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Department of Economics

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Xiaoshan Chen, Spyridon Lazarakis, Petros Varthalitis

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Department Economics
Durham University Business School
Mill Hill Lane
Durham DH1 3LB, UK
Tel: +44 (0)191 3345200
https://www.durham.ac.uk/business/about/departments/economics/

Debt targets and fiscal consolidation in a two-country HANK model for the Euro Area*

Xiaoshan Chen
Durham University Business School

Spyridon Lazarakis
Lancaster University Management School

Petros Varthalitis
Athens University of Economics and Business

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Abstract

This paper builds a two-country Heterogenous Agents New Keynesian (HANK) model for the Euro Area (EA). The two countries differ in the degree of public indebtedness, i.e., the Periphery has a relatively higher public debt-output ratio vis-à-vis the Core. The model captures some key features of the EA's cross- and within-country heterogeneity over the 2010-2020 period. We use this model as a vehicle to study fiscal consolidation policy and reforms of EA fiscal targets. We find that public debt asymmetry can explain qualitatively, and to some extent quantitatively, EA macroeconomic imbalances and within-country disparities. We find that a fiscal consolidation scenario that mimics the current EA institutional arrangements, i.e., the Maastricht Treaty and the Stability Growth Pact Agreement, would result in significant welfare losses, especially for the wealth-poor and wealth-median in the Periphery. A revision of EA fiscal targets closer to their current values, e.g., 100% for the Periphery and 70% for the Core, does not generate a conflict of interest between wealth-rich and -poor households across and within countries. Such reform could make more affordable fiscal consolidation for the large proportion of households in the Periphery. Surprisingly, a Core expansion while the Periphery consolidates would not benefit a large proportion of households in the Periphery, especially those with relatively fewer asset holdings in the status quo stationary equilibrium. Furthermore, a hawkish monetary policy reaction against inflation during fiscal consolidation generates a conflict of interest between the wealth-rich in the union and the wealth-poor households in the Periphery. Such policy disproportionately benefits households who hold more assets in the status quo equilibrium.

Keywords: Fiscal Consolidation, Debt Targets, Monetary Policy, Inequality, Welfare
JEL Classification: E21, H31, E52, E62, H50

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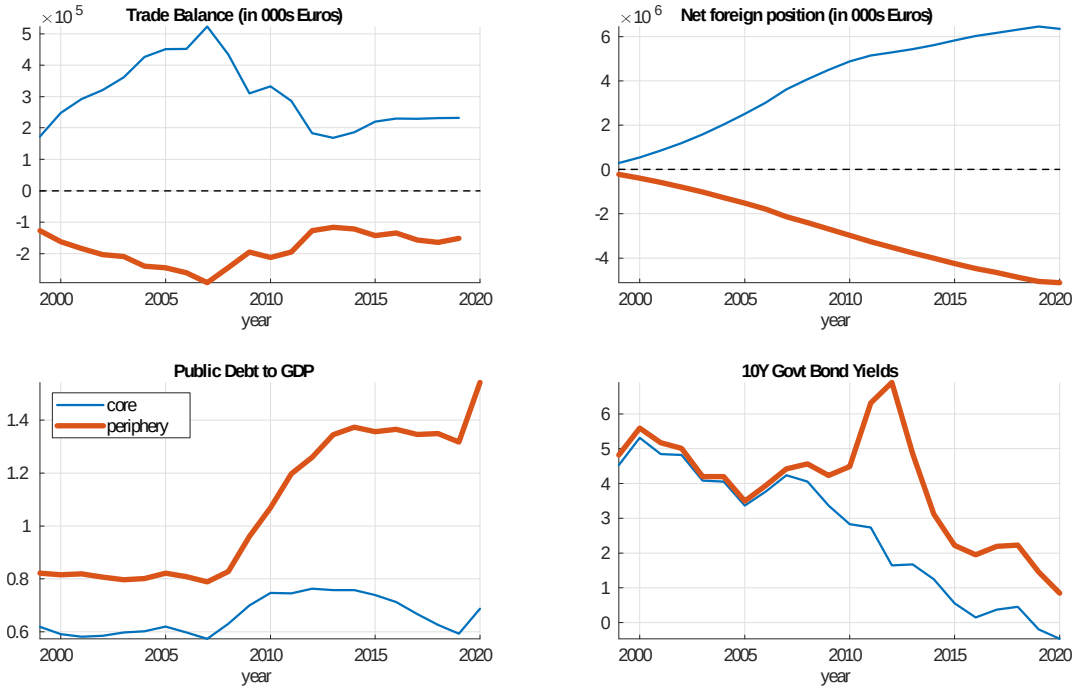
1 Introduction

At the end of the last two decades, the Euro Area (EA) has been severely impacted by two major economic crises. The Great Recession in 2007-08, which led to the European Debt Crisis in 2010, and the COVID-19 pandemic in 2020. The cumulative effect of these crises has left the EA with historically high public debt levels far above the fiscal policy targets imposed by the Maastricht Treaty (MT) and the Stability Growth Pact (SGP) agreement. Although both these crises were global, the inherited macroeconomic imbalances of the EA resulted in a disproportionate impact among its member countries. Furthermore, based on these imbalances the EA is usually divided into two regions (e.g., De Grauwe, 2020). The EA Periphery with relatively weaker public finances and consistently higher levels of public debt-output has consistently run fiscal, current account and trade deficits. These are mostly financed by the EA Core's fiscal, current account and trade surpluses with relatively sound public finances and consistently lower public debt-output ratio.

Figure 1: EA Core-Periphery Imbalances.



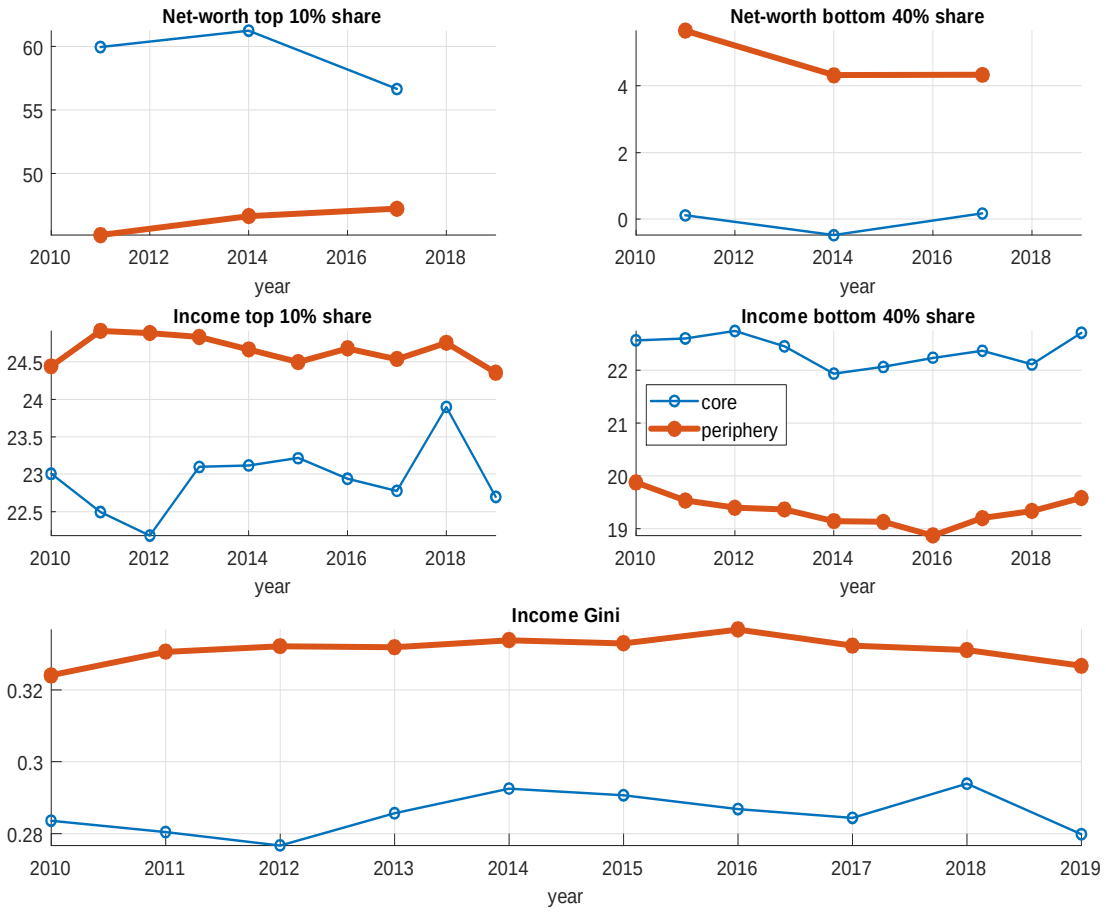
Note: The Core is defined as the GDP weighted average of Austria, Germany and Netherlands while the Periphery is defined as the weighted average of Spain, Italy, Portugal and Greece. The trade balance is computed as the exports minus imports of the Core countries vis-a-vis the Periphery countries.

Sources: WITS and Eurostat.

Figure 1 summarizes these fiscal, macroeconomic and international macroeconomic imbalances among EA countries. A visual inspection of the first row reveals that the Core

trade surpluses (left panel) and external assets (right panel) are almost mirror images of the Periphery trade deficits and external debt, respectively.[1] The second row of Figure 1 illustrates the public debt asymmetry between the Core and the Periphery since 1999, which has deepened in the aftermath of each crisis. Finally, this cross-country heterogeneity is reflected in the borrowing cost (e.g., 10-year Govt Bond yields) facing the Periphery countries vis-à-vis the Core countries in the international financial markets.

Figure 2: Inequality in EA Core-Periphery



Note: Core and Periphery are defined as in Figure 1. The inequality indices are the GDP weighted average of the indices of each region. We used the relative size in GDP terms within each region. Income refers to equivalized net household income (OECD modified), while net-worth refers to the sum of net financial and net housing wealth at the household level.

Sources: World Income Inequality Database (income), OECD (net-worth).

[1] To construct the bilateral net foreign position of each entity we use the following formula $\sum_{t=1999}^{2020} \left(\prod_{j=t}^{2020} (R_j)\, tb_t \right)$ where tb_t is the trade balance scaled by the CPI and R_j is the real rate proxied by the 10 year Government bond yields scaled by the CPI inflation rate. All variables are weighted averages for the Core and Periphery as defined in the note of Figure 1.

Cross-country heterogeneity in the EA coexists with disparities within each EA member country. Figure 2 presents a collection of wealth and income inequality indicators for the Core and Periphery countries. The Periphery performs consistently better than the Core in measures of wealth inequality. For example, the 10% wealthiest households in the Core hold a larger share of total wealth than their counterparts in the Periphery (see the first row). On the other hand, the Periphery performs consistently worse than the Core in measures of income inequality. This is reflected in the income shares held by the top 10% and bottom 40% of the population (see second row) and in the Gini index, which captures the whole distribution (see third row).[2]

In light of this EA economic environment, the soaring national public debts, especially of the Periphery, raise concerns about whether fiscal targets implied by the current institutional arrangements (such as the MT and the SGP) can be met in the foreseeable future and at what social cost (Darvas *et al.* (2018), Blanchard *et al.* 2021 and Cuerpo *et al.* 2022).

The purpose of this paper is twofold. First, we develop a model that captures some key features of the cross- and within-country heterogeneity revealed in Figures 1 and 2, respectively. Second, we use this model to study debated policy issues in the EA, namely fiscal consolidation and reforms of EA fiscal targets. Specifically, we seek to answer the following questions: Is there a scope for reforming the EA fiscal (debt) targets?[3] Who would benefit from this type of reform both cross and within-country? Would the Core expansion make fiscal consolidation in the Periphery less painful? Does the central bank's stance against inflation or using different fiscal instruments to consolidate debt affect our answers to these questions?

To do this, we develop a Heterogenous Agent New Keynesian (HANK) model of two countries that form a monetary union. The model incorporates *cross-* and *within-country* heterogeneity. In each country, there are households, firms, and a national government. The production is subject to standard New Keynesian nominal price rigidities à la Rotemberg (1982). *Within-country heterogeneity* arises from incomplete markets and households' heterogeneity à la Bewley-Huggett-Aiyagari (Bewley 1986, Huggett 1993, Aiyagari 1994), while *cross-country heterogeneity* in the monetary union arises from the degree of public indebtedness of each country. That is, one country has a relatively higher public debt-output ratio, namely the Periphery, compared to the other country, namely the Core. We assume that international financial markets are segmented, and international borrowing/lending takes place via a world financial intermediary (e.g., Itskhoki and Mukhin

[2]The choice to present the bottom 40% wealth share is dictated by the data availability from the OECD. For symmetry in the presentation of inequality measures, we use the same income share.

[3]Proposals to reform the Euro Area fiscal rules have been put forward see e.g., Wyplosz (2019), Beetsma and Larch (2019), Beuve *et al.* (2019), Blanchard *et al.* (2021), Marimon and Wicht (2021) and Fuest (2022).

(2021)). In particular, households in the Core invest in national government bonds, and any excess assets are invested in the world financial intermediary. At the same time, the national government of the Periphery borrows from households in the Periphery, and any excess funding is borrowed from the world financial intermediary. The world financial intermediary makes profits by charging a sovereign premium to the Periphery vis-à-vis the Core. This sovereign premium is an increasing function of the net external debt of the Periphery.

Regarding economic policy, to mimic the EA monetary regime, the two countries fix the nominal exchange rate and abandon independent monetary policies. On the other hand, the two countries follow independent national fiscal policies. We adopt a rule-type approach to policy often used in the literature (e.g., Leeper, 1991). In particular, the union-wide monetary policy is conducted via a Taylor rule for the nominal interest rate, while national fiscal policies are conducted via simple fiscal feedback rules. Moreover, we assume that national governments issue government bonds and levy distortionary labor taxes to finance government expenditures.[4] The reason for the latter assumption is that the previous decade of fiscal consolidation in the Periphery was mainly delivered through spending cuts, which has left these countries less resilient to economic shocks like the Covid-19 pandemic and the Russian invasion of Ukraine. It is, therefore, questionable whether national fiscal policymakers can continue to utilize a non-distortionary fiscal instrument like government consumption to effectively reduce public debt (see, e.g., Prante *et al.* (2020) or van Lerven *et al.* (2022)). As such, governments will likely have to increase the tax burden over time, alongside potentially loosening fiscal rules.

Our baseline calibration focuses only on cross- and within-country heterogeneity generated by public debt asymmetry. Therefore, we set all structural parameters identically in the two countries. In contrast, public debt-output ratios are calibrated equally to their values in 2020, i.e., 70% for the Core and 150% for the Periphery. We call this stationary equilibrium the status quo economy, and it serves us as the point of departure in our policy experiment. Specifically, we assume that the EA economy departs from the status quo and travels towards three reformed economies that differ in the level of public debt-output targets for the Core and the Periphery.

First, we consider a strict fiscal scenario mimicking the MT and the SGP agreement. That is, both countries should reduce the public debt-output ratio to 60%. We refer to this scenario as "*Fiscal Formality*" (*FF*), and it is our benchmark fiscal consolidation scenario to evaluate alternative EA fiscal targets. Second, we consider a fiscal consolidation reform

[4]For completeness, we also consider the scenario of reducing government consumption to deliver fiscal consolidation under various debt targets. According to the conventional view, spending cuts have much smaller costs in terms of output losses than tax increases (See, e.g., Alesina *et al.* 2019). Our results are in line with this view that fiscal consolidation implemented via spending cuts is quantitatively less costly, especially for households with less wealth (and higher marginal propensity to consume).

in which the EA debt targets would be revised closer to the recent historical values of public debt-output ratios, say 100% for the Periphery and 70% for the Core. This reform implies that the size of fiscal adjustment is reduced significantly for the Periphery while the Core adopts a public debt stabilization policy around its current value. We refer to this scenario as "*Fiscal Realism*" (*FR*). Third, we consider a fiscal consolidation scenario widely discussed in the public discourse (e.g., Blanchard *et al.* (2017)). Specifically, whether a fiscal expansion in the Core could ease the fiscal consolidation pain in the Periphery. We mimic this fiscal scenario by allowing the Core to increase its public debt-output ratio to 100% while the Periphery should decrease its public debt-output ratio to 100%. We refer to this scenario as "*Fiscal Accommodation*" (*FA*). In all fiscal consolidation scenarios, unless otherwise stated, national fiscal policies employ the distortionary labor tax to react to public debt-output ratios from their targets. Finally, to mimic the current (post-2022) high inflation environment, we implement a union-wide markup MIT shock calibrated to generate an annualized inflation hike of 10% under the *FF* scenario.

Findings. Our main findings are as follows. First, in a monetary union, public debt asymmetry by itself can explain qualitatively and, to a certain extent, quantitatively cross- and within-country heterogeneity. In a status quo stationary equilibrium where the two countries differ only in their public debt-output ratios, cross-country imbalances emerge similar to those illustrated in Figure 1. At the same time, the country with relatively higher (lower) public debt, i.e., the Periphery (Core), exhibits lower (higher) wealth inequality and higher (lower) earnings inequality, as in Figure 2. Moreover, fiscal adjustments in the level of public debt in one country would affect inequality indicators in the other country of the monetary union. It is worth noting that allowing for richer cross-country heterogeneity does not alter our main results.[5]

Second, fiscal consolidation under the *FF* scenario is quite costly across and within countries. In particular, our quantitative results show that the wealth-poor and wealth-median households in the Periphery incur the highest welfare losses, i.e., equal to 2.42% and 2.21% of their lifetime consumption in the status quo stationary equilibrium. A revision of the EA public debt targets, say from *FF* to *FR*, can significantly mitigate the welfare losses of households at any level of wealth for both countries. In other words, such a reform does not generate a conflict of interest across and within countries, while concurrently would benefit relatively more the wealth-poor and wealth-median households in the Periphery. This implies that reforming EA debt targets could make fiscal consolidation more affordable for the large proportion of households in the Periphery. Since the

[5]Our main results illustrate the importance of public debt asymmetry in our analysis. Richer cross-country heterogeneity means that the Core and the Periphery differ not only in public debt-output ratios but also in several empirically relevant structural characteristics, e.g. aggregate labor productivity, output share of government expenditures, parameters that govern country-specific idiosyncratic productivity, and the degree of tax progressivity.

FF mimics the current EA institutional arrangements, these findings provide a strong rationale for reforming EA debt targets. However, going beyond the *FR* scenario by allowing the Core to expand while the Periphery consolidates, i.e., under the *FA* scenario, will generate a conflict of interest between all households of the Core and the wealth-poor/median households of the Periphery. Surprisingly, a Core expansion will not benefit a large proportion of households in the Periphery, particularly those with relatively fewer assets at the status quo equilibrium compared to *FR*. This finding makes the *FA* scenario politically more challenging to implement than a simple revision of EA public debt targets closer to recent historical values as implied by the *FR* scenario.

Third, the union-wide monetary policy stance against inflation during an era of national fiscal consolidation policies generates a conflict of interest between the wealth-rich and wealth-poor households in the monetary union. Specifically, a more aggressive reaction of the monetary authority against inflation would disproportionately benefit households holding relatively more assets at the status quo equilibrium in each country. In contrast, it makes fiscal consolidation more painful for households holding relatively fewer assets in each country. The latter effect is quantitatively more significant for the wealth-poor households in the Periphery. A repercussion of this result is that a relatively more anti-inflationary policy would reduce the scope of reforming EA public debt targets since the benefits from such a reform would become quantitatively smaller.

Related Literature. Our paper contributes to at least three strands of the literature. First, it contributes to the rapidly growing literature that studies the effects on within-country heterogeneity of various international macroeconomic shocks employing (small) open economy models, e.g., De Ferra *et al.* (2020), Giagheddu (2020), Guo *et al.* (2020), Auclert *et al.* (2021b), Aggarwal *et al.* (2022) and Oskolkov (2022). Modelling-wise, we are closer to Aggarwal *et al.* (2022), which employs a many-country HANK model to study the impact of the COVID-19-induced fiscal stimulus packages on excess savings and twin deficits. We develop a two-country HANK model of a monetary union that is structured to capture the EA Core-Periphery public debt asymmetry. In addition, in our model, labor supply is endogenous, which has a significant impact on welfare and cross-sectional inequality outcomes. We use this model to examine the general equilibrium effects of this public debt asymmetry on cross-country imbalances and within-country inequality.

Second, our paper is also related to the literature that studies fiscal consolidation policies in a monetary union employing two-country open economy Representative Agent New Keynesian (RANK) and/or a Two-Agent New Keynesian (TANK) DSGE models. A non-exhaustive list includes Coenen *et al.* (2008), Forni *et al.* (2010), Clinton *et al.* (2011), Cogan *et al.* (2013), Erceg and Linde (2013) and Philippopoulos *et al.* (2017). This literature primarily focuses on the aggregate macroeconomic and welfare implications of fiscal consolidation policies, as we do in this paper. Nevertheless, these models do

not allow for a rich heterogeneity setup. Instead, we use a two-country HANK model to examine the heterogenous welfare effects of fiscal consolidation. In addition, we can also study the impact of fiscal consolidation on income, consumption, and wealth inequality. An exception to this literature is Viegas and Ribeiro (2016), who use a two-country neoclassical growth model with heterogeneous agents to study alternative fiscal consolidation episodes in the European Union. In contrast to Viegas and Ribeiro (2016), we examine the role of common monetary policy during a fiscal consolidation era, while cross-country heterogeneity in our model results in differences in the borrowing cost between countries. In terms of the policy experiment, we also evaluate alternative EA fiscal targets.

Third, we contribute to the literature that studies the role of public debt in closed economy heterogeneous agents' models. Aiyagari and McGrattan (1998) and Floden (2001) use a neoclassical growth model with heterogeneous agents to study the long-run effect of public debt on utilitarian welfare. We also examine the long-run effects of public debt; however, we consider transitional dynamics while our setup incorporates cross-country heterogeneity in a two-country model of a monetary union. Moreover, we compute welfare across the wealth distribution. Our results for the long-run general equilibrium effects of public debt at the monetary union level are comparable to their findings. More recently, Bayer *et al.* (2022) examine the role of the liquidity premium in a two-asset HANK model. They find similar results as in our paper regarding the long-run movements of interest rates and wealth inequality in a closed economy. The presence of two assets and the endogenous liquidity premium is the key mechanism in their model. Our work can be viewed as complementary to their study on this aspect as we examine the role of public debt in an open economy framework in which public debt asymmetry across countries generates a sovereign premium for the high-indebted country vis-à-vis the low-indebted country.

To the best of our knowledge, this is the first paper that develops a two-country HANK model that is structured to capture the EA Core-Periphery imbalances and their link to within-country cross-sectional inequality. Our paper provides a unified framework to evaluate alternative fiscal consolidation policies and fiscal targets along several cross- and within-country dimensions, i.e., using not only aggregate measures but also a variety of cross-sectional inequality indices.

The rest of the paper is organized as follows. Section 2 develops the model. Section 3 presents the calibration and the numerical solution of the status quo stationary equilibrium while it discusses the role of public debt asymmetry in explaining cross- and within-country heterogeneity. Section 4 lays out the policy experiment, while section 5 presents our main results. Section 6 conducts an extensive robustness analysis. Finally, Section 7 closes the paper.

2 Model

This section builds a two-country HANK model. The two countries form a monetary union; goods markets are perfectly integrated, while international asset markets are segmented. The latter implies that international borrowing/lending occurs via a world financial intermediary. We solve for an equilibrium in which one country acts as a net external creditor, namely the Core, while the other country acts as a net external debtor, namely the Periphery. Due to the financial intermediation, the Periphery borrows with a sovereign premium with respect to the Core.

Each country is populated by a continuum of infinitely-lived households, final and intermediate good firms, and a national government. Within each country, heterogenous households are facing incomplete markets and idiosyncratic productivity shocks. Households maximize discounted life-time utility with regard to their intertemporal consumption and labor supply. The labor supply is frictionless. Final good firms produce a single traded good using differentiated intermediate inputs, which is produced using labor. Labor is an immobile factor. The national governments levy labor taxes and issue public debt to finance government expenditures. In the local financial markets, households invest their assets in national public debt and any excess assets (debts) are invested in (borrowed from) the world financial intermediary.

Since we solve for a monetary union regime, the two countries abandon monetary policy independence and delegate monetary policy to a single monetary authority while national governments can follow independent national fiscal policies. The two countries are of equal size, and the structure of their economy is symmetric. In what follows, we present the decision problems faced by the agents of the home country, which will be referred to as the Core. The foreign country will be referred to as the Periphery, and when necessary the respective variables will be denoted with an asterisk superscript.

2.1 Households

The Core economy is populated by a continuum of households indexed by h normalized to measure 1, who are ex-ante homogeneous, and have CRRA preferences over private consumption, leisure and a public good, G_t,

$$\mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t \left(\frac{(c_{h,t})^{1-\sigma}}{1-\sigma} + \varrho \log(G_t) - \varphi \frac{(l_{h,t})^{1+\eta}}{1+\eta} \right) \right] \tag{1}$$

where $\beta \in (0,1)$ is the households' subjective discount factor, $\frac{1}{\eta}$ is the Frisch elasticity of labor supply, $l_{h,t}$, and $c_{h,t}$ is private consumption. Each household h solves the following maximization problem,

$$v_t\left(a_{h,t-1}, e_{h,t}\right) = \max_{\substack{a_{h,t} \geq 0 \\ c_{h,t} \geq 0 \\ l_{h,t} \geq 0}} \left\{ \frac{\left(c_{h,t}\right)^{1-\sigma}}{1-\sigma} + \varrho \log(G_t) - \varphi \frac{\left(l_{h,t}\right)^{1+\eta}}{1+\eta} + \beta \mathbb{E}\left[v_{t+1}\left(a_{h,t}, e_{h,t+1}\right) \mid e_{h,t}\right] \right\}$$

subject to the period-by-period household budget constraint expressed in real terms (divided by the aggregate price level, P_t),

$$c_{h,t} + a_{h,t} = \left(1 + i_{t-1}\right) \frac{P_{t-1}}{P_t} a_{h,t-1} + (1 - \tau_t^l) w_t e_{h,t} l_{h,t} + d_t + \widetilde{\Xi}_t \tag{2}$$

Each household h is endowed with a stochastic idiosyncratic productivity $e_{h,t}$ which follows a Markov chain with transition probability $\Pr\left(e_{h,t+1} | e_{h,t}\right)$ with state space $E = [\overline{e}_1, \overline{e}_2, ..., \overline{e}_m]$ where $\overline{e}_1 > 0$. The Markov chain is irreducible and aperiodic which means that the Markov chain has a unique invariant distribution denoted by Υ. This productivity results in a pre-tax labor income equal to, $w_t e_{h,t} l_{h,t}$, where the real wage is $w_t \equiv \frac{W_t}{P_t}$. d_t denotes real dividends distributed by firms in the home country, while $\widetilde{\Xi}_t \equiv \frac{\Xi_t}{P_t}$ denotes the real profit from the world financial intermediary that is rebated to the households in the Core country (see section 2.6).[6]

Each household rents its assets with the end-of-period assets equal to $a_{h,t-1}$, which yields nominal returns, i_{t-1}. The financial markets are incomplete which implies that there is a single asset in the economy and households cannot insure themselves against shocks to labor income. The household's state can be described by $(a, e) \in A \times E$, where $A = [0, +\infty)$.

The solution to this problem will give us the policy functions $a_{h,t} = q_t^a\left(a_{h,t-1}, e_{h,t}\right)$, $l_{h,t} = q_t^l\left(a_{h,t-1}, e_{h,t}\right)$ and $c_{h,t} = q_t^c\left(a_{h,t-1}, e_{h,t}\right)$ which denote the households' optimum choices given prices and aggregate quantities. Therefore, in this setup, households exhibit heterogeneity in earnings, $y_{h,t}^E = (1 - \tau_t^l) w_t e_{h,t} l_{h,t}$, wealth, $a_{h,t}$, consumption, $c_{h,t}$, and net income, $y_{h,t}^{NI} = \left(i_{t-1}\right) \frac{P_{t-1}}{P_t} a_{h,t-1} + (1 - \tau_t^l) w_t e_{h,t} l_{h,t} + d_t + \widetilde{\Xi}_t$. The Periphery households face an analogous maximization problem as the Core households.

2.2 Firms and price setting

There is a continuum of monopolistically competitive intermediate goods firms that produce differentiated intermediate goods. In addition, a representative final good firm purchases these differentiated intermediate goods to produce the single traded good. The

[6] The profit from the financial intermediary is trivial and inconsequential for our income inequality result.

technologies and price setting problem faced by the final good firm and intermediate goods firms in the Core country are illustrated below.

Final good firm. The final good firm acts as a competitive good packer, and use a standard Dixit-Stiglitz aggregator:

$$Y_t = \left(\int_0^1 (y_{j,t})^{\frac{1}{\mu_t}} \, dj \right)^{\mu_t} \tag{3}$$

where Y_t is the traded good produced in the Core country, μ_t is the markup which can be time varying, and it shapes the elasticity of substitution among the differentiated intermediate goods, $y_{j,t}$. In particular, we define μ_t as follows,

$$\mu_t = e^{m_t} \mu$$

where μ is the steady-state value and m_t is an AR(1) union-wide markup shock, $m_t = \rho_m m_{t-1} + \epsilon_t$.

The representative final good firm maximizes profits, $P_t Y_t - \int_0^1 p_{j,t} y_{j,t} dj$, by choosing productive inputs. This maximization problem yields the demand function for $y_{j,t}$,

$$y_{j,t} = \left(\frac{p_{j,t}}{P_t} \right)^{-\frac{\mu_t}{\mu_t - 1}} Y_t \tag{4}$$

where $P_t = \left(\int_0^1 (p_{j,t})^{\frac{1}{1-\mu_t}} \, dj \right)^{1-\mu_t}$ denotes the aggregate price level in the Core country.

The problem of the final good firm in the Periphery is analogously defined. The prices in the Periphery (foreign country) are analogously defined, i.e., $p^*_{j^*,t}$ denotes the price of intermediate inputs denominated in foreign currency and $P^*_t = \left(\int_0^1 \left(p^*_{j^*,t} \right)^{\frac{1}{1-\mu^*_t}} dj^* \right)^{1-\mu^*_t}$ is the associated aggregate price level in foreign country (for symmetry we also set $\mu_t = \mu^*_t$,). We assume that the law of one price holds meaning that the final traded goods sells at the same price at the Core and the Periphery markets. Thus, $P_t = S_t P^*_t$, where S_t is the nominal exchange rate. Since we solve for a monetary union regime, S_t is held constant and equal to unity while the real exchange rate is defined as $Q_t \equiv \frac{S_t P^*_t}{P_t} = 1$.

Intermediate goods firms. There is a continuum of intermediate good firms that produce differentiated intermediate goods, $y_{j,t}$, by employing labor services from domestic households. Each intermediate firm j faces the following technology:

$$y_{j,t} = Z n_{j,t} \tag{5}$$

where the intermediate output, $y_{j,t}$, is produced using labor services $n_{j,t}$, while Z is a parameter that measures the aggregate labor productivity. In a symmetric equilibrium, it holds that $n_{j,t} = N_t$.

Intermediate firms operate under monopolistic competition and, thus, they set their prices, $p_{j,t}$, subject to the iso-elastic demand curve (4) and Rotemberg type adjustment costs. The profit maximization problem of firm j is illustrated by the following Bellman equation:

$$J_t\left(p_{H,j,t-1}\right) = \max_{p_{j,t}} \left\{ \frac{p_{j,t}}{P_t} y_{j,t} - \frac{w_t}{Z_t} y_{j,t} - \psi_{j,t} + \frac{1}{1+i_t} \frac{P_{t+1}}{P_t} J_{t+1}\left(p_{j,t}\right) \right\}$$

where $\psi_{j,t} \equiv \frac{\mu_t}{\mu_t - 1} \frac{1}{2\kappa} \left[\ln(\frac{p_{j,t}}{p_{j,t-1}}) - \ln\left(1+\pi\right) \right]^2 Y_t$ denotes the quadratic adjustment cost in real terms.

The solution to this problem yields the standard New Keynesian Philips Curve,

$$\ln\left(\frac{1+\pi_t}{1+\pi}\right) = \kappa\left(\frac{w_t}{Z_t} - \frac{1}{\mu_t}\right) + \frac{1}{1+i_t} \frac{P_{t+1}}{P_t} \frac{\mu_t - 1}{\mu_t} \frac{\mu_{t+1}}{\mu_{t+1} - 1} \frac{Y_{t+1}}{Y_t} \ln\left(\frac{1+\pi_{t+1}}{1+\pi}\right) \tag{6}$$

where $\pi_t \equiv \frac{P_t}{P_{t-1}} - 1$ denotes inflation in the Core country and π is the steady-state inflation rate. The steady-state markup is,

$$\frac{w}{Z} = \frac{1}{\mu}$$

The equilibrium real profit of each intermediate firm is rebated to the household as dividends,

$$d_t = Y_t - w_t N_t - \psi_t \tag{7}$$

The problem of the intermediate good firms in the Periphery is analogously defined.

2.3 Government

The period-by-period government budget constraint in the Core country is (in real terms),

$$B_t + \tau_t^l w_t L_t = \left(1 + i_{t-1}\right) \frac{P_{t-1}}{P_t} B_{t-1} + G_t \tag{8}$$

where B_t is the end-of-period domestic government bonds, G_t is government spending. The government in the Core country borrows at the interest rate i_t from domestic households. $\tau_t^l w_t L_t$ are tax revenues from labor income. The Periphery's national government budget constraint is analogously defined.

The Core and the Periphery follow independent national fiscal policies. We assume that each country's fiscal authority implements simple fiscal rules, in particular, labor income tax are given by,

$$\tau_t^l = \overline{\tau}^l + \gamma \left[\frac{B_{t-1}}{Y_{t-1}} - \frac{B}{Y} \right] \tag{9}$$

$$\tau_t^{l*} = \overline{\tau}^{l*} + \gamma^* \left[\frac{B_{t-1}^*}{Y_{t-1}^*} - \frac{B^*}{Y^*} \right] \tag{10}$$

where $\gamma \geq 0$ and $\gamma^* \geq 0$ are feedback policy coefficients on public debt to output ratio in the Core and the Periphery country, respectively, and variables without time subscript denote fiscal targets.

2.4 Clearing market conditions in local markets

The local labor market clearing requires that the labor demand of intermediate goods firms equals the labor supply of the households,

$$N_t = L_t \tag{11}$$

where $L_t = \int eq_t^l \left(a_{h,t-1}, e_{h,t}\right) d\lambda_t(a_{h,t-1}, e_{h,t})$, and λ_t is the cross-section distribution for the Core.

The local asset market requires that households lend their assets, $A_t \equiv \int q_t^a \left(a_{h,t-1}, e_{h,t}\right) d\lambda_t(a_{h,t-1}, e_{h,t})$, to the Core's government, B_t, and any excess assets, NFA_t, are invested in the world financial market via the world financial intermediary,

$$NFA_t = A_t - B_t \tag{12}$$

Local markets in the Periphery are analogously defined, i.e., $N_t^* = L_t^*$ and $NFA_t^* = A_t^* - B_t^*$.

2.5 The evolution of international assets

Combining the aggregate household budget constraint (2) with the government budget constraint (8), profits from intermediate firms (7) and substituting local clearing market conditions (11) and (12), we obtain the evolution of net foreign assets in the Core country (in real terms),

$$NFA_t = \left(\frac{1 + i_{t-1}}{1 + \pi_t} \right) NFA_{t-1} + \left(Y_t - C_t - G_t - \psi_t \right) + \widetilde{\Xi}_t \tag{13}$$

where $Y_t - C_t - G_t - \psi_t > 0 \, (< 0)$ are net exports (imports) for the Core country. The evolution of net foreign assets in the Periphery is analogously derived.

Below, we solve for an equlibrium in which the Core acts as a net creditor to the

Periphery. Thus, households in the Core country lend their assets, A_t, to the domestic government, B_t, and any excess assets, $NFA_t > 0$, are lent to the Periphery's government via the world financial intermediary (see 2.6). On the other hand, the Periphery is a net borrower from the Core. By issuing government bonds, B_t^*, the Periphery's government borrows A_t^* from domestic households, and $NFA_t^* < 0$ from the Core households via the world financial intermediary. In equilibrium, international borrowing is equal to international lending at each period,

$$\begin{aligned} (A_t - B_t) &= Q_t \left(B_t^* - A_t^*\right) \Rightarrow \\ NFA_t &= -Q_t NFA_t^* \end{aligned} \tag{14}$$

where $Q_t = 1$.

2.6 World financial intermediary

The world financial intermediary adopts a carry trade strategy by taking a long position in the Core's country asset market and a short position in the Periphery's asset market. The real profit of the world financial intermediary is given by,

$$\widetilde{\Xi}_t \equiv \left(\frac{1+i_{t-1}^*}{1+\pi_t^*}\right) Q_t \left(-NFA_{t-1}^*\right) - \left(\frac{1+i_{t-1}}{1+\pi_t}\right) NFA_{t-1} - \zeta_t \tag{15}$$

where $\zeta_t \equiv \frac{\varkappa}{2} \frac{Q_t}{1+\pi_t^*} \left[\exp\left(\frac{-NFA_{t-1}^*}{Y_{t-1}^*}\right) - 1\right]^2$ reflects operational costs of the financial intermediary. When $\varkappa > 0$, the financial intermediary makes profits when the Periphery country has a negative net foreign asset position, i.e., net external debt.

The financial intermediary maximizes profit in equation (15) taking into account (14), which yields the following real uncovered interest rate parity,

$$(1 + r_t^*) = (1 + r_t) + \varkappa \frac{1}{1+\pi_t^*} \left[\exp\left(\frac{-NFA_{t-1}^*}{Y_{t-1}^*}\right) - 1\right] \exp\left(\frac{-NFA_{t-1}^*}{Y_{t-1}^*}\right) \frac{1}{Y_{t-1}^*} \tag{16}$$

where r_t^* and r_t are real returns implied by the Fisher equations, $1 + r_t^* = \frac{1+i_{t-1}^*}{1+\pi_t^*}$ and $1 + r_t = \frac{1+i_{t-1}}{1+\pi_t}$. Therefore, when the Periphery country is a net debtor, i.e., $\frac{NFA_{t-1}^*}{Y_{t-1}^*} < 0$, it borrows with a premium with respect to the Core country's interest rate, i.e. $r_t^* > r_t$.

2.7 World markets

The world market clearing condition in the goods market is,

$$Y_t - C_t - G_t - \psi_t + Q_t \left(Y_t^* - C_t^* - G_t^* - \psi_t^*\right) - \zeta_t = 0 \tag{17}$$

while the clearing market condition in the world asset market is,

$$NFA_t + Q_t NFA_t^* = 0 \tag{18}$$

2.8 Monetary policy in the union

In the monetary union, the nominal exchange rate is fixed to unity, i.e., $S_t = 1$. We assume that the central bank of the EA follows a Taylor-type interest rule. Specifically, the central bank responds to the EA inflation, and since, there is no price differential between the Core and the Periphery in our model, the union-wide inflation equals $\pi_t = \pi_t^*$. The EA Taylor rule subject to the zero lower bound is expressed as follows,

$$i_t = \max\left\{0, i + \phi_\pi \left(\pi_t - \bar{\pi}\right)\right\} \tag{19}$$

where we assume that the central bank's nominal rate is equal to the Core country's government bond yield. While in the Periphery country the government bond yield carries a risk premium over the central bank policy rate ($i_t^* > i_t$). In addition, $\phi_\pi \geq 1$ is the feedback monetary policy coefficient on inflation from its target, $\bar{\pi}$.

2.9 Competitive equilibrium

Given sequences of shocks $\{\mu_t,\ \mu_t^*\}$, the monetary regime, $S_t = 1$, public debt-output targets $\{\frac{B}{Y},\ \frac{B^*}{Y^*}\}$, initial public debt-output ratios, $\{\frac{B_0}{Y_0},\ \frac{B_0^*}{Y_0^*}\}$, and the initial wealth distributions $\{\lambda_0(a_{h,-1}, e_{h,0}),\ \lambda_0^*(a_{h^*,-1}^*, e_{h^*,0}^*)\}$, a *Competitive Equilibrium* is a path of policies $\{q_t^a\left(a_{h,t-1}, e_{h,t}\right),\quad q_t^l\left(a_{h,t-1}, e_{h,t}\right),\quad q_t^c\left(a_{h,t-1}, e_t\right),\quad q_t^{a*}\left(a_{h^*,t-1}^*, e_{h^*,t}^*\right), q_t^{l*}\left(a_{h^*,t-1}^*, e_{h^*,t}^*\right),\ q_t^{c*}\left(a_{h^*,t-1}^*, e_{h^*,t}^*\right)\}$ for households, distributions $\{\lambda_t(a_{h,t-1}, e_{h,t}),\ \lambda_t^*(a_{h^*,t-1}^*, e_{h^*,t}^*)\}$, prices $\{P_t,\ P_t^*,\ W_t,\ W_t^*,\ i_t^* - i_t\}$, policy instruments $\{\tau_t^l,\ \tau_t^{l*},\ i_t,\ G_t,\ G_t^*\}$, and aggregate quantities $\{C_t,\ C_t^*,\ Y_t,\ Y_t^*,\ A_t,\ A_t^*,\ NFA_t,\ NFA_t^*,\ d_t,\ d_t^*,\ \widetilde{\Xi}_t\}$, such that

1. Home and foreign households and firms optimize given prices and taxes.
2. Home and foreign local labor and financial markets clear.
3. The world goods and financial market clear.
4. The national government budget constraints are satisfied.
5. The law of one price holds.

In Appendix A, we define the *Stationary Equilibrium,* as well as summarize the computational algorithm to solve for the *Competitive Equilibrium.*

3 Calibration and status quo stationary equilibrium

The section presents the calibration of the status quo economy in section 3.1, the numerical solution of the status quo stationary equilibrium in section 3.2 and comparative statics that examine the role of public debt asymmetry in the monetary union in section 3.3.

3.1 Calibration of the status quo economy

Table 1 lists the baseline calibration of the structural parameters (top panel) and targeted policy ratios (bottom panel). The time unit is meant to be one quarter. In the baseline calibration, we allow the two countries to differ only in the public debt-output ratios. By doing so, we can single out the role of public debt asymmetry in explaining the cross-and within-country heterogeneity observed in the EA. We relax this assumption in section 6. Interestingly, as we will show later, public debt asymmetry can explain an important part of cross- and within-country heterogeneity.

Table 1: Calibrated parameters

	Core	Periphery	Source
σ, σ^*	2	2	standard value
φ, φ^*	1	1	McKay et al. (2016)
η, η^*	2	2	McKay et al. (2016)
θ, θ^*	1	1	symmetric demand
χ, χ^*	0.5	0.5	symmetric demand
β, β^*	0.9898	0.9898	target ECB interest rate at ZLB in 2020
ϱ, ϱ^*	0.2539	0.2539	target govt CONS/GDP ratio 2010-2020
μ, μ^*	1.20	1.20	McKay et al. (2016)
κ, κ^*	0.1	0.1	Auclert et al. (2021a)
Z, Z^*	1.0210	1.0210	normalize Y^*=1
ρ, ρ^*	0.966	0.966	McKay et al. (2016)
σ_e, σ_e^*	0.5362	0.5362	Vacas-Soriano et al. (2020)
$\varkappa$	-	0.007	Rabanal and Tuesta (2010, 2013)
Targeted policy variables			
π, π^*	0.0025	0.0025	quarterly inflation 2010-2020
$\frac{G}{Y}, \frac{G^*}{Y^*}$	0.2025	0.2025	govt CONS/GDP ratio 2010-2020
$\frac{B}{Y}, \frac{B^*}{Y^*}$	4*0.7	4*1.5	quarterly debt/GDP 2020

Preferences. The preference parameters are set to the values usually used in the literature and are equal across the two countries. Specifically, the inverse of the elasticity of intertemporal substitution ($\sigma = \sigma^*$), and the inverse of Frisch labor elasticity ($\eta^* = \eta$)

are set to 2, respectively, while the relative weight of labor disutility ($\varphi = \varphi^*$) is set to 1 as in McKay *et al.* (2016). In addition, we calibrate the discount factors ($\beta = \beta^*$) to 0.9898, so as to target the central bank's interest rate, i, at the zero lower bound in 2020 at the status quo stationary equilibrium. Following Heathcote et al (2017), we calibrate $\varrho = \varrho^*$ to be equal to $\frac{g}{1-g}$, where g is the union-wide government consumption to output ratio for the 2010-2020 period.[7]

Production. We do not assume any permanent differences in productivity between the countries, i.e. $\frac{Z}{Z^*}= 1$ in the baseline calibration. In particular, we calibrate $Z = Z^* = 1.0210$, so as to normalize Y^* equal to 1 at the status quo stationary equilibrium. In addition, we set the steady-state value of $\mu = \mu^* = 1.2$.

Uninsured idiosyncratic shocks. Parameters that govern the processes of uninsured idiosyncratic shocks are also set identical across the two countries. In particular, we assume that the idiosyncratic productivity, $e_{h,t}$, follows an AR(1) process. Since there is no equivalent study for European countries, following McKay *et al.* (2016) we set the autocorrelation coefficient equal to $\rho = 0.966$. We then calibrate the unconditional variance, σ_e, to target the EU wide wage inequality of 0.30 between 2010-2015 as discussed in Vacas-Soriano *et al.* (2020). We discretize this AR(1) process with a 3-state Markov chain using the method in Rouwenhorst (1995). This method determines an equally spaced (in logarithms) state-space E, normalized to have a unit mean, and the 3×3 transition matrix $\Pi_{ee'}$.

Sovereign premium. The value of parameter, $\varkappa$, that governs the elasticity of the sovereign risk premium with respect to the net foreign debt, is set to 0.007, which is in line with the related literature, see e.g., Rabanal and Tuesta (2010, 2013) and Justiniano and Preston (2010).

Targeted policy variables. Regarding fiscal policy variables, the initial public debt to output ratios, $\frac{B}{Y}$ and $\frac{B^*}{Y^*}$, are targeted to 70% and 150% for the Core and the Periphery, respectively, to mimic the public debt asymmetry in 2020 (see Figure 1). Government consumption to output ratios are targeted to be equal to the weighted-average value of the Final Consumption Expenditure (FCE) of Government over GDP in the union for 2010-2020 period. Thus, labor tax adjusts residually in order to satisfy the respective government budget constraints in both countries.

Regarding the union-wide inflation target, although the European Central Bank (ECB) has an annual inflation target of 2% (quarter to quarter target, $\bar{\pi} = \frac{2\%}{4}$), the average EA wide inflation for the period 2010-2020 is around 1%. Therefore, we opt for setting the initial inflation π to $\frac{1\%}{4}$. The rest of the policy parameters and policy targets in the reformed economies that are used to compute transitional dynamics are discussed in

[7]This assumption is then relaxed in Section 6 where the values are asymmetric for the Core and the Periphery.

section 4.

3.2 Status quo stationary equilibrium

This section presents the numerical solution of the status quo stationary equilibrium. The numerical solution of the status quo stationary equilibrium indicates that our model captures qualitatively and, to some extent, quantitatively key features of the EA over the 2010-2020 period (see Figure 1 and 2). Thus, the status quo stationary equilibrium will serve as the point of departure in our policy experiment below.

Table 2: Macro and International Macro variables

Description	Model	Value
Sovereign spreads in the Per.	$i - i^*$	0.0042
Net foreign assets in the Core	$\frac{NFA}{Y}$	0.354
Net foreign assets in the Per.	$\frac{NFA^*}{Y^*}$	-0.354
Labor tax in the Core	τ^l	0.235
Labor tax in the Per.	τ^{l*}	0.256

Table 3: Within country distributional variables

Variable	Model	Data	Variable	Model	Data
Gini(a_h)	0.68	0.74[a]	Gini(y_h^{NI})	0.22	0.29[b]
Gini(a_h^*)	0.62	0.60[a]	Gini($y_h{}^{*,NI}$)	0.23	0.33[b]
$B_{40\%}(a_h)$	1%	0%[c]	$B_{40\%}(y_h^{NI})$	26%	22%[b]
$B_{40\%}(a_h^*)$	2%	5%[c]	$B_{40\%}(y_h^{*,NI})$	25%	19%[b]
$T_{10\%}(a_h)$	40%	59%[c]	$T_{10\%}(y_h^{NI})$	17%	23%[b]
$T_{10\%}(a_h^*)$	36%	46%[c]	$T_{10\%}(y_h^{*,NI})$	18%	25%[b]

Notes: "a_h" and "y_h^{NI}" denote household wealth and income, respectively;

[a]Cowell and Van Kerm (2015) use data only for late 2010/early 2011;

[b]World Income Inequality Database is between 2010-2020;

[c]OECD.Stat contains only 3 obs. between 2009-2019.

Regarding macroeconomic imbalances, the results in Table 2 suggest that due to fiscal imbalances, namely, public debt asymmetry between the Core and the Periphery, external imbalances similar to those observed in the EA during the 2010-2020 period emerge.

Regarding within-country imbalances, Table 3 shows that public debt asymmetry can explain a significant part of within-country wealth and income inequality. In particular, wealth inequality is higher in the Core vis-à-vis the Periphery, while income inequality is higher in the Periphery vis-à-vis the Core, which is in accordance with the data from the World Income Inequality Database, OECD and Cowell and Van Kerm (2015).

In the next section, we analyse the main mechanisms through which public debt asymmetry can capture satisfactorily key features of the EA economy within our model.

3.3 Comparative statics: The role of public debt asymmetry

In this section, we explore the role of public debt asymmetry in a monetary union in explaining cross- and within-country heterogeneity. To do this, we compute a large set of stationary equilibria in which the Periphery's, $\frac{B^*}{Y^*}$, and the Core's, $\frac{B}{Y}$, public debt-output ratios are asymmetric, i.e., $\frac{B^*}{Y^*} > \frac{B}{Y}$. We examine the effects on the cross- and within-country heterogeneity when public debt asymmetry is reduced in the monetary union. That is, we gradually decrease the degree of asymmetry by reducing the Periphery's public debt to output ratio, $\frac{B^*}{Y^*}$, from its status quo value, i.e., $\frac{B^*}{Y^*} = 1.5 > \frac{B}{Y} = 0.7$, to a value that eliminates asymmetry, i.e., $\frac{B^*}{Y^*} = \frac{B}{Y} = 0.7$. All other parameters and policy variables are as in section 3.1.

Figure 3 compares stationary equilibria as we vary $\frac{B^*}{Y^*}$ on the x-axis. Specifically, the top panel of Figure 3 presents key macroeconomic and international macroeconomic endogenous variables of the model, while the bottom panel presents Gini indices of inequality. The blue, red, and grey dashed lines represent the Core, the Periphery, and their relative or union variables, respectively. We start by discussing the cross-country effects of public debt asymmetry.

Cross-country heterogeneity. In a monetary union with public debt asymmetry similar to the respective asymmetry observed between the EA Core and Periphery, cross-country macroeconomic and international macroeconomic imbalances emerge. Specifically, the country with the relatively higher debt-output ratio, $\frac{B^*}{Y^*}$, would become a net external debtor, $\frac{NFA^*}{Y^*} < 0$, i.e., the Periphery (see red lines in the top panel). On the other hand, the country with the relatively lower public debt-output ratio would become a net external creditor, i.e., the Core (see blue lines in the top panel). The Periphery's net external debt leads to higher interest rates vis-à-vis the Core due to sovereign premia. Since the interest rate is higher in the Periphery, naturally the households in the Periphery save more (see the ratio $\frac{A^*}{Y^*}$ to $\frac{A}{Y}$). In addition, a higher interest rate is needed for both countries to induce higher asset accumulation to sustain a higher total public debt in the monetary union. Put it differently, similar to Aiyagari and McGrattan (1998) and Floden (2001), the higher the total debt in the economy, the higher the interest rate should be to clear the asset market.[8] Furthermore, the Periphery's government needs to levy a higher labor tax *vis-à-vis* the Core to sustain the higher public debt-output ratio. As a result of all the above, in stationary equilibria where the public debt-output ratio in the Periphery is reduced, i.e., public debt asymmetry is lower, external indebtedness, interest

[8] Aiyagari and McGrattan (1998) employ a model with physical capital, however an increase in public debt will have qualitatively similar effects on total asset accumulation.

rates, labor taxes, and asset accumulation in the Periphery reduce. Having discussed the cross-country imbalances, we now turn to within-country heterogeneity.

Within-country heterogeneity. The bottom panel of Figure 3 presents Gini indices of wealth and earnings in the left and right panels, respectively.[9] Our model suggests that a higher public debt-output ratio is related to lower wealth inequality and higher earnings inequality (and income inequality). In other words, wealth inequality would be lower in the country with relatively higher public debt, while earnings inequality would be higher (compare the red with the blue lines). Consequently, our comparative statics indicate that as the Periphery's public debt-output ratio reduces, wealth inequality would increase while earnings inequality would decrease.

Moreover, changes in the degree of public debt asymmetry, i.e., changes in the level of public debt of one country, would not affect only inequality indicators in the country which undertakes the fiscal consolidation policy but also inequality indicators in the other country. Specifically, reducing the public debt-output ratio in the highly indebted country would result in changes in inequality in the low-indebted country. Below we explain the economic logic of these results within our model.

Our model's relationship between public debt and wealth inequality works via asset accumulation and interest rates. The relatively higher public debt in the Periphery, coupled with relatively higher interest rates, leads to higher asset accumulation. Subsequently, higher asset accumulation leads to lower wealth inequality since the wealth-poor households have a higher propensity to save, i.e., for a given increase in the interest rates, they save proportionally more than the wealth-rich households. Put it differently, wealth-rich households already have the buffer stock of assets to insure themselves against idiosyncratic shocks, while wealth-poor households do not. Therefore, when saving has higher returns, the latter build up a buffer stock of assets.[10]

Earnings for a household at any given pair of wealth, a_h, and idiosyncratic productivity, e_h, are a positive function of their equilibrium labor supply and net (from labor tax) real wage. The higher their labor supply and/or the net real wage, the more their earnings increase. In stationary equilibria with lower public debt-output ratios in the Periphery, i.e., $\frac{B^*}{Y^*}$, the following two mechanisms lead to lower earnings inequality in both countries.

First, due to lower public debt and subsequently lower interest payments, national governments could reduce distortionary labor taxes. Obviously, the reduction in the Periphery is much larger. Lower labor taxes result in higher net real wages and, ceteris paribus, higher net earnings. The cut in labor taxes induces the usual substitution and income effects which tend to increase and decrease households' labor supply, respectively,

[9] We show earnings inequality because it is the biggest factor of income inequality, see Appendix B.3 for details. In our results, income and earnings inequalities always "co-move" across stationary equilibria.

[10] For a similar result regarding this point see Angelopoulos *et al.* (2021).

conditional on the pair of a_h and e_h. Thus, in our model, the equilibrium effect of lower public debt, $\frac{B^*}{Y^*}$, on labor supply depends on the level of wealth and productivity of each household.[11] For households that hold enough assets and/or are more productive, the income effect reduces their equilibrium labor supply. As the public debt-output ratio decreases, these households work less, and as a result, earnings increase by less or even fall. On the other hand, for households that hold relatively few (or no) assets and/or are less productive, the income effect is less significant, which implies that the reduction in their labor supply is small (or even slightly increases). As a result, their earnings rise more due to labor tax cuts than wealth-rich and/or productive households' earnings. This mechanism implies a reduction in earnings inequality.

Second, as we discussed above lower public debt to output ratio, $\frac{B^*}{Y^*}$, leads to lower wealth accumulation (consistent with lower interest rates). This means that the distribution of a_h changes as $\frac{B^*}{Y^*}$ reduces. In effect, the latter implies that a larger share of households would possess relatively less assets vis-à-vis a stationary equilibrium with higher $\frac{B^*}{Y^*}$. Indicatively, 13% of households in the Periphery hold zero assets when $\frac{B^*}{Y^*} = 1.5$, but this share shoots up to 17.6% when $\frac{B^*}{Y^*} = 0.7$. Thus, earnings decrease by less (or even increase) for a larger share of households, reinforcing the mechanism discussed in the previous paragraph and intensifying the reduction in earnings inequality. Note that a useful statistic that effectively captures this feature is the covariance between the supply of hours and the idiosyncratic productivity. This covariance becomes smaller (or more negative) so long as $\frac{B^*}{Y^*}$ is smaller.[12]

All in all, the analysis of this section demonstrates that public debt asymmetries can explain a significant part of within-country inequality differences observed between the Core and the Periphery.[13] The finding that the country with the relatively higher debt-output ratio in the stationary equilibrium exhibits lower wealth inequality but higher earnings inequality is consistent with the respective relationships in the data. Figure A2 in Appendix A.3 compares long-run averages of assets over income ratio and inequality indices against long-run averages of public debt using aggregate data for the countries under study. A positive relationship between inequality and debt can be also found in Azzimonti *et al.* (2014), Online Appendix, Tables O1 and O2. However, their theoretical focus is on how inequality leads to higher public debt, while here, we show that there is

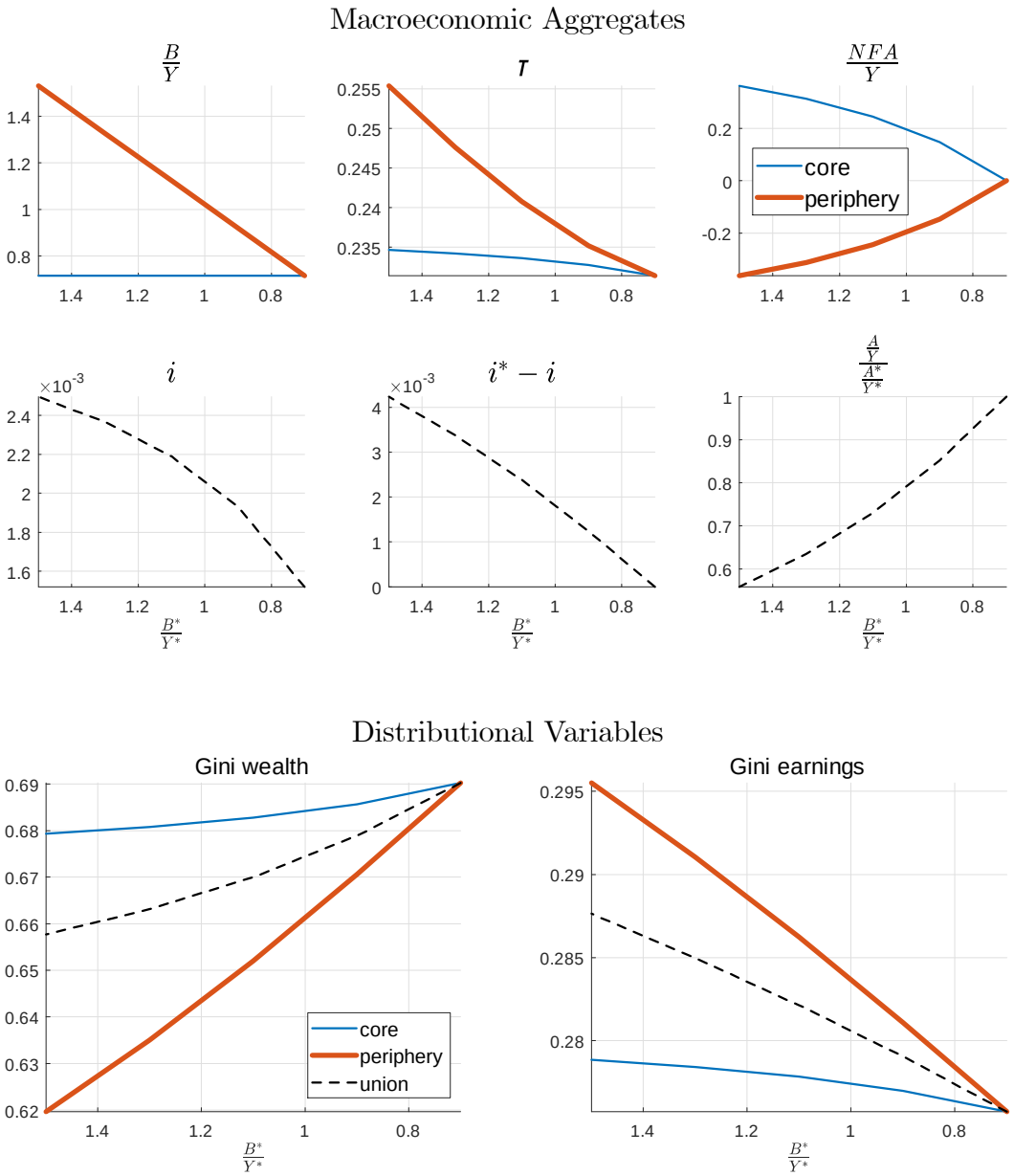
[11] See Figure A1 in Appendix A.3 where we compare the labor supply functions between the two polar cases, i.e. $\frac{B^*}{Y^*} = 1.5$ vs. $\frac{B^*}{Y^*} = 0.7$. The policy functions of labor supply move downwards for most households (especially for the Periphery).

[12] The covariance between hours and idiosyncratic productivity is also an important statistic when we decompose earnings inequality as we will see in Appendix B.3. The covariance is the main factor that captures the bulk of the change in earnings inequality along the transition path.

[13] In section 6.1, we enrich the baseline model with more empirically relevant asymmetries. However, these do not alter our key results related to cross- and within-country heterogeneity (see Table 7 and Figure C1 in Appendix C.1).

a different channel from public debt to inequality.

Figure 3: Stationary Equilibria with debt asymmetries.



Note: We present the annualized value of $\frac{B^*}{Y^*}$, i.e., the model-based value is multiplied by four.

4 Policy experiment

In this section, we specify our policy experiment, i.e., fiscal reforms in the EA debt-output targets. As discussed, the stationary status quo equilibrium of section 3.2 captures some of the key cross- and within-country imbalances as shown in Figures 1 and 2. Thus, in what follows, it will serve us as the point of departure. That is, the EA economy starts from

the status quo stationary equilibrium and travels towards alternative reformed economies.

EA debt-output targets. The three reformed economies differ in the level of public debt-output targets that each EA country member should meet in the new reformed economy, i.e., $\frac{B}{Y}$ and $\frac{B^*}{Y^*}$ in equations (9) and (10). Specifically, the three scenarios that we consider are as follows. First, we consider a fiscal scenario that mimics the Maastricht Treaty (MT). Thus, both countries should meet their formal debt targets, i.e., the Periphery should reduce public debt-output ratio from 150% to 60% while the Core should reduce public debt-output ratio from 70% to 60%. This scenario is referred to as "*Fiscal Formality*" (*FF*). Second, we study a fiscal consolidation scenario in which EA public debt-output targets would be revised closer to their recent historical levels. Specifically, the Periphery's debt-output target is revised from 60% to 100%, while the Core's debt-output target is revised from 60% to 70%. This means that the Periphery should reduce public debt-output ratio from 150% to 100%; while the Core just adopts a debt stabilization policy around its current debt-output ratio. This scenario is referred to as "*Fiscal Realism*" (*FR*). Third, we consider the case in which the Core expands while the Periphery consolidates. Specifically, the Periphery would reduce public debt-output ratio from 150% to 100%. However, the Core is allowed to increase its public debt-output ratio from 70% to 100%. This scenario is referred to as "*Fiscal Accommodation*" (*FA*). Numerical solutions for the three reformed economies are presented in section 5.1.

Fiscal and monetary policy reaction. Along the transition from the status quo economy to each of the reformed economies, the national fiscal policies follow the fiscal rules (9) and (10) while the union-wide monetary policy follows the Taylor rule (19). We calibrate the fiscal policy feedback coefficients, γ and γ^*, to deliver the speed of debt consolidation that is in line with the 1/20th rule defined in the SGP reform, while the feedback coefficient on inflation over its target, ϕ_π, is set equal to 1.3 (see section 5.3 for more details on the role of monetary policy reaction against inflation).[14]

Markup shock. Finally, to mimic the current (post-2022) high inflation environment, we implement an AR(1) union-wide markup MIT shock, m_t, with persistence parameter, $\rho_m = 0.5$ and $\epsilon_1 = 0.156$. This would imply an annualized inflation hike of 10% in the first year and around 5% at the end of the second year, under the FF scenario.[15]

[14] The EU debt-reduction rule requires the country to reduce the difference between the current debt level and the 60% target by 1/20th annually. Therefore, we can model the 1/20th rule at quarterly basis as $\frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}} = -\frac{1}{20\times 4}\left(\frac{B_{t-1}}{Y_{t-1}} - \frac{B}{Y}\right)$. As such, the half-life can be shown as $hl = \frac{\log(0.5)}{\log(1-\frac{1}{20\times 4})} = 55$ quarters. In section 6.2 we perform a sensitivity analysis with respect to the values of the fiscal policy feedback coefficients.

[15] The inflation persistence generated by this markup shock is consistent with the ECB staff projections (released in September 2022) on the euroarea-wide inflation in 2022 and 2023. Section 6.3 conducts a sensitivity analysis with respect to the persistence of the union-wide markup shock.

Table 4: Policy targets and feedback policy coefficients

	Fiscal Formality(FF)	*Fiscal Realism (FR)*	*Fiscal Accommodation (FA)*
$\frac{B}{Y}$	4*0.6	4*0.7	4*1
$\frac{B^*}{Y^*}$	4*0.6	4*1	4*1
$\overline{\pi}$	$\frac{2\%}{4}$	$\frac{2\%}{4}$	$\frac{2\%}{4}$
ϕ_π	1.3	1.3	1.3
γ	0.022	0.025	0.026
γ^*	0.022	0.025	0.026

We compute the transition path from the status quo to each of the three reformed economies implementing the first-order perturbation method in the sequence space developed by Auclert *et al.* (2021a) (see Appendix B for details). Having the transition path of the economy allows us to calculate welfare gains/losses of the households conditional on their initial position in the wealth distribution (see Appendix B.2 for details). Table 4 lists the policy targets and feedback policy coefficients in the three fiscal consolidation scenarios.

5 Results

This section presents the results from our policy experiment. We start by presenting the numerical solutions of each of the stationary reformed economies in section 5.1. Then, in section 5.2, we present transitional dynamics from the status quo economy towards the reformed economies. Results from our welfare analysis are presented in section 5.2.1, section 5.2.2 explain the underlying mechanisms while section 5.2.3 presents the implications for within-country cross-sectional inequality.

5.1 Reformed stationary economies

This section presents the numerical solutions of the reformed economies defined in section 4. Specifically, columns [2]-[4] of Table 5 present reformed economies *FF*, *FR*, and *FA*, respectively, while the numerical solution of the status quo economy is presented in column [1] for comparison. Rows 1 to 13 report key macroeconomic and international macroeconomic endogenous variables, while rows 14 to 17 report measures of within-country inequality, i.e., Gini indices of assets and income.

Table 5: Reformed Stationary Equilibria

	[1] *"Status Quo"*	[2] *"Fiscal Formality"*	[3] *"Fiscal Realism"*	[4] *"Fiscal Accommodation"*
i	0.0000	0.0003	0.0021	0.0043
i^*	0.0042	0.0003	0.0039	0.0043
i^*-i	0.0042	0.0000	0.0018	0.0000
r	-0.0025	-0.0047	-0.0029	-0.0007
r^*	0.0017	-0.0047	-0.0011	-0.0007
$\overline{\pi}$	0.0025	0.0050	0.0050	0.0050
τ^l	0.235	0.229	0.233	0.240
$\tau^{l,*}$	0.255	0.229	0.238	0.240
$w(1-\tau^l)$	0.651	0.656	0.652	0.647
$w^*(1-\tau^{l,*})$	0.634	0.656	0.649	0.647
C	0.798	0.798	0.798	0.798
C^*	0.797	0.798	0.799	0.798
Y	1.0009	1.0007	1.0012	1.0013
Y^*	1.0000	1.0007	1.0013	1.0013
$\frac{NFA^*}{Y^*}$	-0.354	0.000	-0.196	0.000
Gini(a_h)	0.679	0.704	0.684	0.656
Gini(a_h^*)	0.620	0.704	0.661	0.656
Gini(y_h^E)	0.279	0.272	0.277	0.285
Gini$(y_h^{*,E})$	0.296	0.272	0.284	0.285

Notes: "a_h" and "y_h^E" denote wealth and earnings, respectively

By comparing macroeconomic aggregates across reformed economies (say column [1] with column [2]), one can see that fiscal consolidation reduces net external debt, which lowers sovereign premia, nominal and real interest rates in the Periphery. There is also a smaller in magnitude reduction of nominal and real interest rates in the Core. Moreover, lower public debt coupled with lower borrowing costs lead to lower labor taxes and as a result to higher net real wages, hours worked, output and consumption in both countries. Thus, fiscal consolidation results in an aggregate long run macroeconomic benefit.

The last four rows of Table 5 present Gini indices of wealth and earnings inequality across countries and reformed economies. Fiscal consolidation leads to a rise in wealth inequality and a reduction in earnings inequality (compare [1] with either of [2],[3],[4]). Thus, such a reform does not lead to a clear-cut improvement of within-country inequality. National fiscal policymakers face a trade-off and need to make a value judgment.

5.2 Transitional dynamics

In what follows we study transitional dynamics, that is the economy starts from the status quo stationary equilibrium computed in section 3.2 and travels towards one of the reformed economies of Table 5. Policy targets and feedback policy coefficients in the transition are those that have been specified in section 4.

5.2.1 Welfare

In this section, we use welfare to rank the alternative EA public debt targets of section 4. Our model, which features cross- and within-country heterogeneity, enables us to evaluate such reforms across and within countries. To evaluate welfare we need a welfare criterion, as our welfare criterion we use the consumption equivalent variation (CEV) conditional on the relative position of each household in the initial wealth distribution, i.e., the wealth distribution in the status-quo stationary equilibrium. Following, e.g., Domeij and Heathcote (2004) and Kitao (2008), the CEV for each household is defined as the percentage change in consumption required to be given to a household, such that the household is indifferent between remaining in the status quo economy as opposed to the economy that follows the dynamic transition under different fiscal consolidation reforms (for a formal definition see Appendix B.2.).

Figure 4 plots the CEV in percentage points (y-axis) of a household conditional on their asset holdings in the status quo equilibrium (x-axis). The grey solid, the blue dashed, and the red dotted lines correspond to the CEV functions under the *FF*, *FR* and *FA* scenarios, respectively, for the Core (left panel) and the Periphery (right panel) households. Finally, to understand the status quo wealth distribution within each country we introduce the blue dashed and dotted vertical lines which mark the 50th and 90th percentile, respectively.[16]

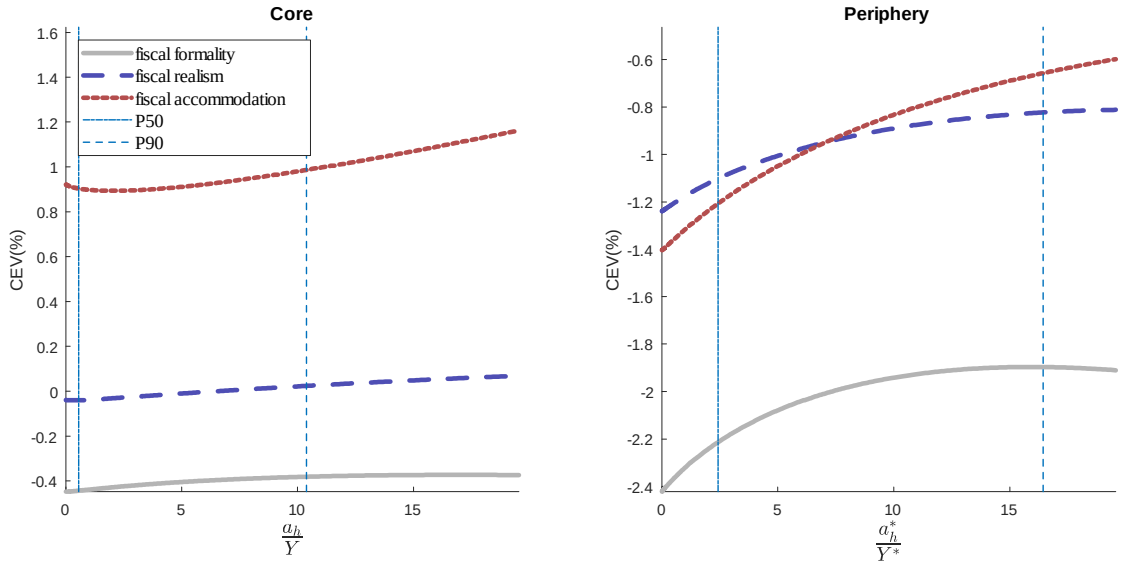
Figure 4 yields a number of interesting results. First, fiscal consolidation policy that targets debt-output ratios implied by the *FF* scenario is quite costly in terms of welfare across and within countries. Second, all three fiscal consolidation scenarios are less harmful (or even beneficial) in the Core than the Periphery for any level of wealth that a household holds at the status quo equilibirum.[17] Third, a revision of EA debt targets, say from *FF* to *FR* and/or *FA*, can mitigate welfare losses at any level of wealth in both countries. In other words, revising EA debt targets closer to their historical levels can make fiscal consolidation more affordable across and within countries. Since the *FF* scenario mimics the actual public debt-output targets that national fiscal policymakers should meet to comply with the current EA treaties, the findings of Figure 4 provide a strong rationale for reforming EA debt targets.

[16] The households at the far right of the x-axis have zero mass.

[17] Note that the two subplot do not have aligned y-axes.

Regarding the welfare ranking of EA debt targets of section 4, Figure 4 implies a clear-cut welfare ranking for the Core. That is, *FA* ranks higher than *FR* in terms of welfare at any level of wealth, while the *FF* scenario is the worst, i.e., generates the higher welfare losses for any level of wealth. In the Periphery, although both *FR* and *FA* scenarios are strictly better (or less harmful) than the *FF* scenario, the welfare ranking of *FR* and *FA* for a particular household depends on its initial wealth. For a large proportion of households who hold relatively less assets in the status quo equilibrium, the *FR* scenario outperforms the *FA* scenario. At the same time, for a smaller proportion of households who hold relatively more assets, the *FA* scenario is better than the *FR* scenario.[18]

Figure 4: Conditional welfare gains



Note: The scale of the x-axis is normalized by transforming assets divided by country GDP.

Table 6 follows the logic of Figure 4 but focuses on three specific percentiles conditional on the status quo wealth distribution at the Union, the Core, and the Periphery. Specifically, we compute the CEV of the tenth (P_{10}), the fiftieth (P_{50}), and the nineteenth (P_{90}) percentile, which can be thought as representing the wealth-poor, the wealth-median, and the wealth-rich households in each entity (superscripts u and $*$ denote the Union and the Periphery respectively).[19] Moreover, Table 5 computes the CEV for the weighted-average welfare of the Union, the Core, and the Periphery, these are computed using the individ-

[18] The CEV function under the *FR* scenario in the Periphery (i.e., blue dashed line in the right panel of Figure 4) intersects with the CEV function under the *FA* (i.e., the red dotted line in the right panel of Figure 4) at the 63rd percentile.

[19] We are agnostic whether the household holding wealth equal to a specific percentile in the Union resides in the Core or the Periphery. It is a mere calculation of the conditional welfare losses/gains of a household with a specific relative position in the cross-sectional distribution of the Union.

ual household CEV weighted by the status quo wealth distributions and the relative size of the two countries (note that the two countries have equal size, namely 0.5). Columns labelled [1], [2] and [3] corresponds to *FF*, *FR*, and *FA* scenarios, respectively.

Table 6: Conditional welfare gains in % CEV

	Percentiles	[1] *"Fiscal Formality"*	[2] *"Fiscal Realism"*	[3] *"Fiscal Accommodation"*
Union	P_{10}^{u}	-1.43	-0.64	-0.24
	P_{50}^{u}	-1.36	-0.60	-0.20
	P_{90}^{u}	-1.14	-0.40	0.15
	Average	-1.30	-0.54	-0.09
Core	P_{10}	-0.45	-0.04	0.92
	P_{50}	-0.44	-0.04	0.90
	P_{90}	-0.38	0.02	0.99
	Average	-0.43	-0.02	0.93
Periphery	P_{10}^{*}	-2.42	-1.24	-1.40
	P_{50}^{*}	-2.21	-1.10	-1.21
	P_{90}^{*}	-1.90	-0.82	-0.66
	Average	-2.18	-1.06	-1.11

Note: Percentiles are computed using the distribution of wealth in the status quo stationary equilibrium.

Results in Table 6 confirm the key findings arising from Figure 4. Under the strict *FF* scenario, fiscal consolidation is quite costly for the Union, with 1.30% CEV losses, and more costly for the Periphery, 2.18% CEV losses, than the Core, 0.43% CEV losses, on average. Table 6 illustrates that under the *FF* scenario, the wealth-poor and the wealth-median households in the Periphery incur the higher CEV losses, i.e., 2.42% and 2.21% in CEV. On the other hand, the wealth-rich households in the Core incur the smallest CEV losses, i.e., 0.38%. A comparison of the CEVs in column [2] with column [1] suggests that all households would benefit from reforming EA debt-output targets, in particular from *FF* to *FR*. Such a reform would benefit the wealth-poor/median households in the Periphery relatively more; CEV losses for the wealth-poor(median) reduce from 2.42% (2.21%) to 1.24% (1.10%). However, going beyond the *FR* scenario by allowing the Core to expand while the Periphery consolidates will generate a conflict of interest between all households in the Core and the wealth-poor/median households in the Periphery. The latter reform of EA debt target increases the CEV losses for the wealth-poor(median)

households in the Periphery with respect to the FR scenario, i.e., from 1.24% (1.10%) to 1.40% (1.21%).

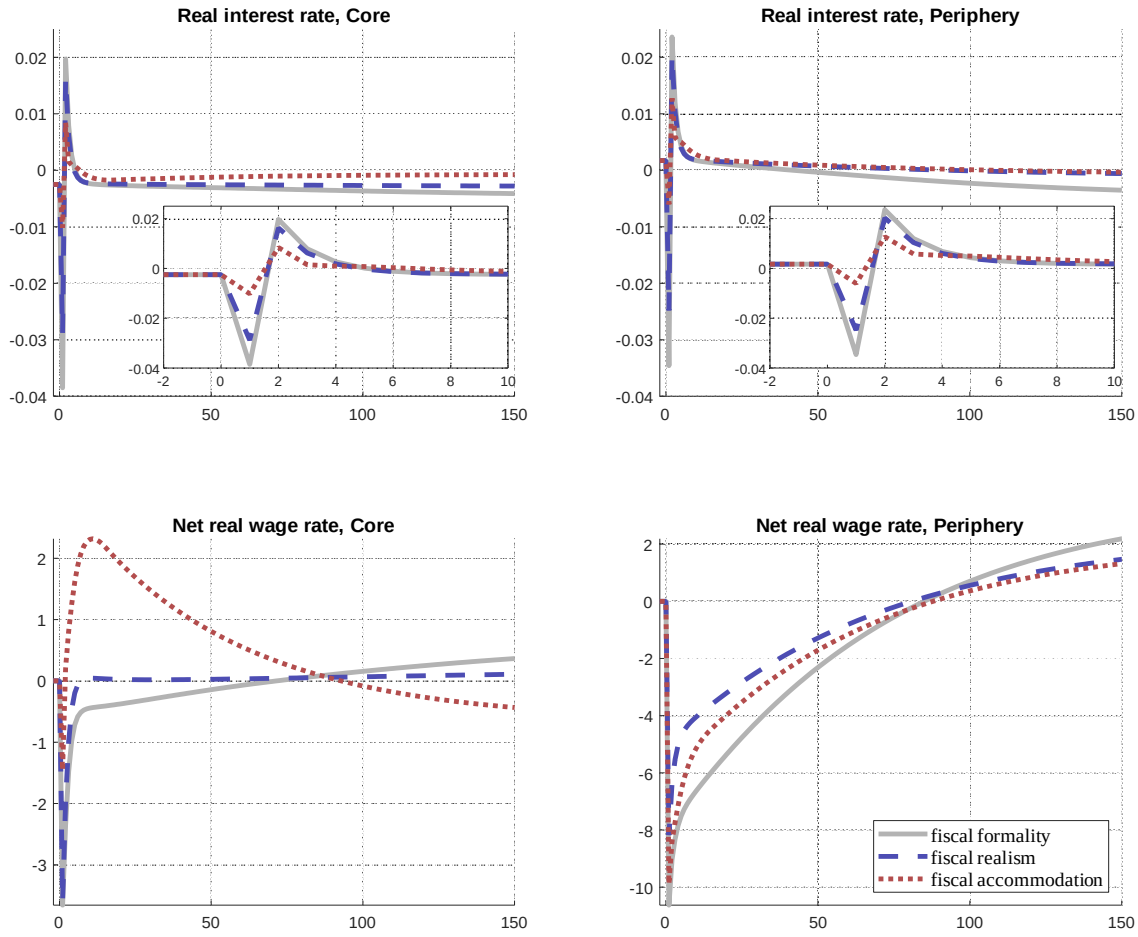
5.2.2 Underlying mechanisms

In this section, we explain the underlying mechanisms that drive our welfare results in section 5.2.1. Figure 5 illustrates the two main variables that dictate individual household choices, namely, the real interest rates and the net real wages under the three scenarios described in section 5.2.1 for the Core (left panel) and the Periphery (right panel). Then, Figures 6 and 7 present the individual choices, i.e., consumption and hours worked, which constitute the main arguments of life-time welfare for the wealth-poor, the wealth-median and wealth-rich households in the Periphery and the Core, respectively.[20] The *FF*, *FR,* and *FA* scenarios are illustrated by the grey solid, blue dashed and red dotted lines, respectively. The subplots within the plots in the upper panels of Figure 5 depict the dynamic path of real interest rates for the first 10 quarters. Note that real interest rates fall on impact due to the union-wide inflation hike generated by the markup shock, and subsequently, increase due to the reaction of the union's central bank which raises the nominal interest rates to counter inflation.

We start by explaining the welfare implications under the *FF* scenario (solid grey lines) and then analyze how reforming EA public debt-output targets could have heterogeneous cross- and within-country welfare implications. The analysis in 5.2.1 suggests that fiscal consolidation, say under the *FF* scenario, harms relatively more the wealth-poor households (esp. in the Periphery). In contrast, it harms relatively less the wealth-rich households (esp. in the Core). The Periphery is relatively more indebted vis-à-vis the Core as such the size of fiscal adjustment needed to meet the targets would be higher. At the same time, the initial wealth determines households reliance on sources of income that are heavily impacted in the short/medium run painful phase of fiscal consolidation, i.e., earnings. Thus, the size of public debt adjustment and the level of wealth that a household hold in the status quo stationary equilibrium eventually determines the welfare cost that this household will suffer during fiscal consolidation.

[20] To construct those series, we calculate the deviation of the average path of households at each percentile using the sequences of policy functions and prices under each reformed economy from the average path obtained using the status quo policy functions and prices. These are the average paths for households starting from a particular level of assets, here one of the 10th, 50th or 90th percentile. Note that the average path of any households, no matter the starting point, will converge to the terminal stationary distribution. For that reason, we do not merely calculate the deviation from an initial point but the deviation from the whole path. For more details regarding the calculation of the conditional welfare gains, see Appendix B.2.

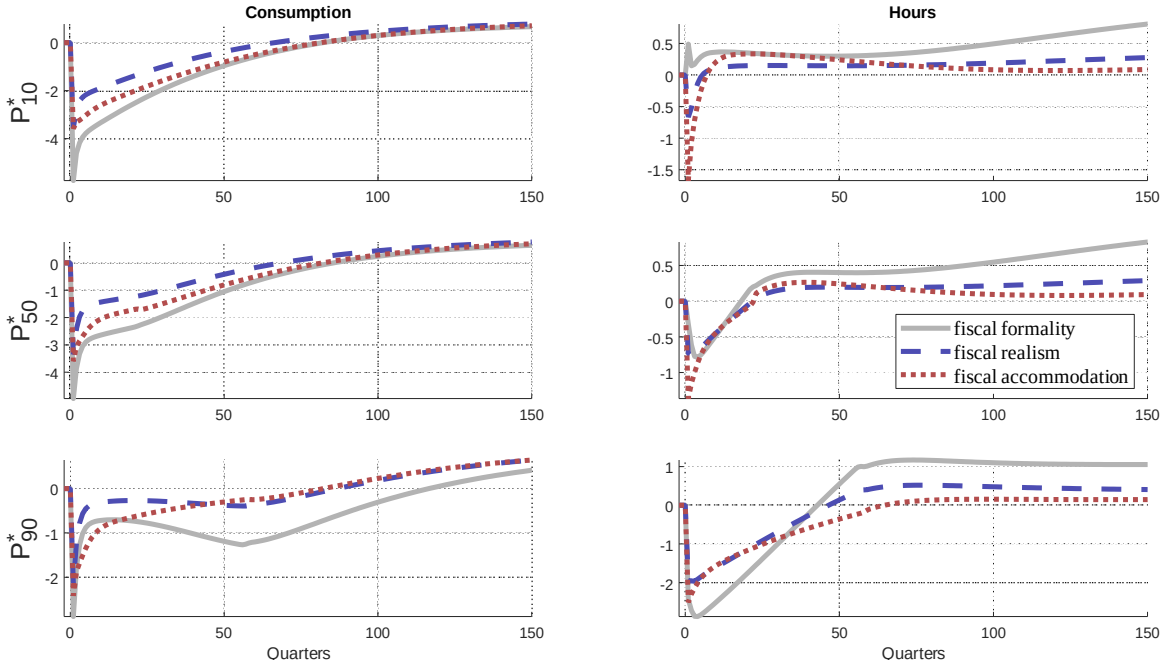
Figure 5: Real interest and net wage rates.



Specifically, the wealth-poor households rely more heavily on net real wage (i.e., earnings) than on wealth and income from assets compared to the wealth-median and the wealth-rich households. Indicatively, the total resources of a wealth-poor household in the Periphery are divided into 99% from earnings and only 1% from wealth in the status quo stationary equilibrium. A sizeable public debt consolidation, as the one undertaken in the Periphery under the *FF* scenario, would induce a significant hike in the labor tax and a large reduction in net real wage (see solid grey line in the bottom panel of Figure 5). This implies that the wealth-poor households reduce consumption and increase hours worked along the transition path (see solid grey lines in the first row of Figure 6). Both these responses lead to a deterioration of their lifetime welfare. A comparison of the respective responses between the Core and the Periphery indicates that net real wage falls more sharply in the Periphery vis-à-vis the Core (compare grey solid lines in the right (Periphery) and left (Core) bottom panel of Figure 5). Subsequently, the wealth-poor households in the Periphery are more severely affected vis-à-vis the wealth-poor house-

holds in the Core (compare the solid grey lines in the top panels of Figure 6 (Periphery) with 7 (Core)).

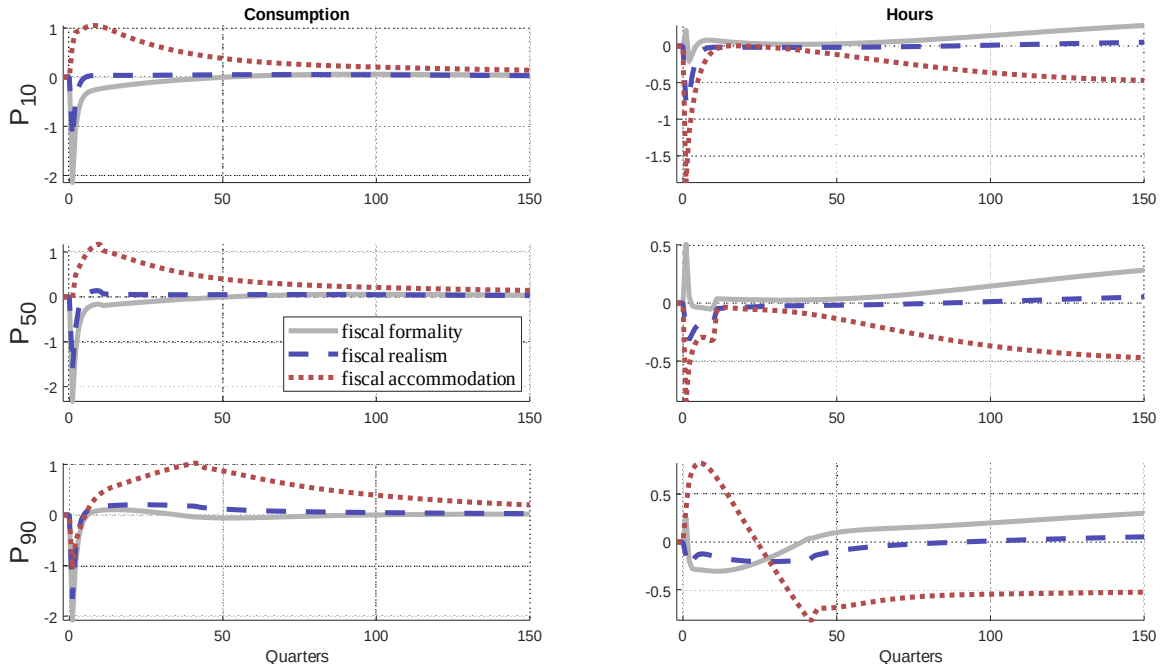
Figure 6: Dynamic responses of key endogenous variables conditional on the relative position in the status quo wealth distribution in the Periphery



Note: All graphs show percentage deviations.

On the other hand, the wealth-median/rich households hold more assets than the wealth-poor households and, as such, rely less on earnings. Indicatively, the total resources of wealth-median (rich) households are divided into 70% (94%) from wealth and only 30% (6%) from earnings in the Periphery, and 35% (91%) from wealth and 65% (9%) in the Core. In effect, these households can smooth consumption over time due to their accumulated wealth, which allows them to reduce hours worked during the short-/medium-run phase of fiscal consolidation, i.e., when labor taxes rise to bring the public debt-output ratio down. Grey solid lines in the middle and bottom panel of Figure 6 illustrate that wealth-median/rich households in the Periphery incur a smaller reduction in their consumption while they can reduce hours worked for a prolonged period of time. Therefore, the welfare losses for these households are moderated. Similarly, a comparison of the middle and bottom panels of Figures 6 and 7 reveals that households in the Periphery are more severely affected than households in the Core.

Figure 7: Dynamic responses of key endogenous variables conditional on the relative position in the status quo wealth distribution in the Core



Note: As in Figure 6

Reforming EA public debt-output targets, say from *FF* to *FR*, would reduce the size of fiscal adjustment in the Periphery and thus allow for a relatively more moderate increase in labor tax during the short/medium run phase of fiscal consolidation. This feature allows the wealth-poor households to sustain a relatively higher level of earnings under *FR* with respect to the respective level under *FF* (compare the blue dashed with the grey solid lines in the bottom panel of Figure 5). As a result, the short/medium run reduction in consumption is smaller, allowing them to reduce hours worked in the short/medium run phase of fiscal consolidation (compare the blue dashed lines with the grey solid lines in the top panel of Figures 6 and 7). These mitigate the welfare losses for the wealth-poor in the Union and especially for the wealth-poor in the Periphery under *FR*.

However, going beyond the *FR* by allowing the Core to expand via labor tax cuts, i.e., under the *FA* scenario, welfare for wealth-poor/median households in the Periphery would deteriorate. The rising public debt to output in the Core would require extra funding, which in turn reduces available resources for the Periphery. Thus, the same reduction in the public debt-output ratio of the Periphery would require a higher increase in labor tax which induces a larger reduction in net real wage along the transition (compare red dotted with the dashed blue line in Figure 5 for the Periphery). Although hours worked reduce relatively more under *FA* with respect to *FR*, consumption loss is higher

in the short/medium run phase of fiscal consolidation. The latter effect dominates for wealth-poor/median households in the Periphery. On the contrary, the *FA* scenario is particularly beneficial for the wealth-poor households in the Core. The mechanism at work is the following. The fiscal expansion in the Core leads to tax reduction during the transition. The wealth-poor household exhibits the largest marginal propensity to consume compared to wealth-median/rich households. Thus, they respond to the tax cut with a significant consumption increase and reduced hours worked, as shown in Figure 7 (compare the red dotted lines of top with middle and bottom panels).

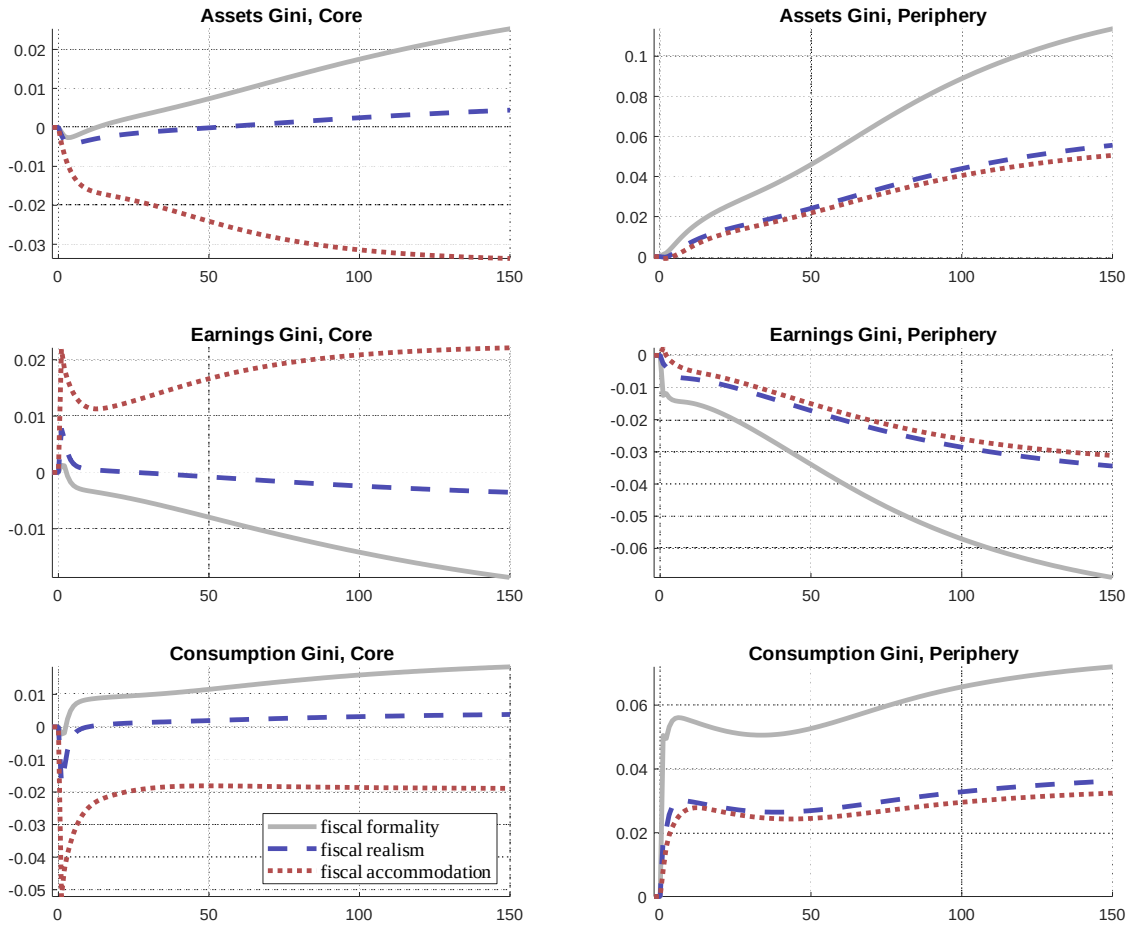
5.2.3 Within-country cross-sectional inequality

Fiscal consolidation policy and reforms of EA debt-output target as those specified in section 4 have significant implications for *cross-sectional* inequality within each country. In this section, we compute some popular inequality indicators to explore these implications. Specifically, Figure 8 computes wealth, earnings, and consumption inequality, i.e., Gini indices, under the *FF, FR,* and *FA* fiscal consolidation scenarios for the Core (left panels) and the Periphery (right panels). To construct these indices we use the policy functions $\{q_t^a\left(a_{h,t-1}, e_{h,t}\right),\ q_t^l\left(a_{h,t-1}, e_{h,t}\right),\ q_t^c\left(a_{h,t-1}, e_t\right),\ q_t^{a*}\left(a_{h^*,t-1}^*, e_{h^*,t}^*\right),\ q_t^{l*}\left(a_{h^*,t-1}^*, e_{h^*,t}^*\right),\ q_t^{c*}\left(a_{h^*,t-1}^*, e_{h^*,t}^*\right)\}$ and the respective households distributions along the transition, $\{\lambda_t(a_{h,t-1}, e_{h,t}),\ \lambda_t^*(a_{h^*,t-1}^*, e_{h^*,t}^*)\}$. We show them as percentage deviations from status quo steady state.

Regarding wealth inequality, the top panel of Figure 8 illustrates that fiscal consolidation policy leads to a significant rise in wealth inequality after the very short run. The worst scenario for wealth inequality is *FF* while reforming EA debt-output targets, say from *FF* to *FR*, can significantly reduce the rise in wealth inequality caused by fiscal consolidation policy. Moreover, adopting debt-output targets implied by the *FA* scenario can improve wealth inequality in the Core; however, the improvement of this metric for the Periphery is quantitatively small.

The main channels through which fiscal consolidation affects wealth inequality is via asset accumulation (or depletion) and the path of real interest rates (for the path of real interest rates see Figure 5). Specifically, under *FF* (solid grey lines), in the very short run higher real interest rates induce households to save more, i.e., accumulate wealth, which leads to a short-run reduction in wealth inequality across countries. However, in the medium/longer run, households deplete assets, especially the wealth-poor, and thus wealth inequality rises. Households use their assets to support their consumption, and this effect is more pronounced for the wealth-poor. At the same time, households expect that in the long-run the returns to assets will fall, and hence they dissave. As a result, a larger proportion will end up with lower wealth.

Figure 8: Wealth, earnings and consumption inequality



Note: Percentage deviations from status quo steady state.

Reforming EA debt-output targets from *FF* to *FR* will mitigate these effects, i.e., the reduction in the long-run real rates and the depletion of assets for precautionary motives and consumption smoothing. The improvement of wealth inequality in the Core under the *FA* scenario works through the same mechanisms. In our model, real interest rates are determined by the level of public debt at the union and country levels. Therefore, public debt works as a policy instrument that improves wealth inequality by enabling households to accumulate wealth and earn higher returns (see also Peruffo and Platzer (2022) for a similar argument).

The middle panel of Figure 8 illustrates that fiscal consolidation leads to a significant reduction in earnings inequality. This reduction is more pronounced in the Periphery and under the *FF* scenario (see the grey solid line in the right panel). In the short-/medium-run, fiscal consolidation requires labor tax rises to reduce the public debt-output ratio. This tax hike induces wealth-rich and more productive households to work less relative

to the status quo economy since the marginal value of each unit of consumption is low. In contrast, the wealth-poor and less productive households work more relative to the status quo economy since the marginal value of an extra unit of consumption is very high. Thus, earnings inequality is reduced due to the rise in hours worked by the latter *vis-à-vis* the decrease in hours worked by the former. The relative rise of labor supply is higher the higher the labor tax hike (in the short-run), i.e., the higher the reduction in public debt-output target.

In the long run, the economic logic of reduction in earnings inequality is the same as in section 3.3. In particular, there is a downward shift in labor supply due to income effects for most households apart from the wealth-poor and less productive households. However, the share of wealth-poor households increases as an outcome of the fiscal consolidation, and, since, the wealth-poor (less productive) households work more while the wealth-rich (more productive) households work less. This leads to a reduction in earnings inequality. This reduction is captured in the reduction in the covariance between labor supply and idiosyncratic productivity (see Figure B3 in Appendix B). For example, 86% (89%) of total reduction in earnings inequality is explained by the reduction in this covariance in the Periphery (Core). So, if the criterion is earnings inequality reforming EA debt-output targets from *FF* to *FR* and/or *FA*, then is not beneficial either for the Core or for the Periphery.

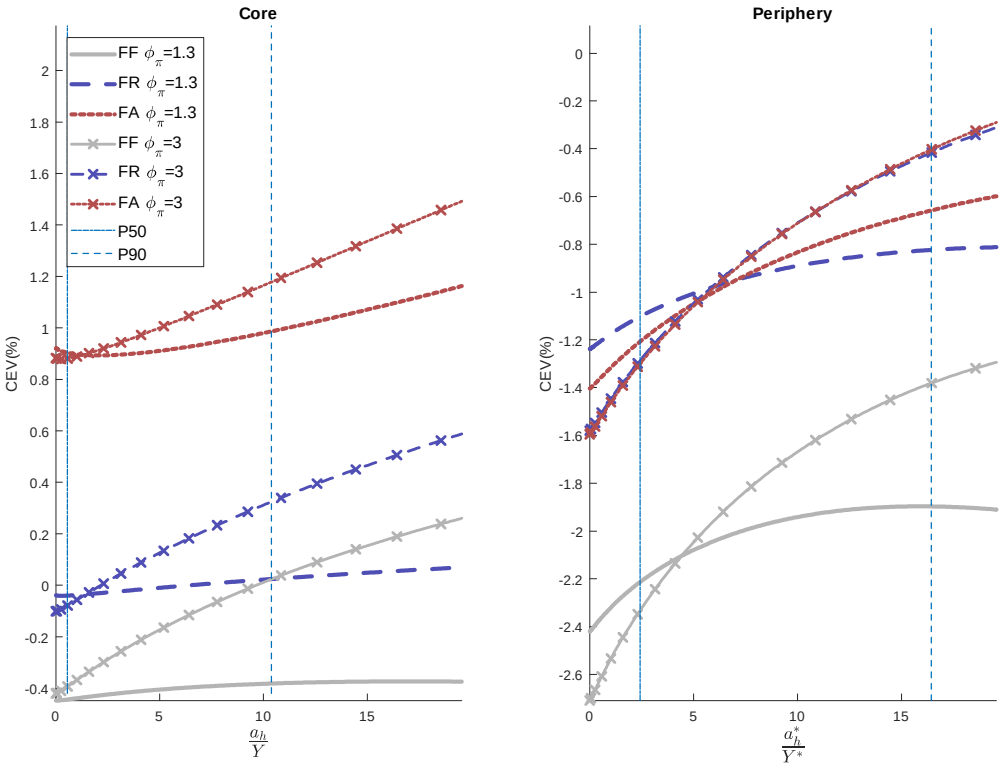
Regarding consumption inequality, the bottom panel of Figure 8 illustrates that consumption inequality increases across countries and fiscal consolidation scenarios (apart from *FA* for the Core see red dotted line in the left panel). Intuitively, consumption is a positive function of wealth, and since wealth inequality increases, consumption inequality will follow. In the short and medium run, the wealth-rich households (which consume more since consumption and wealth are positively correlated) use their assets to smooth consumption over time, so they can sustain relatively higher levels of consumption. On the other hand, the wealth-poor households (which are expected to consume less in comparison to the wealth-rich households) do not possess enough assets to insure themselves against the reductions in real net wages, i.e. they have to reduce consumption. As a result, households at the bottom of the distribution consume less compared to the households at the top and, consequently, consumption inequality increases. In the long run, the rise in consumption inequality is caused by the rise in wealth inequality which is driven by the fall in the real interest rates (see section 3.3). A reform of EA debt-output target, from FF to FR and/or FA, would significantly reduce the rise in consumption inequality, and this effect is more pronounced for the Periphery.

5.3 The role of monetary policy

In this section, we examine whether the union-wide monetary policy stance against inflation can affect the cross- and within-country implications of fiscal consolidation reforms specified in section 4. To do this, we assume that the single monetary authority reacts more aggressively to deviations of inflation from its target, i.e., we set ϕ_π equal to 3, in equation (19). In order to keep the half-life of fiscal consolidation consistent with the 1/20th rule (i.e., equal to 55 quarters), we need to recalibrate the national fiscal feedback policy coefficients, γ and γ^* in equations (9) and (10) respectively. The rest of the calibration is as in section 3, while we conduct the same policy experiment as in section 4.

In the interest of space, we present only Figure 9 which the counterpart Figure 4 of section 5.2.1. Figure 9 computes the CEV functions of a household conditional on their asset holdings in the status quo equilibrium under the *FF* (crossed dotted red lines), *FR* (crossed dashed blue lines) and *FA* (crossed grey solid lines) scenarios when union's single monetary policy reacts more aggressively to inflation, i.e., $\phi_\pi = 3$. For comparison purposes, Figure 9 also plots the analogous CEV functions when $\phi_\pi = 1.3$ (i.e., CEV functions of Figure 4).

Figure 9: Conditional welfare gains, more aggressive monetary policy



Note: The scale of the x-axis is normalized by transforming assets divided by country GDP.

We start by highlighting that the main qualitative welfare results discussed in section 5.2.1 hold. In addition, the analysis of this section unfolds some interesting findings related to the heterogenous welfare effects of monetary policy during fiscal consolidation. Specifically, a more aggressive reaction to inflation would disproportionately benefit households holding assets, i.e., the wealth rich households in each entity. This can be seen by comparing the CEV functions ($\phi_\pi = 3$, crossed lines) with CEV functions ($\phi_\pi = 1.3$, lines without crosses) in Figure 9, the upward shift (higher CEV gains and/or lower CEV losses) is getting larger as we move towards the right of the x-axis, i.e., for households' whose wealth in the status quo equilibrium is higher.

On the other hand, a more hawkish monetary policy makes fiscal consolidation more painful for poor-wealth households, especially in the Periphery. That is, wealth-poor households in the Periphery incur higher CEV losses across all fiscal consolidation scenarios. This can be seen by observing the downward shift in CEV functions ($\phi_\pi = 3$, crossed lines) with respect to the CEV functions ($\phi_\pi = 1.3$, lines without cross) for relatively low levels of wealth. The reason is that a higher interest rate increase leads to higher public debt service costs. Subsequently, this requires a larger labor tax rise to bring public debt-output ratio down to its new target. Thus, the wealth-poor households will see a larger reduction in their earnings which consists of the biggest proportion of their total income.

Thus, our analysis implies that the monetary policy stance against inflation generates a conflict of interest between the wealth-poor and wealth-rich households of the Union. This conflict of interest is more striking between the wealth-poor households of the Periphery and the wealth-rich households of the Periphery and the Core. Finally, we report that all the main findings of section 5.2.3 do not change.

5.4 The role of fiscal policy mix

So far, we have assumed that national fiscal policies employ only labor taxes to react to public debt-output deviations from its target. To examine whether an alternative fiscal policy mix will alter our main findings, in this section, we assume that national fiscal policies use the government consumption-output ratio to react to public debt-output ratio deviations from its target. That is we replace labor taxes, i.e., τ^l and $\tau^{l,*}$, with $\frac{G}{Y}$ and $\frac{G^*}{Y^*}$ in equations (9) and (10) respectively. Distortionary labor taxes are kept constant and equal to their status quo value. In addition, government consumption as a share of output increases in the new reformed economies to reap the benefit of lower public debt-output ratio. As before, in order to keep the half-life of fiscal consolidation consistent with the 1/20th rule (i.e., equal to 55 quarters), we need to recalibrate the national fiscal feedback policy coefficients, γ and γ^*. The rest of the calibration is as in section 3, while we conduct the same policy experiment as in section 4. In the interest of space, we present

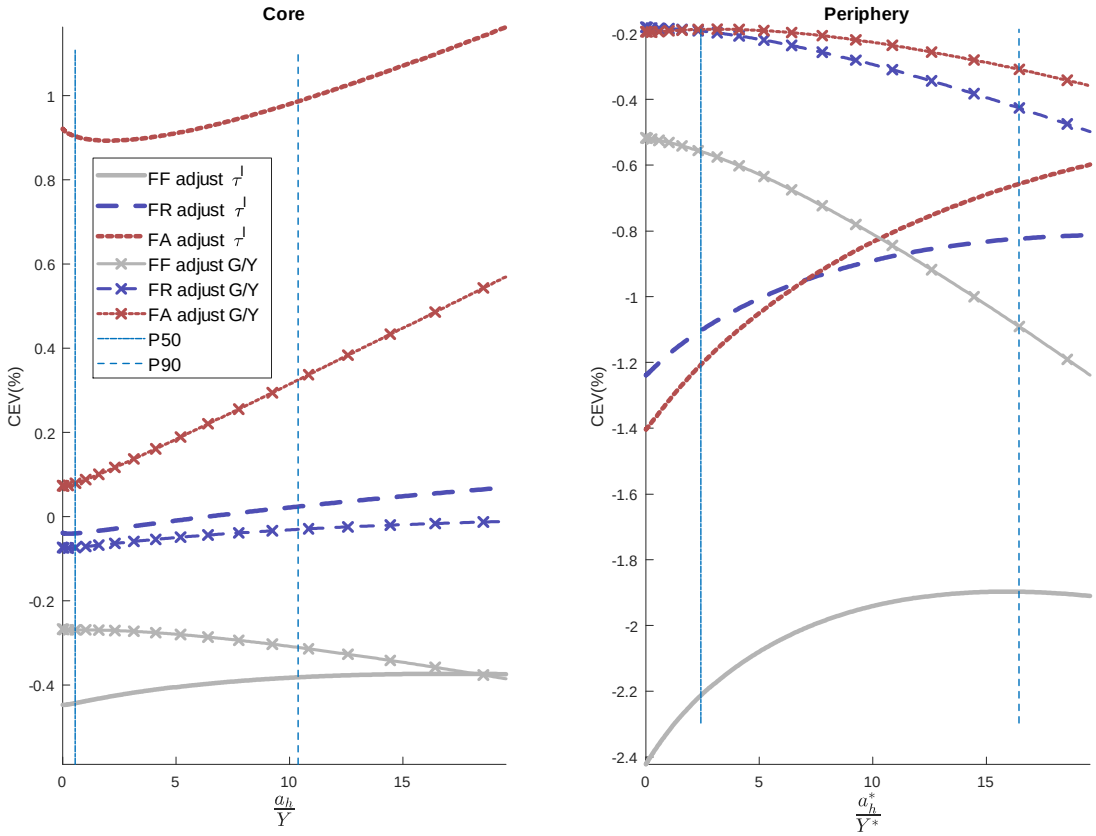
only the counterpart of Figure 4 in section 5.2.1. Figure 10 shows the CEV functions of a household conditional on their asset holdings in the status quo equilibrium under the *FF* (crossed dotted red lines), *FR* (crossed dashed blue lines), and *FA* (crossed grey solid lines) scenarios when $\frac{G}{Y}$ and $\frac{G^*}{Y^*}$ adjust to react to public-debt output ratios. For comparison purposes, Figure 10 also plots the analogous CEV functions when τ^l and $\tau^{l,*}$ adjust to react to public-debt output ratios (i.e., CEV functions of Figure 4).

We start by highlighting that the welfare rankings of EA debt targets, as discussed in section 5.2.1, do not change. We can infer the following results from comparing the spending-based *vis-à-vis* the tax-based fiscal consolidation mix. First, fiscal consolidation implemented via spending cuts is quantitatively less costly across and within countries (except for the very wealth-rich households in the Core, compare grey lines with and without cross markers in the left panel of Figure 10 towards the right end of the x-axis). The welfare improvement in CEV terms depends on the level of wealth that a household holds at the status quo equilibrium as well as the size of fiscal adjustment each country should undertake. The lower the level of wealth of a household (e.g., the wealth-poor) and the larger the size of fiscal adjustment (e.g., the Periphery), the higher the CEV improvement from using spending cuts vis-à-vis labor taxes to consolidate public debt. Indicatively, households in the Periphery with a relatively lower level of wealth would benefit the most in CEV terms when spending cuts are used for fiscal consolidation. This can be seen in the right panel of Figure 10 by comparing CEV functions with crossed lines with their counterparts without cross markers for each fiscal consolidation scenario, respectively. The upward distance of the spending-based CEV functions from the tax-based CEV functions becomes larger as we move towards the left of the x-axis (i.e., for lower levels of wealth). This property is also linked with the second result.

Second, within each country, fiscal consolidation implemented via spending cuts harms relatively more households holding more assets, i.e., the wealth-rich households in each country. This can be seen by comparing the downward slope of spending-based (crossed) CEV functions with respect to the upward slope of tax-based CEV functions (without cross markers) in Figure 10 (except for the *FR* and *FA* scenario in the Core, recall that under both these scenarios the Core does not consolidate).

Third, the benefits from reforming EA debt targets, i.e., from *FF* to *FR* and/or *FA*, are quantitatively smaller at each level of wealth across countries when government consumption is used to bring public debt down. The latter implies that the scope of reforming EA public debt targets is more acute when national fiscal authorities are restricted to use relatively more distortionary fiscal instruments, like labor taxes, because they have already exhausted their alternative fiscal buffers. On the other hand, when national fiscal authorities can utilize less distortive fiscal instruments, like government consumption, the scope of revising the EA public debt targets seems to be reduced.

Figure 10: Conditional welfare gains, consolidation via G/Y



Note: The scale of the x-axis is normalized by transforming assets divided by country GDP.

As expected, government consumption is a less distortive fiscal instrument than distortionary labor tax.[21] Thus, the CEV losses are smaller when spending cuts are used to bring public debt down, i.e., under *FF*, *FR* and *FA* for the Periphery, while the CEV gains are smaller when government consumption is used to take advantage of the extra fiscal space created, i.e., under *FA* for the Core. The mechanism through which wealth-rich households incur higher welfare losses than wealth-poor/median households in the Periphery under spending-based fiscal consolidation is the real interest rates. That is, the households who start with high wealth holdings (i.e. wealth-rich), their total resources depend mostly on asset holdings. Hence, the expectation of lower interest rates in the future leads to a larger and relatively faster reduction in consumption and increase in hours worked in the medium- and long-run than the wealth-poor households. Both forces deteriorate their welfare. At the same time, wealth-poor and wealth-median households

[21] Although government consumption is utility-enhancing, private and government consumption are assumed to be additive separable (see equation (1)) which means that it does not affect household optimality conditions. In addition, we do not allow for productivity-enhancing government spending in our model.

rely more heavily on earnings and since labor tax is held constant, they incur lower welfare losses with respect to a labor-tax based fiscal consolidation.

6 Robustness

In this section, we conduct various robustness checks. Specifically, we allow for richer cross-country heterogeneity in section 6.1, we examine the role of the pace of fiscal consolidation in section 6.2 and the persistence of the MIT mark up shock in section 6.3.

6.1 Allowing for richer cross-country heterogeneity

So far, we have assumed that the two countries differ only in public debt-output ratios in the status quo stationary equilibrium in section 3. This is a natural choice since our aim is to study fiscal consolidation under various EA debt-output targets. Thus, by construction, our main policy experiment attempts to remedy public debt asymmetries in the monetary union. However, EA member countries, namely the Core and the Periphery, differ in several other structural characteristics.

In this section, we relax the assumption that the Core and the Periphery differ only in public debt-output ratios by allowing a number of empirically relevant asymmetries that can be captured with our model. Namely, we allow the Core/Periphery to differ in: (i) aggregate labor productivity; (ii) the output share of government expenditures; (iii) the processes that govern idiosyncratic productivity; and (iv) the degree of tax progressivity in each country.

Adding tax progressivity requires some model modifications. In particular, to model the non-linear labor income tax, we assume a (progressive) labor tax schedule as in e.g., Benabou (2002), Heathcote et al., (2017) and Brinca *et al.* (2021). The Core's household budget constraint, i.e., equation (2) in section (2.1), is replaced with:

$$c_{h,t} + a_{h,t} = (1 + i_{t-1}) \frac{P_{t-1}}{P_t} a_{h,t-1} + (1 - \tau_t^l) \left(w_t e_{h,t} l_{h,t}\right)^{1-\xi} + d_t e_{h,t} + \widetilde{\Xi}_t e_{h,t} \qquad (20)$$

and the Core's government budget constraint, i.e., equation (8) in section (2.3), is replaced with:

$$B_t + \underbrace{w_t L_t - (1 - \tau_t^l) \int \left(w_t e_{h,t} l_{h,t}\right)^{1-\xi} d\lambda_t(a_{h,t-1}, e_{h,t})}_{\text{tax revenues from labor income}} = (1 + i_{t-1}) \frac{P_{t-1}}{P_t} B_{t-1} + G_t \qquad (21)$$

where, τ_t^l and ξ, dictate the level and the progressivity of the tax scheme. The Periphery's household and government budget constraints are analogously defined. Moreover, the

linear part of the progressive tax function reacts to debt over output as in fiscal rules (9) and (10), while the tax progressivity does not change.

In the interest of space, in what follows we explain our calibration strategy by focusing on (i) to (iv), while all other parameters are the same as in the benchmark model. Regarding asymmetry (i), to match the aggregate labor productivity ratio observed in the data between the Core and Periphery, we use data for GDP per hour worked for each country over the 2010-2020 period.[22] The value of labor productivity ratio, $\frac{Z}{Z^*}$, is equal to 1.374. This implies a permanent difference in labor productivity with the Core being more productive than the Periphery. Furthermore, to normalize the output of the Periphery, Y^*, equal to 1 at the status quo stationary equilibrium, we calibrate $Z^* = 1.0907$ and thus $Z = 1.4986$.

Table 7: Within and betwen country distributional variables

Variable	Model	Data	Variable	Model	Data
$\text{Gini}(a_h)$	0.66	0.74^a	$\text{Gini}(y_h^{NI})$	0.22	0.29^b
$\text{Gini}(a_h^*)$	0.60	0.60^a	$\text{Gini}({y_h}^{*,NI})$	0.23	0.33^b
$\text{B}_{40\%}(a_h)$	2%	$0\%^c$	$\text{B}_{40\%}(y_h^{NI})$	25.9%	$22\%^b$
$\text{B}_{40\%}(a_h^*)$	3%	$5\%^c$	$\text{B}_{40\%}(y_h^{*,NI})$	25.8%	$19\%^b$
$\text{T}_{10\%}(a_h)$	39%	$59\%^c$	$\text{T}_{10\%}(y_h^{NI})$	17.1	$23\%^b$
$\text{T}_{10\%}(a_h^*)$	35%	$46\%^c$	$\text{T}_{10\%}(y_h^{*,NI})$	17.2	$25\%^b$
$\frac{Y}{Y^*}$	1.25	1.35^d	$\frac{\frac{A}{Y}}{\frac{A^*}{Y^*}}$	0.55	0.65^c

Notes: "a_h" and "y_h^{NI}" denote household wealth and net income, respectively;

[a] Cowell and Van Kerm (2015) use data only for late 2010/early 2011;

[b] World Income Inequality Database is between 2010-2020;

[c] OECD.Stat contains only 3 obs. between 2009-2019;

[d] OECD.Stat GDP per head of population, 2010-2020.

Regarding asymmetry (ii), we set g and g^* equal to the government consumption to output ratios of the Core and Periphery for the 2010-2020 period, i.e., 0.209 and 0.196 respectively.[23] As in section 3, the parameters that govern the weight of public consumption in period utility are set $\varrho = \frac{g}{1-g} = 0.2642$ and $\varrho^* = \frac{g^*}{1-g^*} = 0.2438$. Regarding asymmetry (iii), we calibrate the unconditional variances, σ_e and σ_e^*, to match wage inequality in Vacas-Soriano et al. (2020) between 2010-2015[24]; while we keep $\rho = 0.966$.

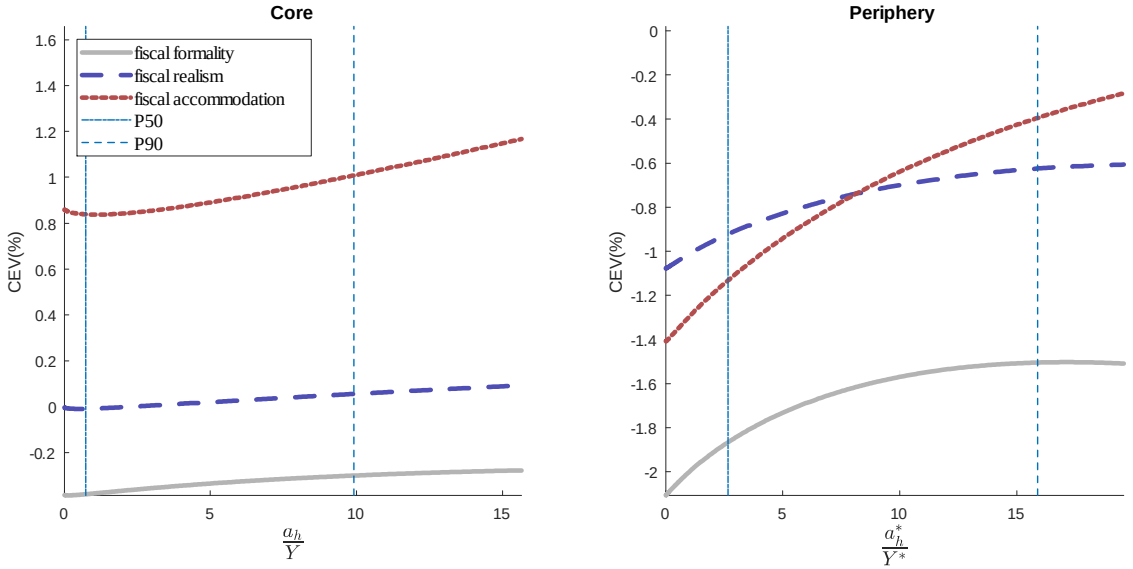
[22] We calculate the weighted average for Core and Periphery using real GDP weights.

[23] Using Aggarwal et al (2022) definition of government consumption, we first calculate the average government consumption to GDP ratio for each country over the period 2010-2020. The same GDP weights used to calculate the weighted average aggregate labour productivity ratios above are applied here too.

[24] Vacas-Soriano et al. (2020) is based on the data from the European Union Statistics on Income and Living Conditions (EU-SILC) for the period 2010–2015. The same GDP weights used to calculate the

Regarding asymmetry (iv), the parameters that govern the tax progressivity, i.e., ξ and ξ^*, are set equal to 0.224 and 0.167 as in Holter *et al.* (2019). This implies higher tax progressivity in the Core than in the Periphery. The level of labor taxes, i.e., τ_t^l and τ_t^{l*}, are the residually determined fiscal policy instruments.

Figure 11: Conditional welfare gains



Note: The scale of the x-axis is normalized by transforming assets divided by country GDP.

In addition, we need to recalibrate the discount factors, i.e., $\beta = \beta^*$ equal to 0.9892, so as to target the central bank's interest rate, i, at the zero lower bound in 2020, i.e., in the status quo stationary equilibrium. We recalibrate the process of union-wide markup shock to generate the same increase in inflation, i.e., m_t, is $\rho_m = 0.5$ and $\epsilon_1 = 0.156$. Finally, we recalibrate the labor tax rule feedback coefficients, γ and γ^*, to deliver the speed of debt consolidation that is in line with the 1/20th rule defined in the SGP reform.

Table 7 is the counterpart of Table 3 in Section 3.2. Similarly with the baseline calibration, the model with richer cross-country heterogeneity captures the differences in wealth and income inequality between the Core and the Periphery. Moreover, as expected allowing for more asymmetries improves model performance in capturing cross-country heterogeneity see e.g., the ratios of output, $\frac{Y}{Y^*}$, and the ratio of (personal) wealth over national income, $\frac{\frac{A}{Y}}{\frac{A^*}{Y^*}}$, in the last row of Table 7. In addition, Figure 11 is the counterpart of Figure 4 in section 5.2.1. As can be seen our main results as discussed in section 5.2.1 remain essentially unaltered (Figures C1 and C2 in Appendix are the counterpart of Figures 3 and 8).

weighted average aggregate labour productivity ratios above are applied here too.

6.2 The pace of fiscal consolidation

Now we examine how the results would change in the case feedback policy coefficients, γ and γ^* in fiscal rules (9) and (10) are set to target a fiscal consolidation half-life equal to 72 quarters in the Periphery as opposed to 55 quarters. This implies a slower pace of fiscal consolidation. Results from this robustness check are reported in Appendix C.2. Specifically, Figure C3 is the counterpart of Figure 4. We report that our main results do not change. As expected, a slower pace of fiscal consolidation is welfare improving compared to the case presented in Figure 4. This results is in line with the tax smoothing argument of Barro (1979). Moreover, these welfare gains, compared to the base results, are spread homogeneously across households.

6.3 Persistence of markup shock

We also implement a more persistent MIT union-wide markup shock by setting the AR(1) parameter, ρ_m, equal to 0.8, and re-calibrating the initial shock ϵ_1 to generate an annualized inflation hike of 10% under the *FF* scenario. Results from this robustness check are reported in Appendix C.2 with Figure C4 being the counterpart of Figure 4. We report that our main results do not change. A more persistent inflation would require higher interest rates for a prolonged period of time and as result this would increase the welfare costs for wealth-poor households *vis-à-vis* the wealth-rich households. The mechanism is similar to the one described in section 5.3

7 Conclusions and future extentions

This paper develops a two-country HANK model of the EA, which captures a number of key characteristics of the cross- and within-country heterogeneity in the EA. In particular, the model features public debt asymmetries between the Core and the Periphery, which successfully explain cross-country imbalances and within-country inequality.

We show that fiscal consolidation via distortionary taxation under the current EA institutional arrangements, namely the Maastricht Treaty and the Stability Growth Pact, is quite costly. Households residing in the Periphery are particularly vulnerable to the adverse effects of these policies. Our key finding is that reforming EA debt targets to more realistic values can significantly mitigate these welfare losses and make fiscal consolidation more affordable for the large proportion of households in the Periphery. However, a Core's expansion while the Periphery consolidates would generate a conflict of interest between the households of the Core and wealth-poor/median households of the Periphery.

Additionally, we find that the union-wide monetary policy stance against inflation during an era of national fiscal consolidation policies can generate a conflict of interest

between the wealth-rich and wealth-poor households in the monetary union . As our analysis showed, an inflation hike along with aggressive monetary stance would disproportionately benefit the wealth-rich while making fiscal consolidation more painful for the wealth-poor. This finding has recently become more important; due to the higher EA inflation rate, there is increased pressure on the European Central Bank (ECB) to maintain a strong stance against inflation.

Moreover, we find that when national fiscal policymakers have the option to utilize a non-distortionary fiscal instrument like government consumption to reduce public debt, the benefits from reforming EA public debt targets become quantitatively smaller. In other words, in cases where non-distortionary fiscal instruments are available, there is a limited benefit for reforming EA public debt targets. However, there is some doubt as to whether the national governments in the EA Periphery have sufficient fiscal capacity to utilize such instruments, given the scale and composition of recent fiscal consolidation programs have reduced the ability to implement further spending cuts on vital social services. In this context, our paper, which examines the effects of reforming EA debt targets, is particularly relevant.

Finally, we find that fiscal consolidation has a significant impact on within-country cross-sectional inequality. However, fiscal consolidation's impact on inequality depends on the specific criterion used to measure it. Notably, public debt reduction tends to increase wealth and consumption inequality while decreasing earnings inequality. As such, reforming EA public debt targets seems an effective strategy to reduce the rise in wealth and consumption inequality. Nevertheless, if the criterion is earnings inequality, we find that reforming EA debt-output targets is not beneficial for either the Core or the Periphery.

We close the paper with some possible extensions. This paper focuses on the role of public debt asymmetry between the Core and the Periphery in explaining cross- and within-country heterogeneity. Although we find that public debt asymmetry can play a quantitatively significant role, it would be interesting to examine in more detail how fiscal asymmetries interact with other types of empirically relevant asymmetries, like those introduced in section 6.1. The richer model would allow us to evaluate how fiscal consolidation reforms interact with other structural reforms affecting cross-sectional within-country inequality. It would also be interesting to examine the role of relative prices by allowing the inflation rates in the Core and the Periphery to differ in the status quo equilibrium and/or along the transition. We leave these extensions for future work.

A Stationary Equilibrium

A.1 Stationary Recursive General Equilibrium

For given values for $b = \frac{B}{Y}$, $b^* = \frac{B^*}{Y^*}$, $g^* = \frac{G^*}{Y^*}$, $g = \frac{G}{Y}$, $\pi = \pi^* = \overline{\pi}$. For notational convenience, we drop the subscripts h and h^*.

A *Stationary Recursive Equilibrium* is stationary distributions $\lambda^*(A \times B)$, $\lambda(A \times B)$, policy functions $q^{a*}\left(a_{-1}^*, e^*\right)$, $q^{l*}\left(a_{-1}^*, e^*\right)$, $q^{c*}\left(a_{-1}^*, e^*\right)$, $q^a(a_{-1}, e)$, $q^l(a_{-1}, e)$ and $q^c(a_{-1}, e)$, value functions, and positive real numbers L, L^*, NFA^*, and i^* such that:

1. The firms maximizes their profits

$$w = \frac{Z}{\mu},\ w^* = \frac{Z^*}{\mu^*}$$

2. The policy functions $q^{a*}\left(a_{-1}^*, e^*\right)$, $q^{l*}\left(a_{-1}^*, e^*\right)$, $q^{c*}\left(a_{-1}^*, e^*\right)$, $q^a(a_{-1}, e)$, $q^l(a_{-1}, e)$ and $q^c(a_{-1}, e)$ solve the households' optimum problems given prices and aggregate quantities.

3. $\lambda(A \times B)$ is a stationary distribution:

$$\lambda(A \times B) = \int_{\mathcal{A} \times E} \Lambda\left[(a, e), A \times B\right] \lambda(da, de),$$

for all $A \times B \in \mathcal{B}(\mathcal{A}) \times \mathcal{E}$, where $\Lambda\left[(a, e), A \times B\right] : (\mathcal{A} \times E) \times (\mathcal{B}(\mathcal{A}) \times \mathcal{E}) \to [0, 1]$ are transition functions on $(\mathcal{A} \times E)$ induced by the Markov process $(e)_{t=0}^{\infty}$ and the optimal policy $q_a(a_{-1}, e)$.[25] The transition function is given by:

$$\Lambda\left[(a, e), A \times B\right] = \left\{\begin{array}{c} \Pr\left(e_{t+1} \in B | e_t = e\right), \text{ if } q^a(a_{-1}, e) \in A \\ 0, \text{ if } q^a(a_{-1}, s) \notin A \end{array}\right\}. \tag{22}$$

Similarly for the Core country.

4. When $\lambda(A \times B)$ and $\lambda^*(A \times B)$ describe the cross-section of households at each date, markets clear.
The labor markets clear

$$\begin{aligned} N &= L = \int e q^l(a_{-1}, e)\, d\lambda(a_{-1}, e), \\ N^* &= L^* = \int e^* q^{l*}\left(a_{-1}^*, e^*\right) d\lambda^*(a_{-1}^*, e^*) \end{aligned}$$

[25] On notation. For any set D in some n-dimensional Euclidean space $\mathbb{R}^n$, $\mathcal{B}(D)$ denotes the Borel $\sigma-$algebra of D.

The international asset market clears, i.e.

$$NFA = -NFA^*$$

where $NFA = A - B$ and $NFA^* = A^* - B^*$ and

$$\begin{aligned} A &= \int q^a(a_{-1}, e)\, d\lambda(a_{-1}, e) \\ A^* &= \int q^{a*}\left(a^*_{-1}, e^*\right) d\lambda^*(a^*_{-1}, e^*) \\ B &= bY \\ B^* &= b^* Y^*. \end{aligned}$$

The goods market clears, which, using factor input market clearing, implies:

$$NFA = \frac{(1+i)}{1+\overline{\pi}} NFA - \left(Y + \widetilde{\Xi} - gY - \int q^c(a_{-1}, e)\, d\lambda(a_{-1}, e) \right)$$

$$NFA^* = \frac{(1+i^*)}{1+\overline{\pi}^*} NFA^* - \left(Y^* - g^* Y^* - \int q^{c*}\left(a^*_{-1}, e^*\right) d\lambda(a^*_{-1}, e^*) \right)$$

where

$$\widetilde{\Xi}_t = \left\{ \begin{array}{c} \frac{(1+i^*)}{1+\overline{\pi}}(-NFA^*) - \frac{(1+i)}{1+\overline{\pi}}(NFA) \\ -\frac{\varkappa}{2}\frac{1}{1+\overline{\pi}}\left[\exp\left(\frac{-NFA^*}{Y^*}\right) - 1\right]^2 \end{array} \right\}$$

and

$$(1+i^*) = (1+i) + \frac{\varkappa}{1+\overline{\pi}} \left(\exp\left(\frac{-NFA^*}{Y^*} \right) - 1 \right) \exp\left(\frac{-NFA^*}{Y^*} \right) \frac{1}{Y^*}$$

A.2 Computation of the stationary problem

In this Appendix we develop the algorithm that is used to compute the stationary general equilibrium. The algorithm is executed in n iterations, where each iteration consists of the following steps:

1. Set g^*, g, b, b^*, $\overline{\pi}$ and for given values of μ, μ^*, Z, Z^*, we guess, values for $\{(N)^n$, $(N^*)^n$, $(i)^n$,$(NFA^*)^n\}$

2. Calculate the quantities needed to solve the problem of the household.

$$\begin{aligned} w &= \frac{Z}{\mu},\ w^* = \frac{Z^*}{\mu^*} \\ d &= Z\,(N)^n \left(\frac{\mu - 1}{\mu} \right),\ d^* = Z^*\,(N^*)^n \left(\frac{\mu - 1}{\mu} \right) \end{aligned}$$

$$
\begin{aligned}
\Omega &= \frac{\varkappa}{1+\overline{\pi}}\left(\exp\left(\frac{-\left(NFA^*\right)^n}{Y^*}\right)-1\right)\exp\left(\frac{-\left(NFA^*\right)^n}{Y^*}\right)\frac{1}{Y^*} \\
(1+i^*) &= (1+(i)^n)+\Omega \\
1+r^* &= \frac{1+i^*}{1+\overline{\pi}} \\
1+r &= \frac{1+(i)^n}{1+\overline{\pi}}
\end{aligned}
$$

$$
\widetilde{\Xi}_t = \left\{ \begin{array}{c} (1+r^*)\left(-NFA^*\right)-(1+r)\left(NFA\right) \\ -\frac{\varkappa}{2}\frac{1}{1+\overline{\pi}}\left[\exp\left(\frac{(-NFA^*)}{Y^*}\right)-1\right]^2 \end{array} \right\}
$$

$$
\overline{\tau} = \frac{Z}{w}\left[rb+g\right]
$$

$$
\overline{\tau}^* = \frac{Z^*}{w^*}\left[r^*b^*+g^*\right]
$$

3. and we solve the problem of the households in the two economies:

$$
\begin{aligned}
&v\left(a_{-1},e\right) = \\
&\quad = \max_{\substack{a\geq 0 \\ c\geq 0}} \{\tfrac{(c)^{1-\sigma}}{1-\sigma}+\varrho\log(G)-\varphi\tfrac{(l)^{1+\eta}}{1+\eta}+\beta E\left[v'\left(a,e'\right)\mid e\right]\}, \\
&c+a=\left(1+r\right)a_{-1}+(1-\tau^l)wel+d+\widetilde{\Xi}
\end{aligned}
$$

$$
\begin{aligned}
&v^*\left(a_{-1}^*,e^*\right) = \\
&\quad = \max_{\substack{a^*\geq 0 \\ c^*\geq 0}} \{\tfrac{(c^*)^{1-\sigma}}{1-\sigma}+\varrho^*\log(G^*)-\varphi^*\tfrac{(l^*)^{1+\eta^*}}{1+\eta^*}+\beta E\left[(v^*)'\left(a^*,(e^*)'\right)\mid e^*\right]\}, \\
&c^*+a^*=\left(1+r^*\right)a_{-1}^*+\left(1-\tau^{l,*}\right)w^*e^*l^*+d^*
\end{aligned}
$$

4. From that we get $\{A,A^*,L,L^*,C,C^*\}_{t=1}^T$ and we calculate the following distances:

$$
\left|(N)^n-L\right|<\varepsilon \tag{23}
$$

$$
\left|(N^*)^n-L^*\right|<\varepsilon \tag{24}
$$

$$
\left|A-(B)^n-(NFA^*)^n\right|<\varepsilon \tag{25}
$$

$$
\left|A^*-(B^*)^n-(NFA^*)^n\right|<\varepsilon \tag{26}
$$

where ε is a pre-specified tolerance level, a stationary open economy general equilibrium has been found. If not, go back to step 1, and update the guesses. We use a nonlinear solver to update the guesses.

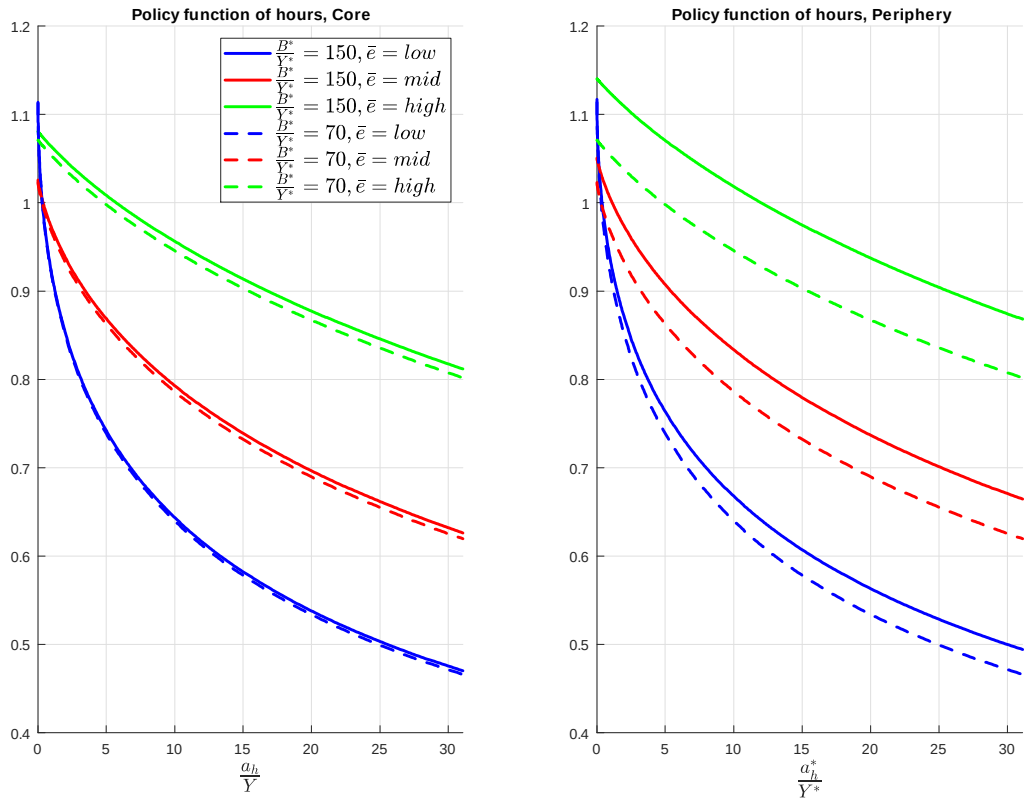
To solve the household problem we use the Endogenous Grid Method (Carroll (2006)). To implement this algorithm we first choose $a^{\min} = 0$. We then let $a^{\max} = 40$, which implies that, in the solution, the probability of asset holdings greater than 40 is zero. Following Maliar *et al.* (2010) we discretize the space of household assets $\left[a^{\min}, a^{\max}\right]$ by allowing for 500 points with the following formula:

$$a^i = a^{\min} + (a^{\max} - a^{\min})(\frac{i-1}{500-1})^{\varpi}, \forall i = 1, ..., 500$$

where $\varpi = 2$.

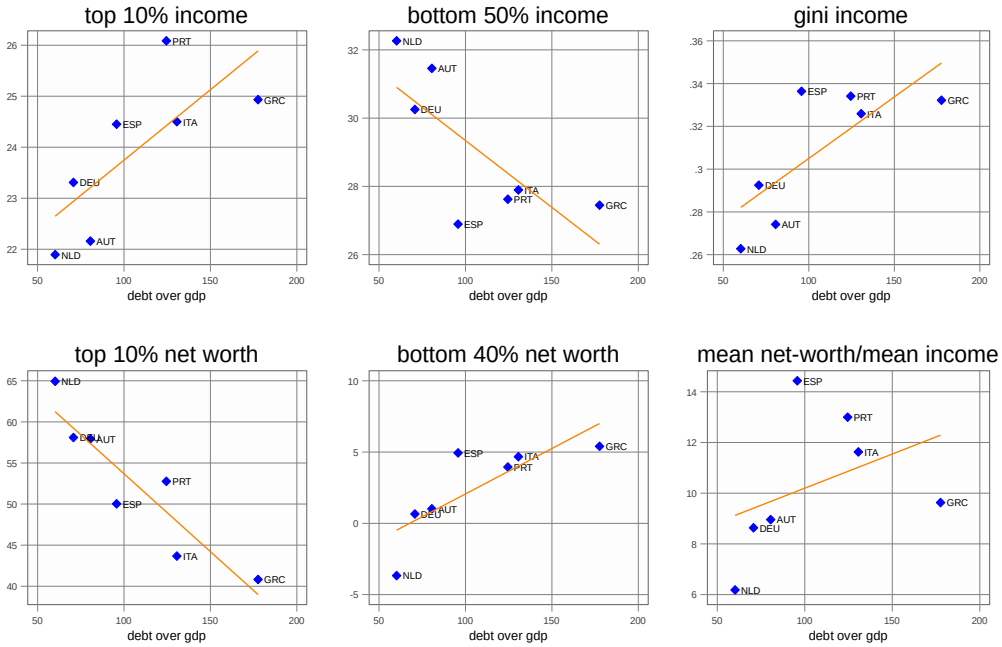
A.3 Additional graphs

Figure A1: Relative changes of the labor supply functions, from $\frac{B^*}{Y^*} = 4 \times 1.5$ to $\frac{B^*}{Y^*} = 4 \times 0.7$



Note: The scale of the x-axis is normalized by transforming assets divided by country GDP.

Figure A2: Relationship between debt and inequality



Note: For definitions of debt over GDP and inequality indices see Figures 1 and 2.

Source: WIID (income inequality), OECD (wealth inequality), Eurostat (debt over GDP)

B Transition

B.1 Computation

We follow the recent literature on perfect foresight transition dynamics (Boppart *et al.* 2018 and Auclert *et al.* 2021a). We assume that there is an unexpected shock to the economy and that all dynamic paths for exogenous and aggregate quantities for $t = 1, ...T$ are deterministic and common knowledge. All these paths are taken into account by households as given sequences. For notational convenience, we drop the subscripts h and h^*. Now, the problem of the Core households becomes

$$\begin{aligned} & v_t\left(a_{t-1}, e_t; w_t, i_{t-1}, \pi_t, d_t, \tau_t\right) = \\ & = \max_{\substack{a_t \geq 0 \\ c_t \geq 0 \\ l_t \geq 0}} \left\{ \begin{array}{c} \frac{(c_t)^{1-\sigma}}{1-\sigma} + \varrho \log(G_t) - \varphi \frac{(l_t)^{1+\eta}}{1+\eta} \\ +\beta E\left[v_{t+1}\left(a_t, e_{t+1}; w_{t+1}, i_t, \pi_{t+1}, d_{t+1}, \tau_{t+1}\right) \mid e_t\right] \end{array} \right\}, \end{aligned} \tag{27}$$

subject to the period-by-period household budget constraint expressed in real terms (divided by P_t):

$$c_t + a_t = \frac{(1 + i_{t-1})}{1 + \pi_t} a_{t-1} + (1 - \tau_t^l) w_t e_t l_t + d_t + \widetilde{\Xi}_t \tag{28}$$

The solution to this problem will give us the policy functions $\{q_t^a\left(a_{t-1}, e_t\right),\ q_t^l\left(a_{t-1}, e_t\right),\ q_t^c\left(a_{t-1}, e_t\right)\}_{t=1}^T$ which denote the households' optimum choices given prices and aggregate quantities. First note that these policy function depend on the future path of $\{w_s,\ r_s,\ \pi_s,\ d_s,\ \tau_s\}_{s \geq t}$.

Each household in the Periphery solves the following maximization problem:

$$\begin{aligned} & v_t^*\left(a_{t-1}^*, e_t^*; w_t^*, i_{t-1}^*, \pi_t^*, d_t^*, \tau_t^{l,*}, \widetilde{\Xi}_t^*\right) = \\ & = \max_{\substack{a_t^* \geq 0 \\ c_t^* \geq 0 \\ l_t^* \geq 0}} \left\{ \begin{array}{c} \frac{(c_t^*)^{1-\sigma^*}}{1-\sigma^*} + \varrho^* \log(G_t^*) - \varphi^* \frac{(l_t^*)^{1+\eta^*}}{1+\eta^*} \\ +\beta^* E\left[v_{t+1}^*\left(a_t^*, e_{t+1}^*; w_{t+1}^*, i_t^*, \pi_{t+1}^*, d_{t+1}^*, \tau_{t+1}^{l,*}, \widetilde{\Xi}_{t+1}^*\right) \mid e_t^*\right] \end{array} \right\}, \end{aligned} \tag{29}$$

subject to the period-by-period household budget constraint:

$$c_t^* + a_t^* = \frac{\left(1 + i_{t-1}^*\right)}{1 + \pi_t^*} a_{t-1}^* + \left(1 - \tau_t^{l*}\right) w_t^* e_t^* l_t^* + d_t^* \tag{30}$$

The solution to this problem will give us the policy functions $\{q_t^{a*}\left(a_{t-1}^*, e_t^*\right),\ q_t^{l*}\left(a_{t-1}^*, e_t^*\right),$

$q_t^{c*}\left(a_{t-1}^*, e_t^*\right)\}_{t=1}^T$ which denote the households' optimum choices given prices and aggregate quantities. First note that these policy function depend on the future path of $\left\{w_s^*, i_{s-1}^*, \pi_s^*, d_s^*, \tau_s^*\right\}_{s\geq t}$. Also further note that $\left\{w_s, i_{s-1}, \pi_s, d_s, \tau_s\right\}_{s\geq t}$ and $\left\{w_s^*, i_{s-1}^*, \pi_s^*, d_s^*, \tau_s^*\right\}_{s\geq t}$ will in turn depend on the aggregate "MIT"-type shocks.

To solve for the transition paths, we follow Auclert *et al.* (2021a) and use a shooting-algorithm to iterate on the path of the prices and aggregate variables, updating them by using a quasi Newton algorithm. We want to find $\mathbf{U}$ that solves the sequence of market clearing conditions along the transition path, $\mathbf{H}(\mathbf{U}, \mathbf{Z}) = 0$. $\mathbf{U}$ consists of 6 sequences of aggregate variables and prices (wage rates, output, net foreign asset position and inflation) while $\mathbf{H}(\mathbf{U}, \mathbf{Z})$ consists of 6 sequences as well; the two asset market clearing conditions, the two Phillips Curves and the two labor market clearing conditions. In particular, we: (i) solve for the final stationary equilibrium, which will give us the $\mathbf{U}_{ss}$ (initial and final); (ii) Calculate numerically the terminal steady-state sequence space Jacobean of the endogenous variables, $\mathbf{H}_{\mathbf{U}}(\mathbf{U}_{ss}, \mathbf{Z}_{ss})$; (iii) guess an initial guess on the path of prices and aggregates for $t = 0, ...T$, $T = 400$, $\mathbf{U}^0 = \mathbf{U}_{ss}$; (iv) solve the household problem backward in time from T, where v_T equals the value function in the new stationary equilibrium to obtain a sequence of policy and value functions; (v) using the transition matrix for idiosyncratic shocks and policy functions for each $t = 0, ...T$ and, starting from the original stationary distributions, we simulate forward to get $\mathbf{H}(\mathbf{U}^j, \mathbf{Z})$; (vi) use the Jacobean Matrix from step (ii) and $\mathbf{H}(\mathbf{U}^j, \mathbf{Z})$ from step (v) to update the guess for the endogenous variables using the quasi-Newton method

$$\mathbf{U}^{j+1} = \mathbf{U}^j - \left[\mathbf{H}_{\mathbf{U}}(\mathbf{U}_{ss}, \mathbf{Z}_{ss})\right]^{-1} \mathbf{H}(\mathbf{U}^j, \mathbf{Z})$$

and (vii) stop if $|\mathbf{U}^{j+1} - \mathbf{U}^j| < 10^{-6}$, otherwise return to step (iv).

B.2 Conditional Welfare

To calculate the conditional welfare change, for all households on the cross-sectional distribution associated with the initial stationary economy and moving towards the terminal stationary equilibrium (i.e. after debt consolidation is over), we work as follows. For the exposition, we will use the Core, but the same expressions hold for the Periphery. For notational convenience we drop the subscript h. First, we define

$$V_{ss}(a, s) = E_0 \sum_{t=0}^{\infty} \beta^t u(q^c\left(a_{-1}, e\right), q^l\left(a_{-1}, e\right), G \mid a_0 = a, e_0 = e),$$

as the expected lifetime utility associated with the decision rules at the initial stationary equilibrium, $q^c(a_{-1}, e)$ and $q^l(a_{-1}, e)$. In addition, we define

$$V_{tr}(a, s) = E_0 \sum_{t=0}^{\infty} \beta^t u(q_t^c(a_{t-1}, e_t), q_t^l(a_{t-1}, e_t), G_t \mid a_0 = a, e_0 = e),$$

as the expected lifetime utility associated with the sequence of decision rules along the debt consolidation transition path, $\{q_t^c(a_{t-1}, e_t)\}_{t=1}^T$ and $\{q_t^l(a_{t-1}, e_t)\}_{t=1}^T$. We then define the consumption equivalent variation, conditional on initial assets and earnings, $\omega(a_{-1}, e_0)$, as the percentage change in consumption required to be given to the household under the stationary equilibrium, so that it is indifferent between remaining in this economy as opposed to the economy that follows the dynamic transition. In particular, $\omega(a_{-1}, e_0)$ is defined as the quantity that solves

$$\begin{aligned} &E_0 \sum_{t=0}^{\infty} \beta^t u((1 + \omega(a_{-1}, e_0)) q_0^c(a_{t-1}, e_t), q_0^l(a_{t-1}, e_t), G \mid a_0 = a, e_0 = e) \\ &\quad = E_0 \sum_{t=0}^{\infty} \beta^t u(q_t^c(a_{t-1}, e_t), q_t^l(a_{t-1}, e_t), G_t \mid a_0 = a, e_0 = e). \end{aligned}$$

Thus, for each tuple (a_{-1}, e_0) there is a corresponding $\omega(a_{-1}, e_0)$. To simplify the analysis, we report the average over e, i.e. we end up with a function $\omega(a_{-1})$, the lifetime consumption equivalent gains for each level of initial wealth. In addition, we can calculate the average lifetime consumption equivalent gains using the initial invariant distribution of wealth holdings.

We can follow a similar procedure with the above, but now the comparison is between the expected lifetime utility associated with the decision rules at the initial stationary equilibrium and the expected lifetime utility associated with the decision rules at the "final" stationary equilibrium.

B.3 Decomposition of inequality

We have the following definitions of income

$$\text{net earnings: } y_{h,t}^E = (1 - \tau_t) w l_{h,t} e_{h,t}$$

$$\text{asset income: } y_{h,t}^A = r a_{h,t-1}$$

$$\text{net income: } y_{h,t}^{NI} = y_{h,t}^A + y_{h,t}^E + d_t$$

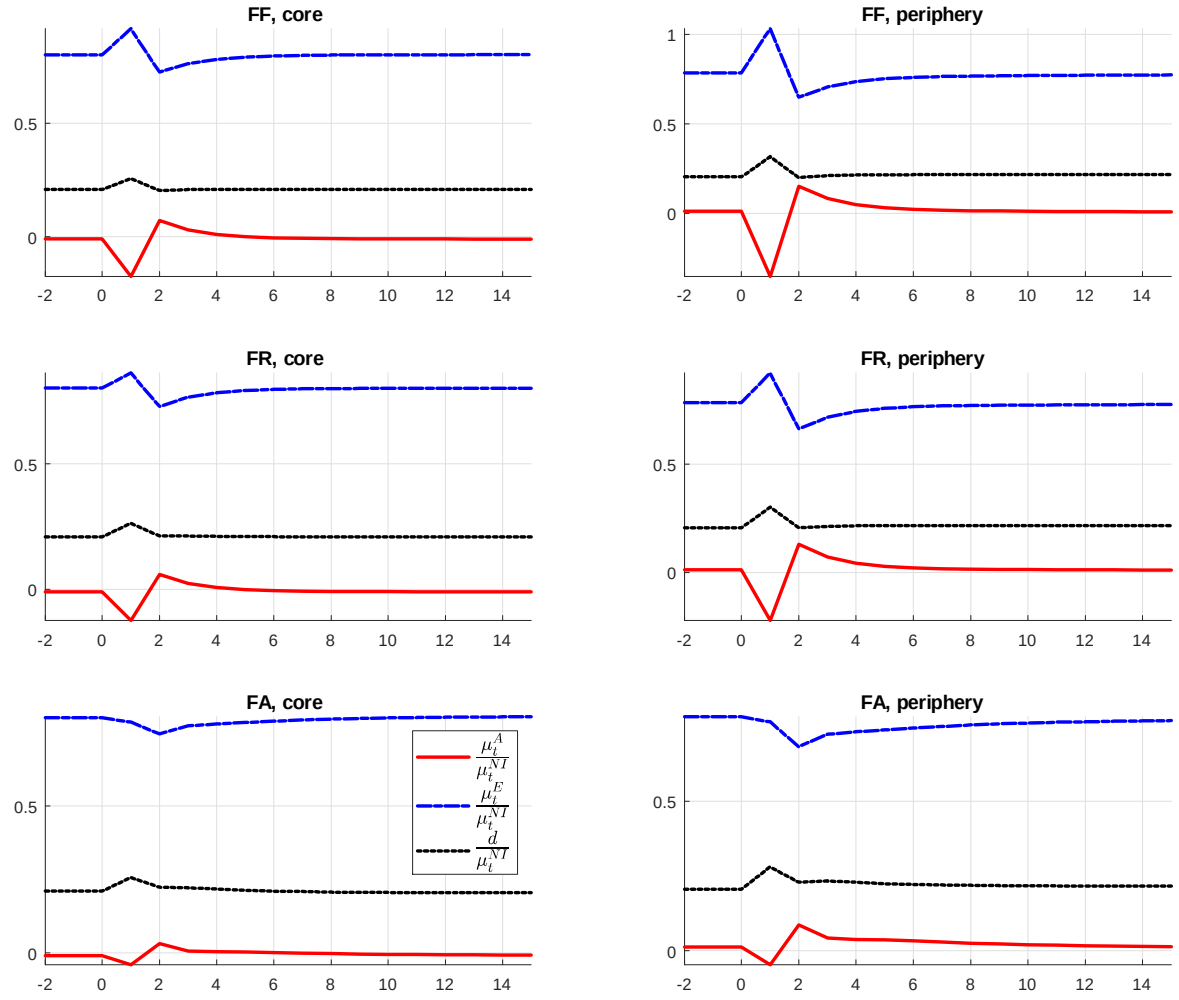
Income inequality exhibits quite sizeable fluctuations in the short run but the path

of inequality very quickly returns to the gradual transition to the long-run values. The short-run fluctuations are determined by changes in net wages, interest rates and profits. Profits change immediately due to the markup shock and changes in labor supply (i.e., output). So, when there is an increase in profits, ceteris paribus, income inequality falls because they are equally distributed (the baseline model). The real interest rate first falls due to the rise in inflation and then jumps up due to the reaction of monetary policy (and afterward transits towards the long run value, which is in the negative area). Here, two things matter, the share of asset income in the total income and the sign of the interest rate. Ceteris paribus, if the sign is positive, the asset income contributes to inequality positively because assets are very unequally distributed. The reverse holds if the sign is negative. Note that the sign might change over the transition.

In the same way, the share of asset income within net income matters too; if the share of asset income increases, it will contribute to inequality according to its sign. The changes in net wage also matter in two ways. First, it alters the incentives of households to supply labor, and second it changes the share of labor income within net income. The former will be discussed below, where we discuss earnings inequality. To see how the latter works, suppose the net earnings is the most unequally distributed part of net income, and net wage falls, then assuming no behavioral changes i.e., labor supply changes, net income inequality falls. Putting all these together, the short-run fluctuations are determined from all these components and their relative shares to total income, and these are different across scenarios and countries. For example, under the FF scenario, income inequality in the Periphery increases by about 25% for one quarter. This is a result of the increase in the share of earnings component due to the vast fall in the share of asset income due to very negative real interest rates in period one (see Appendix Figures B1 and B2). Profits are up too, but their equalizing effects are not enough to reduce inequality. After that, the ECB reacts, and the real interest rates become positive. However, now the earnings share has fallen considerably, and at the same time, earnings have become more equal (see Appendix Figure B3 for the covariance between hours and productivity becomes smaller or more negative).

$$\begin{aligned} E\left[y_{h,t}^{NI}\right] &= E\left[y_{h,t}^{A}\right] + E\left[y_{h}^{E}\right] + E\left[d\right] \\ \mu_t^{NI} &= \mu_t^{A} + \mu_t^{E} + d_t \\ 1 &= \frac{\mu_t^{A}}{\mu_t^{NI}} + \frac{\mu_t^{E}}{\mu_t^{NI}} + \frac{d_t}{\mu_t^{NI}} \end{aligned}$$

Figure B1: Contribution to mean net income



In the main text we showed the path of inequality using the Gini coefficient. Because the Gini is an order measure of inequality, its decomposition is trickier to analyse. It is easier and more intuitive to perform a decomposition of the halved squared coefficient of variation which is defined as

$$I_y = \frac{1}{2}\frac{Var(y)}{(\mu^y)^2}$$

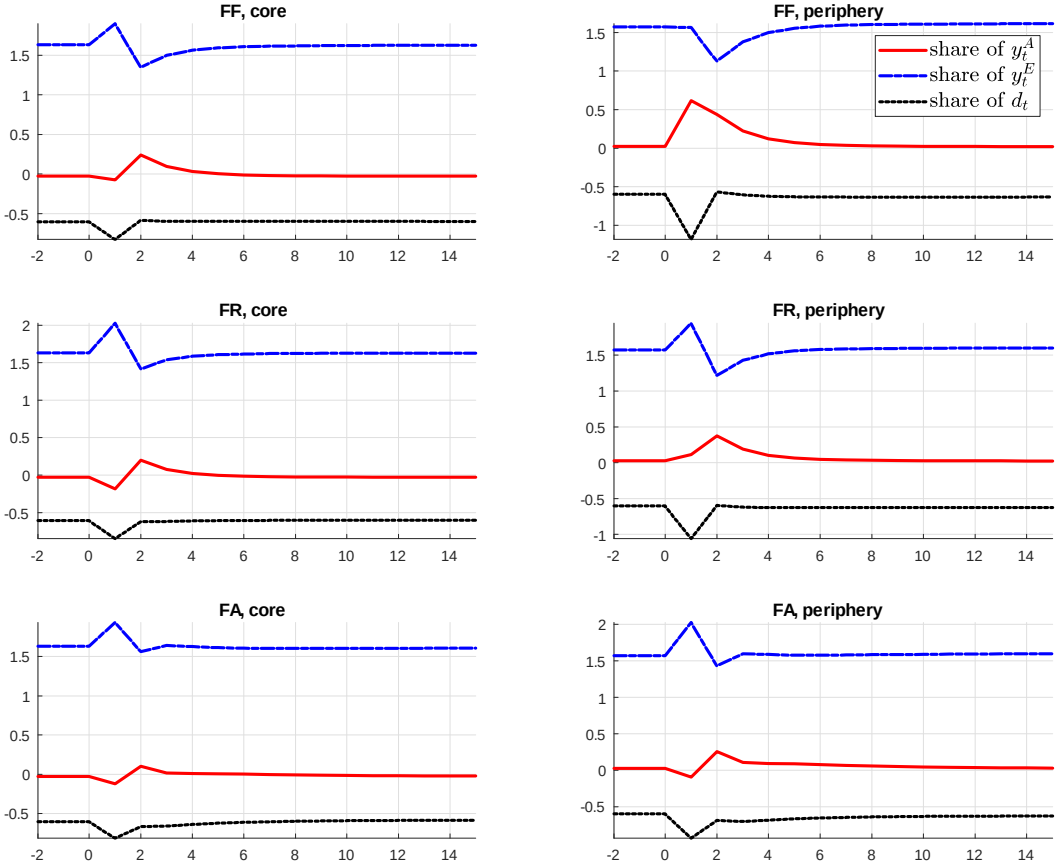
In particular, we will perform a decomposition of the squared coefficient of variation.

Using ideas from Shorrocks (1982), note that

$$
\begin{aligned}
I_{y^{NI}} &= \frac{1}{2}\frac{Var(y_{h,t}^{NI})}{\left(\mu_t^A+\mu_t^E+d_t\right)^2} \\
&= \frac{1}{2}\frac{Var(y_{h,t}^{NI})}{\left(\mu_t^A+\mu_t^E\right)^2} - \frac{1}{2}\frac{Var(y_{h,t}^{NI})\left(d^2+2d_t\left(\mu_t^A+\mu_t^E\right)\right)}{\left(\mu_t^A+\mu_t^E+d_t\right)^2\left(\mu_t^A+\mu_t^E\right)^2} \\
&= \left\{ \begin{array}{c} \frac{1}{2}\frac{Cov(y_h^{NI},y_{h,t}^A)}{\left(\mu_t^A+\mu_t^E\right)^2} + \frac{1}{2}\frac{Cov(y_{h,t}^{NI},y_h^E)}{\left(\mu_t^A+\mu_t^E\right)^2} \\ -\frac{1}{2}\frac{Var(y_h^{NI})\left(d^2+2d_t\left(\mu_t^A+\mu_t^E\right)\right)}{\left(\mu_t^A+\mu_t^E+d_t\right)^2} \end{array} \right\} \Rightarrow
\end{aligned}
$$

$$
\begin{aligned}
1 \;=\; & \underbrace{\frac{Cov(y_{h,t}^{NI},y_{h,t}^A)}{Var(y_{h,t}^{NI})}\frac{\left(\mu_t^A+\mu_t^E+d_t\right)^2}{\left(\mu_t^A+\mu_t^E\right)^2}}_{\text{Share of } y^A} \\
& + \underbrace{\frac{Cov(y_{h,t}^{NI},y_{h,t}^E)}{Var(y_{h,t}^{NI})}\frac{\left(\mu_t^A+\mu_t^E+d_t\right)^2}{\left(\mu_t^A+\mu_t^E\right)^2}}_{\text{Share of } y^E} - \underbrace{\frac{\left(d^2+2d_t\left(\mu_t^A+\mu_t^E\right)\right)}{\left(\mu_t^A+\mu_t^E\right)^2}}_{\text{Share of } d}
\end{aligned}
$$

Figure B2: Contribution to net income inequality (I_y)



Income inequality fluctuates in the short run due to the aforementioned causes, but the main force behind the medium and long-run path of income inequality is the change in earnings inequality. As we discussed in section 3.3 earnings inequality will be determined by the differential labor supply choices across households, heterogeneity in idiosyncratic productivity, and their covariance (i.e., the distribution). We formally show further below the decomposition of earnings inequality (specifically, the variance of logarithms) in the various components. As you can see in Figure B3, earnings inequality falls primarily due to the fall in the covariance between labor supply and idiosyncratic productivity. For example, for the Periphery, 86% of the total drop in earning inequality is due to the change in the covariance, while for the Core is 89%. As we discussed in Section 3.3, the intuition is that the wealth-rich households do not work much because the marginal value of each unit of consumption is low, while the wealth-poor households work more because the marginal value of an extra unit of consumption is very high. Thus, since the debt over income falls over time, the interest rate also falls to induce lower wealth accumulation, and the covariance between labor supply and idiosyncratic productivity becomes smaller. In other words, it is not only the change in the policy functions that matter for inequality but also the change in the distribution.

Below, we perform the earnings inequality decomposition. In this case we do the decomposition in log earnings since the components are mulitplicative instead of additive.

Recall that

$$\text{net earnings: } y^E_{h,t} = (1-\tau_t) w_t l_{h,t} e_{h,t}$$

so that the natural logarithm of y_E is

$$\ln(y^E_{h,t}) = \ln(1-\tau_t) + \ln w_t + \ln l_{h,t} + \ln e_{h,t}.$$

Moreover, the cross section variance of logarithms in each period is

$$Var(\ln(y^E_{h,t})) = \underbrace{Var\left(\ln l_{h,t}\right)}_{\text{endogenous part}} + \underbrace{Var\left(\ln e_{h,t}\right)}_{\text{exogenous part}} + \underbrace{2Cov\left(\ln l_{h,t}, \ln e_{h,t}\right)}_{\text{interaction}}.$$

Therefore, the change in inequality can be decomposed as follows

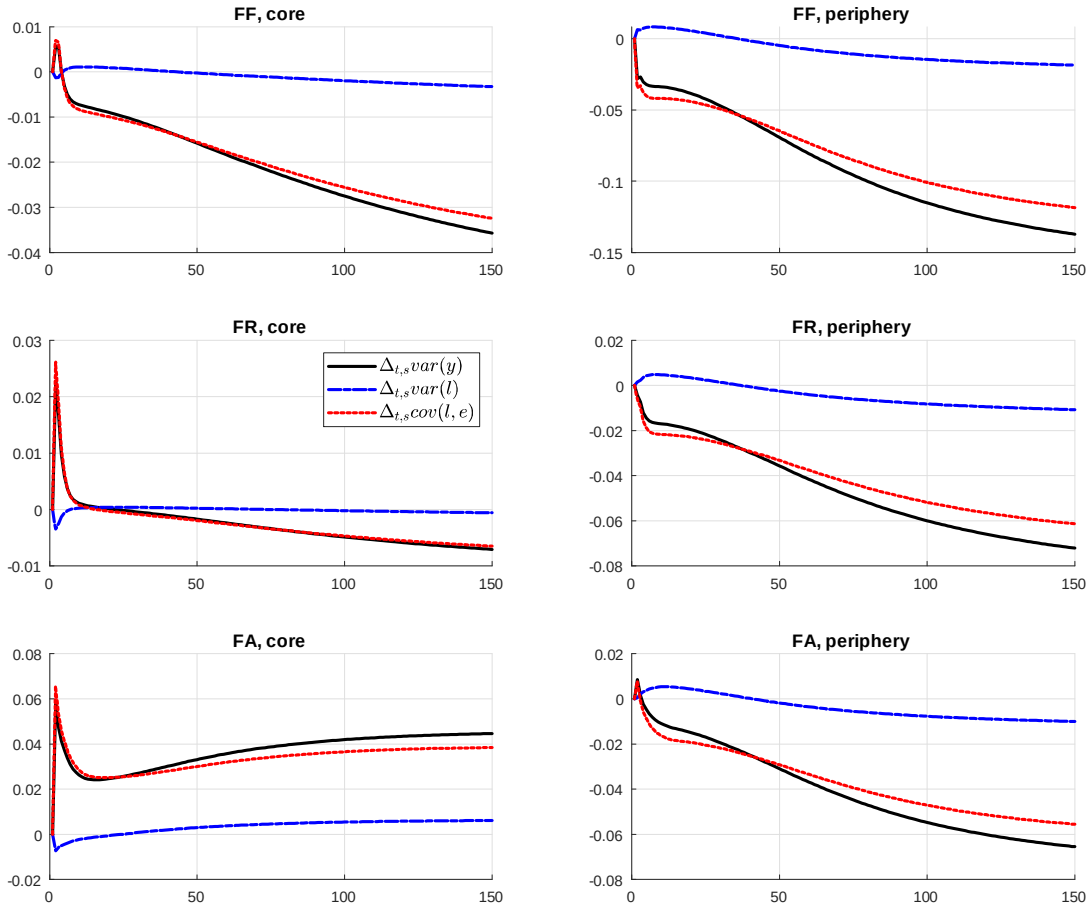
$$Var(\ln(y^E_{h,t+s})) - Var(\ln(y^E_{h,t})) = \left\{ \begin{array}{c} Var\left(\ln l_{h,t+s}\right) - Var\left(\ln l_{h,t}\right) + Var\left(\ln e_{h,t+s}\right) - Var\left(\ln e_{h,t}\right) \\ +2Cov\left(\ln l_{h,t+s}, \ln e_{h,t+s}\right) - 2Cov\left(\ln l_{h,t}, \ln e_{h,t}\right) \end{array} \right\}$$

$$\Delta_{t,s} Var(\ln(y^E)) = \Delta_{t,s} Var(\ln l) + \Delta_{t,s} Var\left(\ln e\right) + 2\Delta_{t,s} Cov\left(\ln l, \ln e\right)$$

$$\underbrace{\frac{\Delta_{t,s}Var(\ln(y^E))}{Var(\ln(y^E_{h,t}))}}_{\text{total change}} = \underbrace{\frac{\Delta_{t,s}Var(\ln l)}{Var(\ln(y^E_{h,t}))}}_{\text{change due to } var(\ln l)} + \underbrace{\frac{\Delta_{t,s}Var\left(\ln e\right)}{Var(\ln(y^E_{h,t}))}}_{=0} + \underbrace{\frac{2\Delta_{t,s}Cov\left(\ln l, \ln e\right)}{Var(\ln(y^E_{h,t}))}}_{\text{change due to covariance}}$$

The last term captures the changes in the covariance between labor supply and idiosyncratic productivity. If it is positive, it implies that, on average, the more productive workers work more. At the same time, if it is negative, it means that, on average, the least productive workers work more, always in relative terms compared to the initial point i.e., the status quo economy. In the long run, what matters is the change in the covariance. For the Periphery, and under all three scenarios, the covariance is getting smaller compared to the status quo economy. This implies that (simplistically) the least productive households work more while the most productive households work less, compared to the status quo economy. The same holds for the Core of the *FF* and *FR* scenarios and the opposite for the *FA*.

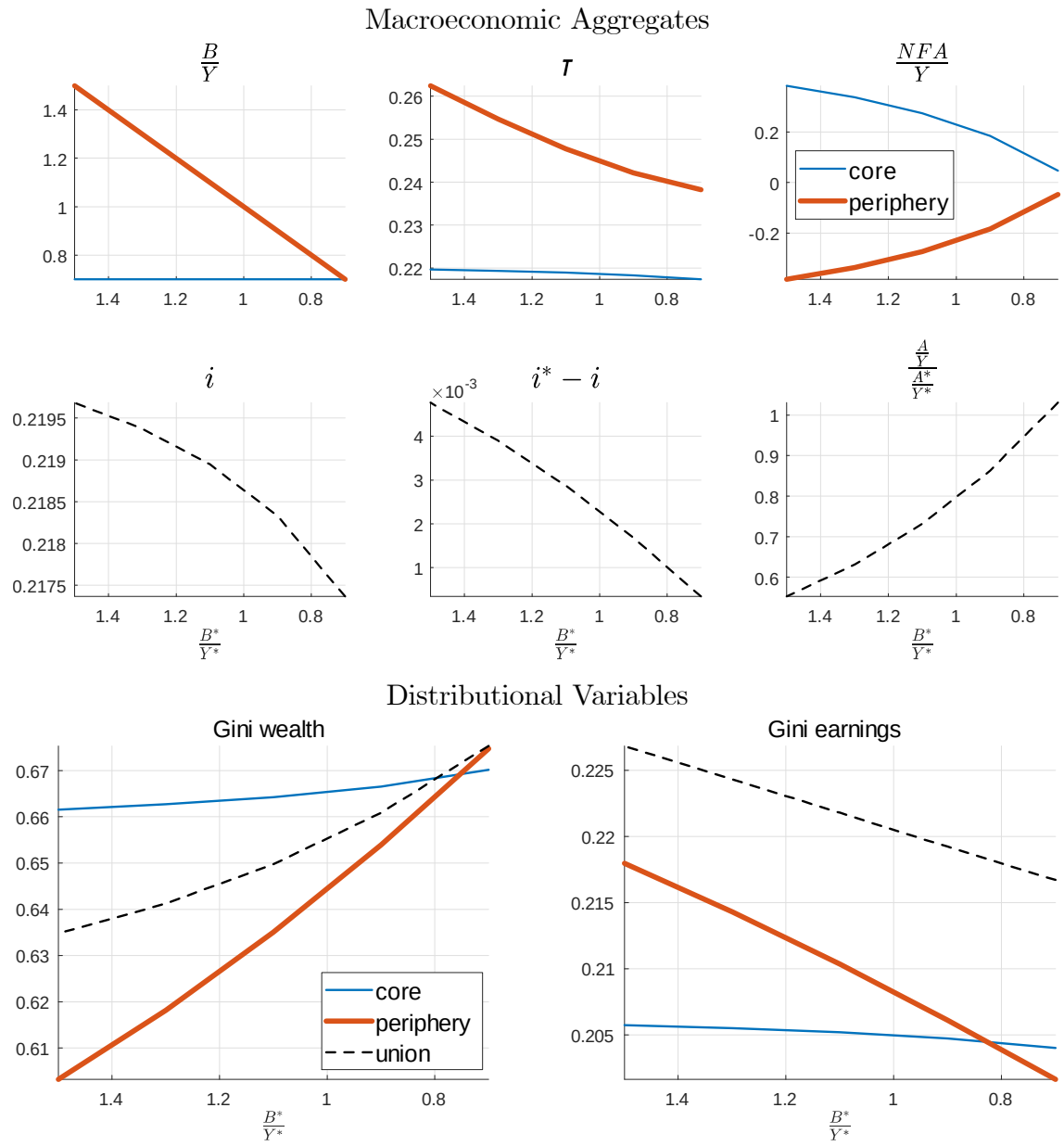
Figure B3: Decomposition of earnings inequality.



C Additional Results

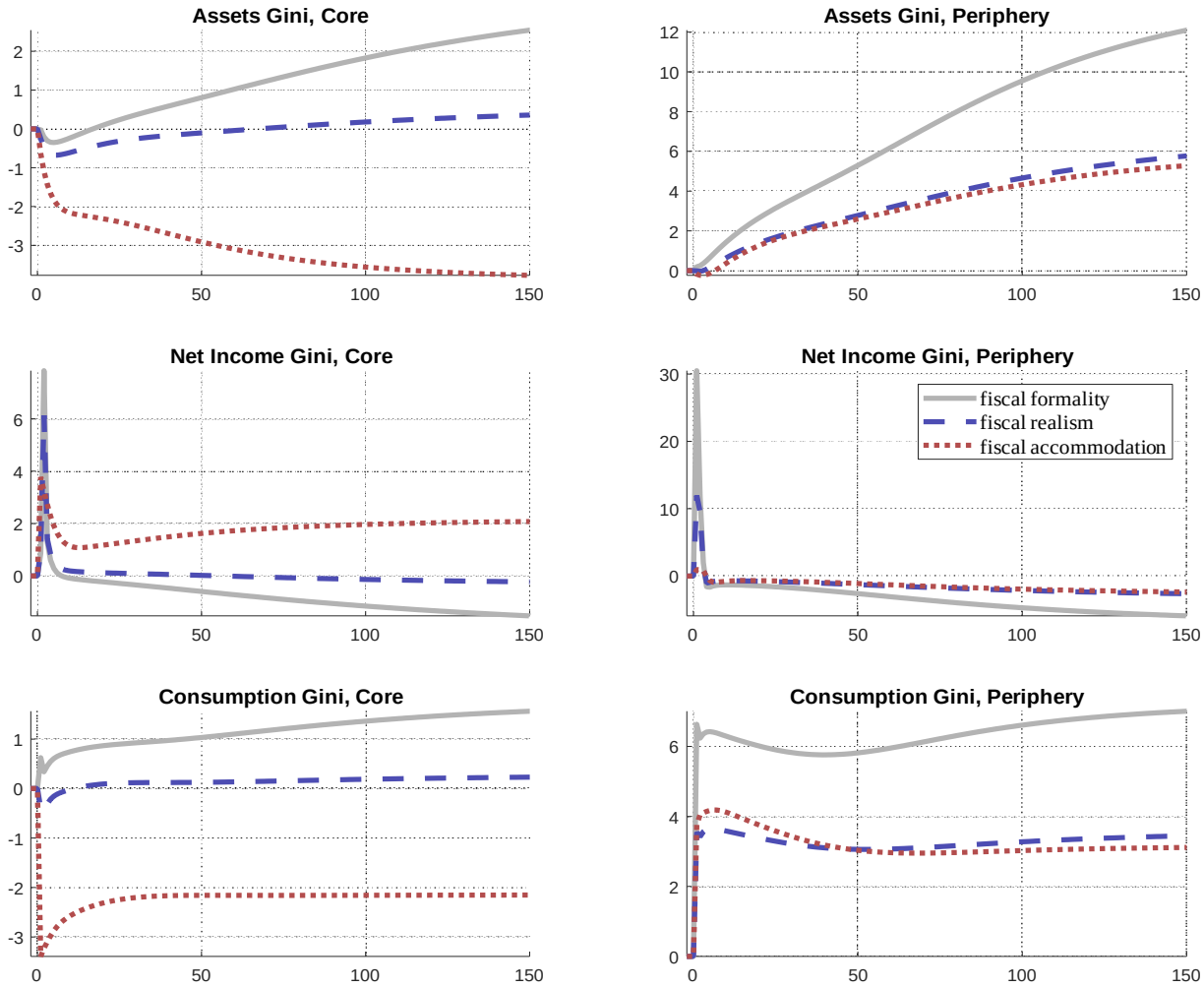
C.1 Model with richer heterogeneity

Figure C1: Stationary Equilibria with debt asymmetries.



Note: We present the annualized value of $\frac{B^*}{Y^*}$, i.e., the model-based value is multiplied by four.

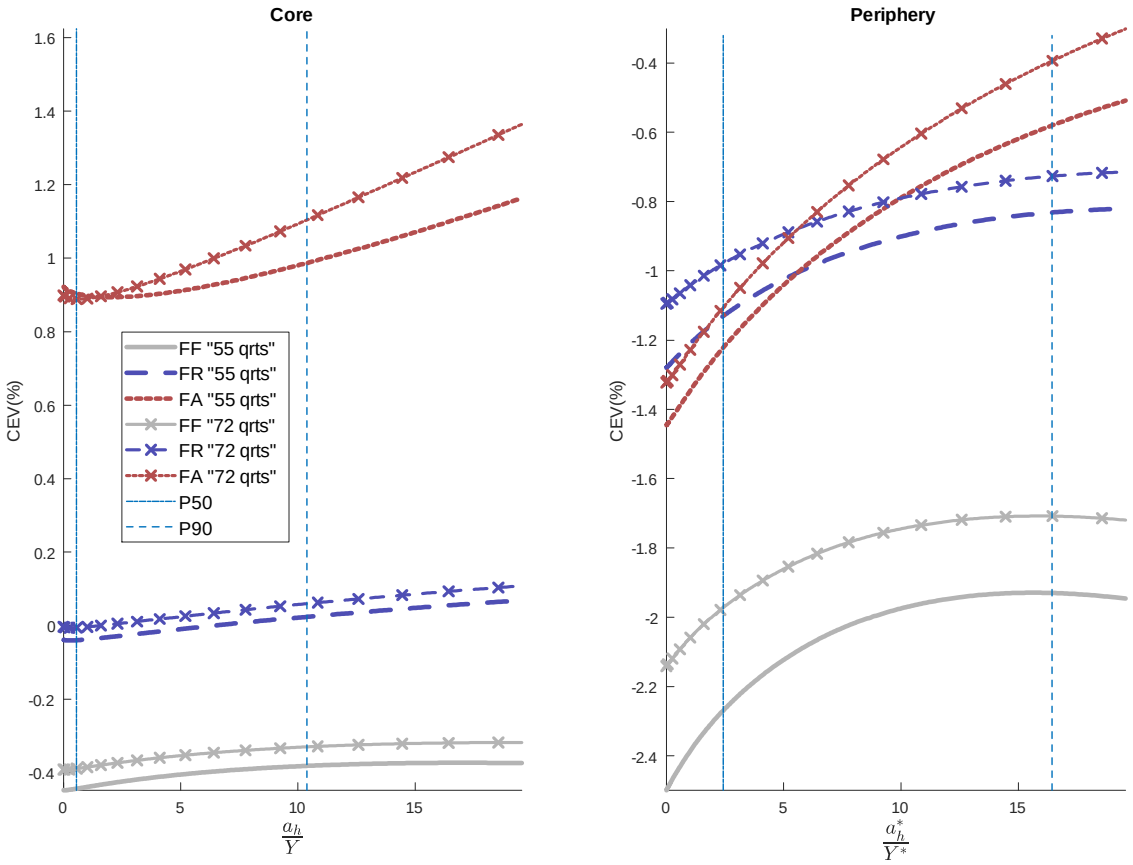
Figure C2: Wealth, income and consumption inequality, richer heterogeneity



Note: Percentage deviations from status quo steady state.

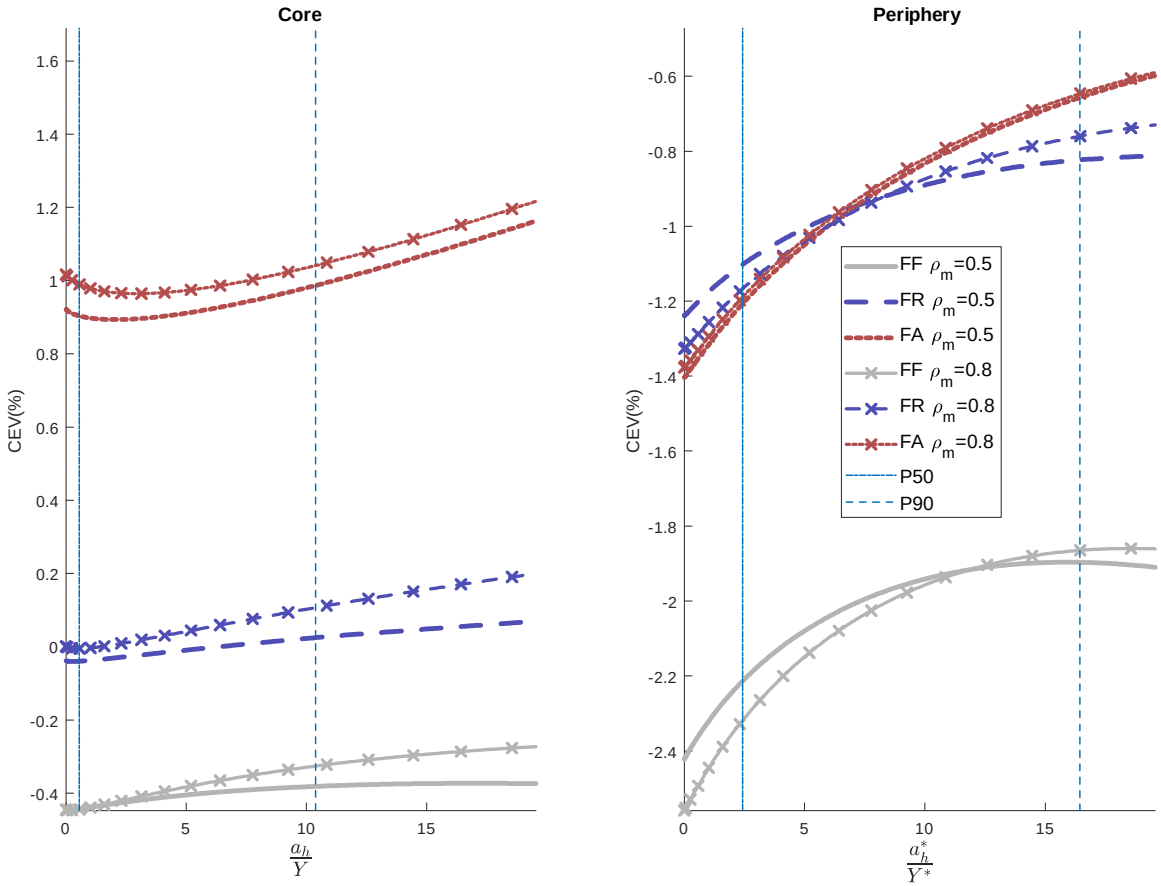
C.2 Further robustness results

Figure C3: Conditional welfare gains, slower speed of consolidation



Note: The scale of the x-axis is normalized by transforming assets divided by country GDP.

Figure C4: Conditional welfare gains, $\rho_m = 0.8$



Note: The scale of the x-axis is normalized by transforming assets divided by country GDP.

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