

# The Inflation-Inequality Connection in the European Union: U-Turn to Equity?

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**Abstract** In this study, we delve into the complex relationship between inflation and inequality in the European Union from 1990 to 2019. Specifically, we explore the non-linear nature of this relationship, uncover turning points, and reveal the distinctive U-shape of the relationship between the two indicators. Our research also uncovers some striking findings: first, we discover that sales taxes disproportionately harm households and drive up inequality, and second, we find that income tax policies are very effective at reducing inequality in Western European countries, while they are substantially less effective in Eastern European countries with lower income tax rates.

**Keywords:** inflation, inequality, European Union

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## I. Introduction

Communist bloc countries, such as Poland, Hungary, Czechoslovakia (present-day Czech Republic and Slovakia), and others, faced economic catastrophe in the aftermath of the fall of the Berlin Wall and the collapse of the Iron Curtain (Svejnar, 2002). It is because used-to-have-a-planned-economy-countries abandoned the communist system and transited their economy very quickly into a market economy. The transmission was hurtful and agonizing for people and companies. However, economic recovery took place very quickly. Economic growth spiked, inflation and unemployment rates fell, and economic integration speeded up (Blanchard, 1997).

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Equality is one of the most pivotal goals that communist regimes strive to achieve (Fuchs-Schundeln and Schundeln, 2020, p.179). For many years, communist regimes availed themselves of wages as a means of making society more egalitarian. Davis and Scase (1985) evinced that inequality narrowed in Eastern Europe under communism. However, in the post-communist era, increasing inequality was observed in Eastern European countries. The reason that inequality was exacerbated is that political elites became economic elites in the market economy thanks to their strong political ties. Moreover, meritocracy allowed economic elites to rise very quickly, which resulted in an increase in inequality in Eastern European countries (Böröcz and Róna-Tas, 1995).

Inflation is another fundamental economic factor that has a profound influence on inequality (Coibion et al., 2017). There is a bit of information as to how inflation looked like in the communist bloc. At the end of the 1980s, satellite states of the Soviet Union experienced hyperinflation, which was triggered by the weak central planned economy (Rostowski, 1989). In the aftermath of the downfall of the communist bloc, almost all ex-communist Eastern European economies endured extreme hyperinflation<sup>1)</sup>, but all of them managed to pull that extreme inflation down to below 20% inflation rate (Åslund et al., 1996).

The gap between Eastern Europe and Western Europe was enormous in the aftermath of the collapse of the Iron Curtain. Eastern European countries that had a communist economic model, non-democratic political system, and a planned economy lagged behind. Western European countries enjoyed prosperity and richness, as Eastern European countries struggled to transition their socialist economic systems into free market systems (Fuchs-Schundeln and Schundeln, 2020). However, Eastern European countries, predominantly present-day European Union countries, were able to converge with Western European Union countries in many fields in the 2000s (Cuaresma et al., 2016).

The inflation-Inequality relationship is one of the very vital economic phenomena in inequality studies, as many scholars have evidenced (Persson and Tabellini (1994); Beetsma and Van Der Ploeg (1996); Romer and Romer (1998); Erosa and Ventura (2002); Crowe (2006); Albanesi (2007); Sun (2011); Maestri and Roventini (2012); Coibion et al. (2017) because price increasing has a direct affectation on the disposable income of people and predominantly hit low and middle-income households (Bach and Ando, 1957, p.2). Therefore, investigating the nexus between inflation and inequality by using consumption and tax data in the European Union enables us to elucidate many significant questions, such as whether there are differences between Eastern and Western European Union countries and whether there are differences between high-income tax and low-income tax European Union countries.

In this article, we are exploring the relationship between inflation on inequality in the European Union and how tax policies, such as income tax and sales tax, can affect inequality. We are aiming to determine if tax policies are effective in the European Union, including

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1) For example, 586% in Poland, 1069% in Estonia, and 951% in Latvia (Åslund et al., 1996)

both Western and Eastern European Union countries. Past research has shown that taxes were not effective in transition economies, which include Eastern European Union countries (Alm and Martinez-Vazquez, 2003). Therefore, we are examining the effectiveness of taxes during inflationary periods and analyzing whether Eastern European countries still have ineffective tax policies.

We examine how inequality changed during the inflationary period and identify which income groups benefited from inflation. We will also investigate if the relationship between inflation and inequality was linear or non-linear in the European Union. Our findings will not only help us compare our study with previous research but also give us a better understanding of the impact of inflation on inequality.

The research indicates that tax evasion is having a significant impact on the effectiveness of income tax policies in Eastern European Union countries compared to their Western counterparts. Consequently, even after tax and transfers, inequality remains higher in the Eastern EU countries than it would have been otherwise. On the other hand, in Western EU countries, inequality decreases sharply after tax and transfers, despite being quite high before them. However, the same trend is not observed in Eastern EU countries.

Another important finding of this study is the correlation between inflation and inequality, which takes the form of a U-shaped curve. Initially, as inflation rises, inequality decreases due to a transfer of income from lenders (capital owners) to borrowers, facilitated by low interest rates. However, as inflation continues to rise, inequality increases once again because central banks raise interest rates to curb inflation, which benefits lenders (capitalists and the wealthy).

Our research also shows that sales taxes in the European Union have a significant impact on inequality due to their high rates. Most European Union countries impose relatively high sales taxes, which disproportionately affect low and middle-income households compared to high-income households. The study found that when households spend on consumption, inequality increases because low and middle-income households pay a significant portion of their disposable income in sales taxes.

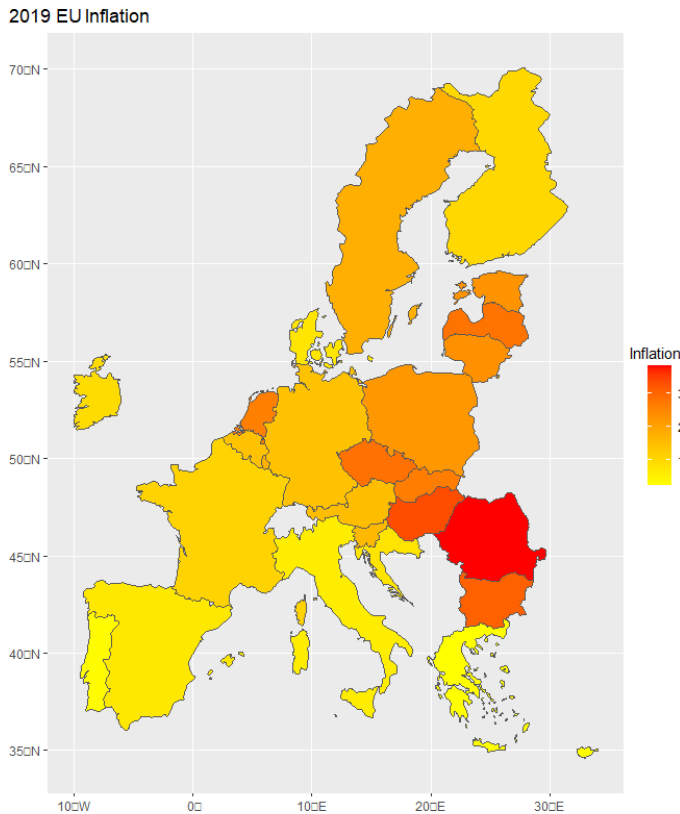
## II. Empirical Analysis

### A. Data

This study focuses on the inequality-inflation nexus in twenty-six European Union countries over the period from 1990 to 2019. For descriptive statistics and resources, we refer to Tables A1 and A2 in the Data Appendix. We exclude Malta and the United Kingdom from our study; it is because Malta does not have subsequent datasets, and the United Kingdom exited the

European Union. We included Eastern European countries in our dataset even though most of them joined the European Union after 2004 as we believe it is important to observe the relationship between inflation and other economic factors on the inequality in Europe as a whole.

**Figure 1.** The map of the 2019 inflation in the European Union



Eastern European Union countries<sup>2)</sup> differ from Western European Union countries<sup>3)</sup> in terms of economic factors such as inflation, GDP per capita, and tax effectiveness (Myck and Trzcín'ski, 2022; Bauer and Börzel, 2010). As seen in Figure<sup>4)</sup> 1, Western and Eastern European Union countries diverge when it comes to the inflation rate. In 2019, most Western European countries had low inflation rates between 0 and 1.5%, as most Eastern European countries had relatively high inflation rates, nearly 3.5%. The highest inflation rate was observed in

2) Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia (Fuchs-Schundeln and Schundeln, 2020)

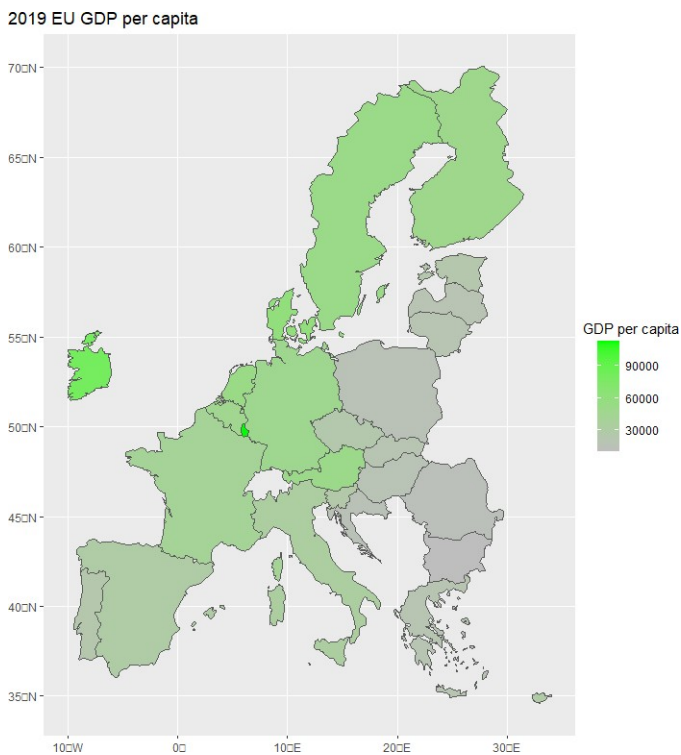
3) Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden

4) All Figures are our plots.

Romania, with a rate of 3.83%, whilst the lowest inflation rate, 0.25%, was captured in Cyprus.

Eastern European countries faced hyperinflation due to the transition from a planned economy to a market economy at the beginning of the 1990s. It took a few years for these countries to bring inflation under control (Joshi, 2014, p.4). Therefore, at the beginning of the timeline under study (the 1990s), Eastern European countries experienced high inflation rates<sup>5</sup>).

**Figure 2.** The map of the 2019 GDP per capita in the European Union



Another striking economic factor that displays differences between Western and Eastern European Union countries is Gross Domestic Product (GDP) per capita, as seen in Figure 2. It is evident that there is a dramatic GDP per capita gap between Western and Eastern European Union citizens. As discussed, it is predominantly because Eastern European Union countries were under communist regimes until 1990. However, even though the gap is large, Eastern European Union countries were able to grow at a neck-breaking speed and moved their GDP per capita to high-income countries' level within 30 years (Fuchs-Schundeln and Schundeln, 2020).

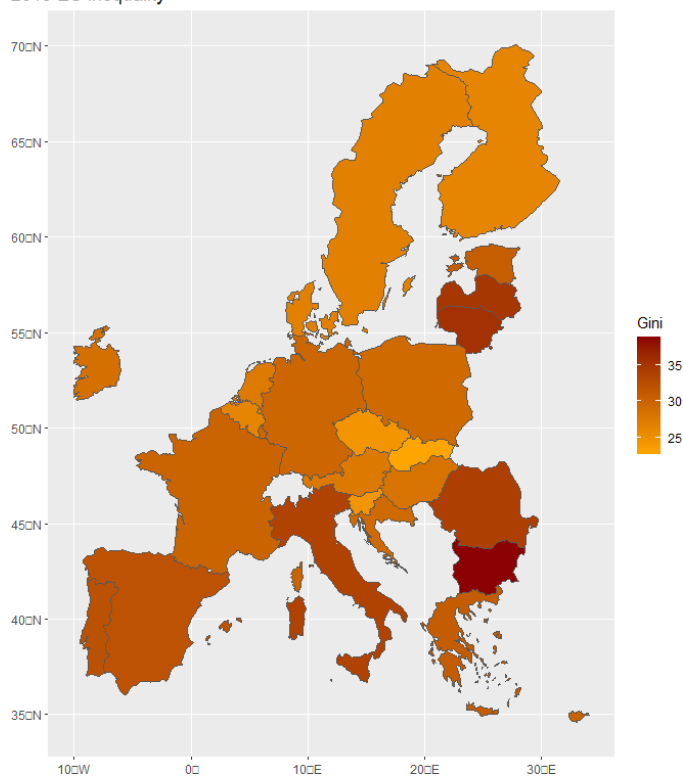
5) We believe, it is important to include the period of hyperinflation, though we like to mention that empirically our overall result is robust to the choice. To confirm, we limited our analysis to the period after hyperinflation, from 1995 to 2019, and we found that the results were akin (available upon request). Eventually, we excluded extreme values of inflation (values above 100%) from our analysis to observe un-skewed turning points.

Among European Union countries, in 2019, Luxembourg had the highest GDP per capita, with about \$ 113,000, as Bulgaria had the lowest GDP per capita, with about \$ 9800. In 2019, Bulgaria was the only European Union country classified in the group of middle-income countries. Other European Union countries were members of high-income (World Bank, 2020). However, as mentioned, it is known in the last 30 years, Eastern members of the European Union have narrowed the GDP per capita gap significantly with Western European Union countries (Joshi, 2014, p.5).

Inequality is the main factor in this study, and it was one of the main concerns in communist countries. Communist ideology concentrated vitally on the Egalitarian approach. However, not all Eastern European societies were not very equal (Libman and Obydenkova, 2019). Moreover, Bukowski and Novokmet (2021) find using very long-range data that in Poland, one of the communist block countries, the top 10% in the income distribution were much richer than the rest of society during the communist regime. After 1990, the top 10% and 1% gained more share.

As seen in Figure 3, Eastern and Western European Union countries have akin Gini coefficients. In 2019, the lowest Gini coefficient (22.6) was recorded in Slovakia, and the highest (38.9 Gini) was observed in Bulgaria.

**Figure 3.** The map of the 2019 inequality in the European Union



## B. Model specification

We estimate a panel-data model with annual data over the period from 1990 to 2019 in the European Union. We adopt a quadratic function in order to observe the non-linear long-term inequality- inflation relationship. We also investigate changes in inequality after and before tax and transfers to detect the effectiveness of taxes and transfers in these European Union countries.

We created the following description to comprehend if tax and transfers are effective or ineffective.

$$\begin{aligned} |\text{Gini}_{\text{Disposable}}| < |\text{Gini}_{\text{Market}}| &\iff \text{EffectiveTaxPolicy} \\ |\text{Gini}_{\text{Disposable}}| > |\text{Gini}_{\text{Market}}| &\iff \text{IneffectiveTaxPolicy} \end{aligned}$$

An "Effective Tax Policy" ensures a fair distribution of the tax burden, with the wealthy class - including both capitalists and the working rich - shouldering a larger proportion of taxes compared to other socioeconomic groups. Conversely, an "Ineffective Tax Policy" is characterized by policies that disproportionately benefit the affluent and discriminate against other segments of society. As a result, the Gini coefficient, which measures income inequality, is further increased under an "Ineffective Tax Policy" when accounting for taxes and transfer payments. We also are interested to know how the dynamics of inflation and Gini compare before the transfers and after the transfers. The expectation from tax policies is to reduce any severe impact of inflation. We will discuss the rationale later in Section 3.1.

Back to the panel-data model, we use a quadratic function to analyze patterns of inequality during times of inflation in the European Union. This allows us to look at both the rate of inflation and the rate of inflation squared in order to get a more complete picture of the pattern of inequality during the inflationary period and capture a non-linear relationship. The panel-data model specification is as follows:

For country  $i \in 1, \dots, I$  and for time  $t \in 1, \dots, T$  we have in generic terms:

$$y_{it} = \rho_1 \text{inf}_{it} + \rho_2 \text{inf}_{it}^2 + X_{it} \beta + \delta_t + \mu_i + \epsilon_{it} \quad (1)$$

and in our specific application:

$$\text{ineq}_{it} = \rho_1 \text{inf}_{it} + \rho_2 \text{inf}_{it}^2 + \beta_1 \text{GDPPC}_{it} + \beta_2 \text{emp}_{it} + \beta_3 \text{pop}_{it} + \beta_4 \text{G.C}_{it} + \delta_t + \mu_i + \epsilon_{it} \quad (2)$$

We use Gini as a measure of inequality (ineq) that non-linearly relates to the values of inflation (inf). The parameters  $\rho$  capture the non-linear relation of current values of inflation.

Note that we take into account both market and disposable income-driven values of Gini in our analysis.

In Equation 1,  $X_{it}$  represents the set of predictors that control for factors such as employment rate, population, GDP per capita, and household and government consumption. The time-specific effects are captured by  $\delta_t$ , and the country-specific effects are captured by  $\mu_i$ .

As shown in Equation 2, this paper employs a quadratic function to detect the point at which inequality switches its pattern. The function has one extremum point (turning point) which is calculated by:

$$\tau = \frac{-\rho_1}{2\rho_2} \tag{3}$$

We employ the fixed effects (FE) method to estimate heterogeneous aggregate panels with multiple-year time series of data. This method, as suggested in the literature, provides more efficient estimates by reducing economic and statistical endogeneity by accounting for unobserved country and time differences through specific fixed effects. To control for unobserved states  $\mu_i$ , a fixed effect model subtracts the average of each state.

$$\widetilde{ineq}_{it} = \rho_1 \widetilde{inf}_{it} + \rho_2 \widetilde{inf}_{it-1} + \beta_1 \widetilde{unemp}_{it} + \beta_2 \widetilde{growth}_{it} + \beta_3 \widetilde{urban}_{it} + \widetilde{\mu}_i + \widetilde{\delta}_t + \widetilde{\epsilon}_{it} \tag{4}$$

in which  $\widetilde{ineq}_{it} = ineq_{it} - \frac{1}{T}(ineq_{i1} + ineq_{i2} + \dots + ineq_{iT})$ .

We provide a robustness analysis of the suggested method in the literature in Section 3.2. In addition to the traditional FE model above. We investigate whether there is any variation in the coefficients across countries by examining a "Random Coefficient" model. In simpler terms, we test if a model, as represented below:

$$y_{it} = (\beta_0 + \alpha_{0i}) + (\beta_1 + \alpha_{1i})Z_{it} + \epsilon_{it} \tag{5}$$

improves upon a model that does not allow for the intercept and slope coefficients to vary across countries.

Moreover, we examine a "highly Dimensional" Feasible estimator for linear models with multi-Way fixed effects. In our general model/equation 1, if we consider

$$y_{it} = \rho_1 inf_{it} + \rho_2 inf_{it}^2 + X_{it} \beta + D\alpha + \epsilon_{it} \tag{6}$$



then the dummy matrix  $D$  could represent country fixed effects across  $T$  dimensions, so it has a block representation  $D = [D_1 D_2, \dots, D_T]$ . The number of levels (states) for the  $t^{\text{th}}$  dimension is  $g_t$  so  $g = \sum_{t=1}^T g_t$ . Note that this model allows for country-fixed effects to vary over

time (Correia, 2016). Note that assuming  $f=1$ , then this is the regular FE model mentioned above, but with the benefit of correcting for possible inconsistencies in the standard errors (for example, in a standard panel with individual and time-fixed effects, we require both the number of states and periods to grow asymptotically, which is not the case here (Stock and Watson, 2008).

We believe that panel data models and estimation strategies, which are further discussed in Section 3.2 (Robustness Check), that examine the dynamics linking inflation to inequality for multi- years and multi-countries will provide insight into how inflation results in equal or unequal social benefits or costs over time across these European Union countries. Specifically, as mentioned above, we are able to divide these European countries based on their average income, and we investigate how the relationship between inflation and income inequality holds within sub-samples (high versus low income). As mentioned, we also investigate the effectiveness of tax policies in Western versus Eastern European countries by comparing how our relationship of interest holds for market income inequality versus disposable income inequality in these countries.

### III. Results

#### A. Main result

In this section, we provide the result of the quadratic model we consider to capture the non-linear relationship between inflation and inequality, with and without the control variables. We also investigate and compare how this relationship holds between Western and Eastern European Union countries, as well as before and after tax and transfers in this section. Moreover, we calculate the turning points for the outcome we observe of the inflation-inequality nexus. To our knowledge, this is the first study calculating extremum points in the European Union countries.

**Table 1.** Estimation Results, Quadratic Inflation, with and without Controls

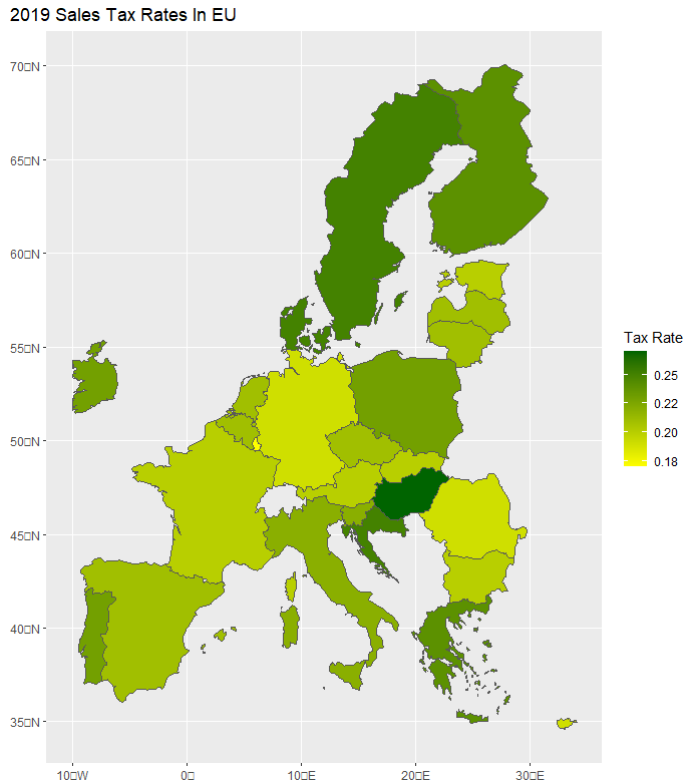
	(1)	(2)	(3)	(4)	(5)
	<i>gini_disp</i>	<i>gini_disp</i>	<i>gini_disp</i>	<i>gini_disp</i>	<i>gini_disp</i>
Inf	-13.899*** (1.277)	-10.974*** (1.332)	-11.089*** (1.336)	-11.068*** (1.310)	-11.021*** (1.308)
InfSq	0.102*** (0.016)	0.057*** (0.019)	0.058*** (0.019)	0.066*** (0.018)	0.066*** (0.018)
GDPPC		0.038*** (0.004)	0.036*** (0.005)	0.064*** (0.006)	0.066*** (0.006)
Population			0.005 (0.072)	0.025 (0.070)	
Employment			0.073 (0.087)	0.021 (0.085)	
Household Consumption				7.912*** (1.265)	7.879*** (1.262)
Gov Consumption				-2.168*** (0.391)	-2.215*** (0.385)
_cons	29.432*** (0.065)	28.325*** (0.137)	27.758*** (0.850)	24.349*** (1.128)	24.951*** (0.719)
N	754	745	745	745	745

Standard errors in parentheses

\*p &lt; 0.10, \*\*p &lt; 0.05, \*\*\*p &lt; 0.01

Table 1 depicts the main outcomes. Column 1 is the estimation result of the quadratic model without any control variables. In Columns 2 to 5, we add and drop the control variables. As seen, the result points up that the dynamic of the inequality-inflation relationship follows an (uninverted) U-shape. Our "U-shape" finding and the turning points, which here occur at 79.07% inflation, match the result of Monnin (2014).

As expected from the literature, we can see that when an EU country's GDP per capita goes up, inequality tends to go up as well. On the other hand, when the government spends more money on education, healthcare, and the like, inequality tends to go down substantially as these programs are designed to help people who might be struggling financially. Household consumption, as discussed below, is associated with higher inequality, and it seems that in the presence of GDP per capita in the model, which here potentially dominates population and employment rates, those variables become insignificant.

**Figure 4.** The map of the 2019 sales tax rates in the European Union

We believe, that one main reason that the inequality-inflation relationship follows a U-shaped pattern in the European Union might be that at the beginning of the inflationary period, predominantly middle-class households tend to get more loans with relatively low-interest rates due to high expected future prices. As a result, income is transferred from lenders (capital owners) to borrowers (middle-class households<sup>6</sup>), and inequality declines (Laidler and Parkin, 1975). However, we know that European Union countries would take action to lower inflation by using every monetary instrument. When they use those instruments to pull inflation down, Galli (2001, p.14) finds that inequality goes up in Europe. It is because central banks in European Union countries raise policy rates, which favor lenders (capitalists), and disfavor borrowers (middle-class households). We observe, from our result of the turning points, that this happens much quicker in Western European countries.

Similar to the U-shaped curve between inflation and economic growth documented in the literature (Gillman and Kejak (2005); Gillman et al. (2004), we find the U-shaped curve between inflation and inequality as one of the key results of this study. Inflation is a regressive sales

6) Poor people have no assets to use as collateral to get loans. Hence, inflation always hurts the poor more (Laidler and Parkin, 1975, p.789)

tax that lowers economic growth and prosperity. Lower economic growth causes less inequality since everyone gets poorer. Another key finding (provided in Table 1) is that Household Consumption<sup>7)</sup> induces an increase in inequality in the European Union. This means that during the inflationary period, households, predominantly low and middle-income families, need to spend more in order to meet needs, which according to our result hurts them. We believe one of the reasons might be that European Union countries have high sales tax rates (Value Added Tax rate), as seen in Figure 4. Households pay a lot for excise and indirect taxes in order to meet essential goods. However, we know that wages are sticky and do not change quickly (Solow, 1979), and during the inflation increase, middle and low-income households pay more from their unchanged disposable income to reach the same amount of essential goods that they had before inflationary period. Companies and governments earn more from the price increase. Therefore, an increase in household consumption induces a rise in inequality in the European Union.

**Table 2.** Estimation Results of High Vs. Low Income, Western Vs. Eastern EU, and Gini Disp. Vs. Gini Market

	(1)	(2)	(3)	(4)	(5)	(6)
	High	Low	Western	Eastern	gini_disp	gini_mkt
Inf	-0.538 (6.776)	-10.861*** (1.743)	-0.467 (3.991)	-6.887*** (1.929)	-11.068*** (1.310)	-16.561*** (1.544)
InfSq	-1.896* (0.966)	0.059** (0.023)	0.452* (0.268)	0.056** (0.024)	0.066*** (0.018)	0.110*** (0.021)
GDPPC	0.068*** (0.005)	0.012 (0.028)	0.059*** (0.005)	0.132*** (0.042)	0.064*** (0.006)	0.121*** (0.007)
Population	-0.146** (0.069)	0.322** (0.125)	0.148** (0.060)	-1.231*** (0.294)	0.025 (0.070)	0.502*** (0.082)
Employment	0.323*** (0.082)	-0.346** (0.154)	0.041 (0.073)	-0.467** (0.233)	0.021 (0.085)	-0.263*** (0.100)
Household Consumption	9.883*** (1.432)	4.162* (2.125)	5.142*** (1.179)	18.814*** (2.812)	7.912*** (1.265)	4.248*** (1.491)
Gov Consumption	-2.603*** (0.330)	1.284 (1.240)	-2.536*** (0.324)	-3.549* (1.892)	-2.168*** (0.391)	-3.084*** (0.461)
_cons	22.693*** (1.432)	25.288*** (1.628)	22.745*** (1.180)	33.031*** (2.801)	24.349*** (1.128)	37.915*** (1.330)
N	330	415	450	295	745	745

Standard errors in parentheses

Dependent Variable is Gini (disposable) for Column 1 to 5.

\*p < 0.10, \*\*p < 0.05, \*\*\*p < 0.01

Table 2 has contrasting categories. *High and Low*, *Western and Eastern*, and *gini disp and gini market*. *High and Low* denote Higher and Lower-income European Union countries (to split countries, we use the GDPPC of European Union countries. Countries with GDPPC  $\geq$

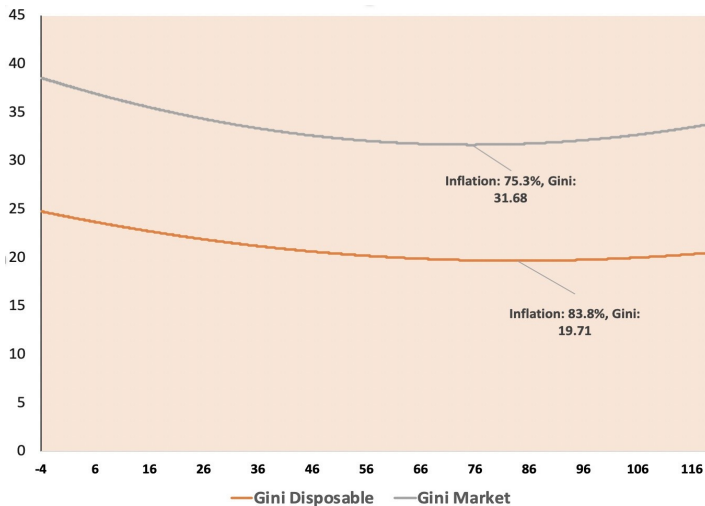
7) Household consumption contains goods and services that are consumed by households. Middle and low-income families spend a big majority of their income on essential goods and services (Hone et al., 2019).

\$20, 000 fall into the high-income category, and those with  $\$20, 000 \geq \text{GDPPC}$  fall into Low-income). In addition, *Gini disp.* and *Gini Market or mkt* denote Gini after-tax and transfers and before-tax and transfers, respectively.

We are using the Gini market and Gini disposable measurements in this article to analyze the effectiveness of income tax and transfers in the European Union. By comparing these two measurements, we can determine how well tax policies are addressing income inequality. If the Gini coefficient significantly decreases from market to disposable income, it indicates that tax policies are successfully reducing inequality by redistributing resources from higher to lower-income individuals.

Table 2 shows that there is a U-shaped relationship between inflation and inequality in all the categories mentioned. This means that inequality initially decreases as inflation rises but then starts to increase once inflation reaches a turning point. For example, for the Low-Income European Union countries, this turning point occurs at 92.04% inflation, and for Eastern European Union countries, it occurs at 61.49%. Furthermore, inequality before-tax-and-transfer and inequality after-tax-and-transfer surpass the peak point when inflation reaches 75.27% and 83.85%, respectively. See Figure 5. The comparison between Western and Eastern countries sheds light on interesting findings about the economic dynamic of the 2 indicators. While inflation has a significant impact on inequality in Eastern European Union countries, the effect is insignificant in Western European Union countries. This suggests that the economic policies used to reduce the effects of inflation are working effectively in Western European Union countries. This is an important observation, particularly for middle and low-income households, which are most affected by increases in inflation.

**Figure 5.** The relationship between inflation and inequality: Disposable and market Ginis, European countries



Similarly, we find that an increase in employment has no significant effect on the dynamics between inflation and inequality in Western European Union countries, while it has a significant effect in Eastern countries. This could also mean that social security systems are well-developed and protective of workers in Western European Union countries. As seen in Table 2, the increase in employment declines inequality sharply in Eastern European countries, potentially due to inadequate social benefits that could support the unemployed during the joblessness period, which during that period could widen the gap between the unemployed and others.

The outcomes of Household consumption are outstanding. Household consumption deteriorates inequality in the European Union, in both Eastern European Union countries and Western European Union countries. As seen earlier in Table 1, household consumption worsens inequality in the entire European Union. Moreover, the effect of Household Consumption is more devastating in Eastern European Union countries. On one hand, citizens of Eastern countries experience lower income (GDPPC is lower) than those of rich Western European Union countries. On the other hand, following our previous argument, they experience higher sales taxes. We believe that, consequently, policymakers of European Union countries, especially policymakers of Eastern European Union members, should re-adjust sales taxes (lower in this case) so as to improve inequality. Lowering sales taxes is plausible to alleviate the burden on middle and low-income households and to reduce income disparity.

Sales taxes are regressive taxes, which means that they impose a heavier burden on low and middle-income households. This is a well-known fact (Burman, 2012). As shown in Figure 4, sales taxes are high in the European Union, which has a direct impact on the relationship between inequality and consumption. When low and middle-income households spend their disposable income on goods, a significant portion of their income goes towards paying sales taxes, while high-income households are not affected as much. As a result, we see that inequality increases when people in the European Union consume more.

It is important to note that essential items, which comprise a significant portion of the spending for those with limited financial means, are subject to regressive levies. This means that low-income individuals should allocate a more substantial proportion of their income to taxes rather than savings or investments, which prevents their ability to accumulate wealth. This impact is particularly pronounced during economic growth, where rising consumption can paradoxically increase income inequality. Additionally, lower-income groups' limited discretionary spending power compared to their wealthier counterparts perpetuates disparities in opportunities for education, skill development, and entrepreneurship. Therefore, sales taxes hinder upward mobility and contribute to inequality, creating long-lasting obstacles to social and economic fairness.

**Table 3.** Estimation Results based on Gini Disposable and Market in Western, Eastern EU Countries

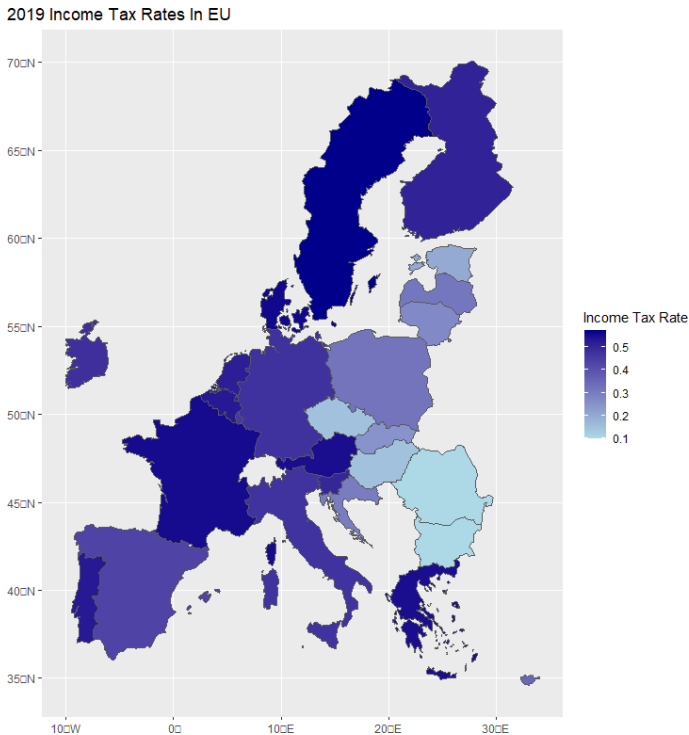
	Western EU		Eastern EU	
	gini_disp	gini_mkt	gini_disp	gini_mkt
Inf	-0.467 (3.991)	-39.349*** (5.342)	-6.887*** (1.929)	-10.866*** (2.165)
InfSq	0.452* (0.268)	1.991*** (0.359)	0.056** (0.024)	0.080*** (0.026)
GDPPC	0.059*** (0.005)	0.110*** (0.007)	0.132*** (0.042)	0.100** (0.047)
Population	0.148** (0.060)	0.450*** (0.080)	-1.231*** (0.294)	-0.897*** (0.330)
Employment	0.041 (0.073)	-0.140 (0.097)	-0.467** (0.233)	-0.698*** (0.262)
household Consumption	5.142*** (1.179)	0.767 (1.578)	18.814*** (2.812)	14.617*** (3.156)
Gov Consumption	-2.536*** (0.324)	-2.900*** (0.434)	-3.549* (1.892)	-2.189 (2.123)
_cons	22.745*** (1.180)	39.332*** (1.580)	33.031*** (2.801)	48.756*** (3.144)
N	450	450	295	295

Standard errors in parentheses

\*p &lt; 0.10, \*\*p &lt; 0.05, \*\*\*p &lt; 0.01

In Table 3, Gini after and before tax and transfer are scrutinized in Western and Eastern European Union members. The outcomes point out that while income tax policies are effective in reducing inequality in the Entire European Union,  $|Gini_{Disposable}| < |Gini_{Market}|$ , yet Western European Union countries use income taxes more effectively than Eastern European Union countries while experiencing higher prices. The expectation from tax policies is to reduce the impact of inflation, which works very well in Western EU countries, but in Eastern EU members, the impact of inflation declines slightly. This shows that even though the European Union countries overall share many widespread rules and laws in many economic fields, Eastern and Western EU countries differ notably.

The reason that income tax in Eastern EU countries is less effective than in Western EU countries is that Eastern European Union countries have relatively very low-income tax rates (see Figure 6 and high excise and indirect tax rates (see Figure 4). To summarize, this means that tax policies in Eastern European Union members favor the rich more. These findings are in line with the result of Myck and Trzciniński (2022), the paper that concludes that the income tax system in Western European Union countries tends to be more redistributive than in Eastern European Union countries.

**Figure 6.** The map of the 2019 income tax rates in the European Union

As also seen in Figure 6, the differences in income tax rates are visible in the European Union. Taxes on income and capital gains are of paramount importance for inequality reduction. (Martorano, 2018, p.259) results in a seminal paper that sales tax did not induce a decline in inequality in Latin American countries, but taxes on income and capital gains reduced inequality very steeply in Latin America.

Some people might argue that certain European Union countries, particularly those in Eastern Europe, have lower income tax rates and rely more heavily on sales tax because of tax evasion. However, this is not entirely accurate because low-income tax countries in the European Union actually have low rates of tax evasion, as shown by a study by (Vellutini et al., 2016). We also conducted our own analysis by calculating a Pearson correlation coefficient to see if there was a strong relationship between low-income tax rates and high tax evasion. The result of our analysis shows that the correlation between income tax and tax evasion was very weak, with a coefficient of only 0.24.

## B. Method robustness check

In this section, we provide a method robustness check to confirm our findings. A standard



assumption for efficiency in panel-data models is that the error terms are independent across sections/countries. We test for heteroscedasticity and cross-sectional dependence in our data. To test for heteroskedasticity, we perform a modified Wald test for group-wise heteroskedasticity in the residuals, and the null hypothesis of homoskedasticity is rejected. The result of the Breusch-Pagan LM test (appropriate for our large T) for cross-sectional independence concludes in the rejection of the null hypothesis (of no cross-sectional dependence). The errors exhibit both heteroskedasticity and contemporaneous correlation.

Although in our original FE model, we use robust standard errors, we test the robustness of our result to different estimation methods suggested and employed in the literature. In Table 4, we provide the result of the estimation of the main relationship of interest working with potential alternative approaches. Column 1, as presented earlier in the paper, is the estimation result from our traditional Fixed Effect model. Column 2 provides the result for the same model specification estimated by the Random Effect estimator. In Column 3, we investigate if there is any heterogeneity in the coefficients across the countries by exploring a Random Coefficient model (Equation 5 in Section 2.2) estimated by restricted maximum likelihood, which allows for the overall level of the response, as well as the marginal effect of the independent variable, conditional on covariates, to vary across countries. Column 4 provides the result of the feasible estimator with multi-way fixed effects (an expanded form of a regular Fixed Effect model) which allows correction for heteroskedasticity and cross-correlations (refer to Equation 6 in Section 2.2). The last column reports the panel-corrected standard error (PCSE) method estimates

**Table 4.** Estimation Result, Different Estimation Strategies

	(1) FE	(2) RE	(3) RC	(4) HDFE	(5) PCSE
Inf	-11.068*** (1.310)	-11.103*** (1.312)	-11.099*** (1.303)	-11.068*** (1.648)	-11.068*** (1.474)
Inf <sup>2</sup>	0.066*** (0.018)	0.067*** (0.018)	0.067*** (0.018)	0.066*** (0.022)	0.066** (0.026)
GDPPC	0.064*** (0.006)	0.066*** (0.006)	0.065*** (0.006)	0.064*** (0.005)	0.064*** (0.003)
Population	0.025 (0.070)	0.023 (0.048)	0.023 (0.048)	0.025 (0.068)	0.025 (0.049)
Employment	0.021 (0.085)	0.008 (0.082)	0.009 (0.081)	0.021 (0.086)	0.021 (0.083)
Household Consumption	7.912*** (1.265)	8.315*** (1.256)	8.281*** (1.248)	7.912*** (1.574)	7.912*** (0.885)
Gov Consumption	-2.168*** (0.391)	-2.356*** (0.385)	-2.341*** (0.383)	-2.168*** (0.324)	-2.168*** (0.333)
N	745	745	745	745	745

Dependent Variable is Inequality (Disposable Income). Robust Standard Errors in Parentheses.

\*p < 0.10, \*\*p < 0.05, \*\*\*p < 0.01

for linear cross-sectional time-series models which assumes by default, heteroscedastic and contemporaneously correlated errors across panels.

The analysis results, depicted in Table 4<sup>8</sup>), are consistent and reliable. All models show that inequality follows a U-shaped trajectory and is statistically significant. Additionally, the table reveals that household consumption has a negative impact on inequality, while government consumption has a positive impact on it. This is because government consumption usually leads to economic growth, which boosts employment and income. When more people are employed and earning more, inequality is likely to decrease.

Dolmas et al. (2000) document a correlation between inflation and inequality, which could point to reverse causality. They conclude by showing that democracies with more independent central banks tend to have better inflation outcomes for a given degree of inequality. We would like to mention this point as a limitation of our estimation strategies. We would also like to mention that with regard to the policy implications of the current study, we are focused on sales and income tax. Otherwise, the future of this work could be the examination/ inclusion of the financial deepening and other indicators in the dynamics of inflation and inequality (Shi et al., 2022).

## IV. Conclusion

In this article, we investigate the nexus between inflation and inequality with a quadratic function in the European Union between the years 1990 and 2019. The European Union is an economic and political union of 27 member states that are located primarily in Europe. The EU has the world's largest economy and is the second-largest trading bloc after the United States. Moreover, the European Union economy is important for several reasons. First, the EU is a major player in the global economy, and its economic performance can have significant impacts on the rest of the world (Didelon and Richard, 2008). Hence, investigating the inequality-inflation nexus provides very viral outcomes.

The relationship between inequality and inflation follows an (uninverted) U-shape. This means that inequality first declines as inflation increases, and then inequality rises as inflation continues increasing. We believe in the beginning, inequality decreases because, due to the low interest rate, income is transferred from lenders (capital owners) to borrowers. However, after a while, inequality increases again because central banks increase the interest rate to slow down the increment in inflation, which favors lenders (capitalists and the working rich). In both cases, inflation hit low-income households due to the fact that low-income households lose more of

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8) FE, RE, Random Coefficient, HD Fixed Effect, and Panel-Corrected Standard Error (PCSE) estimates for linear cross-sectional panel data.

their disposable income to purchase essential goods.

Another paramount uncovering is that an increase in household consumption causes an increase in inequality in the European Union. This is because European Union countries have high sales tax rates, and it worsens inequality. So during the inflationary period, when prices rise, it causes more increase in inequality. To prevent inequality from rising and to protect middle/low-income households, policymakers should lower the rate of sales taxes in European Union countries, especially during the inflationary periods.

Sales tax is not the only issue in the European Union. Income tax is used less efficiently in Eastern European Union countries. It can be seen in Table 3 that inflation does not affect inequality in Western European Union countries thanks to effective income tax policies. However, the changes in inflation after and before tax and transfers are very small in Eastern European Union countries. This is due to the very low income tax rates that Eastern European Union countries implemented to tax the rich. Therefore, it can be said accordingly that income tax and transfers are more redistributive in Western European Union countries than in Eastern European Union countries.

Taxation is a powerful economic instrument for inequality reduction (Piketty, 2014; Atkinson, 2016), and yet it can drive inequality up if used inefficiently (as seen in the results of Household Consumption). Policymakers in European Union countries should reduce sales tax rates and focus more on the efficiency of income tax policies in order to reduce the burden of inflation on low/middle-income households and to improve inequality in the European Union during the inflationary periods.

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## Appendix

The data sources employed for the analysis are summarized in Table A1.

**Table A1.** *Data Sources*

	Definition	Abbreviation Used	Source
Gini coefficient (After-Tax)	The measure is constructed... Gini Coefficient is between 0 and 100.	Gini.disp	SWIID 9.1 (The Standardized World Income Inequality Database).
Gini coefficient (Before-Tax)	The ...Gini Coefficient is between 0 and 100. After-Tax Gini is Disposable Income	Gini.mkt	SWIID 9.1 (The Standardized World Income Inequality Database).
Inflation	Consumer Price Index, Annual Percent Change	Inf and Infsq	The World Bank
Employment Rate	Number of persons engaged (in millions)	Emp	Penn World Table 10
GDP Per Capita	Gross Domestic Product Per Capita, Current USD	GDPPC	The World Bank
Population	Population (in millions)	Pop	Penn World Table 10
Household Consumption	Share of household consumption at current PPPs	H.C.	Penn World Table 10
Government Consumption	Price level of government consumption, price level of USA GDPo in 2017=1	G.C.	Penn World Table 10

(Source) World Bank: <https://data.worldbank.org/> Source for SWIID: <https://fsolt.org/swiid/>  
Penn World Table: <https://rug.nl/ggdc/productivity/pwt/?lang=en>

## Descriptive Statistics

Table A2 provides descriptive statistics.

**Table A2.** *Descriptive Statistics*

		Mean	Std. Dev.	Min	Max	N/n/T-bar
Gini_disp	overall	28.783	3.776	16.8	38.9	780
	between	.	3.283	23.66	33.423	26
	within	.	1.717	19.816	34.433	30
Gini_mkt	overall	46.623	3.89	30.9	56.4	780
	between	.	3.231	39.607	52.41	26
	within	.	2.255	36.989	51.346	30
Inf	overall	.174	.958	-.045	15	776
	between	.	.257	.0157	.973	26
	within	.	.925	-.811	14.201	29.846
GDPPC	overall	25.280	20.113	1.102	123.679	755
	between	.	17.142	4.535	79.329	26
	within	.	10.862	-20.583	69.630	29.038
Pop.	overall	16.704	21.247	.382	83.517	780
	between	.	21.630	.476	81.30	26
	within	.	.984	12.104	21.220	30
Emp.	overall	7.312	9.50	.188	44.795	780
	between	.	9.646	.296	40.089	26
	within	.	.817	3.449	12.018	30
H.C.	overall	.561	.077	.215	.819	780
	between	.	.065	.411	.703	26
	within	.	.0429	.365	.744	30
G.C.	overall	.770	.439	.033	1.842	780
	between	.	.419	.190	1.525	26
	within	.	.158	.319	1.267	30