Economic Policy Uncertainty and Income Inequality across Europe

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Abstract

This paper investigates the impact of Economic Policy Uncertainty (EPU) on income inequality across a broad set of European countries from 1995 to 2022, with a particular focus on the core-periphery divide. Applying both time series and panel data methodologies—including Vector Autoregressions (VAR), panel VAR, and local projections—we assess how economic uncertainty influences inequality dynamics. Our findings reveal three key insights. First, uncertainty shocks significantly affect income inequality in nearly all countries, and the effect is time-varying. Second, the effect is heterogenous across countries but varies: uncertainty tends to reduce inequality in core European countries such as Belgium, Germany, Ireland, and the Netherlands, while mainly increasing it in periphery and intermediate countries like France, Greece, Italy, and Spain. Third, panel analysis confirms this asymmetry, showing more persistent and positive inequality effects in periphery countries. These results suggest that income inequality in Europe's periphery is more vulnerable to economic uncertainty, underscoring the importance of stable policy environments and targeted fiscal responses.

Keywords: economic uncertainty, income inequality, VAR models, rolling impulse response functions, panel LP

JEL classification: C32, D3, D8, E32

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1 Introduction

Economic uncertainty and the study of its effects on key macroeconomic variables have attracted considerable research interest over the past decade. This literature has mushroomed, following both the seminal paper by Baker et al. (2016), which introduced a systematic measure of economic policy uncertainty, and recent global events, including the COVID-19 pandemic, the invasion of Ukraine, the energy crisis, and the subsequent inflationary period. While the macroeconomic effects of uncertainty have been extensively examined by the literature, its implications for income inequality, particularly within the European context, remain relatively understudied. Moreover, the theoretical literature on the uncertainty-inequality nexus remains inconclusive. Recent evidence by the International Monetary Fund (2024) indicates that stagnating growth of four or more years will lead to higher levels of income inequality by up to 20%. Given the limited research on the uncertainty-inequality relationship, the focus of this paper is to shed more light, using a plethora of empirical methodologies, on the impact of economic uncertainty on income inequality, focusing on the European region.

This paper examines the uncertainty - inequality nexus across a sample of European economies. We address three research questions: (a) whether uncertainty shocks have distinctive effects across what may be considered a homogeneous economic region, (b) whether these effects vary over time, and (c) whether the traditional core-periphery country distinction infers the extent of the uncertainty impact on inequality. To address these questions, we employ a plethora of empirical methodologies, using both time series and panel data. We start with a Vector Autoregression (VAR) model and the respective Generalised Impulse Response Functions (GIRFs) to investigate the impact of uncertainty on income inequality for each individual country. However, the impact of uncertainty on income inequality is likely to vary over time, given major events such as the Global Financial Crisis (GFC), the Eurozone sovereign debt crisis, the COVID-19 pandemic, the energy crisis, and the subsequent inflationary period. Thus, to assess this time dependence, we extend our analysis to rolling VAR models and rolling GIRFs. We then extend our empirical framework to a panel data setting, and apply VAR and panel local projections (LP) GIRFs. This enhances the statistical power and robustness of the results, and allows for the identification of common patterns across countries.

The issue of income inequality has been the subject of a growing volume of research given the alarming increase in inequality over the centuries, summarised by Alfani (2022). Given the rising levels of income inequality in the UK and the US, it is unsurprising that academic studies have examined both locations (Fischer et al., 2021; Theophilopoulou, 2022). When we examine European countries, we find that income inequality levels are lower than in the US, and inequality between European countries is at its lowest level since 1980 (see Blanchet et al., 2020 and Morgan and Neef, 2020 respectively). At the same time, however, inequality within individual European countries has increased (Filauro et al., 2025). While the literature tends to focus on specific determinants of inequality, with economic growth playing a primary role, recent work (Chikhale, 2023) has considered the effects of uncertainty on macroeconomic variables being particularly sensitive to levels of inequality. Chikhale

(2023) highlights that the negative effects of uncertainty on economic activity are stronger in times of rising inequality. We formally address both of these specific issues.

The contribution of this paper to the literature is multifold. To the best of our knowledge, this is the first study to examine the inequality implications of economic uncertainty across countries in Europe. In addition to examining the impact of uncertainty across the continent, we also draw on the core-periphery distinction when examining the impact of economic policy uncertainty shocks on income inequality. Unlike previous literature, we apply rolling GIRFs to investigate whether the impact of economic uncertainty on inequality is dynamic and changes over time, thus identifying the events during which the trends differ. We also provide further evidence and robustness by applying a plethora of econometric methodologies (both time series and panel). To the best of our knowledge, those methodologies are used for the first time to examine the nexus of economic uncertainty and income inequality.

As mentioned above, we examine the extent of the uncertainty-inequality nexus across a *relatively homogeneous* sample of European economies in the run-up and since the transition to the single currency. Even within the European context, the debate regarding core-periphery countries and the optimum currency area remains relevant. Bayoumi and Eichengreen (1993) examined the case of aggregate demand-aggregate supply shock synchronicity and highlighted a core and a periphery distinction in the years leading up to the single currency. This work has been further extended by Campos and Macchiarelli (2021) to take into account the dynamic nature of any categorisation. Of particular note to our study is the Campos and Macchiarelli (2021) findings that particular countries continue to remain part of the economic periphery in Europe. Drawing on the dynamic core-periphery categorisation, we examine the impact of economic policy uncertainty shocks on income inequality. We formally distinguish between those countries that are categorised as hard core, intermediate and extended periphery countries (Campos and Macchiarelli, 2021). Our expectation is that countries in the hard core will have the economic ability to weather any elevated levels of uncertainty, while those in the periphery will have considerably less so.

As highlighted by Gill and Raiser (2012) unprecedented wealth, technological sophistication, and the world's best quality of life have emerged in Europe post WWII. "The United States had the might and China the momentum, but Europeans had the highest standard of living" (Gill and Raiser, 2012). The risks to the sustainability of the *convergence machine* are reflected in the rising levels of within-country inequality as well as the implications of uncertainty shocks. Understanding these effects will be critical for individual countries in adopting the most appropriate fiscal policy stance, as well as for informing broader European-level assessments of the associated risks. These risks could relate not only to sustainable economic growth and the implications for fiscal rules, but also to broader concerns, such as the potential erosion of social cohesion across Europe (Filauro et al., 2025).

We find a number of important results. First, the effects of uncertainty shocks on income inequality are statistically significant in all countries, except for Denmark and Sweden. Second, the sign of the dynamic impact of domestic uncertainty shocks on income inequality varies across countries. There is quite consistent evidence that uncertainty shocks do have distinctive effects across different countries. We find that the effect is negative in Belgium, Germany, Ireland, the Netherlands, and the UK (mostly hard core countries), and positive in France, Greece, Italy, and Spain (mostly intermediate and periphery countries). Additionally, our rolling GIRFs analysis indicates strong evidence for the time-varying nature of the uncertainty effects on inequality, as expected given the frequency of exogenous disturbances during the sample period. The rolling results identify higher values of responses during crisis periods (GFC, Eurozone crisis, or Covid pandemic) for most of the countries examined. These findings underscore that a one-size-fits-all approach to addressing the uncertainty-inequality nexus is inappropriate. Instead, policy responses should be designed based on their own economic structures, the time-varying effects, and keeping in mind that there is still evidence of a core-periphery division in Europe.

For our panel setting, using both the panel VAR and the LP methodologies, we find that the extended periphery countries report a positive effect of the uncertainty shock on income inequality. While the impact effect between the core and the periphery is consistent, we do find tentative indications of greater levels of persistence for those countries in the periphery. This result infers that inequality in the periphery countries of Europe is more vulnerable to domestic uncertainty shocks. Our results certainly lend weight to the economic implications of countries being representative of the core versus the periphery. Notably, countries with positive inequality responses to uncertainty shocks tend to have higher government deficits. These findings imply that strengthening fiscal frameworks and enhancing automatic stabilisers in more vulnerable economies could be key to mitigating the adverse effects of uncertainty on income inequality.

The rest of the paper is structured as follows: Section 2 offers a review of the literature on uncertainty, inequality, and the uncertainty-inequality nexus. Section 3 outlines the empirical methodology. Section 4 presents the data and the results. Finally, Section 5 concludes and offers some policy implications arising from the heterogeneity of the uncertainty effects on inequality across countries.

2 Literature Review

The turn of the century has witnessed a considerable re-evaluation of the nature and extent of economic inequality, particularly in advanced economies. For example, Piketty (2014) has highlighted the rising levels of both wealth and income inequality for developed countries (especially the US). Qureshi (2023) has also highlighted the trend of rising income inequality in most advanced economies and major emerging economies over the past four decades, which account for approximately two thirds of the world's population. As highlighted by Piketty (2014) the rapid growth of countries such as China and India leading to reduced global inequalities will, to a certain extent, mask the within-country levels of inequality. A deterioration of equality has had considerable implications for society in terms of the efficiency of resource allocation, implications for consumption and investment, and overall output growth. For example Alesina and Perotti (1996) and Stiglitz (2015) have highlighted the association between income inequality and slower economic growth. Whether the focus is on developed or developing economies, achieving economic growth along with balanced distribution can prove elusive (Qureshi, 2023). Recently, Creel and El Herradi (2024) found some evidence of monetary policy effects on income inequality in the Euro Area, but primarily for countries with high levels of income inequality.

As highlighted by Bloom (2014) uncertainty can impact economic performance via three main channels. Real options effects of uncertainty on the partial irreversibly of investments have been well developed in the literature, including Bernanke (1983), Dixit (1989) and Bloom (2009). Increased levels of uncertainty raise the likelihood of a delay in investments. A second possible channel is related to financing constraints. With higher levels of uncertainty, there is also an elevation in asymmetric information, which reduces the investment opportunities of credit constrained firms (Benlemlih et al., 2023). Finally, precautionary saving effects on consumers will impact firms' opportunity for investments (Romer, 1990). Any purchase delays by households are likely to adversely affect aggregate demand. According to Alfani (2022) economic policy uncertainty might include uncertainty regarding policy decisions, timing and nature of policy actions (or inaction) and the subsequent economic effects of the policy.

Although traditionally there is a dearth of research examining the impact of uncertainty on income inequality, there has been considerable interest in recent years with the improved modelling of uncertainty and the appreciation of its macroeconomic effects. From the theoretical viewpoint, the effects of uncertainty on income inequality may take place via a direct or indirect channel and are in both cases, a priori, ambiguous. First, the direct effects of uncertainty on inequality indicate either a negative or a positive impact, with higher uncertainty raising financial market volatility and reducing asset returns, thus lowering income inequality (Fernández-Villaverde and Guerrón-Quintana, 2025). However, higher uncertainty also increases the risk premium and interest rates, reducing employment and wages, thus increasing inequality as low-income people are dependent on labour income (Carpenter and Rodgers III, 2004). Overall, the direct uncertainty effect on inequality is ambiguous.

The indirect effects of uncertainty on inequality are also unclear. These indirect effects occur via the effect of uncertainty on the business cycle. Recessions generally affect low-skilled workers, thus causing higher inequality (Blanchard, 1995). However, during recessionary periods, social protection programmes tend to improve and as a result lower inequality (Coibion et al., 2017). The empirical literature on the macroeconomic uncertainty-inequality nexus is particularly limited and has only recently emerged. Two empirical papers have investigated the impact of uncertainty shocks on income inequality, namely, Fischer et al. (2021), and Theophilopoulou (2022), while two papers have considered both income and wealth inequality, namely, Albert and Gómez-Fernández (2023) and Choi and Phi (2024). Fischer et al. (2021) employ a global VAR and Bayesian estimation method and examine the impact of uncertainty shocks on household income inequality using quarterly data (1985-2017) for a panel of US states. The authors proxy uncertainty using the EPU index. The main result is that the effects of uncertainty on inequality are not uniform but depend on the geographical region under consideration. Theophilopoulou (2022) also examines the case of uncertainty shocks, focusing on income, wage, and consumption inequality for the case of the UK. Three inequality measures are adopted, using the Family Expenditure Survey (FES) data. Macroeconomic and financial time series are used to construct the economic uncertainty measure using the model developed by Jurado et al. (2015). The author finds that uncertainty shocks decrease inequality measures over the course of a year and consistently across all three measures. Distributional evidence indicates that households and individuals on the right-hand side of the distribution are most severely affected by economic shocks.

Albert and Gómez-Fernández (2023) using a VAR framework examine the case of economic uncertainty on both income and wealth inequality for the largest Euro Area countries, namely, Germany, France, Italy, and Spain using quarterly data for the 2000-2019 period. The authors find that a positive uncertainty shock reduces income inequality in Germany and France but leads to higher levels of inequality in Spain. For the case of wealth inequality, the response in Spain and Italy is also a rise in inequality, whereas no statistically significant evidence is found for Germany and France. Finally, most recently, Chikhale (2023) using an Interacted-VAR model estimated with US data finds that the effects of uncertainty on macroeconomic variables depend on the distribution of wealth. Specifically, the negative uncertainty effects on consumption are larger in the presence of higher wealth inequality.

In summary, the existing very limited empirical literature on the relationship between uncertainty and economic inequality has concentrated on very few large (mostly European) countries and the results are rather mixed. There is considerable ground for expanding this literature by improving on the methodologies and the set of countries examined. In particular, the results of Albert and Gómez-Fernández (2023) indicate that the relationship between uncertainty and inequality may be related to the core-periphery divide.

3 Methodology

3.1 Time series VAR Analysis

The first task of the present paper is the estimation of GIRFs to test for the qualitative and quantitative effects of uncertainty shocks (proxied by the EPU index) on income inequality measured by the Gini coefficient. The GIRFs are at first estimated for a sample of 11 countries to domestic EPU shocks, and later for 16 countries to Europe-wide uncertainty shocks. Second, we estimate rolling GIRFs to establish the sensitivity of the uncertainty effects on inequality arising from various events during the sample period such as the Eurozone crisis, and the Covid-19 pandemic.

First, we will estimate a $VAR(p)$ model which in its standard form is given by equation 1 below:

$$y_t = \sum_{i=1}^{p} \Phi_i y_{t-i} + \varepsilon_t, \tag{1}$$

where $\varepsilon_t \sim (0, \Sigma)$ is a vector of *iid* disturbances and y_t is a 5-variable vector including inequality, the EPU index, output growth, inflation, and the short-term interest rate.

The respective moving average (MA) representation is:

$$y_t = \sum_{i=0}^{\infty} A_i \varepsilon_{t-i}, \tag{2}$$

where A_i is a $n \times n$ coefficient matrix and $A_i = \Phi_1 A_{i-1} + ... + \Phi_p A_{i-p}$, A_0 is a $n \times n$ identity matrix and $A_i = 0$ for $i < 0$.

We estimate country VAR models for a large sample of European countries. In the following step, we construct GIRF, which are insensitive to the variable ordering. This approach has been proposed by Koop, Pesaran, Potter and Shin (KPPS framework) (Koop et al., 1996; Pesaran and Shin, 1998). This framework allows for the shocks to be correlated, but appropriately, using the historically observed distribution of the errors, the result becomes invariant to the ordering. The advantage of this methodology is that it avoids the criticism of the Choleski decomposition where the model's variables are ordered from the most exogenous to the least endogenous.

Second, we estimate rolling GIRFs to establish the sensitivity of the uncertainty effects on inequality arising from various events during the sample period, such as the GFC, the Eurozone sovereign crisis, the pandemic, the energy crisis, and the current inflationary episode.

3.2 Panel VAR Analysis

After the completion of the VAR analysis for individual countries, we extend the analysis using a panel VAR model. Panel VAR models were first introduced by Holtz-Eakin et al. (1988), and later extended by Binder et al. (2005) and Sigmund and Ferstl (2021). These models have been applied to a host of macroeconomic issues and in some cases can be generated from standard intertemporal optimisation problems under constraints (Canova and Ciccarelli, 2013). The panel VAR, following fixed effects, is described by equation 3:

$$y_{i,t} = \mu_i + Bx_{i,t} + \Sigma_{j=1}^{p} A_j y_{i,t-j} + Cs_{i,t} + \epsilon_{i,t}, \tag{3}$$

where $y_{i,t}$ is the endogenous variables vector for item i at time t, $x_{i,t}$ is the predetermined variables vector, and $s_{i,t}$ is the strictly exogenous variable vector.

Following the above model, we estimate a 16-country panel VAR and estimate the respective GIRFs of the Gini coefficient to a one standard deviation shock on European uncertainty.[1]

3.3 Panel LP Analysis

In recent years, the estimation methodology of LP surveyed by Jordà and Taylor (2025) has been at the forefront of applied macroeconomics research using time series data, following the seminar article by Jordà (2005). The LP approach avoids the criticism of the VAR specification, which assumes a specific form of the data-generating process and is easy to

[1] The R package *panelvar* by Sigmund and Ferstl has been used for the estimation of the Panel VAR GIRF.

implement. This methodology has been extended to a panel setting. Therefore, as a final methodological tool, we adopt a panel LP model to estimate the dynamic effects of an uncertainty shock on income inequality (Jordà et al., 2015; Adämmer, 2019). Thus, for each horizon h we estimate equation 4:

$$y_{i,t+h} = w_i^h + v_t^h + \beta^h x_{i,t} + u_{i,t}, \tag{4}$$

where w_i^h and v_t^h are country and time fixed (or random) effects, and GIRFs are obtained by the estimated coefficients (β^h) which will be reported together with estimated standard errors. The variables y and x represent income inequality and uncertainty, respectively.[2]

4 Data and Empirical Results

4.1 Data

We examine quarterly data on eleven core and periphery European countries from 1995 to 2022[3] and later we extend the analysis using 16 European countries.[4] Our list of variables includes economic uncertainty (measured by the EPU index), income inequality (measured by the Gini coefficient), real GDP growth, GDP deflator growth, and the short-term (3-month) interest rate.[5] The choice of these variables is more or less standard in the relevant literature examining the effects of uncertainty on major macroeconomic (inflation and output growth) and financial (short-term interest rate) variables (Baker et al., 2016; Zalla, 2017). Furthermore, existing empirical evidence indicates that inequality is affected by macroeconomic variables such as output growth, inflation and monetary policy (captured by the interest rate) (Theophilopoulou, 2022; Chikhale, 2023). All series are included in a quarterly frequency. GDP growth and the GDP deflator are in log differences. The macroeconomic data have been retrieved from the Federal Reserve Bank of St. Louis database (FRED). The Gini coefficient for income inequality has been sourced from Eurostat and the UK Office for National Statistics, while the EPU index draws on the studies cited on the EPU website.[6] Due to the lack of income inequality data at the quarterly frequency, we construct the quarterly series from the annual series using linear interpolation. Our initial country list includes the following 11 countries: Belgium, Denmark, France, Germany, Greece, Ireland, Italy, the Netherlands, Spain, Sweden, and the UK. For the extended analysis we have 16 countries; the initial 11

[2]The R package *lpirfs* by Adämmer has been used for the estimation of the Panel LP GIRF.

[3]The number of countries is dictated by the limited data availability for the domestic EPU index.

[4]For the 16-country sample, we adopt a Europe-wide EPU index, due to lack of data for some of the countries.

[5]One exception is Ireland, where we adopt Gross National Income (GNI), or more formally GNI*, which subtracts from GNI the factor income of re-domiciled companies, depreciation on aircraft leasing and imported intellectual property. See Honohan (2021).

[6]See `http://policyuncertainty.com`. Data have been constructed by Baker et al. (2016), and for Belgium by Algaba et al. (2020), Denmark by Bergman and Worm (2021), Greece by Fountas et al. (2018), Ireland by Zalla (2017), the Netherlands by Kroese et al. (2015), Spain by Ghirelli et al. (2019), and Sweden by Armelius et al. (2017).

ones plus Austria, Finland, Norway, Portugal, and Switzerland. We formally consider the categorisation developed by Campos and Macchiarelli (2021), namely hard core, intermediate and extended periphery. Our primary sample of countries includes countries within each of these categories; hard core (Austria, Belgium, Germany, and the Netherlands), intermediate (Denmark, France, Italy, Spain, and the UK) and extended periphery (Finland, Greece, Ireland, Norway, Portugal, Sweden, and Switzerland). We also extend our analysis to include additional extended periphery countries (Finland, Norway, Portugal, and Switzerland) and hard core countries (Austria). For the extended country analysis, we adopt a Europe-wide EPU uncertainty measure, as individual country alternatives are not currently available.

4.2 Results: Individual Country Setting

Figures 1-3 present the GIRFs (GIRF) for the effects of domestic uncertainty shocks on each of the model's variables for the eleven countries, with each country categorised according to levels of integration (Campos and Macchiarelli, 2021) (Figures 1, 2, and 3 correspond to the extended periphery, the intermediate, and the hard core group). The macroeconomic effects for each country are generally consistent, with, for example, the impact on GDP growth being negative and dying away relatively quickly and within two years for all country cases. In response to an uncertainty shock, short-term interest rates usually respond negatively, with Denmark being a notable exception in the short run. In some countries (like Greece and Sweden) the effects are not uniform across time as output growth first falls and then rises. Finally, the uncertainty effects on inflation are rather mixed. In most countries, inflation responds positively but in Belgium, Greece, and Spain, inflation drops, even though the effect is not always statistically significant. Where we do see considerable variation is the impact on the Gini coefficient, which is the main focus of the present research. The variation in terms of sign and persistence is particularly evident across our core-periphery categorisation.

We now examine the impact of uncertainty on income inequality in considerably more detail, with an emphasis on those countries that report a statistically significant effect (see Figures 4 and 5). In Figure 4 we present the responses for those countries that report a statistically significant and positive impact on income inequality (France, Greece, Italy and Spain), while those countries with a negative impact are reported in Figure 5 (Belgium, Germany, Ireland, Netherlands, and UK). For Figure 4, with the exception of Greece, all countries have a relatively consistent impact, with the impact being quite persistent. Similar effects in terms of impact are also observed in Figure 5, with Belgium and the Netherlands indicating very similar dynamics, while for Germany, Ireland, and the UK, there is evidence of considerable persistence. Our individual country results are consistent with previous literature, e.g. Theophilopoulou (2022) has also found considerable persistence when examining the impact of uncertainty shocks on income inequality in the UK. However, our particular focus is on the trends across the different country categories in Europe. Those countries reporting a negative impact, namely Belgium, Germany and the Netherlands, are categorised by Campos and Macchiarelli (2021) as hard core countries. The exceptions are the UK, which is categorised as being in the intermediate group, and Ireland, which is in the group of extended periphery. This negative impact should be compared with those countries categorised as either intermediate or the extended periphery. For these countries, in particular France, Greece, Italy and Spain, we observe not only positive effects on income inequality but particular evidence of persistence in all country cases.

We extend the number of countries to sixteen, by adding Austria, Finalnd, Norway, Portugal, and Switzerland. For those five countries no domestic EPU data are available, thus we now use a Europe-wide EPU alternative.[7] Results for the GIRFs for the effects of uncertainty shocks on each of the model's variables for the complete sixteen countries, are reported in Appendix A. Figures 6 and 7 provide the GIRFs of the Gini coefficient to Europe-wide uncertainty shocks for the sixteen countries. In Figure 6 we present the responses for those countries that report a statistically significant and positive impact on income inequality (Austria, France, Greece, Italy, Norway, and Portugal). For the case of Spain, the impact is no longer significant, while the inclusion of Austria is somewhat surprising since it is included in the hard core countries. We continue to report consistent evidence for France, Greece and Italy, with the dynamics comparable to the case of domestic shocks. Norway and Portugal are now included, which is unsurprising given their categorisation as extended periphery in European countries. It is noteworthy that all of the countries reporting a positive effect are either the intermediate group or extended periphery (with the exception of Austria). Figure 7 reports those countries for which we find a negative impact of a Europe-wide EPU shock on the Gini coefficient. Again our results are extremely consistent, relative to the case of domestic uncertainty shocks. Belgium, Germany, Ireland, the Netherlands, and the UK remain with similar dynamics reported. In addition, Finland and Denmark are also reporting a negative effect.

Table 1 presents the country list and mean value of fiscal deficit/surplus in the first and second columns, along with the country list and labour share in the third and fourth columns[8]. Comparing the first and second columns of the table with the GIRFs from Figures 4 to 7, we observe that the countries with the highest government deficits (like Greece, Portugal, Spain, France, and Italy) are those with positive inequality responses to uncertainty shocks. This result is in line with the conclusion of Kebalo and Zouri (2024) who find that uncertainty has a positive impact on inequality for countries with high fiscal deficits. On the other hand, we can see from Table 1 that for countries with government surpluses (Denmark and Finland) and those with lower deficits (like Germany and the Netherlands), inequality responds negatively to increases in the EPU index. The fiscal conditions can also provide some justification for some of our seemingly counter intuitive results. As highlighted above, Finland and Denmark report a negative inequality response to the EPU shock. Although Finland and Denmark are categorised as extended periphery and intermediate group respectively, these are countries with fiscal surpluses. Finally, Ireland, even though categorised as an extended periphery country, has one of the lowest listed fiscal deficits.

As mentioned in the theoretical literature review in Section 2, the indirect effects of uncertainty on inequality work via changes in the labour share and are a priori ambiguous.

[7] The Europe-wide EPU has been constructed as the mean value of the EPU indices of the European countries for which there are domestic EPU data available.

[8] The data for the table have been retrieved from Eurostat, the IFS, and the ILO.

This is the case since, on the one hand, uncertainty reduces wages and the labour share (thus increasing inequality) and, on the other hand, it reduces inequality, as social protection schemes are upgraded. On the basis of this analysis, we may discuss our uncertainty effects in the context of the labour share figures reported in Table 1. Countries with large labour share (notably, Belgium, Germany, and the Netherlands) appear to be countries where uncertainty affects inequality negatively, indicating perhaps the role of government intervention to promote social protection. In contrast, some countries where the labour share is low (Greece) show positive effects on inequality indicating perhaps the lack of social protection schemes. In Ireland, the finding of a negative effect on inequality conforms with the very small size of the labour share.

The GIRFs so far are estimated for the full sample.[9] However, we now extend our analysis to investigate how the effect of uncertainty on inequality changes over time. To do so, we employ a rolling VAR estimation using a 40-quarter window, to determine the rolling GIRF.[10] The results are provided in Figures 8 to 11. All figures show the responses of the Gini coefficient to domestic EPU shocks, apart from Austria, Finland, Norway, Portugal, and Switzerland, which show the GIRFs to Europe-wide EPU innovations, due to the lack of domestic EPU data for those five countries.[11] In the figures, the vertical (y) axis shows the value of the responses, the horizontal-front (x) axis the time, and the horizontal-depth (z) axis the quarters after the shock.

The results highlight the sensitivity of the responses to the examined time period and, in some cases, contrast with those obtained from the earlier GIRF. The rolling GIRFs do not show a clear common path for the responses of inequality to uncertainty shocks among the European countries, but it is interesting to note how they respond differently in every country over the years since 2004. Even countries that show strong negative responses in the full sample estimation, may face periods with positive GIRFs during specific periods (like Germany) and vice versa. Most of the countries present extreme values of GIRF, during the outbreak of the Covid-19 pandemic (see Austria, Belgium, Denmark), although in some cases the impact is not statistically significant (see France and Germany). There are also noteworthy findings for the GFC and the Eurozone crisis. A number of hard core or intermediate group countries indicate higher responses (in absolute value) to the uncertainty shocks (e.g. Austria, France, and Germany). Additionally, the periphery countries, most of which were severely affected by the Eurozone crisis, report high impact values during the crisis, in particular Greece, Ireland, Portugal and Spain.

[9] Apart from the full sample estimation for the period 1995-2022, we have estimated the VAR and respective GIRFs also for a shorter sample, excluding the period after the onset of the Covid-19 pandemic. The GIRFs for the sample 1995-2019 provide similar results, which corroborate the robustness of our findings for the full sample estimation.

[10] A 60-quarter window has also been adopted, providing qualitatively and quantitatively similar results.

[11] The rolling GIRFs for the Netherlands are not presented due to the short availability of domestic EPU data.

4.3 Results: Panel Setting

We now move from the individual country analysis to a panel data setting. In Figure 12a we report the panel VAR GIRFs of the EPU shock on income equality across the overall 16-country panel. As is to be expected, the overall panel results are somewhat ambiguous, since the effect is not statistically significant. In Figures 12b, 12c, and 12d, we report the hard core, intermediate, and extended periphery panels, respectively. For the hard core panel, the impact of the EPU shock on income inequality is negative and statistically significant. This is consistent with the individual country results presented in Section 4.2. Consistent findings are also presented for the case of the extended periphery, with a positive and statistically significant effect. The results for the intermediate case are initially positive, but are only statistically significant for the first two years.

Following directly from our individual-country results, we also examine specific positive and negative effect panels. Those countries reporting a positive and statistically significant effect in the time series analysis are Austria, France, Greece, Italy, Norway and Portugal, while those reporting a negative and statistically significant effect include Belgium, Denmark, Finland, Germany, Ireland, Netherlands, and the UK. Results for the positive (Figure 13a) and the negative (Figure 13b) effect panels are consistent with those of the individual country setting, with the panel for those countries reporting a positive (negative) effect remaining positive (negative). The majority of country cases in the positive panel are representative of the periphery group, while hard core countries dominate the negative panel.

As a further sensitivity check, we will also examine the panel LP model. As indicated in Section 3, the panel LP GIRFs offer a flexible alternative to the traditional panel VAR. The results for the overall 16 country setting, the hard core, intermediate and extended periphery are presented in Figures 14a, 14b, 14c, and 14d respectively. Again, we find consistent evidence of a positive effect (and statistically significant for approximately two years) for those countries on the periphery, with the impact of uncertainty on inequality for the core countries being not statistically significant.[12] We also report the LP model results for those countries where we find a positive (Figure 15a) and a negative (Figure 15b) effect in the individual country setting. Again our results, presented in Figure 15, are perfectly consistent with those presented using the panel VAR approach. The panel results using the LP model for those countries reporting a positive (negative) effect remain positive (negative).

Our results, both at an individual-country level and at a panel level, very much point to the asymmetric effects of economic uncertainty on income inequality across Europe. Those countries in the core are able to counteract any negative effects on income inequality. While those on the periphery are consistently adversely affected by the uncertainty shock, that is, income inequality increases. Notably, this is the case whether we adopt the original setting (11 countries) or the extended country setting (16 countries). It is also important to note that the magnitudes of the effects is consistent. The uncertainty shock is as detrimental to inequality in the periphery as it is beneficial in the core countries. There also appears to

[12] For the 11-country panel LP model, we find a statistically significant negative effect for the core counties. Results are available upon request.

be evidence of persistence for the periphery (relative to the core) countries. With a total of 7 countries within our periphery category, our findings should be of particular concern to policy makers across the EU. These findings highlight that there is not a common policy that fits all countries, thus calling for targeted policies which reflect national economic structures and address the core-periphery division.

5 Conclusions

A growing literature has highlighted the trend of rising income inequality in advanced economies over the past four decades, while research on economic uncertainty mainly focuses on its impact on macroeconomic variables, usually leaving out any distributional effects. To shed more light on this gap, we examine the effects of uncertainty shocks on income inequality in Europe. We start with an initial 11 European countries sample extending later to a 16 European countries analysis with time series data over the 1995 to 2022 period. Our study is motivated by rising levels of inequality at a period when uncertainty as measured by the EPU index is quite volatile reflecting business cycle movements and various exogenous disturbances, including the GFC, the pandemic, the energy crisis and the subsequent period of inflation. We draw on the core and periphery distinction when examining the impact of economic policy uncertainty shocks on income inequality. We formally distinguish between those countries that are categorised as hard core, intermediate and an extended periphery group, following the classification by Campos and Macchiarelli (2021). Our expectation is that countries in the hard core will have the economic ability to weather any elevated levels of uncertainty, while those on the periphery of Europe, considerably less so. We also extend to a panel dataset, employing LP GIRFs, underscoring that our results remain robust when applying alternative econometric methodologies.

We obtain the following results. First, the effects of uncertainty on inequality are statistically significant in all countries, except for Denmark and Sweden. Second, the sign of the dynamic impact of uncertainty shocks on income inequality varies across countries, in line with previous relevant literature, with the effect being negative in Belgium, Germany, Ireland, the Netherlands, and the UK (mostly core countries), and positive in France, Greece, and Italy (mostly periphery countries). Rather than focusing purely on the individual country cases, we also examine suitable panels, namely following the classification by Campos and Macchiarelli (2021) and a sign-based panel drawing on the individual country results. Consistent with the individual country setting and across both panel VAR and panel LP models, is the asymmetric effects of the uncertainty shock on income inequality. In particular, there is consistent evidence of a positive effect of the uncertainty shock on income inequality for the extended periphery. While the magnitude of the effect is similar for core and periphery countries, we find tentative evidence suggesting that the impact for the periphery countries is more persistent. Our results consistently point to evidence that income inequality in the periphery countries of Europe is more vulnerable to economic uncertainty shocks than the hard core ones.

The findings of this paper have important policy implications. Given that uncertainty has asymmetric effects on inequality across Europe, a one-size-fits-all approach is inadequate. Instead, policies should account for national economic structures, time-varying impacts, and the core-periphery division in Europe. One may as well support that policymakers should apply more stable economic policies to reduce the distributional impact of economic policy uncertainty, especially in the periphery countries. Otherwise, income disparities will persist inside national borders. This is particularly the case for Eurozone member countries where the constraint of a common monetary policy implies that inequality cannot be dealt with using the tools of monetary policy. Moreover, evidence provided in this research connects the negative implications of uncertainty on income distribution, mainly for the countries with high government deficits. This calls for a need for redistributive fiscal policies.

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Table 1: **Economic Fundamentals**

Mean Values			
Country	**Fiscal (Deficit/Surplus)**	**Country**	**Labour Share**
Greece	-6.55	Ireland	44.52
Portugal	-4.55	Norway	48.23
Spain	-4.21	Sweden	55.05
France	-4.05	Greece	56.02
Italy	-3.85	Finland	56.35
Austria	-2.73	UK	57.81
Ireland	-2.71	Italy	58.21
Belgium	-2.45	Portugal	59.09
Norway	-2.31	Denmark	59.19
Germany	-1.85	Austria	59.71
Netherlands	-1.69	Spain	60.63
Sweden	-0.09	Germany	61.40
Finland	0.02	France	61.41
Switzerland	0.32	Netherlands	62.94
Denmark	0.66	Belgium	64.04
United Kingdom	8.01	Switzerland	68.15

This table shows the mean value for government deficit/surplus as a percentage of GDP from Eurostat (annual data, 1995-2022) and mean values (ascending order) for labour income share as a percentage of GDP from the International Labour Organisation (annual data, 2004-2022).

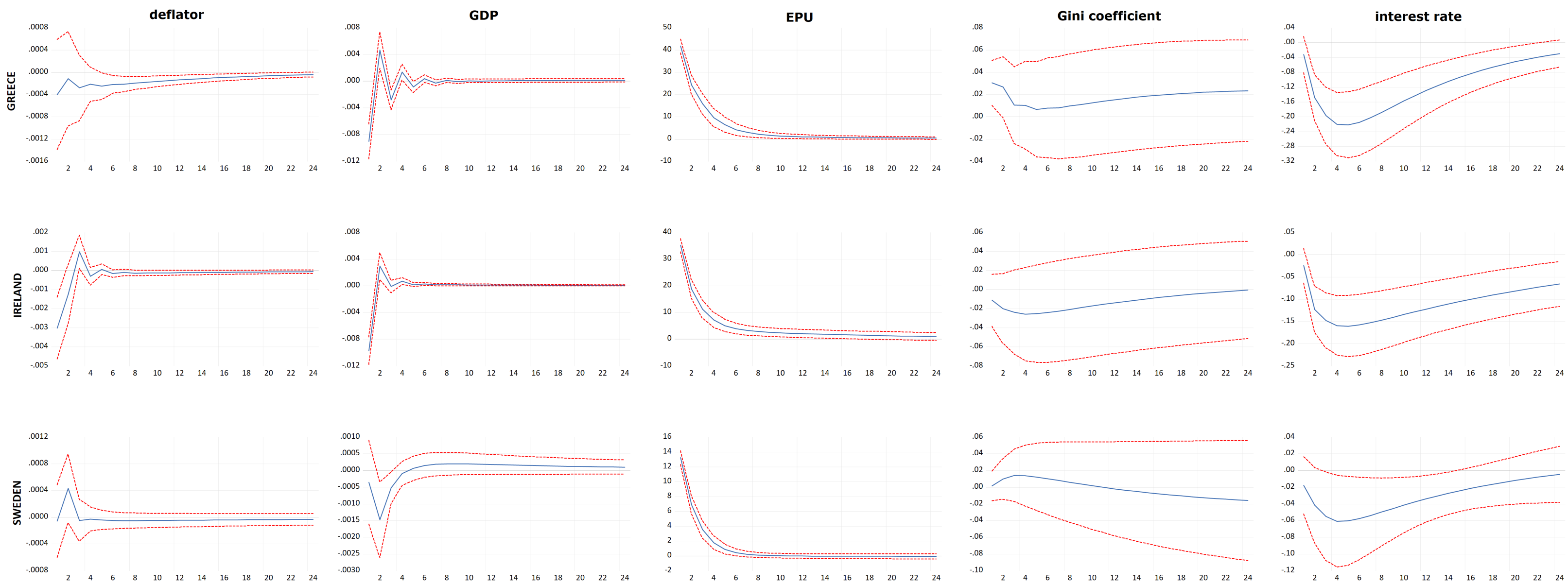


Figure 1: GIRFs to 1 standard deviation (SD) domestic EPU shocks - extended periphery countries (68% CI bounds)

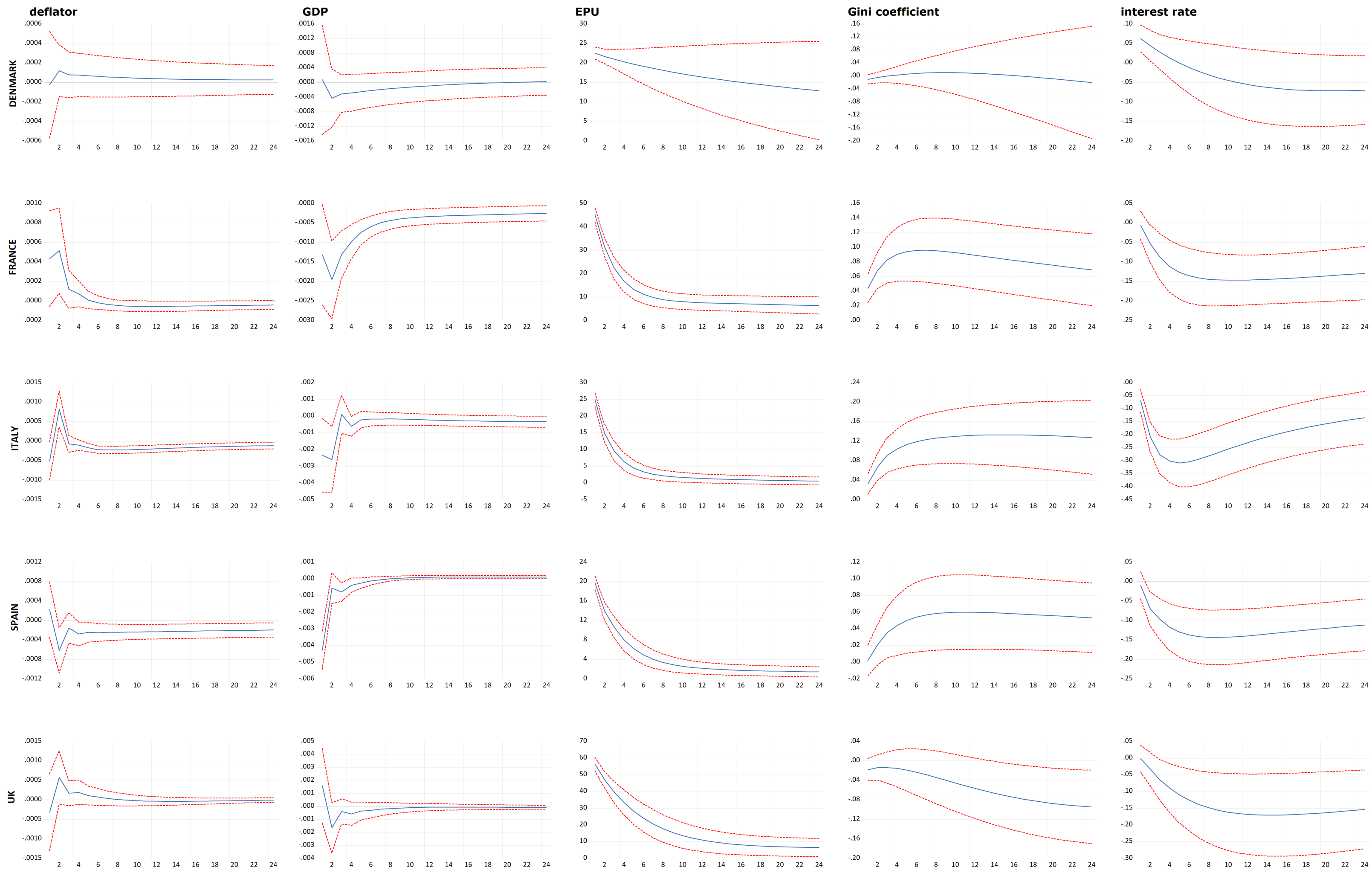


Figure 2: GIRFs to 1 SD domestic EPU shocks - intermediate countries (68% CI bounds)

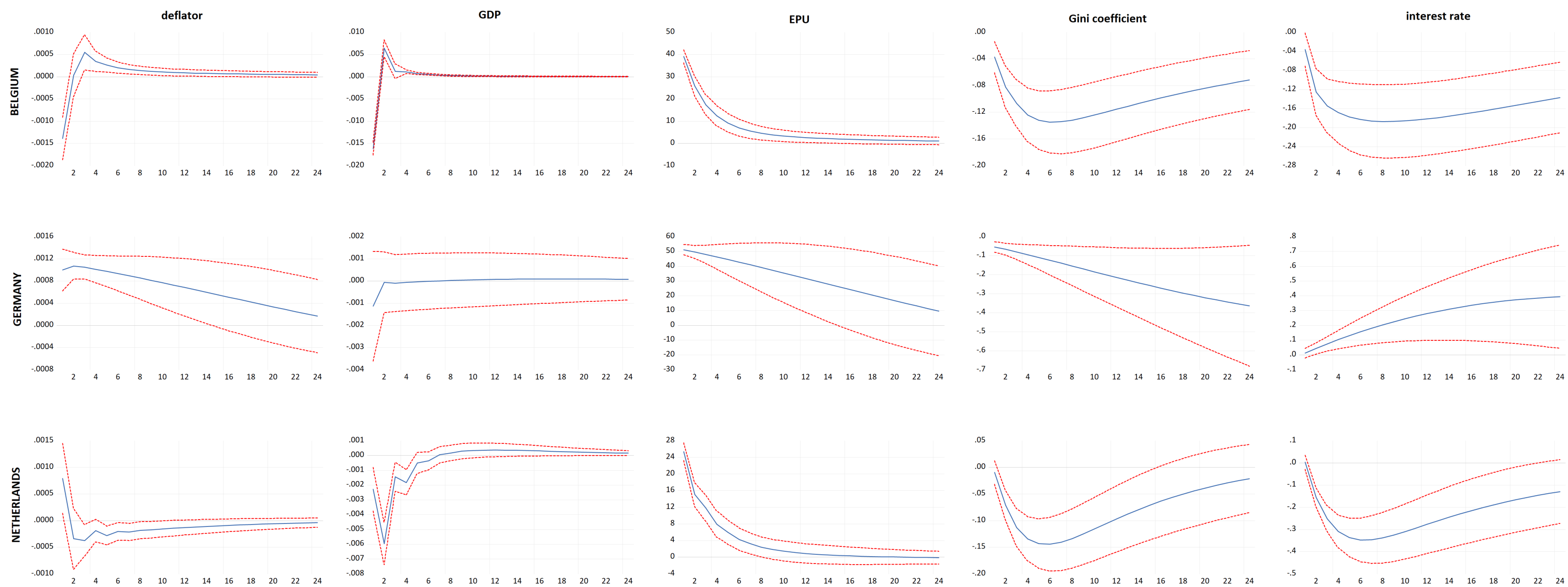


Figure 3: GIRFs to 1 SD domestic EPU shocks - hard core countries (68% CI bounds)

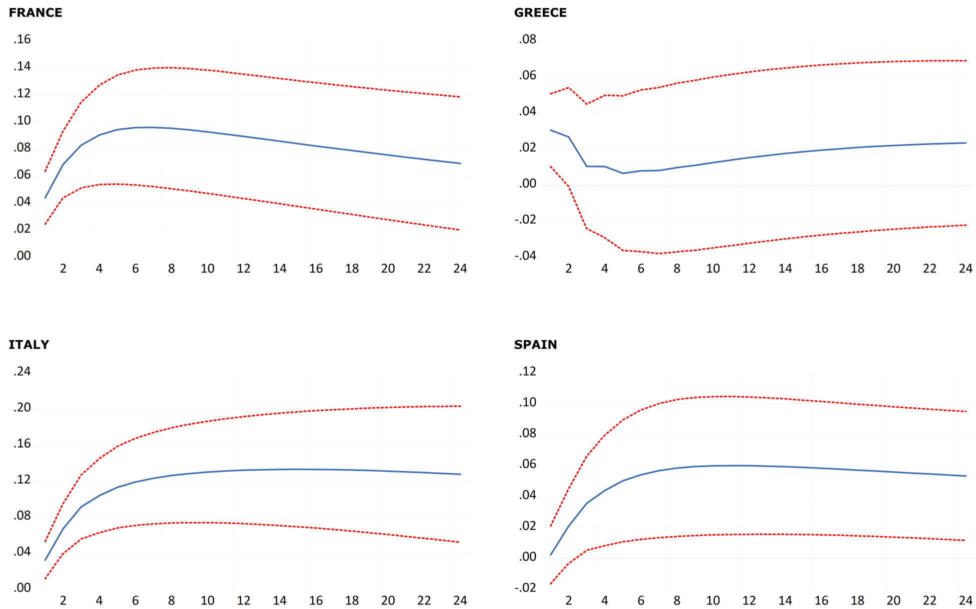


Figure 4: GIRFs of the Gini coefficient (positive) to 1 SD domestic EPU shocks (68% CI bounds)

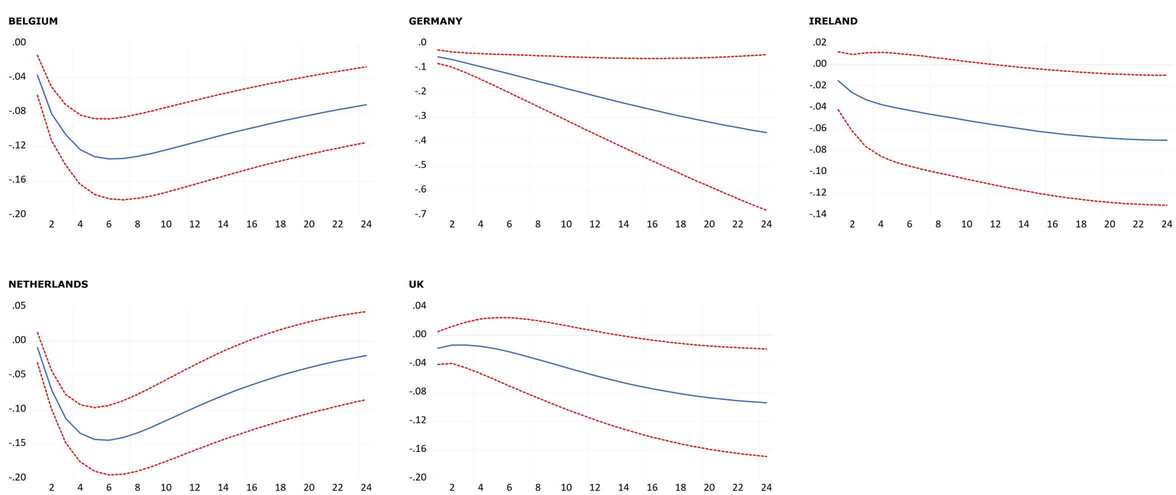


Figure 5: GIRFs of the Gini coefficient (negative) to 1 SD domestic EPU shocks (68% CI bounds)

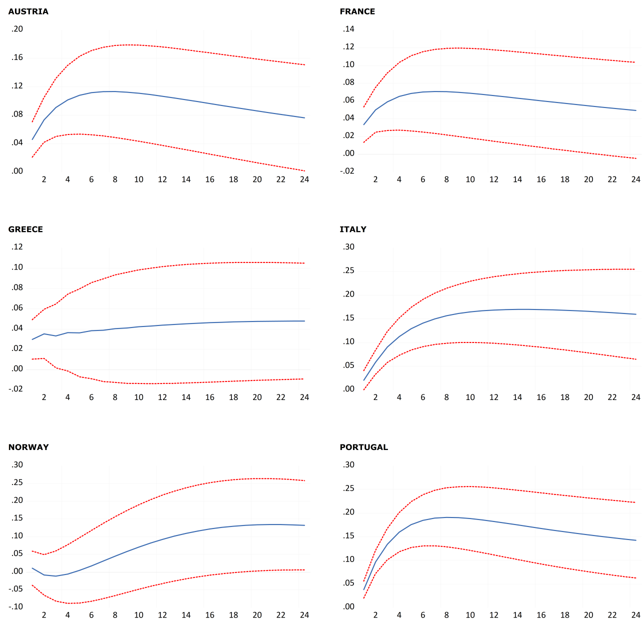


Figure 6: GIRFs of the Gini coefficient (positive) to 1 SD European EPU shocks (68% CI bounds)

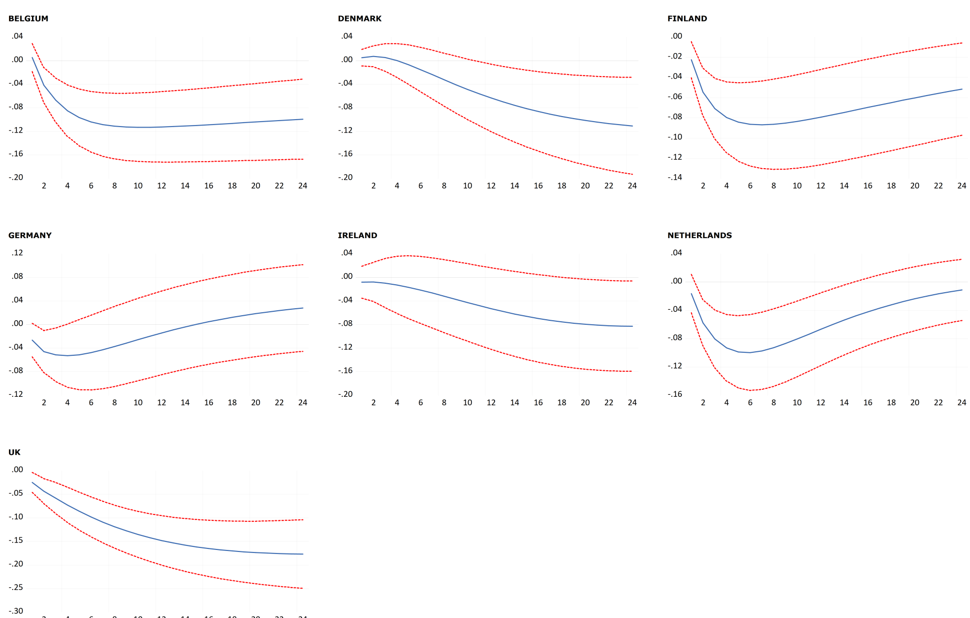
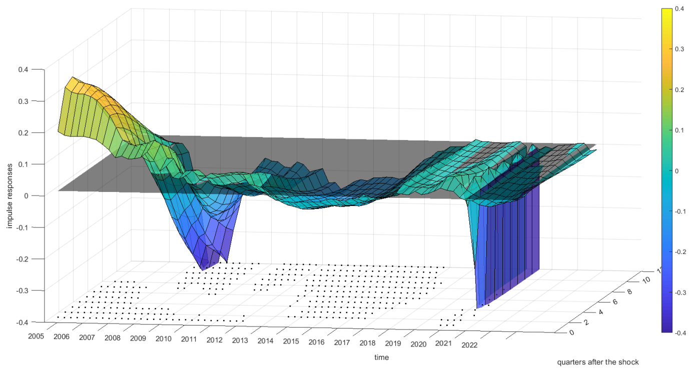
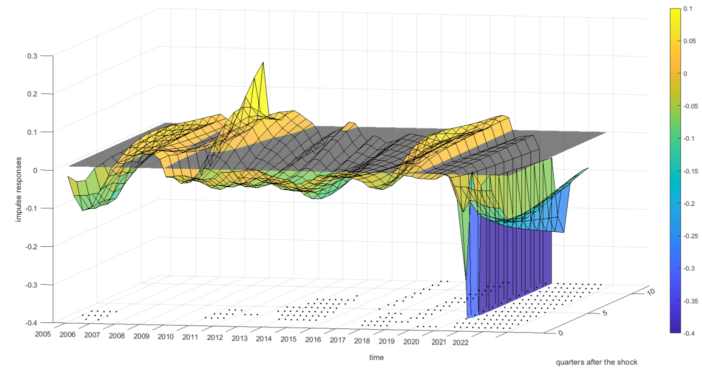


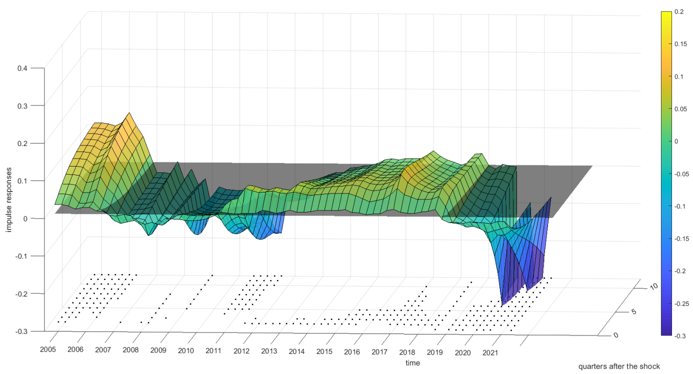
Figure 7: GIRFs of the Gini coefficient (negative) to 1 SD European EPU shocks (68% CI bounds)



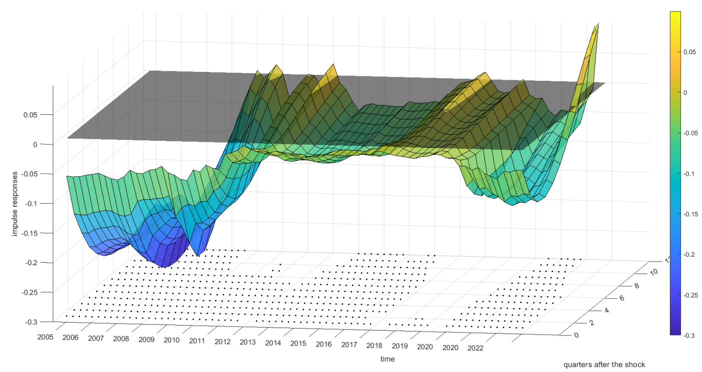
(a) Austria



(b) Belgium



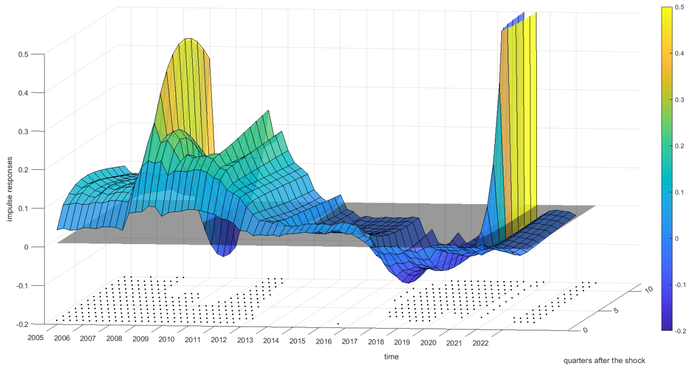
(c) Denmark



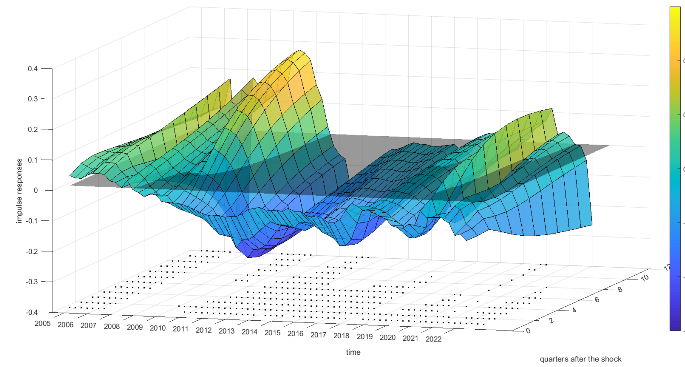
(d) Finland

Figure 8: Rolling GIRFs of the Gini coefficient to 1 SD EPU shocks (68% CI)

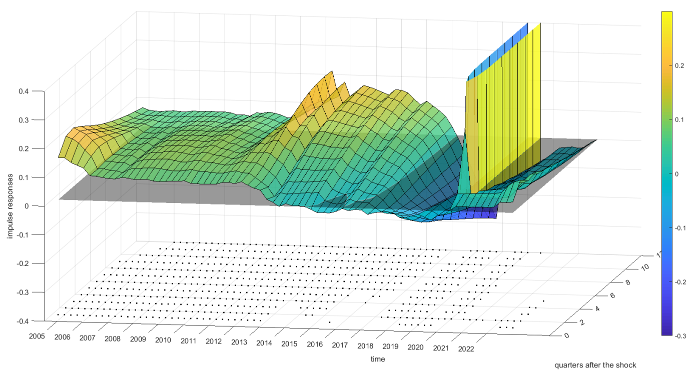
Note: For Austria and Finland, the Europe-wide EPU index has been used. For Denmark, the rolling estimation stops in 2019, due to a lack of data. The dots on the bottom surface represent the projections of the statistically significant responses.



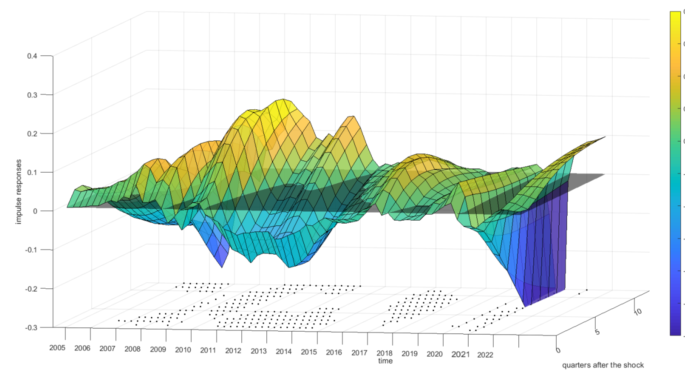
(a) France



(b) Germany



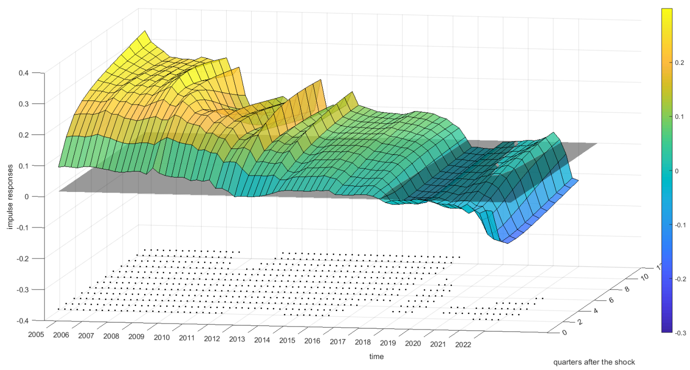
(c) Greece



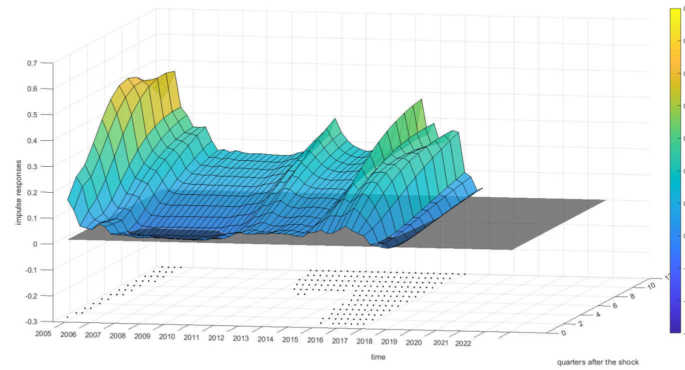
(d) Ireland

Figure 9: Rolling GIRFs of the Gini coefficient to 1 SD EPU shocks (68% CI)

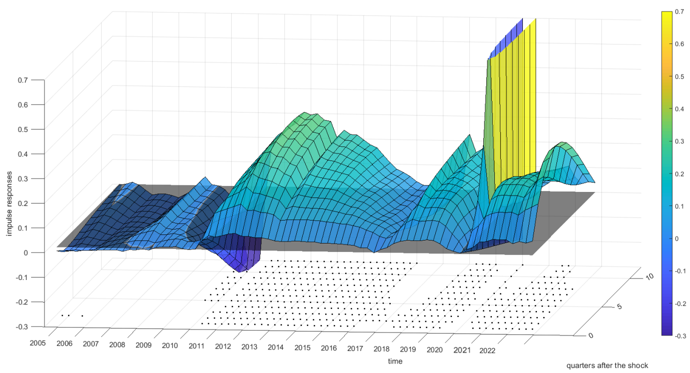
Note: The dots on the bottom surface represent the projection of the statistically significant responses.



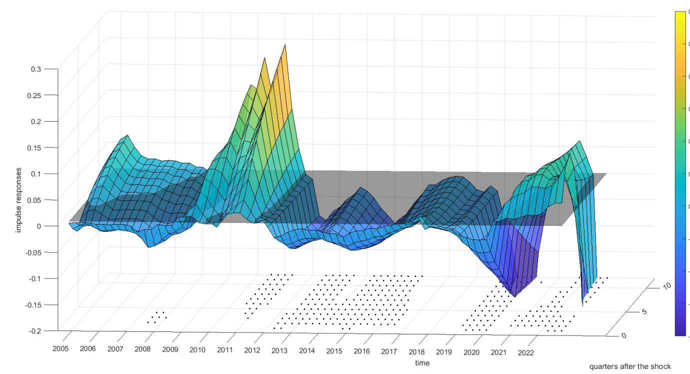
(a) Italy



(b) Norway



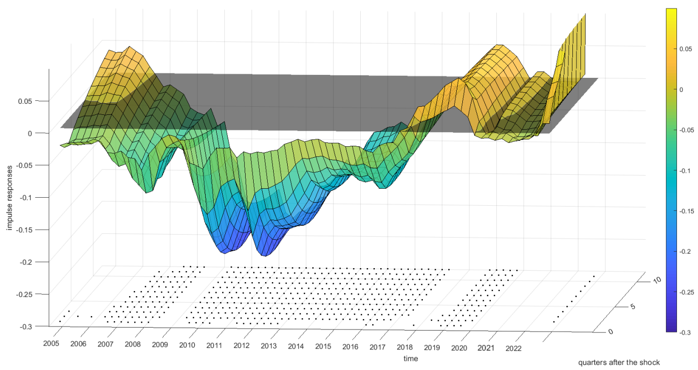
(c) Portugal



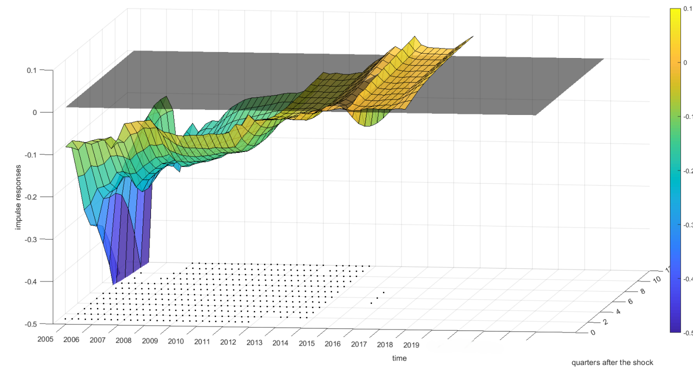
(d) Spain

Figure 10: Rolling GIRFs of the Gini coefficient to 1 SD EPU shocks (68% CI)

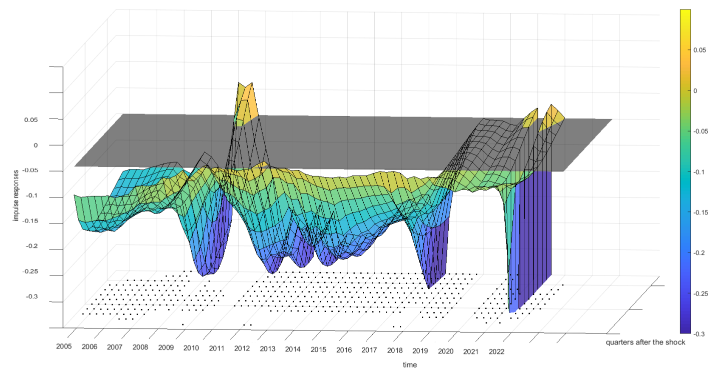
Note: For Norway and Portugal, the Europe-wide EPU index has been used. For Norway, the rolling estimation stops in 2019, due to a lack of data. The dots on the bottom surface represent the projection of the statistically significant responses.



(a) Sweden



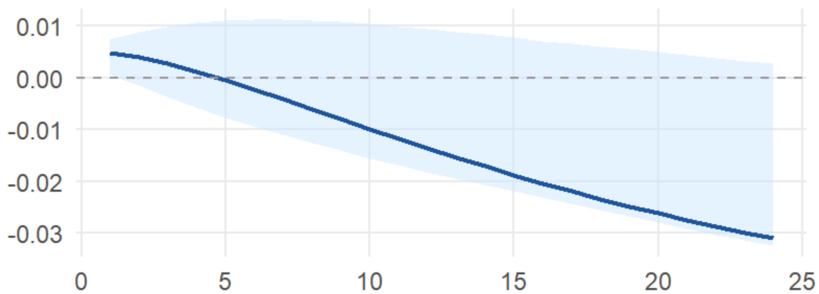
(b) Switzerland



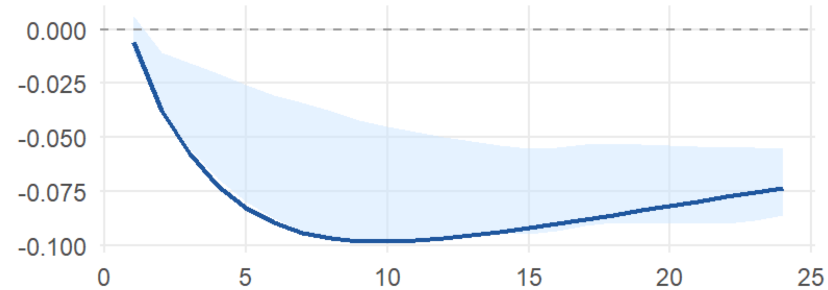
(c) UK

Figure 11: Rolling GIRFs of the Gini coefficient to 1 SD EPU shocks (68% CI)

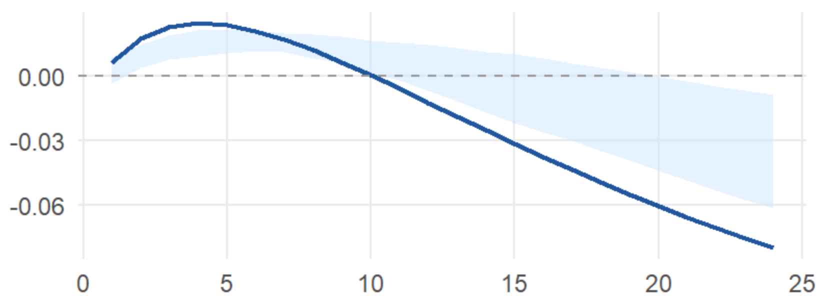
Note: For Switzerland, the Europe-wide EPU index has been used. For Switzerland, the rolling estimation stops in 2019, due to a lack of data. The dots on the bottom surface represent the projection of the statistically significant responses.



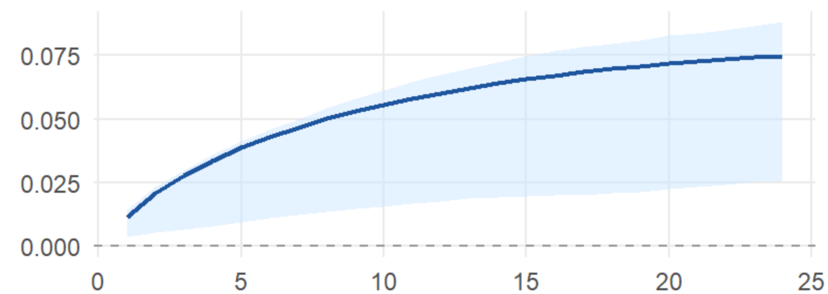
(a) all countries



(b) hard core countries

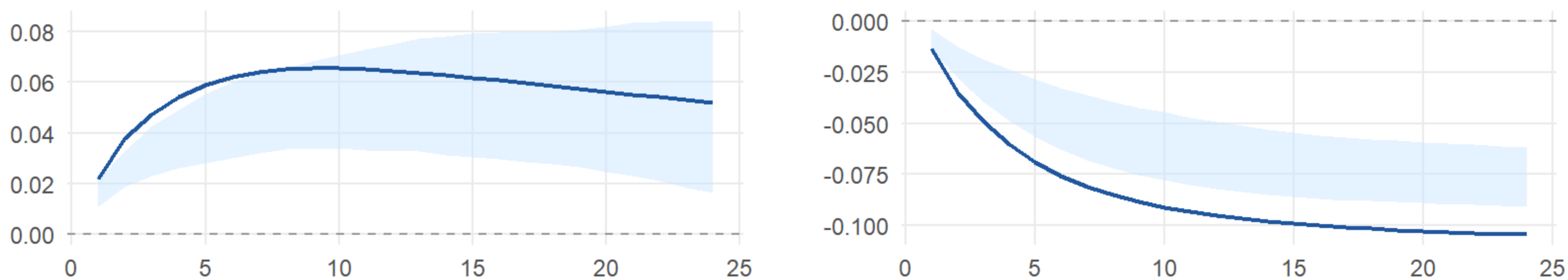


(c) intermediate countries



(d) extended periphery countries

Figure 12: Panel VAR GIRFs of the Gini coefficient to 1 SD European EPU shocks (68% CI bounds)

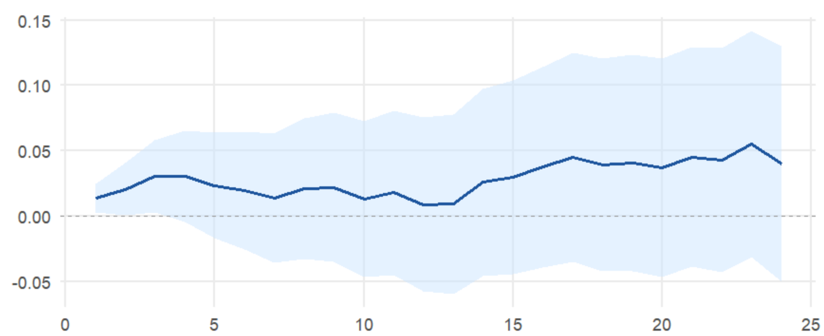


(a) countries with positive time series impact

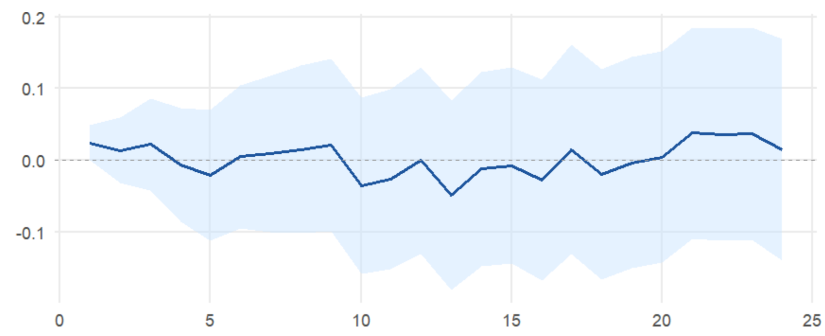
(b) countries with negative time series impact

Figure 13: Panel VAR GIRFs of the Gini coefficient to 1 SD domestic EPU shocks (68% CI bounds)

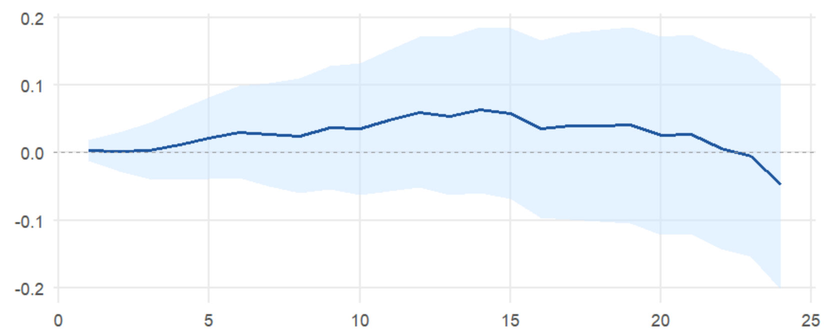
Note: The graph in panel (a) refers to a panel of countries that had a positive response of inequality to uncertainty shocks in the time series VAR model, (b) refers to a panel of countries that had a negative response of inequality to uncertainty shocks in the time series VAR model.



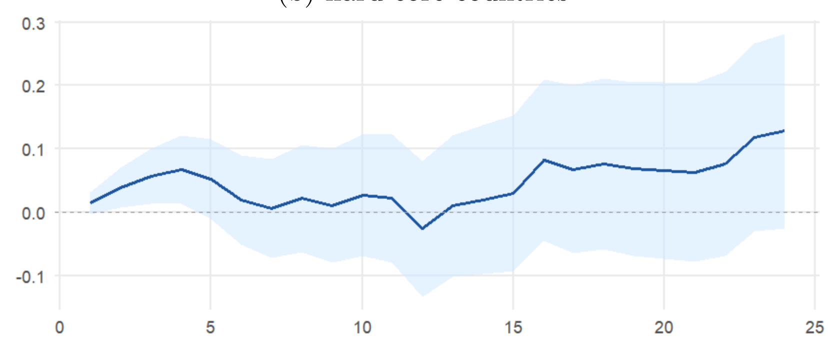
(a) all countries



(b) hard core countries

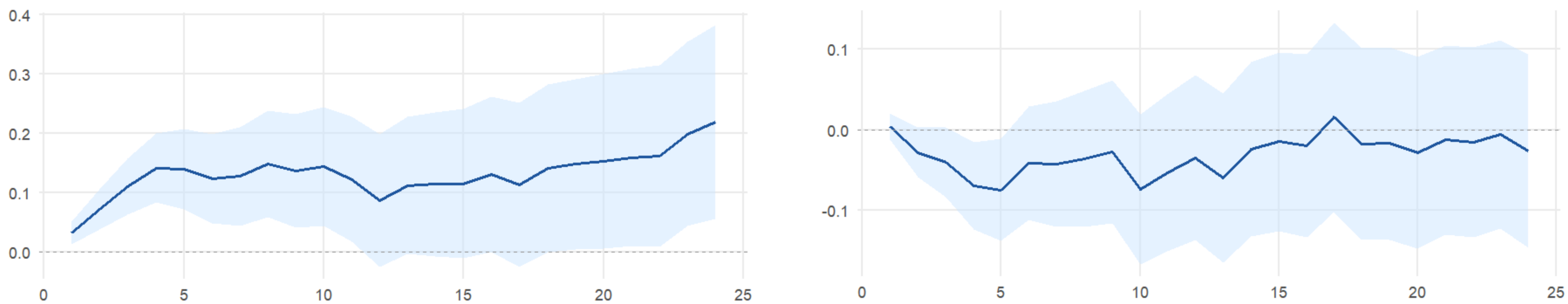


(c) intermediate countries



(d) extended periphery countries

Figure 14: Panel LP GIRFs of the Gini coefficient to 1 SD European EPU shocks (68% CI bounds)



(a) countries with positive time series impact

(b) countries with negative time series impact

Figure 15: Panel LP GIRFs of the Gini coefficient to 1 SD European EPU shocks (68% CI bounds)

Note: The graph in panel (a) refers to a panel of countries that had a positive response of inequality to uncertainty shocks in the time series VAR model, (b) refers to a panel of countries that had a negative response of inequality to uncertainty shocks in the time series VAR model.

Appendix A: European EPU Shocks

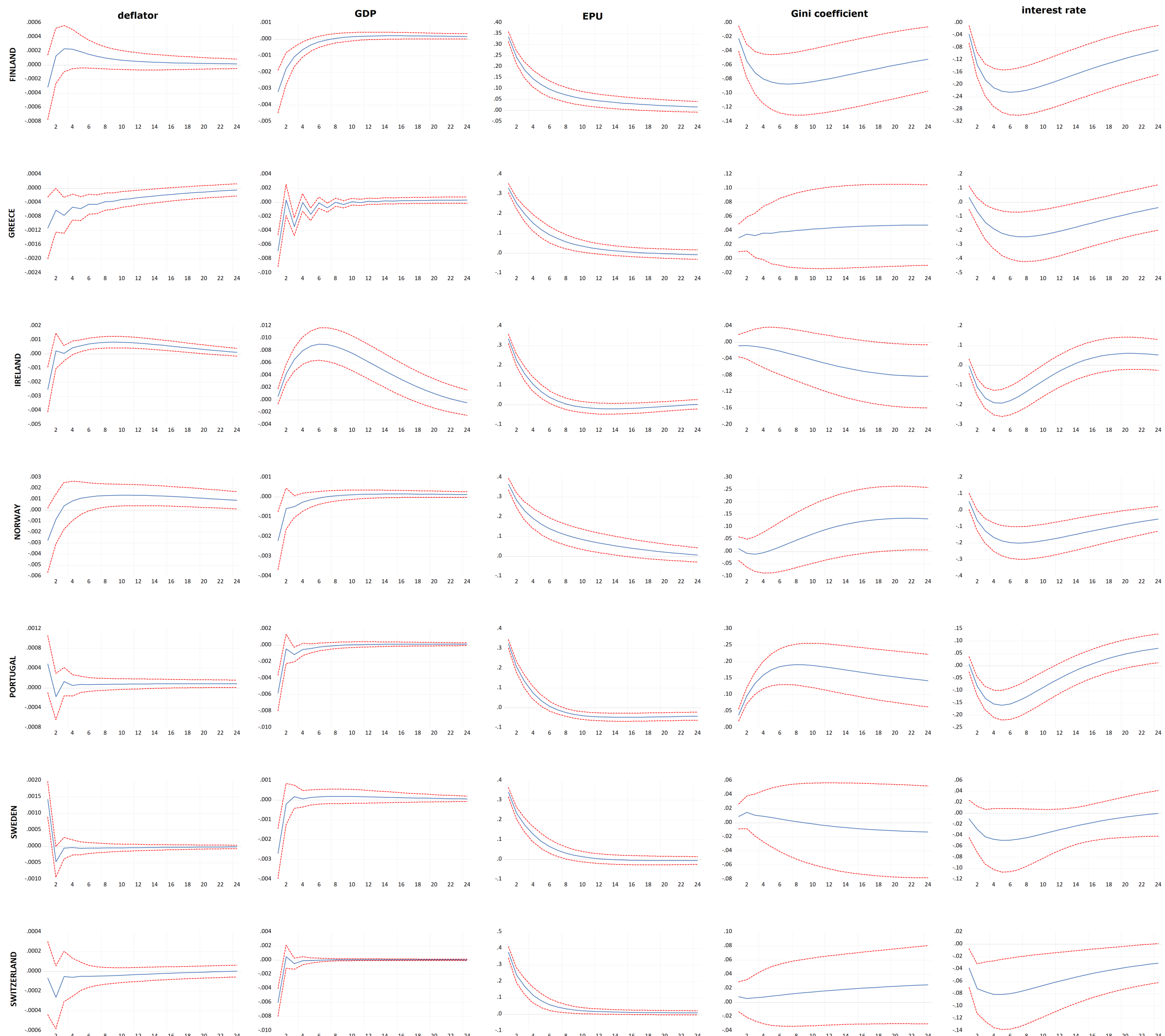


Figure 16: GIRFs to 1 SD European EPU Shocks - extended periphery countries (68% CI bounds)

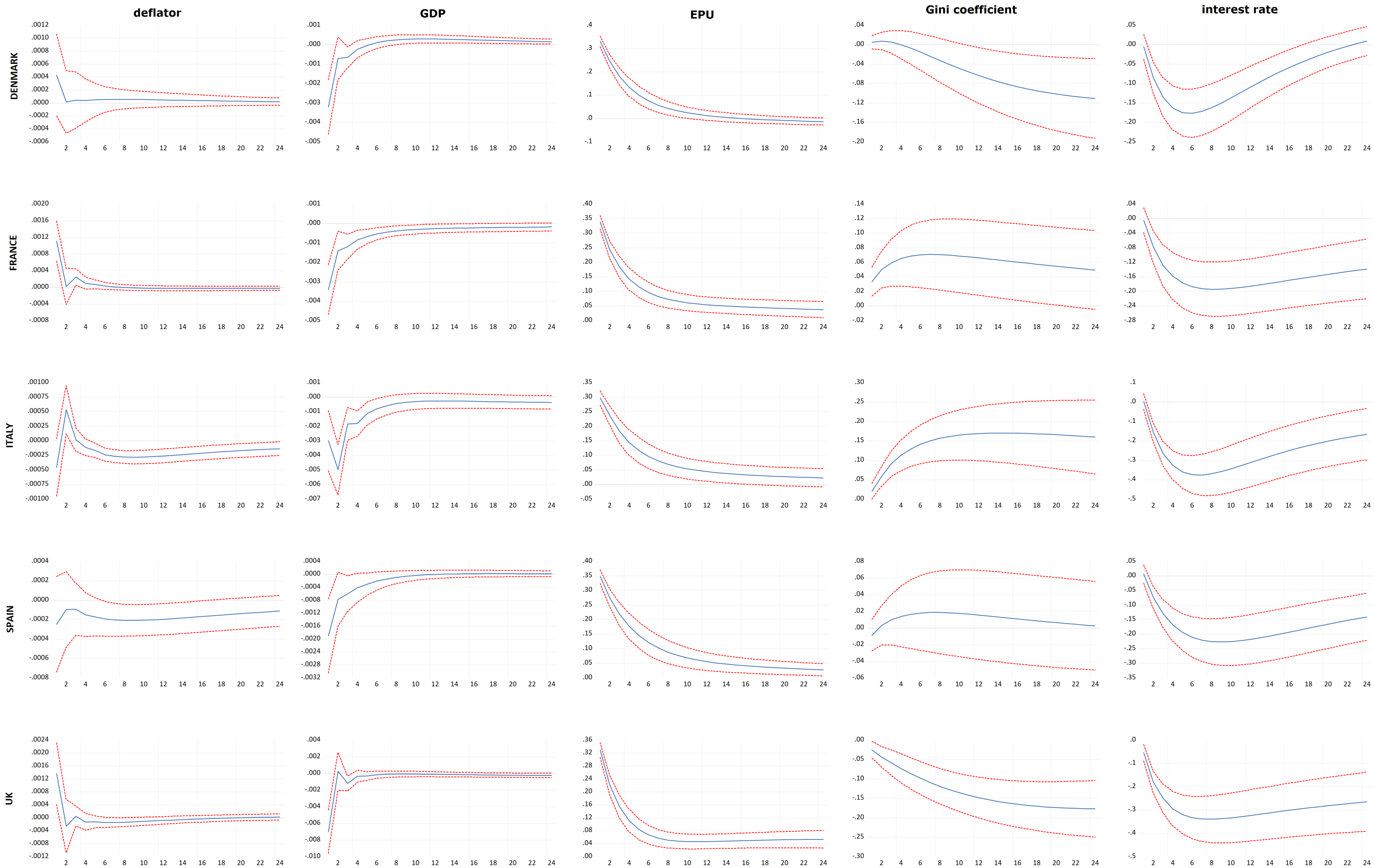


Figure 17: GIRFs to 1 SD European EPU shocks - intermediate countries (68% CI bounds)

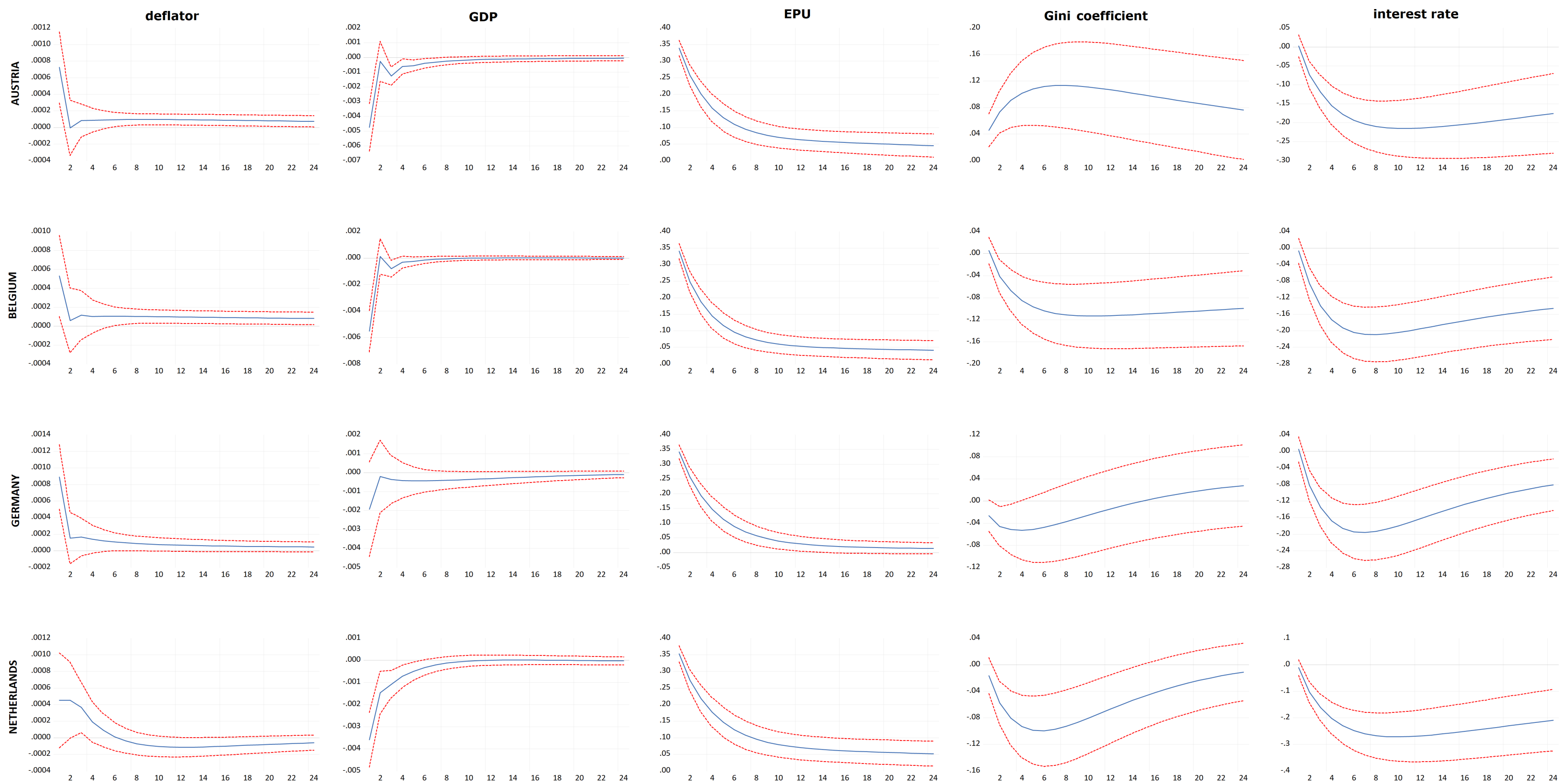


Figure 18: GIRFs to 1 SD European EPU shocks - hard core countries (68% CI bounds)