The macroeconomic effects of the European Monetary Union's fiscal consolidation from 2011 to 2013: A quantitative assessment.

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Abstract

The impacts of fiscal consolidation pursued by the Euro Area between 2011 and 2013 are assessed employing three DSGE models developed for fiscal policy analysis by the Bundesbank (FiMod), the ECB (the NAWM), and the European Commission (QUEST III). To account for the Euro Areas's economic and financial crisis, we constrain the response of monetary policy, raise the share of non-Ricardian consumers and introduce a financial accelerator along the lines of Bernanke et al. (1999). We also account for likely myopia among Ricardian households. We find that fiscal consolidation caused a cumulative loss between 13% and 23% of annual real GDP over the 2011 to 2013 period in the Euro Area with a cumulative multiplier somewhere between 1.5 and 2.5.

Keywords: Fiscal policy simulations, fiscal consolidation, fiscal multiplier, Euro Area
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1 Introduction

Starting in 2010 as, when the Euro Area (EA) was just for about a year into recovery from the downturn caused by the world financial crisis, fiscal policy in the EA turned progressively more restrictive. Virtually all of the EA, except for Germany, embarked on an ambitious course of fiscal consolidation. According to estimates by the European Commission (2012), spending cuts and tax increases accumulated to about 4% of annual EA GDP between 2011 and 2013 (as reported in Table 1 below).

The switch to fiscal austerity has been associated with a return of the EA economy to recession by the end of 2011, from which it emerged by the middle of 2013. Member states in the so-called periphery have been hit particularly hard. At the same time, the influential spring forecast by the European Commission (2012) based on a medium-scale Dynamic Stochastic General Equilibrium (DSGE) model projected a low contraction following the fiscal consolidation program and a fast recovery. Yet, the EA's economic performance has repeatedly undershot predictions by the European Commission and the IMF, suggesting that these institutions have consistently underestimated the adverse effects of austerity. Blanchard and Leigh (2013) argue that the growth forecast errors in the IMF's and the European Commission's projections are systematically positively correlated with the size of fiscal consolidation.

The low multipliers found in early projections such as European Commission (2012) result from the assumption of excessive crowding-in of consumption and investment due to forward-looking Ricardian agents as well as from rather optimistic expectations regarding the effectiveness of the monetary transmission mechanism in stabilizing the economy and the state of the financial markets in intermediating financial resources (cf. in 't Veld 2013). The following observations in the recent literature may question these views: First, forward-looking households are likely subject to a certain degree of myopia (cf. Kumhof et al. 2010). With myopic households the crowding-in of demand would be less pronounced in the case of permanent consolidation measures. Second, the monetary transmission mechanism has been malfunctioning for an extended period of time due to problems in the banking sector and the European sovereign debt crisis (cf. Coeure 2013, Al-Eyd and Berkmen 2013, Bedendo and Colla 2013, Bofondi et al. 2013). At the same time, those problems constitute a big demand shock, which in itself would be expected to induce a reduction in the central bank interest rate from its low level at the beginning of 2011. Hence, the assumption of monetary policy being constrained only for a short period of time may be overly optimistic. The effect of fiscal policy shocks on output in DSGE models is stronger if monetary policy is constrained for a longer period of time (cf. Eggertsson 2011, Woodford 2011). Third, collateral constraints on firms and households tighten during a period of financial crisis which amplifies the effect of fiscal shocks, especially in the presence of constraints on monetary policy (Carrillo and Poilly 2013, Freedman et al. 2010, Roeger and in 't Veld 2009).

We therefore believe a fresh assessment taking into account these aspects is called for. We reassess the consequences of the EA fiscal consolidation effort during the period 2011 to 2013 using variants of three DSGE models developed for fiscal policy analysis: FiMod developed by staff of the Deutsche Bundesbank and the Banco de España (Stähler and Thomas 2012), the ECB's New Area Wide Model (NAWM) published in Coenen et al. (2008) and QUEST III developed by the European Commission and published in Ratto et al. (2009). We have extended and modified these models in order to address the sensitivity of these models' simulation results with respect to assumptions regarding planning horizons of economic agents, monetary policy effectiveness and future financial market conditions.

In particular we address the sensitivity of the simulation results with respect to the following

changes to the original variants of the models considered. First, we mimic the myopia of households by assuming that the forward-looking households expect the consolidation measures to be highly persistent and temporary instead of permanent. As shown by Denes et al. (2013) in a canonical New Keynesian model, the effect of government spending cuts depends crucially on whether they are assumed to be temporary or permanent. Second, we consider different durations with the interest rate at the zero lower bound, in particular from 1 year up to 5 years. Third, to capture financial crisis conditions, we introduce a *financial accelerator* in the vein of Bernanke et al. (1999) to the models under consideration. Furthermore, the share of liquidity-constrained households has been raised and calibrated according to the recent ECB Household Finance and Consumption Survey (HFCS 2013).

We find that once these features of the economic crisis which the EA faced at the beginning of 2011 are taken into account, the GDP effects of fiscal consolidation are much bigger than what is suggested by the European Commission (2012). Depending on the model considered, we find that fiscal consolidation caused a cumulative loss in output in the EA from 2011 to 2013 which ranges from 13% (NAWM) and 23% (FiMod and QUEST III) of annual real GDP. This corresponds to cumulative multipliers of 1.5 (NAWM) and 2.5 (FiMod and QUEST III), respectively. GDP declines by more than the ex-ante effect of the fiscal consolidation, and persistently so. As a consequence of lower tax revenues and higher welfare expenditures, the improvement in the primary budget balance lags strongly behind the ex-ante effect of the fiscal consolidation, and worsens during the first year in all models. In conjunction with the decline in GDP and a strong decline in inflation, this result causes a persistent and substantial increase in the debt-to-GDP ratio. In this sense, the consolidation may be described as self-defeating. Our sensitivity analysis shows that each of our three aspects–accounting for the constraints on monetary policy, the constraints on households and firms spending and the myopia of forward looking households– matters for this result.

To our knowledge, the only published quantitative assessments of the effects of the fiscal consolidation in the EA are Holland and Portes (2012), European Commission (2012) and in 't Veld (2013). Holland and Portes (2012) find austerity to be self-defeating but use the National Institutes Global Economic Model (NIGEM), which does not feature explicit optimizing behavior and thus differs substantially from our choice of models. The European Commission (2012) finds a fairly low multiplier effect based on a version of QUEST III. However, the simulation does not adequately take into account the constraints faced by monetary policy and assumes permanent and perfectly credible measures. in 't Veld (2013) also uses QUEST III and also allow for significant constraints on monetary policy, limited degree of fiscal policy credibility and an elevated share of liquidity constraint households. He finds substantial intra-EA spillovers of simultaneous consolidation in different member states, but does not report GDP effects for the EA aggregate.

The paper proceeds as follows. Section 2 reviews the models employed, i.e. FiMod, the NAWM and QUEST III, and discusses in detail the changes made for the purpose of our simulations. Section 3 discusses the duration of the zero lower bound to be assumed as well as the expected duration of the measures to be maintained. Section 4 presents the simulation results. The focus is on the macroeconomic effects of each single policy instrument as well as the macroeconomic effects of the actual consolidation package implemented in the EA between 2011 and 2013. Section 5 concludes the paper.

2 The Models

Our simulations are based on adapted versions of three open economy medium-scale DSGE models of the EA, namely a version of FiMod developed by staff of the Deutsche Bundesbank and the Banco de España (Stähler and Thomas 2012), a version of the ECB's New Area Wide Model (NAWM) published in Coenen et al. (2008) and a version of QUEST III developed by the Directorate General for Economic and Financial Affairs of the European Commission and published in Ratto et al. (2009). FiMod is a two country model of the EA with labor market frictions developed by Stähler and Thomas (2012). We calibrate the two countries to be Germany and the Rest of the EA, motivated by the observation that fiscal consolidation took place mainly outside of Germany. The other two models are two region models of the EA and the US (NAWM) and the rest of the world in reduced form (QUEST III), respectively, which enables us to gauge the international repercussions of the EA's consolidation effort. All models feature a considerable degree of disaggregation of government revenues and expenditures and are, therefore, suitable for fiscal policy simulations. In the following, we first review the core features of these models and discuss our modifications subsequently.

2.1 Reviewing FiMod, the NAWM and QUEST III

The models share a number of common standard features such as nominal rigidities in labor and goods markets, habit formation and investment adjustment costs. In QUEST III, nominal wage and price rigidities take the form of wage and price adjustment costs, while in FiMod and NAWM they are of the Calvo (1983) type. Furthermore, apart from the so-called *Ricardian* households with frictionless access to financial markets and infinite horizon, all models are also populated by a fraction of households whose consumption is closely linked to their disposable income. Liquidity-constrained households are arguably a feature of the data (Campbell and Mankiw 1990, Attanasio 1999, Johnson et al. 2006, Agarwal et al. 2007, Parker 2011, Hall 2011) and help sticky-price DSGE models to match the positive response of consumption to government spending increases found in many VAR studies (Gali et al. 2007, Blanchard and Perotti 2002). During crisis periods, the share of these households may be especially high. The incorporation of liquidity-constrained households is also critical for a realistic assessment of the contractionary effects of transfer cuts, which form the majority of the expenditure cuts as discussed below. The transfer system performs an important redistributive function in advanced economies and transfer- based fiscal consolidations have been found to increase income inequality (OECD 2012, Rawdanowicz et al. 2013), suggesting that transfer cuts are largely borne by poorer and thus liquidity-constrained households.

All models feature lump sum taxes and transfers as well as distortionary taxation on wages, profits and consumption, implying that an economic downturn adversely affects government revenues. Such feedback from the state of the economy to the budget balance is enhanced in FiMod via unemployment benefits. Regarding the government's expenditure on goods and services, unproductive government consumption appears in all models, while FiMod and QUEST III also incorporate government investment, which enhances the total factor productivity of private companies. In all models, government spending on goods and services is only on domestic resources, and a fiscal rule relates a tax instrument (distortionary labor taxes in FiMod, lump sum taxes in the NAWM and QUEST III) to the level of public debt in order to render the latter stationary in the long run.

A key difference between FiMod on the one hand and the NAWM and QUEST III on the other is the functioning of the labor market. FiMod allows for equilibrium unemployment

due to search and matching frictions as proposed by Pissarides (2000). The nominal wage is determined by staggered Nash bargaining between the firm and a union. Each period, only a fraction of firms can renegotiate nominal wages. The presence of matching frictions implies that the change in employment matters the marginal cost of firms and thus inflation. In the NAWM and QUEST III, by contrast, there is no unemployment. In the NAWM households act as wage setters in monopolistically competitive labor markets, subject to nominal rigidities in the vein of Calvo (1983). In QUEST III, the there is a trade union adjusts the nominal wage according to an aggregate measure of the markup of the real wage over the marginal rate of substitution.

Regarding the open economy dimension, the yield on international lending is negatively related to the net foreign assets of the country which is a net lender in order to ensure that net foreign assets are stationary in the long run. The flow of trade is modelled in more detail in the NAWM than FiMod and QUEST III. It assumes that domestic consumption and investment are separate CES aggregates of domestic and foreign intermediate goods, implying that the share of foreign inputs may differ between the two and that the elasticity. of substitution between domestic and foreign inputs may differ from one. By contrast, in FiMod domestic private consumption and investment are identical Cobb-Douglas aggregates of domestic and foreign inputs. Furthermore, in the NAWM and FiMod, government consumption and investment are non-traded goods, while in QUEST III they are traded goods.

2.2 Changes to the models

In order to be able to appropriately gauge the effects of the EA's fiscal consolidation, we modify FiMod, the NAWM and QUEST III in a number of ways spelled out in detail in this section.

2.2.1 Changes to the calibration of the models

In the NAWM and FiMod, we increase the Calvo-wage and price parameter to 0.95, and in QUEST III we increase the price and and wage adjustment cost parameter in order to achieve an equivalent reduction in the response of inflation and nominal wage growth to the price and wage markup, respectively. This modification is motivated by the observation that in spite of the EA's fall-back into recession in 2011 and an increase in unemployment of a magnitude similar to the one the EA suffered during the financial crisis, nominal wage growth and output prices did not decline over the period of 2011-2013 as compared to 2010 or 2009. In fact, they increased somewhat in 2011 (Eurostat 2014). The absence of a decline in average nominal wage growth may be related to an increased incidence of downward nominal wage rigidity, caused by the decline in average nominal wage growth during the financial crisis of 2007-2009. This decline presumably shifted the wage distribution to the left, thus increasing the share of wage changes affected by downward nominal wage rigidity. A growing survey-based literature supports the existence of downward nominal wage rigidity [1]

As discussed above, all models are populated by *non-Ricardian*, i.e. liquidity-constrained, households whose consumption is closely linked to their disposable income, besides *Ricardian* households with frictionless access to financial markets and infinite horizon. The share of Ricardian households assumed by Coenen et al. (2008) and Stähler and Thomas (2012) was based on estimates from the *Great Moderation* period. During periods of economic and financial crises like the one affecting the EA during the last couple of years, the share of these households can be argued to be especially high. We therefore recalibrate the share of non-Ricardian households

[1] See Bewley (1998, 1999), Fabiani et al. (2010), Galuscak et al. (2012) and Agell and Lundborg (2003). Similar results are obtained by Fehr and Falk (1999) from an experiment.

based on the results of the recent ECB Household Finance and Consumption Survey (HFCS 2013), assuming that it equals the share of those households exactly consuming their current income plus half of those consuming more. As a result the share of non-Ricardian households in the EA, Germany and the rest of the EA equals 53%, 42% and 60%, respectively.

2.2.2 Adding a financial accelerator

None of the three models feature any frictions in the relationship between non-financial firms and their creditors, implying that firm leverage does not matter for the cost of external finance and investment spending. Gelain and Kulikov (2011) provides evidence that such frictions matter in the EA by reestimating a version of the DSGE model of Smets and Wouters (2003) extended by a *financial accelerator* along the lines of Bernanke et al. (1999) (henceforth referred to as BGG). Furthermore, there is broad agreement that over the past couple of years, such constraints were especially relevant in the EA. Carrillo and Poilly (2013) and Freedman et al. (2010) show that in the presence of a zero lower bound on nominal interest rates, a financial accelerator enhances the effect of fiscal policy shocks. We therefore introduce a simplified version of the Financial Accelerator to the three models, which up to the first order yields the same key relations as the BGG approach.[2]

More specifically, we assume that capital accumulation is carried out by risk-neutral entrepreneurs instead of Ricardian households. At the end of period t, entrepreneur j buys capital K_t^j for price $P_t Q_t$. In period $t+1$, this entrepreneur rents his capital stock to retailers at a rental rate $P_{t+1} r_{t+1}^k$ (optimally choosing the utilization rate U_t if the respective model includes this variable) and then sells the non-depreciated capital stock at price $P_{t+1} Q_{t+1}$. The return to capital is given by

$$R_t^K = \Pi_t \frac{\left(1-\tau_t^K\right)\left(r_t^k U_t - a\left(U_t\right)\right) + \tau_t^K \delta P_t^I + Q_t\left(1-\delta\right)}{Q_{t-1}} \tag{1}$$

$$r_t^k = a'\left(U_t\right) \tag{2}$$

where τ_t^K denotes the tax rate on rental income from capital. To fund the acquisition of the capital stock, the entrepreneur uses her own net worth $P_t N_t^j$ and a loan $P_t L_t^j = P_t\left(Q_t K_t^j - N_t^j\right)$ from the banking sector. At the beginning of period $t+1$, the entrepreneur pays the bank $R_t P_t\left(Q_t K_t^j - N_t^j\right) + P_t BC_t^j$, where $P_t BC_t^j$ denotes the average cost arising from the bankruptcy of some entrepreneurs at the beginning of period $t+1$ due to idiosyncratic uncertainty, specified as a fraction of the value of the capital stock:

$$BC_t^j = \left(f\left(\phi_t^{e,j} - \phi^e\right) + BC^f\right) \tag{3}$$

with

$$\phi_t^{e,j} = \frac{Q_t K_t^j}{N_t^j} \tag{4}$$

denoting entrepreneurial leverage and $f\left(0\right)=0$, $f'\left(0\right)=0$, $f''\left(0\right)>0$. $BC^f \geq 0$ is a constant. Hence, as in BGG, we assume that the bank passes all costs associated with bankruptcy to the entrepreneurial sector, implying that it always earns the risk free rate R_t. The bank has no equity of its own and returns all interest income to its depositors, i.e. Ricardian households.

[2]Note that in the NAW, we added the financial accelerator only to the EA block. Adding it to both regions caused indeterminacy.

After the realization of R^K_{t+1}, entrepreneurs die with a fixed probability $1-EPROB$. Dying entrepreneurs consume their equity V_t. This assumption ensures that entrepreneurs never become fully self-financing. The fraction $1-EPROB$ of entrepreneurs who have died are replaced by new entrepreneurs in each period who receive a transfer W^e from households, which under our calibration is very small.

The objective of the entrepreneur is thus to maximize

$$E_t\left\{R^K_{t+1}Q_tK^j_t-\left(Q_tK^j_t-N^j_t\right)R_t-Q_tK^j_t\left(f\left(\phi^{e,j}_t-\phi^e\right)+BC^f\right)\right\}$$

which can also be written as

$$E_t\left\{R^K_{t+1}\phi^e_t-\left(\phi^e_t-1\right)R_t-\phi^e_t\left(f\left(\phi^e_t-\phi^e\right)+BC^f\right)\right\}$$

Note that we can drop the j superscript as the objective depends only on $\phi^{e,j}_t$, implying that all entrepreneurs will choose the same leverage. The FOC is then given by

$$\begin{aligned}E_tR^K_{t+1}-R_t &= f\left(\phi^e_t-\phi^e\right)+BC^f+\phi^e_tf'\left(\phi^e_t-\phi^e\right)\\ &= BC_t+\phi^e_tBC'_t\left(\phi^e_t\right)\end{aligned}\tag{5}$$

with

$$BC'_t\left(\phi^e_t\right)=f'\left(\phi^{e,j}_t-\phi^e\right)\tag{6}$$

Note that the steady state external finance equals BC^f.

Linearizing this yields

$$\begin{aligned}R^KE_t\widehat{R}^K_{t+1}-R\widehat{R}_t &= f'\left(\phi^e_t-\phi^e\right)\phi^e\widehat{\phi}^e_t+f'\left(\phi^e_t-\phi^e\right)\phi^e\widehat{\phi}^e_t\\ &\quad +f''\left(\phi^e_t-\phi^e\right)\left(\phi^e\right)^2\widehat{\phi}^e_t\\ &= f''\left(\phi^e_t-\phi^e\right)\left(\phi^e\right)^2\widehat{\phi}^e_t\end{aligned}$$

We assume that $f\left(\phi^e_t-\phi^e\right)=\frac{\chi}{2\phi^e}\left(\phi^e_t-\phi^e\right)^2$, with $\chi\geq 0$, implying that

$$R^KE_t\widehat{R}^K_{t+1}-R\widehat{R}_t=\chi\widehat{\phi}^e_t$$

Hence up to the first order, our assumptions produce the same relationship between entrepreneurial leverage and the spread between the return on capital and the risk free rate as the BGG-financial accelerator.

Total entrepreneurial net worth at the end of period t consists of that part of entrepreneurial equity V_t not consumed by dying entrepreneurs and a transfer from Ricardian households to entrepreneurs W^e, which entrepreneurs need in order to be able to start operations:

$$N_t=\gamma V_t+W^e\tag{7}$$

Entrepreneurial equity and consumption C^e_t are given by

$$V_t = \frac{R^K_tQ_{t-1}K_{t-1}-\left(Q_{t-1}K_{t-1}-N_{t-1}\right)R_{t-1}-Q_{t-1}K^j_{t-1}BC_{t-1}}{\Pi_t}\tag{8}$$

$$C^e_t = (1-EPROB)\,V_t\tag{9}$$

We assume $BC^f=0$, while our calibration of $EPROB$, ϕ^e and γ, which then also determine W^e, equal the choices and estimates of Gelain and Kulikov (2011).[3]

[3]As a result, for each region where we add the financial accelerator, we have 7 new variables, namely R^K_t, BC_t, $BC'_t\left(\phi^e_t\right)$, ϕ^e_t, N_t, V_t and C^e_t, and 7 new equations, namely (1) to (9). Furthermore, equation (1) replaces the first order condition of Ricardian households with respect to capital. Also, C^e_t has to be added to the equation summing up total consumption in the economy.

2.2.3 Changes to the fiscal rule

In all models, we assume that as in Stähler and Thomas (2012), the government adjusts the distortionary wage tax in response to deviations of the debt-to-GDP ratio from its target and the lagged labor tax, i.e.

$$\tau_t^w - \tau^w = \rho(\tau_{t-1}^w - \tau^w) + (1-\rho)\phi^w(((B_{t-1})/(P_{t-1}Y_{t-1})))$$

with τ_t^w, B_{t-1} and $P_{t-1}Y_{t-1}$ denoting the wage tax, the stock of government debt and nominal GDP, respectively, with $\rho, \phi^w > 0$. In order to limit the short run endogenous response of the labor tax to the consolidation measures as much as is consistent with a long-run stationary government debt-to-GDP ratio, we calibrate ρ and ϕ^w to 0.99 and 0.04.

2.2.4 Changes specific to the NAWM and FiMod

In the NAWM, we modify the monetary policy rule. The rule specified by Coenen et al. (2008) is

$$R_t^4 = \phi_R R_{t-1}^4 + (1-\phi_R)\left[R^4 + \phi_\Pi\left(\frac{P_{C,t}}{P_{C,t-4}} - \Pi\right)\right] + \phi_{gY}\left(\frac{Y_t}{Y_{t-1}} - g_Y\right)$$

with R_t^4, $\frac{P_{C,t}}{P_{C,t-4}}$ and $\frac{Y_t}{Y_{t-1}}$ denoting the annualized nominal interest rate, inflation and quarterly GDP growth. Note that the implied nominal output growth rate response is given by $\frac{\phi_{gY}}{(1-\phi_R)} = \frac{0.1}{1-0.95} = 2$. This is much higher than what is typically estimated. In our baseline simulation, which features a zero lower bound, this calibration dramatically *increases* the adverse output effects of fiscal consolidation. When the rule is switched back on, the EA-economy is growing and thus a response to output growth tends to increase the nominal interest rate. As we do not want our results to be driven by this mechanism, we changed the rule to $R_t^4 = \phi_R R_{t-1}^4 + (1-\phi_R)\left[R^4 + \phi_\Pi\left(\frac{P_{C,t}}{P_{C,t-4}} - \Pi\right) + \phi_{gY}\left(\frac{Y_t}{Y_{t-1}} - g_Y\right)\right]$, with $\phi_{gY} = 0.612$, as in the estimated version of the NAWM by Christoffel et al. (2008).

Furthermore, we add public capital to the EA-economy in order to be able to distinguish between cuts of public investment and public consumption. The elasticity of private production with respect to public capital has been calibrated as in FiMod. In particular, private sector output $Y_{f,t}$ is now determined by

$$Y_{f,t} = z_t K_{g,t}^{\alpha_g} K_{f,t}^{\alpha} N_{f,t}^{1-\alpha} - \psi$$

where z_t, $K_{g,t}$, $K_{f,t}$ and $N_{f,t}$ denote exogenous productivity, the government capital stock, the private capital stock, and private sector employment, respectively.

Furthermore, we add transfers to households which depend negatively on the deviation of employment from the steady-state as an automatic stabilizer. In a model featuring unemployment like FiMod, this objective would be fulfilled by unemployment benefits. This modification somewhat lowers the adverse consequences of fiscal consolidation by stabilizing non-Ricardian household consumption while increasing the feedback of the state of the economy to the fiscal balance.

Finally, in the NAWM, non-Ricardian households have considerable money holdings, which limit their consumption response to declines in their disposable income. We modify the behavior of non-Ricardian households by assuming that they have no financial assets, as standard in the literature.

Table 1: Ex-ante deficit effects of consolidation measures implemented in the EA, % of GDP

	2011	2012	2013
Consumption taxes	0.3	0.4	0.2
Labor taxes	0	0.3	0
Corporate taxes	0.1	0	0
Social security contributions	0.2	0	0
Total revenue	0.6	0.7	0.2
Transfers	-1	-0.2	-0.3
Consumption expenditure	-0.2	-0.2	-0.1
Gross fixed capital formation	-0.2	-0.2	0
Total expenditure	-1.4	-0.6	-0.4

Notes: Source: European Commission (2012).

Stähler and Thomas (2012) calibrate the two countries in FiMod to be Spain and the Rest of the EA. We calibrate the model for Germany and Rest of the EA, as most of the EA's fiscal consolidation took place outside Germany. We therefore change the steady state ratios targeted by Stähler and Thomas (2012), e.g. the unemployment rate, the share of government spending and imports in GDP or the replacement rate to fit it to these regions, using annual Eurostat, AMECO and OECD data over the 2000-2012 period. All parameters and ratios pertaining to the efficiency of the matching process, the cost of hiring, labor market flows and the elasticity of output with respect to public capital are as in Stähler and Thomas (2012). Furthermore, the monetary policy rule parameters, investment adjustment costs, the degrees of consumption habit formation and relative risk aversion have been calibrated as in the estimate of the NAWM by Christoffel et al. (2008). We have also modified the calibration of the fiscal rule in order to avoid an endogenous response of the labor tax rate to the debt-to-GDP ratio in the short run, as we want to focus on the effect of the enacted fiscal consolidation.

3 Simulation design

Table 1 summarizes the extent of the consolidation measures implemented in the EA between 2011 and 2013 as reported by European Commission (2012). The numbers reported indicate by how much the respective measure affects the public deficit as percent of GDP assuming everything else staying the same. Note the following: First, the total fiscal consolidation effort was 2% of GDP in 2011, 1.3% in 2012 and 0.6% in 2013. Second, consolidation was primarily based on expenditure cuts rather than tax increases. Third, the expenditure cuts were mainly carried out by reducing transfers. We will assume that transfer cuts are borne exclusively by liquidity constrained households, which is consistent with findings that across the board transfer cuts tend to increase inequality of disposable income OECD (2012), Rawdanowicz et al. (2013). Fourth, tax increases affected primarily consumption taxes.

A key question is the period of time during which the consolidation measures are kept in place. In an infinite horizon environment, fully credible permanent expenditure cuts will tend to crowd in the consumption of Ricardian households who anticipate that a lower future share of output consumed by the government implies higher future private consumption, as shown

in the context of a stylized model by Denes et al. (2013), as is also admitted by European Commission (2012). Thus, the smaller multipliers of permanent measures crucially depend on the infinite horizon assumption. Arguably, this feature is unrealistic and results might differ if forward looking agents have a certain degree of myopia, as for instance in the GIMF model of the IMF, in which the planning horizon is typically only 10 years (Kumhof et al. 2010). An operational approach to account for the existence of myopia in the models we use is to simulate the consolidation measures as temporary. Furthermore, governments may decide to phase out the spending cuts due to their adverse effects of transfer cuts on the distribution of income OECD (2012, Box 1.7), the quality of public services like education and health care, and the deterioration of the public infrastructure, and the associated degree of public discontent.

In our baseline simulation, we therefore assume that the measures are kept in place for 15 years, after which they are gradually phased out following an AR(1) process with a coefficient of 0.9. Note that our assumed duration of the consolidation measures is considerably longer than what is assumed in int' Veld's (2013) baseline specification where measures are kept in place for one year and are then phased out with an autoregressive coefficient of 0.9.

The second key issue is the monetary policy response to the decline in output and inflation caused by the fiscal consolidation. In our baseline simulation, we assume that the central bank interest rate is kept constant for 5 years, after which it follows the interest feedback rule in the model. This is similar to what is assumed by int' Veld (2013). During the period the fiscal consolidation took place the monetary transmission mechanism was arguably malfunctioning(Coeuré (2013)), due to problems in the banking sector and the European sovereign debt crisis. Changes of the Euro Over Night Index Average (EONIA) were not completely passed through to the borrowing costs of households and non-financial firms. Furthermore, at the beginning of 2011, the EONIA was already at a quite low level of 0.7% and was reduced to effectively zero by the end of the year. Arguably, this reduction would have taken place even in the absence of fiscal consolidation, as the financial sector problems had a contractionary effect on the EA economy via a tightening of credit markets and increased the borrowing costs for non-financial corporations. Al-Eyd and Berkmen (2013) estimate that bank funding pressures increased lending rates on small loans by about 1 percentage point in both 2012 and 2013. Other contributions also find a negative effect of the sovereign debt crisis on lending.[4]

We simulate the founding-pressure related increases in the cost of external finance found by Al-Eyd and Berkmen (2013) for 2012 and 2013 as a persistent shock to the wedge between the central bank interest rate and the cost of funding of private households and financial intermediaries with a first-order autoregressive coefficient of 0.97 in the NAWM and assume that the ECB follows the rule discussed above. We find that the ECB's interest rate declines by about 0.7 percentage points for more than 20 quarters. Arguably, the scale of the simulated output decline in response to the shock, peaking at over 10% after two years, would motivate the ECB to prescribe an even more expansionary policy than prescribed by the policy rule, which was estimated on pre-crisis data.

To incorporate these frictions in our baseline simulation we keep the central bank interest

[4]Bedendo and Colla (2013) find a statistically significant impact of sovereign risk on the credit risk of non-financial corporations in the Euro Area from January 2008 to December 2011. The magnitude is about one fourth of the impact on financial institutions' credit risk as estimated by Acharya et al. (2011). Marco (2013) argues that the sovereign debt crisis considerably reduced corporate credit supply and increased the lending rates in the EU between 2009 and 2012. The ECB interventions, Term Refinancing Operations in December 2011 (LTRO 1) and February 2012 (LTRO 2) are argued not to have alleviated the impact of the credit crunch. Bofondi et al. (2013) put forward some evidence for Italian bank-firms relationships between December 2010 and December 2011 suggesting that lending of Italian banks grew on a rate 3%-points lower than the lending of foreign banks. The sovereign debt crisis seems to have caused an increase of their interest rates by 15-20 basis points.

rate constant for an extended period of time, namely 5 years. By contrast, recent simulation results in a study by the European Commission (2012) allow only for a constant interest rate period of at most one year. In the NAWM, we assume that the Federal Reserve Bank is constrained by the zero lower bound for three years.

4 Simulation results

4.1 Effects of changes in individual fiscal instruments

We first analyze how each single fiscal policy instrument affects the economy of the EA in FiMod and NAWM given our modifications of these models as discussed above. To make these measures comparable, the shocks are calibrated such that each of them has an ex-ante deficit effect of 1% of GDP, ex-ante meaning before taking into account the response of the economy to the change of the instrument.

For both FiMod and NAWM, Figures 1a and 1b plot the responses of various macroeconomic variables to such ex-ante deficit reducing shocks to selected fiscal policy instruments. The responses are deviations from the steady-state values. In line with earlier studies (e.g. Erceg and Lind 2013), we find that changes to the government's demand for goods and services, i.e. changes to government consumption and investment, exceed the effects of increasing labor or consumption taxes. Cuts to government investment are especially harmful since they cause a successive decline in private sector productivity in each period they are in place. They thus increase marginal cost and inflation, implying a more restrictive monetary policy once the zero lower bound ends. This effect is especially strong in QUEST III, mostly because the elasticity of private sector output with respect to public capital equals 10% rather than 1.5% as in FiMod. Transfer cuts in FiMod have an effect quite similar to the reduction of government consumption, which is due to our assumption that only non-Ricardian households are affected. By contrast, in the NAWM, the decline of GDP caused by a transfer cut mirrors the path associated with a cut in government consumption only over the first three years, but then converges to the steady state much faster. In QUEST III, the effect of a transfer cut is also smaller than the cut in government expenditure. The reason appears to be that the consumption decline associated with the transfer cut causes an expansion in non-Ricardian households labor supply and thus a decline in the real wage and inflation as compared to the paths associated with a cut in government consumption. Therefore, once it is no longer constrained, monetary policy is loosened more in response to a transfer cut.

Note that increasing employer's social security contribution increases GDP in all models. Increasing this tax has no direct effect on households' disposable income as it is borne by employers, but increases inflation and thus lowers the real interest rate. This increases the consumption of non-Ricardian households and investment spending.

We also examine how the adverse effects of fiscal consolidation depend on our assumptions regarding the duration of the consolidation measures, the duration of the zero lower bound, the presence of financial frictions, and the degree of nominal wage rigidity. Figures 2a and 2b single out government consumption and plot its effect on the variables of interest under different scenarios. As expected the assumed length of an impaired monetary transmission mechanism as well as whether measures are believed to be temporary or permanent are crucial for the simulated impact of the austerity program on the EA-economy. In the baseline simulation, the through of GDP is reached after about 5-7 quarters in all models, with a reduction of output of a little more than 2% of steady-state GDP in the maximum. Changing the duration

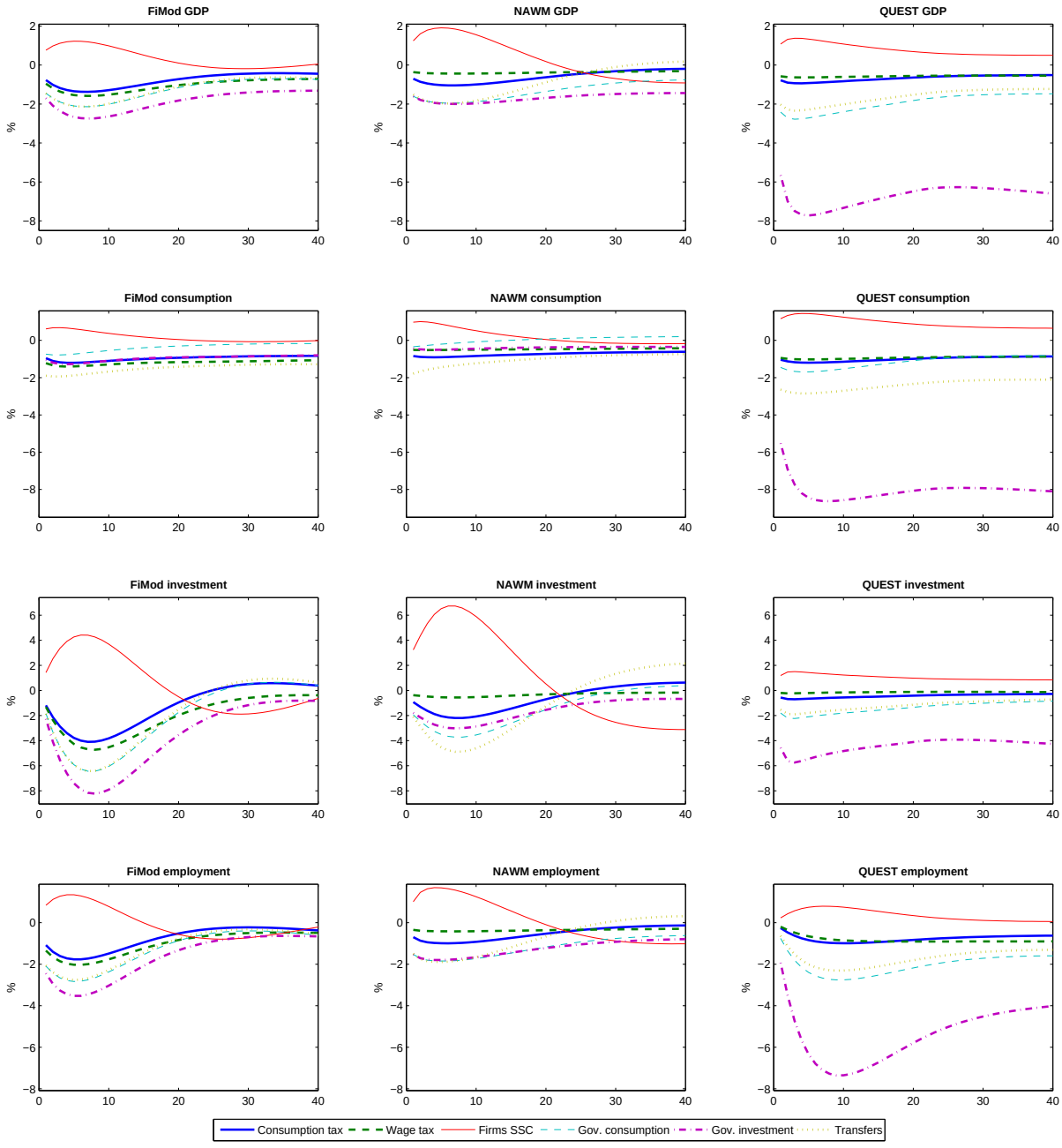

Figure 1a: Responses of selected variables of the EA to shocks to single fiscal policy instruments with ex-ante deficit-reducing effects of 1% of GDP in baseline specification (phase-out after 60 quarters, zero lower bound for 20 quarters, Calvo wage parameter of 0.95, financial crisis conditions): consumption tax rate, labor tax rate, social security contribution tax rate, government consumption, government investment, and transfers.

of the consolidation measures from 60 quarters to permanent considerably reduces the the contraction of the economy. This is because credible permanent expenditure cuts will crowd in the consumption of the Ricardian households who anticipate that a lower future share of output consumed by the government implies higher future private consumption. Changing the duration of the zero lower bound from 5 years to 1 year also greatly reduces the contractionary effect of the reduction in government consumption as the resulting effect on the interest rate

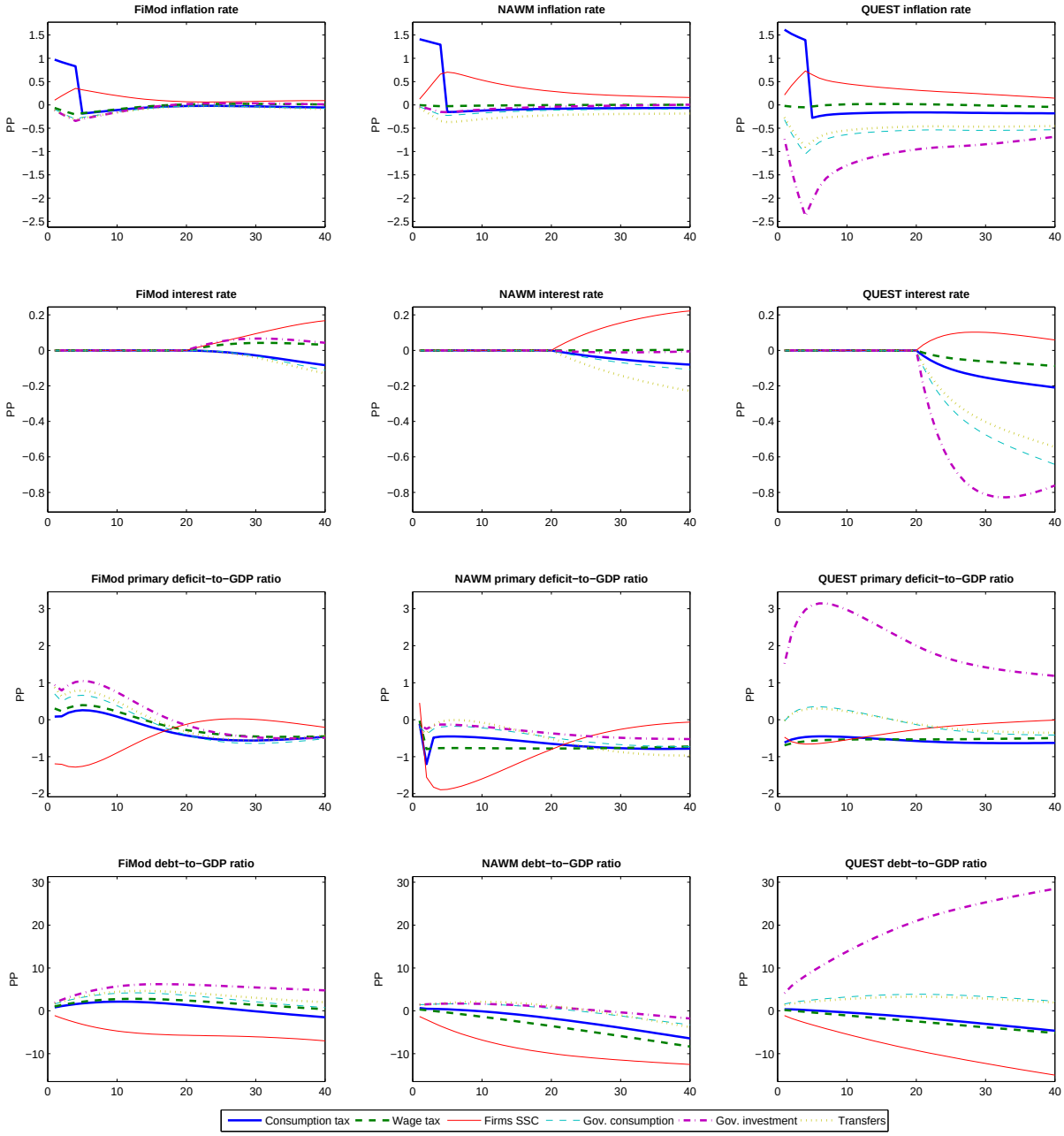

Figure 1b: Responses of selected variables of the EA to shocks to single fiscal policy instruments with ex-ante deficit-reducing effects of 1% of GDP in baseline specification (phase-out after 60 quarters, zero lower bound for 20 quarters, Calvo wage parameter of 0.95, financial crisis conditions): consumption tax rate, labor tax rate, social security contribution tax rate, government consumption, government investment, and transfers.

is now much lower than in the other scenarios. Removing the financial accelerator, setting the share of ROT-households to the lower values assumed by the authors of the models we use and allowing ROT households in the NAWM to hold money also strongly reduces the effect of cutting government consumption. By contrast, increasing the degree of nominal wage flexibility by lowering the Calvo wage parameter from 0.95 to 0.9, still far above commonly estimated values, increases the contraction of output in the NAWM and to a lesser extent in QUEST III

by enhancing the decline of inflation and thus the increase in the real interest rate, the real debt burden of enptrepreneurs and the associated decline in consumption and investment. The finding that an increase in nominal flexibility increases the effect of demans shocks at the zero lower bound is in line with Eggertson and Krugman (2012) as well as Battharai et al. (2013), although these authors focus on price flexibility. By contrast, in FiMod, output declines less if wages are more flexible. The likely reason is that the adverse effects of lower inflation on spending are overcompensated by the expansionary effects of greater monetary accommodation once the zero lower bound is no longer binding. Note though that the finding of a benign effect of higher nominal wage flexibility in FiMod is overturned if the degree of price rigidity is reduced to values conventionally estimated for the Euro area, say 0.92.

4.2 Effects of actual consolidation - baseline results

So far, we have analyzed the responses to shocks to single fiscal policy instruments. Moreover, we have studied these responses for the economy of the whole EA. In the following, we discuss the simulation results for the consolidation measures actually implemented in the EA and focus on Germany and the Rest of the EA in FiMod, the EA and the US in the NAWM, and the EA in QUEST III, respectively.

Figures 3a and 3b plot the response of the economy as deviations from the steady state to the consolidation measures implemented in the EA between 2011 and 2013 as reported above. The plots for FiMod show the responses of Germany, the Rest of the EA and the total EA, the plots for the NAWM the responses of the EA and the US, and the plots for QUEST the responses of the EA. At the trough, EA GDP is a bit more than 5% below its steady state in NAWM, about 7% in QUEST III and about 9% in FiMod, and recovers only gradually. Persistence is highest QUEST III. Until 2013, the cumulative losses of GDP are 13% in the NAWM and 23% in FiMod and QUEST III. Recall that all fiscal consolidation measures amount to about 4% of EA GDP by 2013, i.e. quarter 9 in the simulation. The corresponding cumulative multipliers are 1.5 and 2.5, respectively. This implies that the overall fiscal multiplier exceeds one for a considerable horizon. By contrast, the European Commission projects a cumulative loss of the EA's real GDP over the period 2012-2016 of 2.5% assuming perfect credibility and unconstrained monetary policy. With imperfect credibility and a binding zero-bound constraint on nominal interest rates for 2012 the cumulative loss of real GDP in the EA over the same period is reported to be 3.4%. This is still considerably below our simulated costs.

The output contraction in both models lowers tax revenues and increases transfer payments, implying that the primary deficit ratio at first increases in all models, substantially so in FiMod and QUEST III, and only very gradually approaches the ex-ante GDP effect of the combined consolidation measures. As a result of the negative feedback of the economic contraction to the budget balance, the decline in GDP and the increase in the real value of debt due to lower inflation, the debt-to-GDP ratio increases substantially and persistently in all models. In FiMod and QUEST III, the decline of the debt-to-GDP ratio takes longer than three years.

Regarding the intra-EA spillovers, even though fiscal consolidation is almost exclusively concentrated in the rest of the EA, the German economy is strongly affected as well via a decline in exports and inflation spillovers via declining import prices, which increase the real interest rate and depresses consumption and investment spending. German inflation is also more directly depressed via the decline in import prices.

The NAWM and QUEST III offer clues regarding the role of international real and financial linkages in shaping the effect of the EA's fiscal consolidation. In both models, the stabilizing effect on GDP of lower imports caused by lower domestic demand is compensated by an

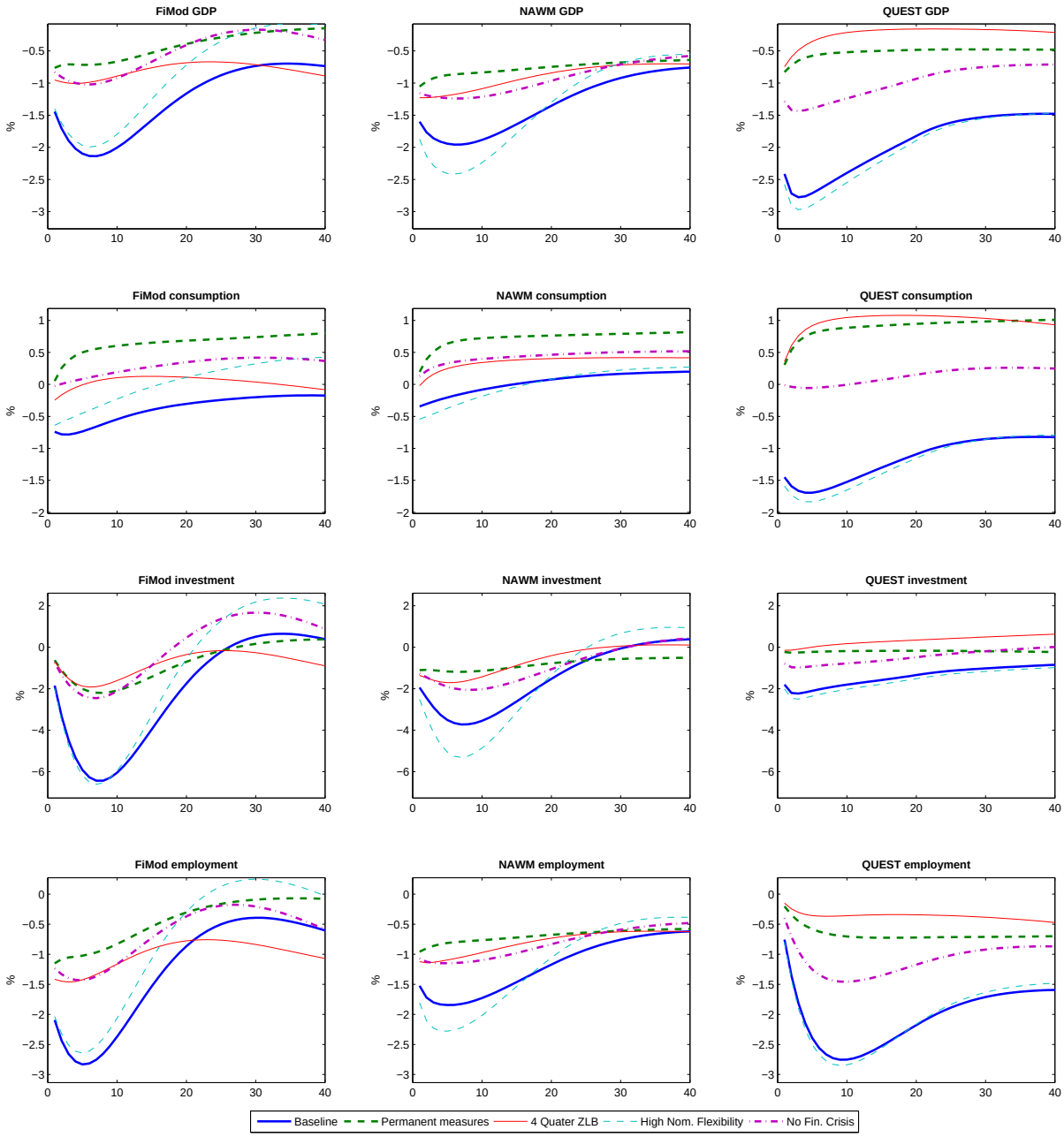

Figure 2a: Responses of selected variables of the EA to a shock to government consumption with an ex-ante deficit-reducing effect of 1% of GDP for the baseline specification (phase-out after 60 quarters, zero lower bound for 20 quarters, Calvo wage parameter of 0.95, financial crisis conditions) and the following deviations from the baseline: no phase-out, zero lower bound for 4 quarters, Calvo wage parameter of 0.9, and no financial crisis conditions (i.e. no financial accelerator, lower share of ROT consumers, liquidity constrained households in NAWM hold money) , respectively.

appreciation of the nominal exchange rate, as well as a decline in US GDP in the NAWM. Therefore, in the NAWM, there is only a small but persistent improvement of the trade balance (not shown), peaking at 0.25% of GDP, while in QUEST III, the trade balance is actually worsened by the fiscal consolidation during the first three years, with a through at -0.7% of GDP

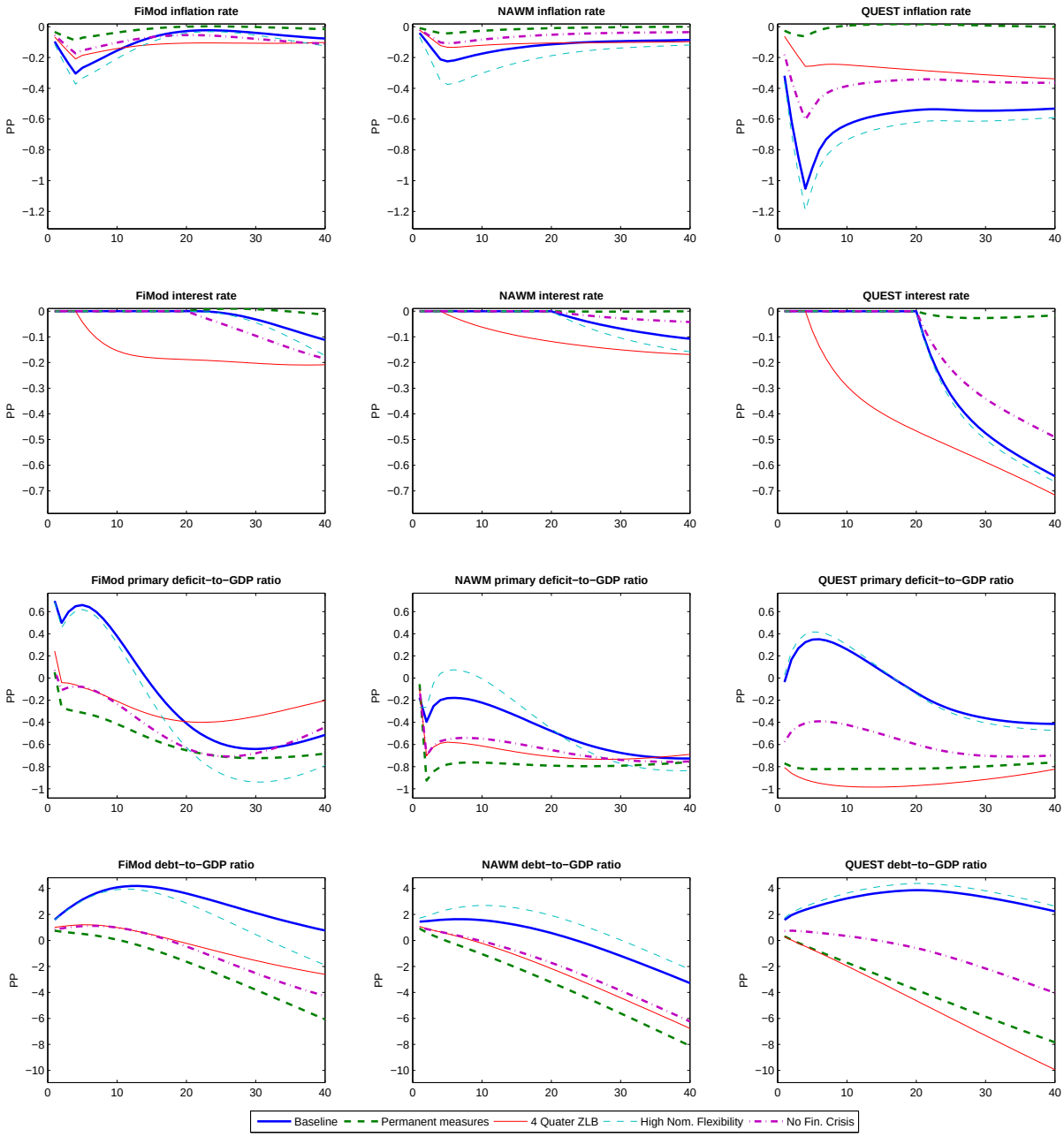

Figure 2b: Responses of selected variables of the EA to a shock to government consumption with an ex-ante deficit-reducing effect of 1% of GDP for the baseline specification (phase-out after 60 quarters, zero lower bound for 20 quarters, Calvo wage parameter of 0.95, financial crisis conditions) and the following deviations from the baseline: no phase-out, zero lower bound for 4 quarters, Calvo wage parameter of 0.9, and no financial crisis conditions (i.e. no financial accelerator, lower share of ROT consumers, liquidity constrained households in NAWM hold money) , respectively.

in the second quarter. In the NAWM, the appreciation of the EA's exchange rate is driven by the accumulation of net foreign assets caused by the improvement in the trade balance, which increases the cost of accumulating dollar assets. By contrast, in QUEST III, the key driver of the appreciation appears to be the very persistent inflation decline. The constant long-run real

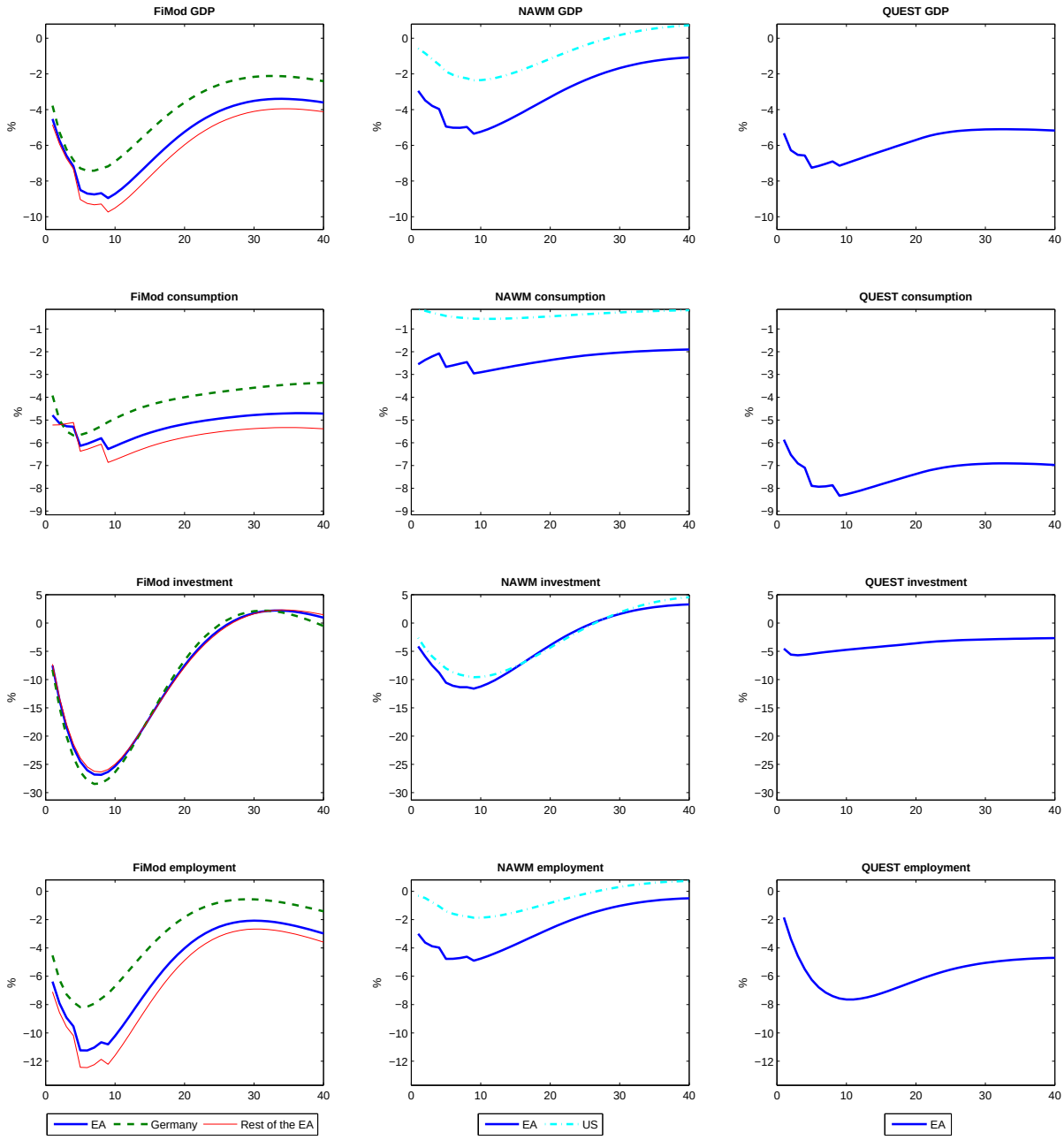

Figure 3a: Responses of selected variables of Germany, the Rest of the EA and the EA in FiMod, the EA and the US in the NAWM, and the EA in QUEST III, respectively, to the consolidation measures implemented in the EA between 2011 and 2013 using the baseline specification (phase-out after 60 quarters, zero lower bound for 20 quarters, Calvo wage parameter of 0.95, financial crisis conditions).

exchange rate thus requires a long run nominal appreciation, which via UIP raises the nominal exchange rate on impact.

Figures 4a and 4b compares the effects of the fiscal consolidation depending on the length of the zero lower bound, whether measures are permanent or temporary and the degree of nominal wage rigidity and whether financial crisis conditions hold. The effect of these perturbations are very similar to their effect to a cut on government consumption. If we assume the interest rate

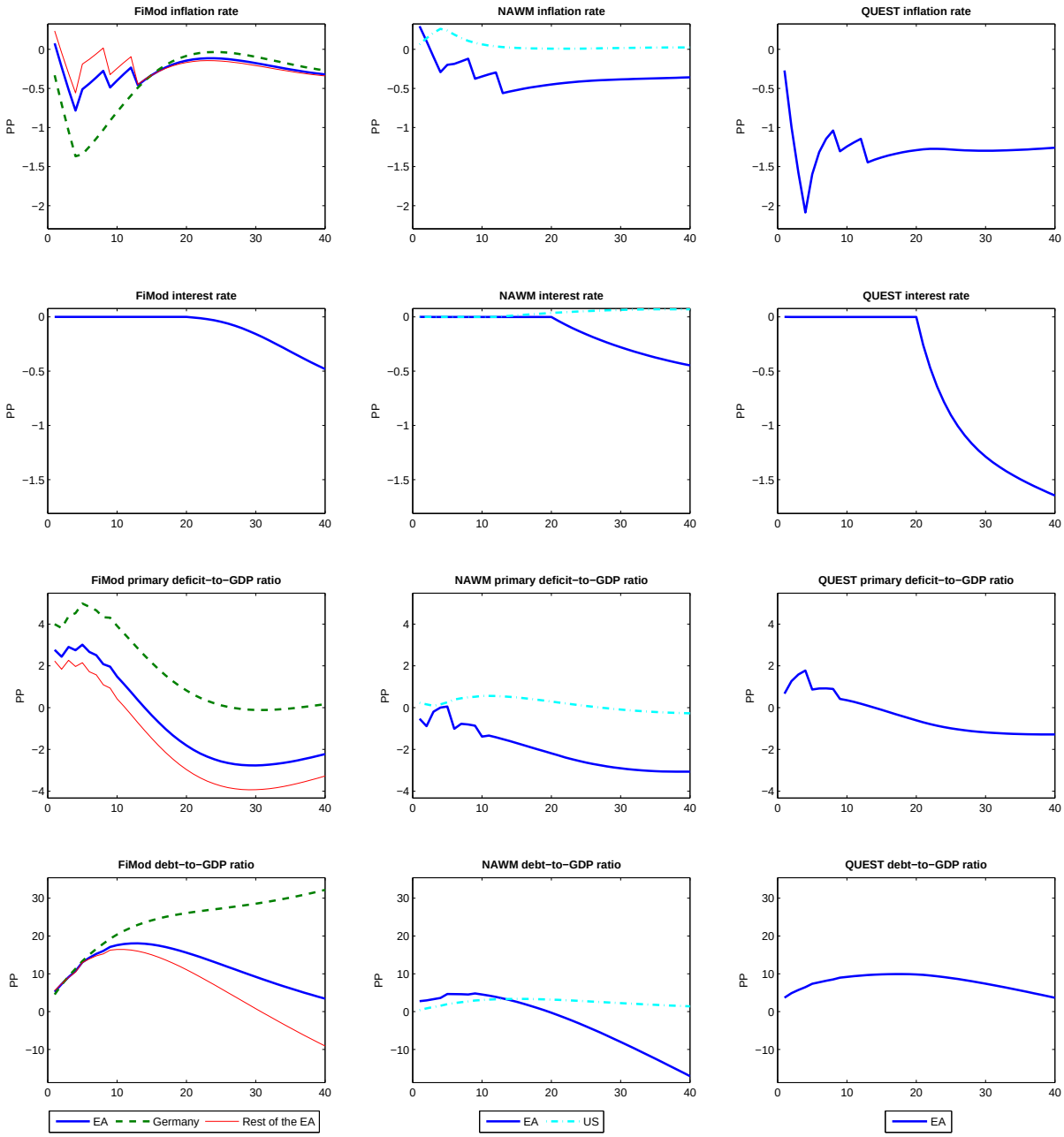

Figure 3b: Responses of selected variables of Germany, the Rest of the EA and the EA in FiMod, the EA and the US in the NAWM, and the EA in QUEST III, respectively, to the consolidation measures implemented in the EA between 2011 and 2013 using the baseline specification (phase-out after 60 quarters, zero lower bound for 20 quarters, Calvo wage parameter of 0.95, financial crisis conditions).

to be constant for only one year as in European Commission (2012), the adverse effect of fiscal consolidation is strongly reduced in all models. Assuming that the measures are permanent has a similar effect. Hence properly taking into account the financial constraints on households and firms as well as allowing for myopia among forward looking households leads to a much more pessimistic assessment of the EA's fiscal consolidation than abstracting from these features.

Lowering the degree of nominal wage rigidity increases the adverse effects of fiscal consolida-

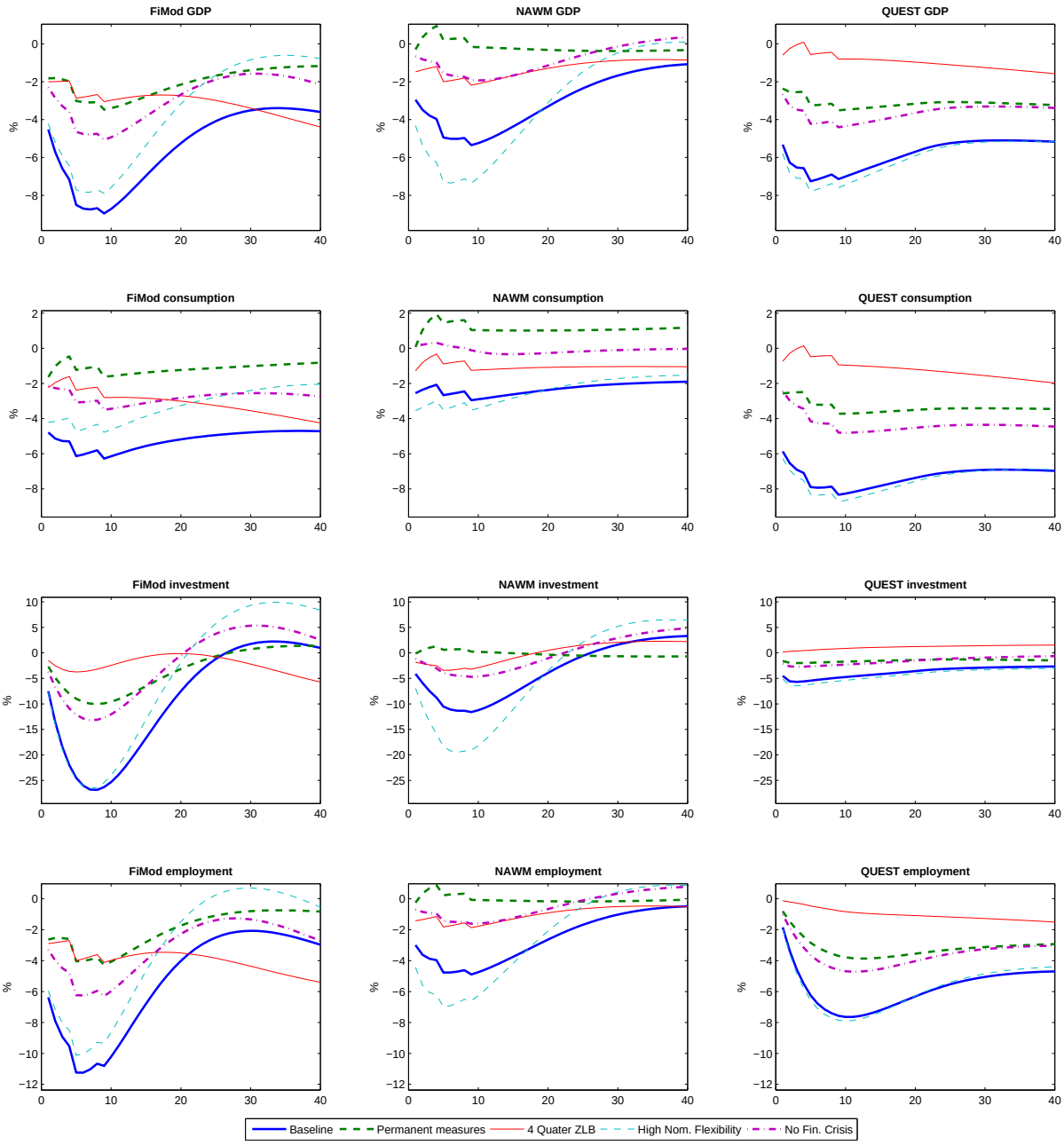

Figure 4a: Responses of selected variables of the EA to the consolidation measures implemented in the EA between 2011 and 2013 for the baseline specification (phase-out after 60 quarters, zero lower bound for 20 quarters, Calvo wage parameter of 0.95, financial crisis conditions) and the following deviations from the baseline: no phase-out, zero lower bound for 4 quarters, Calvo wage parameter of 0.9, and no financial crisis conditions (i.e. no financial accelerator, lower share of ROT consumers, liquidity constrained households in NAWM hold money) respectively.

tion in the NAWM and slightly in QUEST III, but reduces it FiMod. Again, the latter result is sensitive to lowering the degree of nominal price rigidity. Therefore, by and large our simulation results suggest that the existence of downward nominal wage rigidity contributing to prevent a slide of the EA into deflation as a consequence of fiscal consolidation.

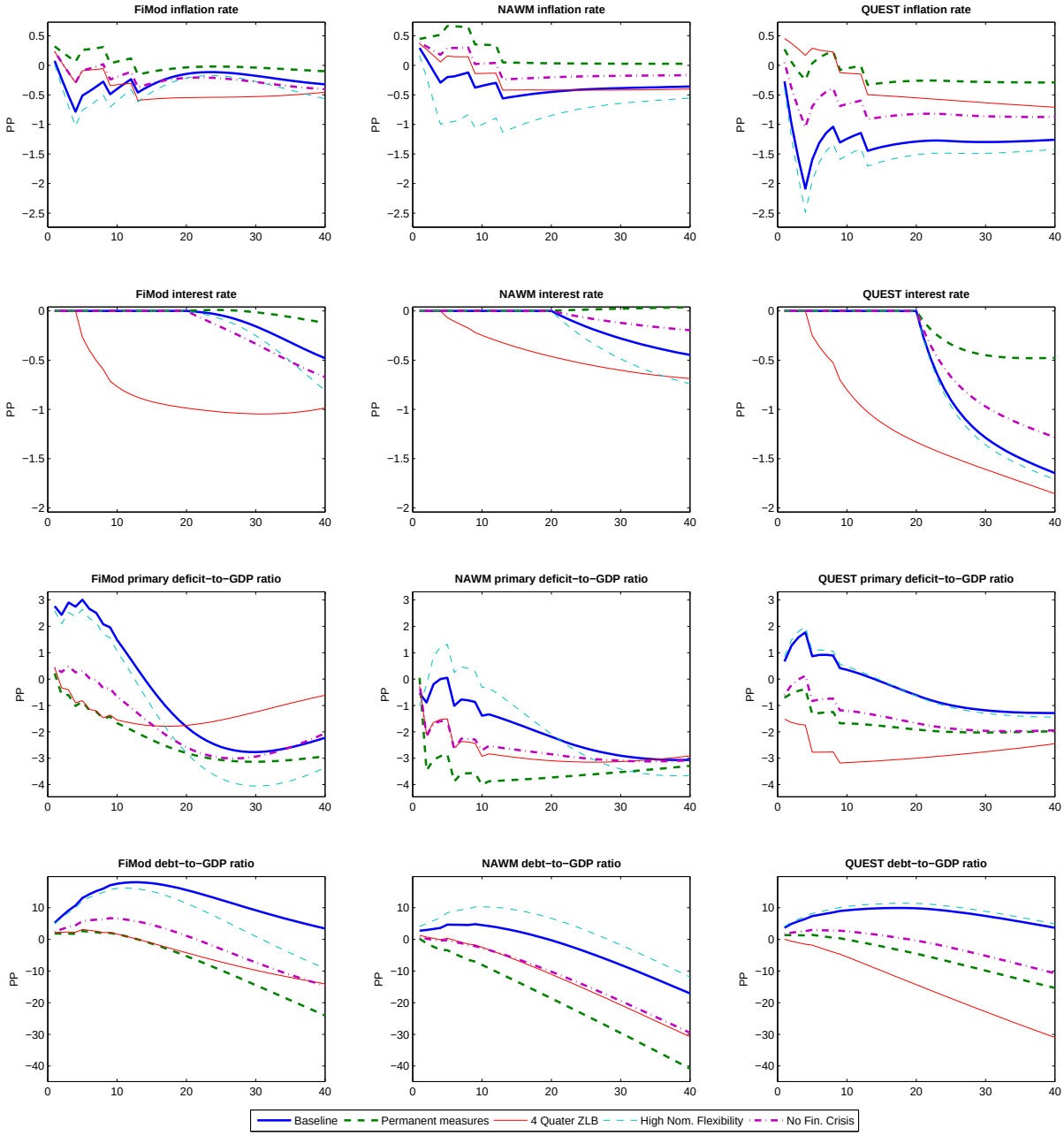

Figure 4b: Responses of selected variables of the EA to the consolidation measures implemented in the EA between 2011 and 2013 for the baseline specification (phase-out after 60 quarters, zero lower bound for 20 quarters, Calvo wage parameter of 0.95, financial crisis conditions) and the following deviations from the baseline: no phase-out, zero lower bound for 4 quarters, Calvo wage parameter of 0.9, and no financial crisis conditions (i.e. no financial accelerator, lower share of ROT consumers, liquidity constrained households in NAWM hold money) respectively.

5 Concluding remarks

Between 2011 and 2013, countries of the Euro Area have implemented spending cuts and tax increases accumulating to about 4% of EA GPD (European Commission 2012). Early assessments of the macroeconomic effects of this austerity package such as European Commission

(2012) have not adequately taken into account the restrictions imposed on monetary policy, the tightening of liquidity constraints for households during times of financial turmoils, and have not allowed for the existence of myopic behavior by forward looking households, which would be expected to limit the Ricardian effects of permanent spending cuts. This paper therefor seeks to reassess the impact of fiscal consolidation pursued in the EA between 2011 and 2013 employing variants of three DSGE models developed for fiscal policy analysis by the ECB (the NAWM), the European Commission (QUEST III) and the Bundesbank (FiMod), which we modify in order to take account of the above considerations.

As a result, the simulated GDP effects of the EA's fiscal consolidation are large, and would be more than sufficient to explain the recent recession in the EA. GDP declines by more than the ex-ante effect of the fiscal consolidation, and persistently so. As a consequence lower tax revenues and higher welfare expenditure, the improvement in the primary budget balance lags strongly behind the ex-ante effect of the fiscal consolidation, and worsens during the first year in all models In conjunction with the decline in GDP and a strong decline in inflation, this result causes a persistent and substantial increase in the debt-to-GDP ratio. In this sense, the consolidation may be described as self-defeating. Our sensitivity analysis shows that each of our three foci–accounting for the constraints on monetary policy, the constraints on households and firms spending and the myopia of forward looking households– matters for this result.

We find that, under these crisis conditions, the fiscal consolidation measures implemented may have caused a cumulative loss of somewhere between 13% and 23% of annual real GDP in the EA over the 2011 to 2013 period.

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