the World Inequality

[1]This topic is at the top of the agenda of international organisation, as Eurostat and ECB, focusing on the integration among macro data (i.e. National Accounts/Financial Accounts) and micro level data (see also Ahnert et al. (2020))

database (WID) to provide a backasting of the measures for the period 1995-2002. This allows incorporating micro information in the macroeconomic model, thus improving the latter without necessarily turning to micro models.

Considering heterogeneity in modelling aggregate consumption is important because of heterogeneous consumers might have different propensity to consume with lower values for people at the top of the income distribution and higher for the poorest. A decrease in the share of national income perceived by poor people will suddenly reflect in less consumption due their higher marginal propensity to consume. Moreover, using a macroeconometric model that is characterized by a Keynesian approach opens also to a reconsideration of the relationship between distribution and growth, which is the key issue presented by Kaldor (Kaldor (1955)).

Even if consumption smoothing can hinder the income-consumption transmission mechanisms, the evaluation of the Italian scenario from 1995 to 2018 reveals that income inequality rose substantially during the economic crisis, when credit constraints were strict and consumption smoothing less feasible. For this reason, the increase in income inequality could have worsened the depression of aggregate consumption during the crisis and could be responsible to the subsequent slow recovery. The empirical analysis confirms our hypothesis showing that income inequality captured by the P90/P10 index is statistically significant and negatively related to the aggregate consumption.

Using this new consumption function in the MeMo-It model, we evaluate the effect of a new policy measure, that Italian Government has recently launched with the aim of reducing poverty, the so-called "Reddito di Cittadinanza - *Citizens' income* henceforth RdC".

Our findings reinforce the usefulness of an extension of the macroeconometric model MeMo-It by using indexes based on microdata such as the one on inequality. Overall, the approach presented in the paper improves remarkably the ability of MeMo-It for policy simulation.

The paper is structured as follows. Section 2 discusses different measures of inequality and their evolution in Italy. Section 3 illustrates the extension of the private consumpion inside the macroeconometric model for the Italian economy. Section 4 presents the simulation results of the policy measure on RdC using the new framework.

2 Measuring inequality

2.1 A review of the indicators

Economic literature presents different methods able to measure income inequality. Inside this basket of measure the Gini coefficient is the most popular one (Cowell (2000), Atkinson (1975), Gini (1921)). Gini coefficient is based on the Lorenz curve, a cumulative frequency curve that compares the distribution of a variable with the uniform distribution that represents the case of perfect equal distribution. The formula of the Gini coefficient is:

$$Gini = 1 - \frac{1}{N} \sum_{i=1}^{N} \Big(y_i + y_{i-1} \Big)$$

Where y_i is the value of income for the $i-th$ observation with $y_i \geq y_{i-1}$ (World Bank Institute, 2008). The Gini coefficient ranges between 0 and 1 (or 0% to 100%) where a coefficient of 0 indicates a perfectly equal distribution of income or wealth within a population. A coefficient of 1 represents a perfect inequality when one person in a population receives all the income, while other people earn nothing.

In some rare cases, the coefficient can exceed 100%. That may occur when a population's income or wealth is negative. Another way of thinking about the Gini coefficient is as a measure of deviation from perfect equality. Indeed, the coefficient is not an absolute measure of a country's income or wealth. It only measures the dispersion of income or wealth within a population.

Economists working with the Gini coefficient need to be aware of its sensitivity to inequalities in the middle part of the income spectrum. This may be appropriate in many studies, but in some cases researchers will have valid reasons to emphasise inequalities in the top or bottom of the distribution. Despite these limitations, the Gini coefficient has been used extensively in the economic literature, and it remains the most wide measure of inequality (see the project on World Income Inequality Database, WIID, for international comparison based on the Gini coefficient WIID (2020)).

However, several methods exist, and they offer researchers the means to develop a more nuanced understanding of the distribution of income. The set of income inequality indexes commonly used by economists includes:

- Decile ratios: P90/P10, P75/P25, P80/P20 indicate the ratio between different percentiles of the income distribution. The indexes provide a measure of inequality between the upper and the lower tail of the distribution and do not consider changes in the middle part of the distribution. Whereas ratios P90/P50 P10/P50 indicate the distance between respectively the higher or lower tail and the median. Taking the percentile differential in log-levels allows us to diminish the sensitivity to extreme observations (outliers) in the tails of the distribution.
- Generalized entropy measures (GE) that are measures of inequality that vary between 0, in case of equal distribution and $+\infty$ as the distribution become more unequal (Jenkins and Van Kerm (1988)). The general formula is:

$$GE(\alpha) = \frac{1}{\alpha(\alpha-1)}\left[\frac{1}{N}\sum_{i=1}^{N}\left(\frac{y_i}{\bar{y}}\right)^{\alpha} - 1\right]$$

Where $\bar{y}$ is the mean income, y_i the income observed for each individual and α indicates the weight assigned to distances in the different part of the income distribution. The more positive α (the sensitivity parameter; -1, 0, 1 or 2) is, the more sensitive GE(α) is to inequalities at the top of the income distribution. In particular for lower values of α, GE is more sensitive to changes in the extreme tails of the distribution and the opposite is for higher values of α. The theoretical range of GE values is 0 to infinity, with 0 being a state of equal distribution and values greater than 0 representing increasing levels of inequality. Another beneficial property of the GE measure is that it is decomposable; that is, it can be broken down to component parts (i.e. population subgroups). This enables analysis of between- and within-area effects.

2.2 Recent trends in income inequality distribution in Europe

In the last years, income inequality has emerged as a key issue for the European policy agenda. This view has been reinforced by the COVID-19 crisis that has impacted on the more fragile groups of the population, such as temporary workers for example, increasing inequality again.

The latest data on Income and Living Conditions (EU-SILC) does not capture the impact of 2020 but confirms that the trend to greater equality of incomes, which had characterized the postwar period, has been reversed. After the global financial crisis and the sovereign debt crisis, the economic recovery has gradually led to improvements in labor markets and household incomes but it has not yet delivered inclusive growth and not reversed the trend towards increasing income inequality observed over the past decade. The recovery has often been associated with fiscal tightening to restore the sustainability of public finance, in some cases with stricter access to social transfers, which are concentrated at the bottom of the income distribution. Indeed, over the past ten years, income inequality levels have remained at historical highs (OECD, 2016).

Data from Eurostat shows a high level of inequalities in the income distribution. In 2018 the income quintile share ratio[2] in EU-27 was 5.1, meaning that people in the top income quintile earns on average 5.1 times more than those in the bottom quintile. The index is below 4 in Czechia, Finland, Slovakia, Slovenia, Belgium and the Netherlands are the most egalitarian member states, on the contrary, peaks of over 6 are registered in Latvia, Romania, Lithuania and Bulgaria. Figure 1 shows the change in income quintile share ratio from 2008 to 2018 revealing that 12 out of the 27 European countries analysed have

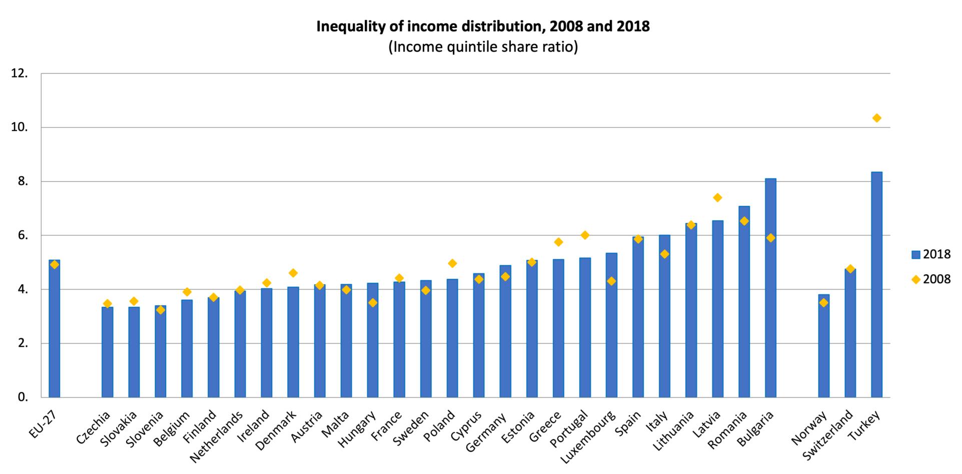
[2] The income quintile share ratio, also known as $S80/S20$ ratio, is a measure of income distribution that represents the ratio between the income received by the 20% of the population with the highest income to that received by the 20% of the population with the lowest income (Eurostat, 2019).

experienced a decrease in inequality, between them Greece, Latvia, Poland and Portugal registered the largest fall[3]. For the other countries, income inequality increased, and the largest peaks have been registered in Bulgaria, Luxembourg and Hungary (Eurostat 2020). Italy belongs to the countries for which inequality sharply increased in 2018 (6.0 ratio) concerning 2008 (5.3 ratio).

Particularly for Italy in 2020, two estimations of the income quintile share ratio have been provided by the Government that, according to the Budget Law, is required to measure the impact of the economic policy on a selected set of well-being indicators (see Bacchini et al. (2021) for details).

According to the Government estimation, in 2020, the income quintile share ratio would be jumped at 6.8, but the policies put in place to face the COVID-19 crisis have been able to contain the surge of inequality to 6.3 (MEF (2021)).

Figure 1: Income inequality in Europe from 2008 to 2018 measured by the income quintile share ratio.



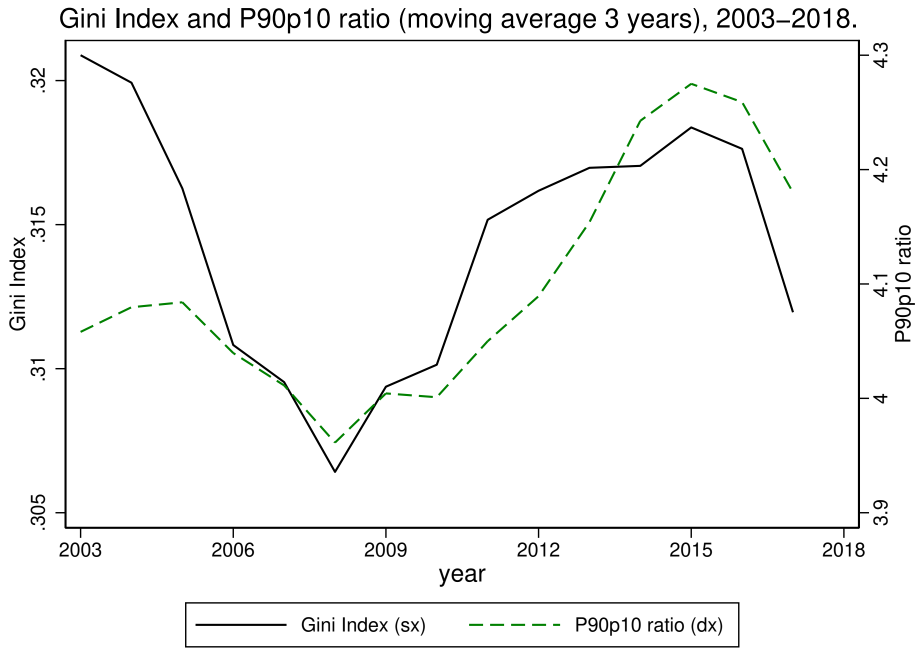
Note: Author's calculations based on the Eurostat database.

Figure 2 shows the Italian trend 2003-2018 of two measures of inequality based on the equivalised disposable income: the Gini coefficient and the ratio P90P10. Both measures exhibit an increasing dynamics from 2008 up to 2015, and a downward path in recent years.

These data confirm that despite the different dynamics during the recent economic crisis, income inequality has continued to rise in the majority of the European countries and it is still one of the major problems that government policies have to address.

[3]These evidences are in line with the study related to the impact of fiscal consolidation (Forni and Novta (2014) and to the core-periphery debate (De Santis and Cesaroni (2016) and Bacchini et al. (2020)

Figure 2: Income inequality in Italy from 2003 to 2018 measured by the Gini coefficient (post-taxes) and decile share ratio.



Note: Author's calculations based on the IT-SILC equivalised disposable income (imputed rent included) 2003-2018.

2.3 Backcasting inequality indexes

According to the official picture provided by Eurostat, the yearly time series of the Gini coefficient, P90/P10 and P50/P10 ratios described in section 2 are available for the period 2003-2018. This time span should be too short in the light of the use of these indicators of inequality in the macroeconometric model for Italian economy (MeMo-It), where the the the consumption function is estimated starting from 1969. To overcome this problem, we apply a backcasting technique based on the average individual post-tax national income for a given percentile group that are available, starting from 1995, in the World Inequality Database (WID), is a powerful source of data that aims to provide useful information of inequality trends on several fronts.

WID develops a technique based on the notion of Distributional National Accounts to calculate the distribution of national income based on different information, i.e. national accounts, households survey data, tax data and release data about income for percentiles groups (for further details about the methodology see on the website World Inequality Database).

Exploiting the WID data, we end up with a database containing time series of the Gini index and percentile inequality indexes obtained from EU-SILC data from 2003 to 2018 and the same indexes calculated using WID data from 1995 to 2018. Subsequently we use WID income percentiles to calculate the ratios P90/P10, P50/P10, P90/P50 and P75/P25. Once the main inequality indexes have been computed, our backcasting technique consists in finding for each pair of indexes the best model that links the EU-SILC inequality measure to the corresponding WID index using the observations from 2003 to 2018, for which both the time series are available, and then use the resulting model to backcast the EU-SILC index from 2002 to 1995 when only WID data are available.

Due to the few observations at our disposal, it was difficult to identify a historical pattern for each index and use it to backcast the series using of ARIMA models. Thus we run simple linear regression models with the EU-SILC index as the dependent variable and the same index calculated using WID data as the explanatory variable. Finally, we found three models suitable to backcast the EU-SILC measures of inequality from 2002 to 1995. In particular, the coefficient of the Gini index, the ratios P90/P10 and P50/P10 calculated using WID data are positive and statistically significant for all the regressions suggesting that WID indexes are suitable to explain the behaviour of the corresponding EU-SILC indexes. Finally, the three models are used to backcast the three EU-SILC indexes from 2002 to 1995.

3 Including inequality in the Macroeconometric model for Italy (MeMo-It)

The literature on the reconciliation of the micro evidence into macro aggregate pictures has grown faster in the latest years. Contributions might be included in two different areas. The first, mainly referring to the statistical domain, that aims to reconcile the micro evidence, derived from the household surveys on income and consumption, with the macro ones provided by national accounts and related to the households as an institutional sector[4]. The second strand of works aims to define the theoretical framework by combining macro and micro modeling in various ways (See Bourguignon and Bussolo (2013) for a review and Peichl (2009)). This analysis relies more on the computable general equilibrium (CGE) approach.

However, as it is well-known, the CGE or DSGE are just one of the approaches proposed in the literature for macroeconometrics model. Pagan (Pagan (2003)) has proposed a classification of macroeconometric models introducing a dichotomy between two methodological approaches: *theory comes first*, as for example in the CGE or DSGE models, versus *facts come first*, as for example in the tradition of the Cowles Commission (see for example Fair (2013), Fair et al. (2009) and Garratt et al. (2003))[5].

This work aims to contribute to the debate on the model reconciliation by micro and macro evidence by exploring the impact of an inequality measure based on the micro data on household consumption and the aggregate consumption function. We perform this exploration using the Italian macro econometric model (MeMo-It), developed and maintained at Istat, the Italian National Statistics Institute, that represents a new Keynesian economic system and belongs to the second class of models proposed by Pagan, the one where the *facts come first*[6]. The proposed approach also allows for exploring the impact on the macro aggregates of policy measures aiming to reduce poverty, as the ones put in place in Italy from 2019 [7].

[4]see for example the Eurostat's project on the experimental statistics `https://ec.europa.eu/eurostat/web/experimental-statistics/ic-social-surveys-and-national-accounts.`

[5]For a recent proposal on model classification see Blanchard (2018).

[6]This work is not related to the comparison of the performances of the different classes of model. A useful starting point inside the new-Keynesian paradigm is for example Vines and Wills (2018).

[7]MeMo-It was built by the Italian national institute of statistics (Istat) for releasing the medium term economic projections. The model is composed by 66 stochastic equations and 91 identities, and represents a New Keynesian economic system including households, firms, public administration, and a foreign sector. In terms of the dichotomy proposed by Pagan, MeMo-It is strongly grounded in empirical information (data-based model) in order to assess the data-admissibility of the theoretical assumptions, and does not assume explicit micro-foundations of weak-form (see Bacchini et al. (2018) and Bacchini et al. (2015) for further details)

3.1 Introducing income inequality indexes in the consumption function

MeMo-it models the private consumption according to the following dynamic linear equation:

$$\begin{aligned}\Delta \log CHO_t = \beta_0 + \beta_1 \Delta \log \frac{YDHN_t}{PCH_t} + \beta_2 \Delta \log \frac{YDHN_{t-1}}{PCH_{t-1}} \\ + \beta_3 \log \frac{CHO_{t-1} * PCH_{t-1}}{YDHN_{t-1}} + \beta_4 \log \frac{1 + INTR_{t-1}}{100} \\ + \beta_5 \log \frac{HWFA_{t-1}}{YDHN_{t-1}}\end{aligned} \tag{1}$$

where CHO is the real private consumption, $YDHN$ is the disposable income net of interests at current prices, PCH is the consumption deflator, $HWFA$ is the financial wealth at current prices and $INTR$ is the short-term nominal interest rate.

All the variables are taken in the first difference because of they are integrated of order $I(1)$ as confirmed by Augmented Dickey-Fueller tests [8].

Since MeMo-it is estimated using the 3SLS approach to solve the endogeneity problem, to be coherent with the result of the whole system the single equation in 1 and all the new formulations have been estimated using the 2SLS approach.

Table 1 reports a comprehensive picture of all the results related both to different time span and to different specifications (columns); each rows refers to the value estimated for the parameters in the equations. In detail, the first two columns (Table 1) provides the estimates of the consumption equation with the full sample of data available from 1969 to 2018. As expected, real current disposable income and the real disposable income of the previous year have a positive and statistically significant impact on the aggregate consumption ($\hat{\beta}_1$ and $\hat{\beta}_2$). The short-term interest rate is negative, confirming that if the interest rate increases, households would prefer to save money more than consume ($\hat{\beta}_4$). The coefficient of financial wealth is also positive even if its impact is small and the p-value is higher ($\hat{\beta}_5$).

Starting from the results for the full sample, we compare them with the ones starting in 1995 (Table 1, col. 3-4 of the results), that is the first year for which inequality index is available. The results with the reduced sample are in line with the ones on the full sample but the short-term interest rate is no more statistically significant due to the shorter sample embedding the zero lower bound, that is the short-term rate is almost at zero and since 2015 in a negative territory[9].

[8] The ADF test and the Johasen cointegration test Johansen (1988) illustrates that the only feasible long-run relationship is between the real private consumption CHO and the real disposable income $YDHN/PCH$

[9] As robustness check the same regression has been run for the period 1995-2012 to verify the signif-

This equation has been used as a benchmark for testing the augmented consumption equation with different inequality indexes introduced in the previous paragraph[10]. As already mentioned in section 1, income inequality indexes can reveal how much the increase in heterogeneity reflects on the aggregate consumption due to the higher marginal propensity of consumption of poor people.

Test of the importance of each index of inequality has been investigated looking both at the performance of the equation and, following Muellbauer et al. (2016), considering a new indicator for private debt that indicates the total households' debt in percentage over disposable income. This variable can reveal information about the relationship between households' debt and consumption and can also interact with the inequality index.

Both the Gini index and P50/P10 ratio are not statistically significant. Table 1 reports the result with the Gini index for which the p-value of the null hypothesis $\beta_6 = 0$ can not be rejected[11]. The impact of inequality on aggregate private consumption is statistically significant with negative sign only using the indicator P90/P10 when a dummy is added in 2011[12]. The new aggregate consumption function is the following:

$$\begin{aligned} \Delta \log CHO_t = & -0.004 + 0.451 \Delta \log \frac{YDHN_t}{PCH_t} + 0.383 \Delta \log \frac{YDHN_{t-1}}{PCH_{t-1}} \\ & - 0.261 \log \frac{CHO_{t-1} * PCH_{t-1}}{YDHN_{t-1}} - 0.167 \log \frac{1 + INTR_{t-1}}{100} \\ & + 0.123 \log \frac{HWFA_{t-1}}{YDHN_{t-1}} - 0.044 \Delta \frac{P90_{t-1}}{P10_{t-1}} + 0.013 D2011 \end{aligned} \tag{2}$$

while Figure 3 presents the graph of residuals.

Compared to the benchmark consumption's equation, the coefficients of the real current disposable income ($\hat{\beta}_1$) and the real disposable income ($\hat{\beta}_2$) of the previous year remains positive and statistically significant even if the impact of the current component increases, while the impact of the lagged component decreases. The impact of the long run component remains negative with a similar magnitude and the interest rate is no more statistically significant. This remarkable result confirms that inequality negatively impact on the aggregate consumption, i.e. that the coefficient of the P90/P10 index is negative and statistically significant[13]. This evidence confirms the link between the income heterogeneity at micro level and macro behaviour for consumption that need to be properly addressed in macro-econometric models.

Looking at the coefficient of the new equation 2 is possible to directly evaluate the impact of the increase in income inequality on aggregate consumption. An increase of the

icance of the interest parameter which, despite the few number of observations, showed a p-value equal to 0.06

[10] All the indexes are included in the equation using the first difference taking into account that the consumption function is defined in growth rates.

[11] A similar result holds when we use P50/P10 even considering the interaction of the indexes with the households' debt

[12] However, also in this case the interaction between debt and P90/P10 are not statistically significant.

[13] Including the inequality index implies also an higher Adjusted R-squared, from 0.86 to 0.89.

Figure 3: Actual values, residuals and fitted values of the new consumption function that includes P90/P10

Table 1: Models of consumption and inequality

Sample-equation	1969-2018-base eq.		1997-2018-base eq.		1997-2018+GINI		1997-2018+P90/P10	
Variables	**Coeff.**	**T-stat(p)**	**Coeff.**	**T-stat(p)**	**Coeff.**	**T-stat(p)**	**Coeff.**	**T-stat(p)**
Constant ($\hat{\beta_0}$)			-0.004	0.1	-0.004	0.1	-0.004	0.05
Dlog(YDHN/PCH)($\hat{\beta_1}$)	0.495	0.0	0.349	0.0	0.377	0.0	0.451	0.0
Dlog(YDHN(-1)/PCH(-1)) ($\hat{\beta_2}$)	0.273	0.01	0.462	0.0	0.438	0.0	0.383	0.0
log(CHO(-1)*PCH(-1)/YDHN(-1)) ($\hat{\beta_3}$)	-0.09	0.02	-0.254	0.07	-0.244	0.09	-0.261	0.04
Dlog(1+INTR(-1)/100) ($\hat{\beta_4}$)	-0.294	0.01	-0.177	0.26	-0.193	0.24	-0.167	0.23
DLOG(HWFA(-1)/YDHN(-1)) ($\hat{\beta_5}$)	0.06	0.14	0.1	0.0	0.1	0.0	0.123	0.0
Distribution Measure(-1) ($\hat{\beta_6}$					-0.155	0.58	-0.044	0.06
R2- adj	**0.73**		**0.86**		**0.85**		**0.89**	

P90/P10 growth rate equal to its standard deviation (0.082), generates a decrease of the aggregate consumption growth rate of $-0.0036\%(= -0.044 * 0.082)$ in the subsequent period. It is interesting to compare the impact of P90/P10 with the impact of the disposable income on consumption. In particular if the real disposable income growth rate increases of one standard deviation (0.0078), the growth rate of the aggregate consumption increases of 0.0035% in the current year, while in the next year it generates an increase of the aggregate consumption growth rate equal to 0.0030%. Taken together these results reveal that if the income increase is not equally distributed and also P90/P10 experienced an increase equal to its standard deviation, in the current year consumption increases, but in the next year the negative impact of the income inequality index completely off-sets the positive effect of income. This result implies that both the increment in household disposable income and its distribution are relevant in order to obtain long-lasting effects on consumption.

The formulation of the consumption function augmented by the inequality index also shows better forecasting performance. In particular, we consider the Forward-Chaining approach, which creates many splits in the sample and averages the errors over all the splits. The training sample of data refers to the period from 1995 to 2011, for which the model is estimated and a forecast for the next year derived. Then the distance between the real value of $\Delta \log CHO$ and the predicted value has been computed. The procedure runs adding one year each time up to 2018.

We end up with a vector of errors that has been used to compute the accuracy measures: Mean absolute error (MAE); Mean Absolute percentage error (MAPE); Root Mean Square Error (RMSE). Even if the sample size is short, difference in the forecast error could be a piece of evidence either in favour of the new specification of the consumption function or for the benchmark specification. Results are displayed in Table 2.

Table 2: MAE, MAPE and RMSE calculated with the time series Cross-Validation for both the new and the old consumption function

	old consumption function	new consumption function
MAE	0.0049	0.0039
MAPE	0.2493	0.0459
RMSE	0.0061	0.0052

All three out of sample accuracy measures are lower for the new consumption function, indicating that the new equation's forecasting performance is better than the previous one. Even if the introduction of the P90/P10 index improves the performance of the aggregate consumption function, it implies that the short-term interest rate coefficient is not longer statistically significant.

4 Simulating the impact of a new policy measure to fight for inequality in Italy: *Reddito di Cittadinanza (RdC)*

One of the main advantages of introducing of the inequality index in MeMo-It is its improvement for policy evaluation allowing for the evaluation of the macro-economic consequences of redistributive policies. The income inequality measure can capture heterogeneous agents' behaviours considering that if the policy is addressed to poor people with higher MPC, the effects on aggregate consumption and other macro-variables may be amplified.

The version of MeMo-It that includes the new consumption function has been used to measure the impact of the policy measure released in 2019 to fight for inequality, the so called *Reddito di Cittadinanza*

4.1 Main characteristics of the *RdC*

The Italian *Reddito di Cittadinanza (RdC)* has been introduced by the Italian law since 2019 (D.L. 4/2019). It aims to reduce poverty, inequality, social exclusion guaranteeing labour rights and promoting activism in the labour market. The RdC is a public transfer based on patrimonial and income requirements and it is provided to Italian families that have lived in Italy for at least 10 years. The amount of the transfer is based on the age of the family components and the ownership of the dwelling house and it is composed of two elements: an income integration and a contribution to pay rental costs. The RdC can be required by all the families whose income or patrimonial parameters are under a fixed threshold and, after appropriate checks, the transfer is paid for a maximum period of 18 months and can be renewed after a month from the end of the period[14].

The Italian RdC is then composed of two pillars: one related to reducing inequality providing support to the income for lower-income households; the other concerning improving the labour market condition.

4.2 The macroeconomic impact of the RdC

This exercise refers to the first pillar of the RdC considering the impact of an increase of the aggregate household income, associated to the RdC transfers, which implies a reduction of income inequality.

The impact generated by the RdC can be assessed by looking at the MeMo-It public spending multiplier. It is a sort of impulse-response function of the reduced form of the model's parameter that quantifies the effects on endogenous variables, such as GDP, of permanent changes in exogenous variables, and is used to evaluate the transmission mechanisms of specific economic policies.

The MeMo-It public spending multiplier is also useful to assess the transmission of a redistributive policy: by assuming an exogenous shock and comparing the simulated effects concerning the base scenario (i.e. without RdC), it is possible to understand the net effects generated by the policy.

Before the introduction of the measure of heterogeneity in the aggregate consumption function, it was possible to evaluate the impact of the redistributive policies only shock-

[14] The formulation of the RdC provides also a labour market policy that supports unemployed or inactive people able to work and to find a job. In fact RdC beneficiaries have to subscribe a labour pact in which they declare to be willing to accept possible vacancies. People that cannot work are also helped by municipalities and they sign a pact in which they declare to be available to participate to social inclusion programs.

The economic transfer established by the RdC is suspended if an active person doesn't subscribe the pact or refuses three job offers in line to its experience and aptitudes, or if a person unable to work refuses to subscribe the social inclusion pact or to participate to public initiatives (Ministry of Economic and Finance, 2019).

ing household disposable income or directly shocking the private consumption and both alternatives do not allow to evaluate the positive impact of inequality reduction generated by redistributive policies[15]. The new formulation of the aggregate consumption function proposed in this work, makes it feasible to evaluate the impact of the Italian RdC on GDP and other macro-variables considering a positive income shock associated with a decrease in the inequality measure.

The shock on income is transmitted to consumption assuming that beneficiaries spend a fraction of the transfer received according to the average MPC, but the simultaneous shock on inequality allows to consider that the transfer is addressed to the poorest thus it stimulates aggregate consumption more than considering only the change in income *per se*. For these reasons, we evaluate the impact of Italian *Reddito di Cittadinanza* in 2019 and 2020, using the consumption function introduced in this work and the information released by MEF (Ministry of Economic and Finance) on the amount of the transfers and the impact on inequality in Italy. In particular, (MEF, 2019) reports that the maximum expected outlay of the RdC is 7.1 billions in 2019 and 8.055 billions in 2020. Moreover, (MEF, 2019) states that this policy has a reduction of income inequality measured through the P80/P20 index by 0.3 points (from 5.9 to 5.6) in 2019.

Two different scenarios are simulated:

- Scenario 1: Assuming an increase in the households' disposable income of 7.1 billions in 2019 and 8.055 billions in 2020.
- Scenario 2: Assuming the same shock for income as in scenario 1, plus a reduction of the income inequality index P90/P10 by 0.21, proportional to the reduction estimated by MEF for P80/P20 index[16].

Table 3 presents the results in 2019 and 2020 for the two different scenarios expressed as a difference between each scenario and the baseline scenario (without the introduction of the RdC).

Considering the second scenario, the one based on the new aggregate function for consumption, the effect of the new policy in 2019 is equal to the effect registered for the first scenario, because the inequality shock generated by the transfers in 2019 produces its effect one year later. In 2020 GDP increases by 0.4 percentage points and CHO increases by 1.1 p.p. in comparison to the baseline scenario.

The introduction of the new function produces an impact completely different both on consumption and GDP driven by the reduction in inequality. The introduction of a

[15]Under the first scenario the introduction of the RdC, for a total amount of 9 billion of euro, generates an increase of 0.2 percentage points (pp) of the Italian GDP in 2019 in comparison to the baseline scenario, while under the second scenario, the GDP increases of 0.3 pp (Istat, 2018).

[16]It is important to remember that, as the income inequality index enters the consumption function at time t-1, the inequality reduction generated by the *Reddito di Cittadinanza* in 2019 produces its effect only in 2020

Table 3: Effects of the Italian *Reddito di Cittadinanza* on GDP, real private consumption and consumption deflator with respect to the baseline scenario - Percentage points

		2019	2020
Scenario 1:	GDP	0.2	0.1
	Consum. Private (CHO)	0.2	0.3
	Consum. Deflator (PCH)	0.0	0.1
Scenario 2:	GDP	0.2	0.4
	Consum. Private (CHO)	0.2	1.1
	Consum. Deflator (PCH)	0.0	0.2

measure of income inequality in the aggregate consumption function is crucial in order to capture the effect of redistributive policies on GDP.

5 Conclusion

This paper proposes a novelty approach to account for inequality measures in the aggregate consumption function of the macro-econometric model for the Italian economy developed by Istat (MeMo-It).

Using the Income and Living Conditions survey (EU-SILC), three different indicators for inequality, based on the micro data of the survey, were considered. After a backcasting procedure, based on World Inequality Database, each indicator was tested as an augmented regressor in the consumption function contained in the MeMo-It model.

The empirical analysis confirmed that income inequality captured by the P90/P10 index is statistically significant and negatively related to the aggregate consumption. A positive income shock that increases aggregate consumption in the current year might be completely off-set by the negative effect of the increase in inequality that becomes effective in the successive year.

Using the extending private consumption function, we evaluated the impact of the Italian "Reddito di Cittadinanza (RdC)", a valuable policy measure aiming to reduce poverty. The results of the simulation were substantially higher for those obtained using the old equation as the new one allows for the decrease in income inequality generated by the policy.

According to the findings for Italy, we support the idea that step forward on well-being and sustainability measurement could be realized even inside the actual boundaries of the structural macroeconometric models, improving their performance too.

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