

# A Tale of Inter-Linkages: Monetary Policy and Income Inequality

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# Abstract

This thesis analyses the effects on income inequality deriving from conventional monetary policy. We proceed via a rigorous implementation of a two agents New Keynesian (TANK) model in which a simple measure of income inequality is embedded. Following the model parametrization, the impulse response functions show that restrictive monetary policy shocks lead to soaring income inequality levels. Furthermore, we observe that such levels have a volatility that remains smaller compared to aggregate consumption inequality levels. Finally, we contextualize our findings using income data from 1980-2008 for the USA and Italy. The historical data confirm our theoretical findings and highlight a more pronounced income inequality trend in the USA during the period considered. Eventually, we identify two key channels responsible for the phenomena observed: the savings redistribution channel and the income composition channel.

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# Introduction

Inequality is a *boiling* topic. In recent times, both academics and policy makers have stressed how trends in inequality have increased globally (Amaral (2017), Piketty (2017), Blanchard and Rodrik (2021)). The past several decades have seen the most sustained rise in disparities since the 19<sup>th</sup> century after more than 40 years of narrowing inequality following the Great Depression. Greater inequality worsens the efficiency of resource allocation, constrains aggregate demand and output growth, and depresses consumption and investment (Samarina and Nguyen (2019)) especially for certain categories of individuals. This reinforces the view that the issue of inequality is at the core of most of the international economic debate and the study of the distributional consequences of policies is of paramount importance.

There are several policies which have often been regarded as factors causing or augmenting inequality in income. It must be noted, though, that very little emphasis has been placed onto monetary policy, at least until very recently. Of course, central banks are not charged with the task of addressing inequalities in the distribution of wealth, income or consumption; nor are they dealing with the broader challenge of promoting economic justice for society as a whole. Traditionally, we are used to think of monetary policy as a powerful tool dedicated to inflation and output gap stability. It is precisely for this reason that there has not been so much focus by policy makers to address the issue of inequality through the lenses of this important policy channel. As a matter of fact, the distributive implications of monetary policy, which are most likely unintended consequences of central bank policies, have been considered by researchers only in recent times. That is, since the late 1990s and with

renewed vigor and a widened interest starting from the 2008 Great Recession. This time with a specific focus on unconventional monetary policy and its heterogeneous effects across households. The *explosion* of empirical and theoretical research on the links between monetary policy and inequality is sufficient to make us realize that the understanding of these mechanisms has gained momentum in the academic community. More generally, inequality is of interest to central banking discussions because monetary policy itself has deep distributional consequences.

The subsequent parts of this work shall be organized in the following manner. Chapter 2 reviews the literature related to the topic, highlighting the main findings and contributions. We will eventually proceed in identifying the current limitations of the debate together with its policy relevance and subsequently, we will proceed in framing the research question characterising this report. Chapter 3 frames the modelling technique by means of a two agents New Keynesian model and discusses the main assumptions needed to answer the research question. Chapter 4 presents the most salient results from the model calibration and extends the analysis via the consumer survey data for the USA and Italy. The discussion of the main findings and the concluding remarks are found in the final chapter.

# Chapter 1

## Literature Review

### 1.1 Synopses of Relevant Studies

In general, the underlying theoretical argument is that changes in interest rates set into motion changes in the broader economy that indirectly affect households. Thus, the effects of a monetary policy easing or tightening can look very uneven. This view, however, is at odds with what others have suggested. That is, when aggregating across all possible transmission channels, the gains appear much more evenly distributed. Various other studies have pointed out that factors such as the existence of an inflation threshold and the position in the business cycle affect the results observed. By taking stock of such a research agenda, we can acknowledge that a vast amount of the literature has questioned the connection between monetary policy and inequality in advanced economies, where this phenomenon is perceived to be more evident. We will then proceed in listing the contributions from a more theoretical literature. Finally, we will report the main findings from the studies on emerging economies.

Romer and Romer (1999) investigates monetary policy effects on poverty and inequality in the short and long run. The study looks at the different primary channels through which monetary policy could impact inequality. The authors analyze this effect using two different data sets: time series data for the USA and cross

sectional data from a panel of 76 countries. As a measure of inequality, the study looks at the data concerning the income share of the poorest fifth of the populations considered. Until then, studies focused mainly on macroeconomic policy on inequality, the relationship between poverty and inflation and the effects of unemployment on income distribution. Thus, it is immediate to grasp that this was one of the first papers to focus on the monetary policy aspect of inequality. The study shows that the effects in the short and long run go in opposite directions. For the case of the USA, it is observed that expansionary monetary policy creates a reduction in income inequality and poverty in the short run, while in the cross section case, a reduction in income inequality and well-being of the poor is seen when there is a contraction in the monetary policy stance. Furthermore, the study identifies that inflation is the main channel through which monetary policy affects inequality.

Another crucial contribution to the literature comes from Coibion et al. (2017). The paper adds on to the existing literature by looking at the effect of monetary policy shocks and inequality in the USA, both in terms of income and consumption inequality. The inequality measures are based on *Household Consumer Expenditure Survey*, where quarterly data have been obtained. The study points out that there has been a decrease in inequality (defined using measures of total income, labor earnings, total expenditure and consumption) after an expansionary monetary policy shock, and vice versa. This paper also highlights a number of reasons for this result by focusing on the effect of monetary policy on different percentiles of income distribution, labor earnings, expenditure and consumption distribution. Results point to restrictive monetary policy shocks as having heterogeneous effects on labor earnings which raise labor incomes at the upper end of the distribution while lowering that of those at the bottom end of the distribution.

A similar approach is presented by Guerello (2018). The study recovers measures of income dispersion from the *European Commission Consumer Survey* and analyzes whether conventional and unconventional monetary policies affect income inequalities in the Euro Area. With the aid of a VAR framework, results sug-

gest a high cross-country heterogeneity in the impact of monetary policy and nonlinearities associated with the redistributive strength of fiscal policy and the maturity of the household portfolio.

In another European study by Ampudia et al. (2018), it is argued that all monetary policy decisions tend to have redistributive consequences. For instance, expansionary monetary policy, both standard and non-standard, tends to reduce income and wealth inequality. The authors demonstrate that the impact of monetary policy on households' income is likely to be the most important aspect of the distributional consequences of standard monetary policy. The results also suggest that a few hand-to-mouth households, with very low liquidity, account for the *lion share* of the consumption response to monetary policy shocks.

It is based on these premises that several authors have shown a mounting interest over the topic. The contrasting results that have been highlighted so far have inevitably drawn the attention of various researchers in the academic community at distinct points in time. We observe that, in an attempt to solve this ambiguity, Mumtaz and Theophilopoulou (2017), Furceri et al. (2018), Lenza and Slacalek (2018), Samarina and Nguyen (2019) and Park (2021) have shown results in line with Coibion et al. (2017). On the other hand, Saiki and Frost (2014) and Domanski et al. (2016) have shown results that contrast with this strand of the literature. Most of these studies seem to indicate that the reason behind such ambiguity is due to the differences in the economic structure among different countries.

Moreover, a relevant portion of the literature has focused on this topic from a purely theoretical perspective, thus contributing to the argument's formalization emerged from the empirical findings. Gornemann et al. (2012) build a DSGE model featuring asset market incompleteness, a frictional labor market, as well as nominal frictions. The authors find that contractionary monetary policy shocks lead to a pronounced increase in earnings, income, wealth, and consumption heterogeneity. Particularly for wealth and consumption heterogeneity, the effects are very persistent and continue to be present even once the monetary impulse on the aggregate

economy has largely dried out. These findings are particularly interesting as they seem to be consistent with the results of the empirical literature featured in Coibion et al. (2017). The paper further highlights that, due to the interest earned on capital, households in the top 5% of the wealth distribution benefit slightly from a contractionary monetary policy shock, while the bottom 5% suffers. However, a limitation of this contribution is that results have kept the heterogeneity of households to a minimum. In particular, no substantial heterogeneity with respect to labor market prospects has been allowed.

Ko (2015) investigates the effect of income inequality on optimal monetary policy design. The author incorporates segmented labor markets with limited asset market participation into the standard New Keynesian DSGE model. Results show that income inequality moves counter-cyclically in response to monetary policy shocks. This is because any economic shock that affects the relative wage results in a variation in income inequality. This amplifies aggregate dynamics through strategic complementarities in wage setting. Similar conclusions are also reached by Areosa and Areosa (2016), which is one of the first papers to call for an explicit welfare-based objective of monetary policy that includes inequality stabilization.

The emerging macroeconomic literature surveyed by Iacoviello (2005), Kaplan and Violante (2018) combines heterogeneous agent models, nominal rigidities, and aggregate shocks. This contributed to opening the doors to the direct and indirect analysis of distributional issues, economic fluctuations, and stabilization policies within the same framework. Debortoli and Galí (2017) show that both the TANK and the HANK models can deliver similar equilibrium outcomes in response to monetary policy and other shocks, for comparable redistribution schemes and other frictions. Moreover, the paper decomposes the total effect of HANK heterogeneity as the sum of *between* and *within* heterogeneity.

The analysis is extended by Bilbiie (2018), and Bilbiie (2020) which introduce a supply side and study analytically the implications for optimal monetary policy by providing a second-order approximation to aggregate welfare, and apply the entire

apparatus to the analysis of liquidity traps and policies therein. Overall, results from this strand of the literature converge on the idea that aggregate demand elasticity to interest rates increases with the share of hand-to-mouth consumers. What delivers this conclusion, though, is not the mere addition of hand-to-mouth agents but also a distribution such that poor households' income rises more than one-to-one with aggregate income. In other words, it is assumed that individual income elasticity to aggregate income is larger than 1.

Based on this ground, the paper by Auclert (2019) evaluates the role of redistribution in the transmission mechanism of monetary policy to consumption. The conclusions arising from this paper are that with long asset maturities, lower real interest rates can benefit asset holders with lower Marginal Propensity to Consume (MPC). The reason being that the shorter asset maturities are, the less capital gains expansionary monetary policy generates. Since capital gains accrue to low MPC agents, monetary policy is more potent in affecting consumption with short-term assets than with long-term ones. The paper relies on a heterogeneous agent model with liquid and illiquid assets and focuses also on the liquidity channel for public debt used to finance fiscal transfers. Results show that the marginal propensities to consume out of past and future income shape the responses of the economy to income shocks and are compared to those found in the data.

Sims et al. (2022) develops a DSGE model with uninsurable household income risk and financial intermediaries subject to an endogenous leverage constraint. The paper investigates the aggregate implications of central bank asset purchases when there is substantial household wealth heterogeneity. The authors reach the conclusion that the aggregate responses to central bank asset purchases are very similar in a HANK specification compared to a RANK version of the model.

Finally, for completeness, we have to note that a smaller fraction of the literature has devolved its attention to the case of emerging economies. This is due to the difficulty in obtaining reliable data sources. Overall, results have been quite heterogeneous also in this case. Sánchez-Fung (2015) conduct a VAR analysis for the

case of China and find out that expansionary monetary policy leads to an increase in the Gini coefficients. The study relies on multiple indicators of monetary policy such as inflation, real money gap and the monetary overhang measure.

Park (2021) looks at the Korean case by implementing another VAR model with block exogeneity. Results show that a restrictive monetary policy shock causes an increase in the income inequality only after a time lag of one year. On the other hand, it is also observed that in this setting, it is the earnings heterogeneity channel that is regarded as the most significant linking factor between monetary policy and inequality.

The paper by Villarreal (2014) looks at the case of Mexico and similarly to Coibion et al. (2017) relies on survey data to measure inequality. The paper contributes to a large extent to the advancement of the literature as it implements both DSGE and SVAR models to identify monetary policy shocks. The results point out that there has been an increase in income inequality due to an expansionary monetary policy shock and vice versa, highlighting the relevance of the financial segmentation channel.

## 1.2 Research Question and Tools

It can be argued that so far, the results emerged from the studies analyzing the effects of monetary policy on inequality are ambiguous and often conflicting with one another. The results obtained up to now were largely affected by the measures of inequality considered, thus leading to empirical evidence that pointed in different directions. Findings vary across the countries and the time periods considered; several contrasting literature contributions have focused exclusively on a single country case and in general, on advanced economies.

Starting from the literature review, we notice that a predominantly empirical focus is placed on the topic. Hence, we question whether it is possible to offer an alternative perspective via a more theoretical and formal approach. Moreover, it is

also strikingly evident that relatively little attention has been given to the effects of monetary policy on income inequality, even in its declination via conventional instruments.

This thesis, shall contribute in bridging the gap of this strand of the literature. The relevance of this topic is evidenced by the unsettled debate around the desired policy action and its inequality implications across the layers of society. This work is aimed at stressing the need for a broader consideration of the necessary tools in crafting an effective monetary policy response, that up to now has generated some tangible collateral effects. Based on these considerations, the research question is as follows: *To what extent does conventional monetary policy matter in the transmission of income inequality? and how much income inequality gap can it generate?*

We seek to provide an answer via a two agents framework so as to define a more clear-cut linkage between monetary policy shocks and inequality. Contrary to Bilbiie (2020) and Auclert (2019), we will focus on explaining the dynamics of conventional monetary policy and thus, we will look at the data behaviour preceding 2008. Furthermore, contrary to Galí (2015) we do not explain heterogeneity via the channel of cyclical inequality. Instead, we focus on the income composition channel and the savings redistribution channel which emerge from a simpler TANK setting. Finally, this segment of the literature often looks at monetary policy design as optimal policy found by maximizing aggregate welfare. Given the phenomenon and the time period in which we are interested, we choose to focus on rules consisting of setting the nominal interest rate only.

# Chapter 2

## Methodology

### 2.1 Baseline Model

We proceed in building a special case of the model in Bilbiie (2018). This section introduces a two agents New Keynesian (TANK) model where the variance of idiosyncratic income shocks is zero. We consider an economy with two types of households, a continuum of firms and a monetary authority. The only source of heterogeneity is based on the assumption that a time-invariant subset of households features financial frictions in the form of borrowing constraints. Therefore, households in this category consume their current income in a hand-to-mouth fashion. The TANK model is expressed in terms of three equations: a monetary policy rule, the New Keynesian–Phillips curve with forward-looking properties and the Euler Equation for unconstrained (richer) households. Eventually, we introduce a simple measure for income inequality.

#### 2.1.1 Households

We impose that all households have identical preferences, given by:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t U(C_t^s, N_t^s) \tag{1}$$

Where we denote by  $\beta \in [0, 1]$  the discount rate,  $C_t^s \equiv \left( \int_0^1 C_t^s(i)^{1-\frac{1}{\epsilon_p}} di \right)^{\frac{\epsilon_p}{\epsilon_p-1}}$  the consumption index,  $C_t^s(i)$  the quantity consumed for good  $i \in [0, 1]$ ,  $N_t^s$  the hours of work and the superscript  $s$  specifies the household type. We characterise the utility as follows:

$$U(C_t^s, N_t^s) \equiv \frac{(C_t^s)^{1-\sigma} - 1}{1-\sigma} - \frac{(N_t^s)^{1+\psi}}{1+\psi} \quad (2)$$

We now start considering a fraction  $\lambda$  of households, who can just consume their labor income at every period. Essentially, they do not have any access to financial markets (the literature often refers to them as *Keynesian* households, so we denote their type with the superscript  $K$ ). We can express their budget constraint as:

$$\frac{1}{P_t} \int_0^1 P_t(i) C_t^K(i) di = W_t N_t^K + T_t^K \quad (3)$$

Where  $C_t^K, N_t^K, T_t^K$  denote, respectively, consumption, hours worked and lump-sum transfers for this category of households. Furthermore,  $W_t$  is the real wage and the price index is  $P_t \equiv \left( \int_0^1 P_t(i)^{1-\epsilon_p} di \right)^{\frac{1}{1-\epsilon_p}}$ , with  $P_t(i)$  being the price for good  $i \in [0, 1]$ .

Then, we consider a portion  $1 - \lambda$  of households that have an unconstrained access to the financial markets (the literature often refers to them as *Ricardian* households and we denote their type with the superscript  $R$ ). They can trade one-period nominally risk-less bonds and own the aggregate profits in the economy. Their budget constraint is given by:

$$\frac{1}{P_t} \int_0^1 P_t(i) C_t^R(i) di + \frac{B_t}{P_t} = \frac{B_{t-1}(1+i_{t-1})}{P_t} + W_t N_t^R + D_t \quad (4)$$

Where  $B_t$  stands for the holdings of bonds, while  $D_t$  is the dividend. Note also that allocation of expenditures across goods is optimal. The inter-temporal optimality condition for the *Ricardian* households is as follows:

$$\frac{1}{1+i_t} = \mathbb{E}_t \left[ \Lambda_{t,t+1} \left( \frac{P_t}{P_{t+1}} \right) \right] \quad (5)$$

Where  $\Lambda_{t,t+1} \equiv \beta \left( \frac{C_{t+1}^R}{C_t^R} \right)^{-\sigma}$  is the discount factor.

A final remark is that both types of agents take the wage as given and are willing to supply as much labor as demanded by firms. Hence, the wage schedule is as follows:

$$W_t = \mathcal{M}^\omega C_t^\sigma N_t^\psi \quad (6)$$

Where  $\mathcal{M}^\omega > 1$  is interpreted as the gross average wage markup and  $C_t \equiv \int_0^1 C_t(s) ds$  is the average consumption.

### 2.1.2 Firms

There exists a continuum of identical monopolistically competitive firms  $i \in [0, 1]$ , each producing a product given a technology. In order to concentrate our attention on the households and to keep the model as simple as possible, no capital is included in the production function. We have that:

$$Y_t(i) = A_t N_t(i) \quad (7)$$

Where  $Y_t(i)$  indicates output,  $N_t(i)$  denotes labor input and  $A_t$  indicates the technology parameter. Technology follows the process  $a_t = \rho_a \log(a_{t-1}) + \epsilon_t$ , where  $\epsilon_t \sim N(0, \sigma^2)$ . Moreover, every firm will optimally set the price of its good at each period. This will however be subject to a quadratic cost adjustment  $\mathcal{C}(\cdot) \equiv \frac{\xi}{2} P_t Y_t \left( \frac{P_t(i)}{P_{t-1}(i)} - 1 \right)^2$  with  $\xi > 0$ . The demand for each good is assumed to be isoelastic and is described by  $Y_t(i) = \left( \frac{P_t(i)}{P_t} \right)^{-\epsilon} Y_t$ . Since all firms are identical, profit maximization implies that all firms choose the same price,  $P_t(i) = P_t \forall i \in [0, 1]$ , thus producing the same output with the same labor input (symmetric equilibrium conditions). It follows that the gross price inflation rate  $\Pi_t \equiv \frac{P_t}{P_{t-1}}$  evolves à la Rotemberg (Rotemberg (1982)):

$$\Pi_t(\Pi_t - 1) = \mathbb{E}_t \left[ \Lambda_{t,t+1} \left( \frac{Y_{t+1}}{Y_t} \right) \Pi_{t+1} (\Pi_{t+1} - 1) \right] + \frac{\epsilon}{\xi} \left( \frac{1}{\mathcal{M}_t^p} - \frac{1}{\mathcal{M}^p} \right) \quad (8)$$

Where  $\mathcal{M}_t^p \equiv \frac{A_t}{W_t}$  stands for the average gross markup. Finally, aggregate profits are given as  $D_t = Y_t \Delta^p \Pi_t - W_t N_t$  where  $\Delta^p \Pi_t \equiv 1 - \left(\frac{\xi}{2}\right) (\Pi_t - 1)^2$ .

### 2.1.3 Monetary Policy

The central bank follows a Taylor rule where the interest rate responds to inflation and output. The following equation is borrowed from the New Keynesian literature and is used to describe the behaviour of the central bank in *normal* times. Therefore:

$$\hat{i}_t = \phi_\pi \pi_t + \phi_y \hat{y}_t + v_t \quad (9)$$

Where  $\phi_\pi \geq 0$ ,  $\phi_y \geq 0$  and  $v_t$  is an exogenous monetary policy shock that follows a typical AR(1) process with an auto-regressive coefficient  $\rho_v \in [0, 1]$ .

## 2.2 Equilibrium and Dynamics

### 2.2.1 Market Clearing Conditions

Starting from the clearing in the goods market, we have that:

$$Y_t = C_t = \lambda C_t^K + (1 - \lambda) C_t^R \quad (10)$$

The market clearing in the bond market is such that:

$$\int_0^1 B_t(s) ds = 0 \quad (11)$$

Moreover the aggregate employment is assumed to be uniformly distributed among all household types and is described as:

$$N_t = \lambda N_t^K + (1 - \lambda) N_t^R = \int_0^1 N_t(i) di = \frac{Y_t}{A_t} \quad (12)$$

### 2.2.2 Fundamental Equations

In the log-linearized equilibrium system, the inter-temporal equations are the monetary policy rule (described in the section above), the New Keynesian Phillips curve:

$$\pi_t = \beta \mathbb{E}_t(\pi_{t+1}) + \kappa \tilde{y}_t \quad (13)$$

Where  $\kappa \equiv \omega(\sigma + \psi)$ , and the Euler Equation for the *Ricardian* household:

$$\hat{c}_t^R = \mathbb{E}_t(\hat{c}_{t+1}^R) - \frac{1}{\sigma} [\hat{i}_t - \mathbb{E}_t(\pi_{t+1})] \quad (14)$$

Finally, the definition of the inequality measure,  $\mathcal{I}$ , reads as follows:

$$\mathcal{I} = \frac{y^R}{y^K} \quad (15)$$

Where  $y^R$  and  $y^K$  stand respectively for the richer and the hand-to-mouth households' income. *Keynesian* households' income is consumed as shown in equation 3, while the income of *Ricardian* households is expressed through equations 4 and 11. Obviously, since *Ricardian* households receive dividends from the firm and have access to the bond market, their income will be higher compared to their *Keynesian* counterparts. Intuitively, we may presume that the ratio above will always be greater than 1.

We argue that, as in Bilbiie (2020), the amplification channel resembled by the parameter  $\chi$  is a *sufficient statistic* to regulate and assess the monetary policy shocks in this heterogeneous setting. In particular, to ensure a counter cyclical behaviour of income inequality, we impose that the individual income elasticity to aggregate income shall be greater than 1. A deeper elaboration of the above is provided in Appendix A.

# Chapter 3

## Results

### 3.1 Parametrization

The parameter values are assigned based on a mix between the New Keynesian literature and several empirical studies:

Table 1: Calibration Parameters

Parameter	Description	Value
<b>Households</b>		
$\lambda$	Portion of <i>Keynesian</i> households	0.2
$\beta$	Discount factor	0.97
$\epsilon_p$	Elasticity of substitution between goods	7
$\psi$	Inverse of Frisch elasticity	1
$\sigma$	Coefficient of relative risk aversion	1
$\mathcal{M}^\omega$	Gross average wage markup	1.2
<b>Firms</b>		
$\rho_a$	Persistence of technology shock	0.95
$\xi$	Adjustment cost	93.2
<b>Monetary Policy</b>		
$\phi_\pi$	Taylor coefficient for inflation	1.5
$\phi_y$	Taylor coefficient for output	0.125
$\rho_\nu$	Persistence of monetary policy shock	0.5

Some remarks shall be made. A crucial parameter is the share of *Keynesian* households which was set to be equal to  $\lambda = 0.2$ , as it roughly matches what is estimated by Kaplan and Violante (2018) and is in the range considered by Romer and Romer (1999) and Campbell and Mankiw (1989) for some European countries. The value for the elasticity of substitution across goods is the result of an average taken over the reference literature and reflects the high degree of substitutability that is typical of a complex economy. Meanwhile, the value assigned to the inverse of Frisch elasticity reflects our prior assumption on labor supply being perfectly elastic. The adjustment cost value is set so that the slope of the New Keynesian Phillips curve is the same under Rotemberg and Calvo price rigidities. The monetary policy parameters are exactly the ones estimated by Taylor.

### 3.1.1 Impulse Response Functions Analysis

We now move to an analysis of the impulse responses (shown in Appendix B) to a structural shock, such as a monetary contraction, and the consequent income inequality effects. A monetary contraction increases both consumption and income inequality, although the peak in consumption inequality appears to be more pronounced. This result seems to be in agreement with a large part of the empirical literature examined.

The drop in consumption is largely explained by the impact of monetary contractions on *Keynesian* households' consumption, who are suffering more relative to the *Ricardian* portion of the population. Increasing interest rates inevitably result into a slow-down of the economy and of firm's output productivity. This is reflected into the labor market by looking at the small reduction in employment and wages.

Moreover, a monetary contraction reflects positively into financial markets as for what concerns the rise in dividends received by *Ricardian* households, who can now offset their initial losses. Finally, the rise in corporate profits is evidence of the increasing market power of top-performing firms. In an effort to solidify these

findings, we extend our analysis and perform a robustness check with a positive productivity shock calibration in Appendix B.

Overall, we can say that monetary policy impacts both the income and consumption of the *Ricardian* individuals through real interest rates. That is, via the so-called *savings distribution channel*. Indeed, the real interest rate affects consumption decisions of *Ricardian* households since they will smooth their consumption activities. When the real interest rate increases, *Ricardians* decide to consume less and save more. As for the *Keynesian* households, it will be the *income composition channel* to play a role in the transmission of monetary policy. In the TANK setting, their hand-to-mouth behaviour is clearly visible: the reduction in consumption (and so income) of the *Keynesian* households is roughly similar to the drop in their wages.

## 3.2 Empirical Evidence

The purpose of this section is to check whether the model examined so far is compatible with the empirical evidence from two economies like the USA and Italy. We summarize long-run changes in income inequality from the 1980s up to 2008 using data from the *World Inequality Database* and the *Luxembourg Income Study Database*. We exclude the period following 2008 due to the abrupt changes in monetary policy that would over-complicate the modelling and the corresponding analysis.

Moreover, we deliberately keep the definition of income as broad as possible; so as to aggregate data on interest income on savings or bonds, rental income, but also property income, payments made by a corporation to its stockholders, periodic receipts from estates or trust funds, net income or loss from the rental of property, real estate, or farms and net income or loss from roomers or boarders. To ensure comparability, pre-tax income is considered for both countries under scrutiny.

### 3.2.1 Evidence from the USA

There has been a gradual diminishment on an annual basis of the interest rates between 1980-2008, as can be attested by the graph of Figure C.1 in Appendix C. Over the past few decades, this laxer environment has accompanied a general increase in the gap between the richest and the poorest 20% of the American population (Figure C.2).

According to the data retrieved from the *US Bureau of Labor Statistics*, peaks in interest rates do coincide with soaring inequality. The choice to focus on the poorest 20% is intended to partially reflect the portion of agents that are assumed to exhibit a hand-to-mouth behaviour in the model. Furthermore, this choice is also well supported by the *Global Findex Database* which attributes a share of 23% to the American population featuring a constrained behaviour.

The data show that a worsening of income inequality has been ongoing in the period considered, the share of income for the top 1% incredibly outpaced the rest of society. This remains true even after all taxes have been subtracted and all income from Social Security, welfare, and other payments are added. A graphical representation is shown in Figure C.3 and C.4. We present in Figure C.5 the ratios between the income of the 99<sup>th</sup> and 90<sup>th</sup> percentiles with respect to the income at the 50<sup>th</sup> percentile, which further confirm the trend described so far.

### 3.2.2 Evidence from Italy

It is very difficult to produce, and even retrieve, aggregate data for the entire Euro Area. Nonetheless, in order to show the intersectionality of the topic under study, we focus on a European country that has historically inherited an income inequality burden and for this reason is of extreme relevance: Italy.

As a methodological note, the interest rate considered before the entrance in the Euro Area is the annual average of the interest on government securities and bonds. In general, Italy has experienced a decreasing interest rate that is mainly due to the

gradual convergence to a common European interest rate (Figure C.6). Also in this case, a peak in income inequality between the richest and the poorest 20% of the population is registered in concomitance with higher interest rates, more specifically, later in the 1980s and earlier in the 1990s (Figure C.7). However, a reducing trend in income inequality is observable in the years following the introduction of the common currency (January 2002).

By replicating the same analysis on the 90<sup>th</sup> and 99<sup>th</sup> percentiles, the inequality gap keeps intensifying on a yearly basis (Figure C.8 and C.9). However, we can claim that the magnitude of the inequality gap is considerably lower compared to the one witnessed in the American case.

# Conclusion

In this thesis, we have analysed the effects of conventional monetary policy on households' income inequality by means of a TANK model. The simple distinction between a richer and a poorer portion of the population has allowed us to study closely the mechanics of the phenomenon under scrutiny. As can be attested by the income gap analysis and the impulse response functions, we can conclude that an increase in interest rates (that is, a restrictive monetary policy) induces an increase in the level of income inequality between the *Ricardian* and *Keynesian* household groups.

Based on these premises, we were able to clearly isolate the channels responsible for these dynamics. In the first place, the *savings distribution channel* encompasses the ways in which people choose to invest or distribute their excess income or funds to maximize returns, smooth consumption activities or achieve specific financial goals. Secondly, the *income composition channel* highlights how income sources affect growth and development for the more and less constrained households.

We have concluded our inspection with real world evidence from the USA and Italy. The data considered over the period 1980-2008 have described a trend which boosts the observations made from the theoretical setup of Chapter 2.

On a critical note, this work carries some limitations. For instance, the choice of implementing a TANK model, for simplicity of analysis, sacrifices a more *granular* understanding that could be reached should a HANK model be introduced. We do not completely close the gap in the literature as it is difficult to relate these

theoretical findings with the fragmented data of developing economies. Nonetheless, the findings of this paper still contribute in shedding light on the intricate relation between monetary policy and inequality.

As for what concerns future work extensions, we could keep proceeding in the direction of optimal policy research. That is, the conventional Taylor rule might not be the best policy in an economy with heterogeneous agents, especially when one also takes into consideration the distributional repercussions of monetary policy. Finally, in a system where interest rates are used as a tool to stimulate or cool down the economic activity, the Gini index can be seen as an alternative, more polished, measure of income inequality.

Overall, we can claim that a greater understanding of these matters is crucial for policymakers and economists as it can guide the formulation of policies aimed at promoting inclusive growth, reducing inequality, and enhancing overall economic well-being. By analyzing the distribution and composition of income sources, policymakers can identify areas of improvement, such as promoting job creation, addressing wage gaps, fostering entrepreneurship, or implementing social safety nets to support vulnerable layers of the population. These are all aspects which, one day, could be clearly expressed in the mandate of monetary authorities.

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