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**Working Paper**

## Does It Matter When Labor Market Reforms Are Implemented? The Role of the Monetary Policy Environment

CESifo Working Paper, No. 7844

**Provided in Cooperation with:**

Ifo Institute – Leibniz Institute for Economic Research at the University of Munich

*Suggested Citation:* Lastauskas, Povilas; Stakėnas, Julius (2019) : Does It Matter When Labor Market Reforms Are Implemented? The Role of the Monetary Policy Environment, CESifo Working Paper, No. 7844, Center for Economic Studies and ifo Institute (CESifo), Munich

This Version is available at:

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## **Impressum:**

CESifo Working Papers

ISSN 2364-1428 (electronic version)

Publisher and distributor: Munich Society for the Promotion of Economic Research - CESifo GmbH

The international platform of Ludwigs-Maximilians University's Center for Economic Studies and the ifo Institute

Poschingerstr. 5, 81679 Munich, Germany

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Editor: Clemens Fuest

[www.cesifo-group.org/wp](http://www.cesifo-group.org/wp)

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# Does It Matter *When* Labor Market Reforms Are Implemented? The Role of the Monetary Policy Environment

## Abstract

Do labor market reforms initiated in periods of loose monetary policy yield different outcomes from those that were introduced in periods when monetary tightening prevailed? Since economic theory usually pays attention to the steady state change and ignores business cycle interactions of structural reforms, we connect local projection methodology with the Mallow's  $C_p$  averaging criterion to arrive at an inference that does *not* require knowledge of the exact functional form, is robust to mis-specification, admits non-linearities, and cross-sectional dependence and addresses uncertainty regarding interactions between labor reforms and macroeconomy. We also develop a test to check the importance of monetary policy for any horizon and the entire impulse response function, taking the multiple testing problem into account. We document that replacement rates deliver substantially different outcomes on real GDP, inflation and real effective exchange rate, whereas labor activation schemes bear different effects on unemployment in low- and high-interest rate environments. There is also evidence of monetary policy trend playing an important role and increasing synchronized monetary and labor market policies across European countries.

JEL-Codes: C330, C540, E520, E620, J080, J380.

Keywords: labor market reforms, nonlinear responses, Mallow's  $C_p$  criterion for model averaging, error factor structure, low and high interest rate environments.

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We are grateful, without implication, to the participants of the ECB MPC task-force on structural reforms, particularly Klaus Masuch. Special thanks to Romain Duval, Balázs Égert, Yuemei Ji, and participants at 2019 CESifo Venice Summer Institute Workshop "The Future of Europe". Needless to say, all errors remain our own. Both authors are thankful for the partial support from the research grant No P-LL-18-246 under agreement with National Science Centre in Poland and the Research Council of Lithuania. The views expressed are those of the authors and do not necessarily represent those of the Bank of Lithuania or the Eurosystem.

*Structural and cyclical policies – including monetary policy – are heavily interdependent. <...> If structural reforms are credible, their positive effects can be felt quickly even in a weak demand environment. <...> And our accommodative monetary policy means that the benefits of reforms will materialize faster, creating the ideal conditions for them to succeed.*

(Mario Draghi, 22 May 2015)

## 1 Introduction

In his introductory speech quoted above, Mario Draghi, president of the ECB, notes that “(t)he term “structural reforms” is actually covered in approximately one-third of all speeches by various members of the ECB Executive Board.” And yet, despite the understanding that monetary policy needs to be supported by other reforms, in particular, structural ones, there is little theoretical and empirical work on the ways in which these factors interact. Although there is a consensus, in particular after the global financial crisis that started in 2008, that economies should strive for efficiency, resilience to adverse shocks, adaptability and flexibility (especially the swift reallocation of resources, particularly workers), policymakers lack guidance on the timing and required pre-conditions for different policy measures to deliver desired results. In fact, the [ECB \(2017, Box 5\)](#) emphasizes that businesses consistently ranked labor market reforms as the most pressing area for further work. We therefore consider the European context and its persistently high unemployment before the global crisis ([Blanchard and Wolfers, 2000](#); [Blanchard, 2006](#)) and the secular stagnation after it ([Teulings and Baldwin, 2014](#)). We concentrate on labor market reforms and their effects on macroeconomy in different monetary policy environments, proxying for loose and tight monetary policies. Unlike a standard approach, where a comparison of steady states of structural labor reforms is conducted, our attention is paid to the interactions between structural policies and business cycles. This also helps to address causality issues.

The monetary policy environment is partitioned into periods with decreasing (or low) interest rates, increasing (or high) interest rates and periods during which no change occurs. A low interest rate environment is defined as a period of time when the interest rate is lower than usual, making it cheaper to borrow money to fund investment. To be more precise, we allow for a few definitions in the empirical framework (we consider a drop in the short-term interest rate on an annual basis as well as a lagged measure on a quarterly basis).<sup>1</sup> As recent practice demonstrates, a low interest rate environment may even be associated with negative interest rates, applied to commercial banks’ excess funds held on deposit at the central bank. The main goals of such policies include higher bank lending, higher investment and private spending, and a fall in demand for currency, thus also helping to make exports cheaper. In rising interest rate environment, to the contrary, the cost of borrowing increases whereas saving becomes more attractive. Typically, such an environment coincides with the recovery phase of a business cycle. This makes our empirical exercise somewhat different from those found in the existing literature – we are targeting business cycle frequency, while labor market reforms are usually analyzed at a lower frequency (a few examples that differ

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<sup>1</sup>Importantly, we choose to explore interactions between policies themselves, not identified monetary and labor market policy shocks. Though both approaches are of interest, the economic question is different. In the identified shock case, the question is about the interaction between surprise (unexpected) monetary policy (or interest rate) shocks and labor reforms, whereas our focus is on the monetary policy environment within which labor market reforms happened to be initiated. Suppose that agents expect 1 p.p. decrease in the policy rate and it actually drops by 1 p.p. Though the shock is zero, agents’ behavior may be different in a higher and in a lower interest rate environment.

in spatial coverage and granularity but are limited to annual or other low-frequency data include [Bassanini and Duval 2006](#); [Boeri 2011](#); [Bouis et al. 2012](#); [Boysen-Hogrefe et al. 2010](#); [Duval and Furceri 2018](#); [Egert and Gal 2017](#); [Gal and Theising 2015](#); [Kahn 2010](#); [Nickell et al. 2005](#); [Turrini et al. 2014](#)).

Nonetheless, some prominent counter-examples in the literature stand out. Macro-labor studies with a business-cycle emphasis can be found in [Stähler and Thomas \(2012\)](#), [Cacciatore \(2014\)](#), [Cacciatore et al. \(2016b\)](#), [Cacciatore and Fiori \(2016\)](#), and [Cacciatore et al. \(2016a\)](#), where the traditional DSGE framework is extended to accommodate structural reforms and an international dimension. The latter three papers lay the theoretical foundations for our inquiry: it has been demonstrated that some reforms may have adverse effects in the short run and that it takes time for reforms to pay off, thus making it critical to disclose the whole dynamic path of reform outcomes. Mainly theory-driven calibration exercises have shown that more flexible labor markets (lower firing costs) have steep adverse effects on employment and output in the short run (in particular, if implemented in recession), whereas a drop in unemployment benefits boosts the economy more in recession than in normal times. Abstracting from political economy considerations,<sup>2</sup> we empirically explore differences in macroeconomic responses under the two interest rate environments in 11 euro-area countries in the period 1985-2010.<sup>3</sup> The covered reforms include employment protection legislation, spending on active labor market policies and the replacement rate (the share of a salary one can expect to receive when unemployed). Note that the monetary policy entered into tightening in 2011, so there were no unconventional measures such as a negative deposit facility rate in the foresight when our sample stops.

In sum, we are concerned with the following questions. First, we are interested in the effects that labor market reforms have on the macroeconomy, depending on whether the reform is implemented in a low- or high-interest rate environment. Second, we explore the interactions of realized labor and monetary policies, allowing for different definitions as well as regimes (independent monetary policy versus common policy in the monetary union) and non-linearities. Third, we merge [Jordà](#) and [Hansen](#) into a methodological framework which does not require knowledge of the exact functional form, is robust to mis-specification, admits non-linearities, and cross-sectional dependence, and addresses uncertainty regarding interactions between labor reforms and the macroeconomy. Moreover, the framework deals more generally with other policies and their (macroeconomic) effects. We admit cross-sectional dependence, which proves to be an important element in both outcomes and policy variables.

The paper is organized as follows. In [Section 2](#), we briefly describe the economics of labor reforms, data, econometric methodology, a baseline model and a few extensions. [Section 3](#) describes the empirical results of local projections, by splitting the entire sample into pre- and post-euro periods (to capture monetary policy differences) as well as covering the overall sample. A formal test is developed and carried out to evaluate the importance of the monetary policy environment on the dynamic responses of macroeconomic variables to labor market reforms. [Section 4](#) sets out a unified framework wherein model uncertainty is taken into account. It describes the choice of weights for each time horizon, each response variable and each labor market policy. After constructing and testing an average model, we

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<sup>2</sup>Clearly, the role of the business cycle is crucial for the very implementation of structural reform. Though our aim to learn the differences in the effects of reforms under different monetary policies differs from learning the feasibility of implementing the reform, we refer to [Alesina and Drazen \(1991\)](#), [Fernandez and Rodrik \(1991\)](#), [Saint-Paul \(1996\)](#), [Saint-Paul \(2000\)](#), among many other contributions in that area.

<sup>3</sup>[Duval and Furceri \(2018\)](#), [Lastauskas and Stakenas \(2018a,b\)](#), among others, have most recently explored dynamic macroeconomic effects. These studies, however, have not taken monetary policy stances into account.

extend our framework to the case where a horizon-specific error factor structure is taken into account in Section 5. Section 6 concludes and specifies policy implications and directions for further research. The Appendices provide all the supporting material.<sup>4</sup>

## 2 Framework

We briefly review the economics literature on the policy evaluation of labor market reforms. It indicates the different econometric issues that need to be addressed in order for results to be valid and robust. We thus set out by describing the economics of labor reforms and then proceed to the econometric framework, a baseline model and some extensions.

### 2.1 Economics of Labor Reforms

Our focus on three types of reforms makes it possible to shed light on important dimensions of the labor market. The first variable, employment protection legislation, measures the difficulty in hiring and firing workers; the second one – spending on active labor market policies – accounts for spending on programs that help the unemployed find work; whereas the last one – the replacement rate – accounts for the expected unemployment benefits as a share of salary before losing a job. The interaction of labor market institutions with macroeconomic fluctuations has recently been investigated by [Gnocchi et al. \(2015\)](#). The authors empirically demonstrate that a higher replacement rate and employment protection are associated with the volatility of unemployment. We thus consider aggregate variables from a standard small open economy macroeconomic model (refer, for instance, to the canonical model in [Galí and Monacelli \(2005\)](#) and its extensions with empirical considerations in [Pesaran and Smith \(2006\)](#) or [Dees et al., 2007](#)). It is standard to cover real output, inflation, exchange rate and interest rate with some additions for the small open economy context (to account for the trade network wide effects, we deal with the real effective exchange rate). We complement this setup with unemployment, as it is of genuine interest to the policymakers who devise and implement labor market reforms.

The efficacy of labor market policies remains an open question in the literature, so our work also contributes to that stream. More generous unemployment benefits generally have an increasing effect on unemployment (similar to a tax wedge, which also tends to make it rise); things are less transparent for active labor market policies (ALMP), and depend on the specific ALMP categories (see [Bassanini and Duval, 2006](#), [Nickell et al., 2005](#), and [Orlandi, 2012](#)). In a macro model with a spatial dimension and cross-country inter-dependencies, [Felbermayr et al. \(2013\)](#) find that labor market institutions that are prone to increase unemployment in a home economy spill over to foreign countries and make unemployment rise there.<sup>5</sup> We omit a number of important dimensions that the literature has explored (income and substitution, labor supply, and other channels) but instead offer new light on the importance of non-linearities, model uncertainty and interactions between labor market policies

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<sup>4</sup>Codes and data sets will be posted on the corresponding author’s website.

<sup>5</sup>Emphasis on cross-country spillovers is another emerging aspect that has recently been examined in a number of contributions. [Dao \(2008\)](#) finds that German labor market reforms create positive spillovers for the rest of the euro-area countries. [Felbermayr et al. \(2013\)](#) analyze 20 OECD countries and find that more rigid labor market increase unemployment at home and abroad, and the spillover magnitude depends on the relative size of countries and the trade costs. The theoretical accounts of [Felbermayr et al. \(2015\)](#) conclude that labor market reforms benefit trading partners, whereas [Lastauskas and Stakenas \(2016\)](#) stress that spillover effects depend on the particular labor reform.

and business-cycle movements.

As our identification stems from both temporal and cross-country variation, we abstract from country-specific experiences and concentrate on a monetary union instead.<sup>6</sup> We hypothesize that the low- or high-interest rate environment as well as common and independent monetary policy may lead to different effects of labor reforms. There is a growing literature that sheds light on the potential effects of labor market reforms, yet relatively little is known about interactions between labor market policies and stances of monetary policy.<sup>7</sup> [Bassanini and Duval \(2006\)](#) find evidence that high replacement rates and tax wedges are associated with higher unemployment, as is anti-competitive product market regulation. [Boeri \(2011\)](#) reviews a large strand of literature on reforms of employment protection, unemployment benefits, active labor market policies and employment subsidies. He reports that effects are very sensitive to the nature of the reform, its magnitude, as well as the phasing-in and phasing-out stages, and stresses the need to account for severe asymmetries that many real-world reforms create as they rarely affect the entire population. Yet, little is known if monetary policy, affecting firms' and households' decisions, makes labor reforms deliver different outcomes. Adjustment mechanisms for labor reforms (in fact, to a substantially lesser extent for product market changes, which we abstract from) are found to be different in normal times compared to recessions in [Cacciatore et al. \(2016a\)](#). Intuitively, when aggregate productivity is below trend, job creation and destruction react differently to policy changes due to their effects on outside options and wages. Since monetary policy targets a cyclical component, it is of interest to learn whether job creation and destruction frictions deliver different reform outcomes over the business cycle frequency.<sup>8</sup>

As is clear from the above discussion, monetary policy interactions with labor market reforms are far from settled. Economic theory, however, helps to justify shocking labor market variables and conditioning on the macroeconomic aggregates. The theoretical lit-

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<sup>6</sup>We thus abstract from country-specific experiences such as the flexicurity reforms in Denmark and the Nordic countries and the so-called 'Kurzarbeit' reduced-working-hours program and Hartz reforms in Germany (see [Moeller \(2010\)](#) on the buffer capacity within firms, [Faia et al. \(2012\)](#) on large fiscal multipliers from 'Kurzarbeit' policies and [Burda and Hunt \(2011\)](#) for the effects of German labor market regulation during the financial crisis).

<sup>7</sup>There is, however, a rather rich literature on monetary policy and fiscal policy over business cycles. While these are usually analyzed separately, there is an emerging strand on the interactions of these factors. However, labor market reforms, despite being one of the most heavily used policies in practice, [Boeri \(2011\)](#), do not receive the same attention. For more general definitions regarding the fiscal side, see, among many others, [Auerbach and Gorodnichenko \(2013\)](#) who, using a panel of OECD countries, establish the importance of cross-country spillovers and a larger impact of fiscal shocks when the affected country is in recession. [Owyang et al. \(2013\)](#), for their part, find that government spending multipliers are no greater during periods of high unemployment in the United States but there is some evidence otherwise for Canada. On the monetary policy side, [Cloyne and Hürtgen \(2016\)](#) demonstrate that an increase in monetary policy rate reduces output and inflation. [Belinga and Ngouana \(2015\)](#) employ quarterly U.S. data and show that the federal government spending multiplier is substantially higher under accommodative than non-accommodative monetary policy. On the interactions, [Rossi and Zubairy \(2011\)](#) analyze monetary and fiscal policy shocks simultaneously and conclude that fiscal shocks are more important in explaining medium-cycle fluctuations, whereas monetary policy shocks matter more for business cycle fluctuations. [Tenreyro and Thwaites \(2016\)](#) report that monetary policy is less powerful in recessions, and gather some evidence that fiscal policy has counteracted monetary policy in recessions but may have reinforced it in booms.

<sup>8</sup>There are also a number of possible channels which are relevant for households such as the role of financial frictions (borrowing constraints), planning horizon, asset types – everything that affects labor supply and income is relevant for unemployment and the macroeconomy (recent literature on the heterogeneous agent New Keynesian models point to the importance of labor market adjustments; see [Kaplan et al. \(2018\)](#) and references therein). Our intention, however, is limited to identifying the existence of interactions, not the channels that give rise to them.



erature, for example, [Helpman et al. \(2010\)](#) derive results when the labor market can be separated from the goods market in the sense that first labor market conditions (such as search costs and labor market tightness) are computed and then the goods market is solved for (average or aggregate productivity), given labor market conditions. [Felbermayr et al. \(2011\)](#), in a different environment, also find that the average productivity is independent of labor market outcomes, thus also yielding a recursive structure. Following the theoretical trade literature, we thus condition on all macroeconomic variables, and consider first (exogenously) changing labor market policies and exploring how aggregate variables evolve. Economic theory, however, falls short of guiding medium-run (business-cycle) adjustments and interactions with loosening and tightening monetary policy, in particular for economies with independent monetary policy and for monetary union members. We therefore have to address model uncertainty along with the different, possibly nonlinear, channels that might describe interactions between labor and monetary policies.

## 2.2 Econometrics of Policy Evaluation

Neither economic theory nor the aforementioned empirical research have yielded clear-cut answers about macroeconomic effects of labor market institutions in a changing monetary policy environment. Adding an international dimension makes things even more obscure.<sup>9</sup> Given the uncertainty regarding the way labor market policy affects macroeconomic outcomes, the timing of labor reforms and the time span over which reforms yield results as well as uncertain responses of cross-country interactions, we propose to estimate a dynamic path of macroeconomic outcomes in a flexible way using cross-country variation to average out country-specific as well as spillover effects. It is clear that econometric methodology should allow for flexible functional form to ensure that monetary policy and labor market reforms are adequately captured. What is more, abstracting from a particular economic framework, we should ensure that model uncertainty is part of the modeling strategy.

For the above ends, we combine local projections ([Jordà, 2005](#)) with the Mallows  $C_p$  criterion ([Hansen, 2007](#)) to arrive at an inference that does not require knowledge of the exact functional form, is robust to mis-specification, admits non-linearities, and addresses uncertainty regarding interactions between labor reforms and the macroeconomy. The dynamic effects of policy changes are conveniently captured by the impulse response function. It has a connection to the causal inference and treatment effect: an impulse response can be considered as an average treatment effect provided conditional independence holds. As labor market policies do not follow established rules (as, for instance, in the monetary policy case), we resort to the regression control strategy and do not expect that, after controlling, specific labor market policies (which are fiscally rather negligible from a macroeconomic perspective) are correlated with an unobserved variable which is correlated with macroeconomy-wide outcomes.<sup>10</sup> What is more, we model independent monetary regimes and the monetary union, where the latter provides us with the causal interpretation about reform outcomes (independent monetary policy at the Euro area level is legally and institutionally separated from

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<sup>9</sup>Theoretical contributions by [Felbermayr et al. \(2013\)](#) predict a positive relationship between bad labor market institutions at home and abroad; in contrast, a country harms its trading partner by reducing its labor market frictions in [Helpman and Itskhoki \(2010\)](#); finally, in a quite different environment, [Alessandria and Delacroix \(2008\)](#) obtain that an economy with rigid labor market institutions increases a country’s welfare, whereas a flexible one experiences welfare loss due to the terms of trade effects (gains in consumption do not offset the foregone leisure).

<sup>10</sup>This condition is also known as the “selection on observables” assumption. The literature has entertained a number of potential solutions, such as instrumental variables, but they do not naturally exist in our context.

the individual country’s labor market changes). Suspecting anticipation effects and common shocks across economies, as a robustness check, we further control for the forecasts of GDP, output gaps and time-varying unobserved dynamic factors with country-specific loadings.

Note, however, that conditions for consistency are weak by construction; [Jordà \(2005\)](#) shows that impulse responses can be calculated by a sequence of projections of the endogenous variables shifted forward in time onto its lags. The residuals from the local projection are a moving average of the forecast errors from time  $t$  to  $t + k$  and as such are uncorrelated with the regressors, which are dated  $t - 1$  to  $t - p$  under weak requirements of no announcement effects (which are very likely to hold in our application specific labor market policies, observed over quarterly frequency).<sup>11</sup> Since labor market reforms are usually set having long-term developments in mind (structural changes), our business-cycle frequency in outcome variables alleviates endogeneity problem of the labor reform variable (even having in mind a political cycle argument, large reforms are not done having a few quarters ahead in mind). What is more, projections are local to each forecast horizon and therefore more robust to misspecification of the unknown data generating process. We also do not face a problem of unobserved shock or response variables, so impulse responses can be simply uncovered using a standard regression method. We will make use of this property whilst dealing with the model uncertainty.

In fact, we employ a method to average a model by selecting the weights that minimize a Mallows’  $C_p$ , which is an estimate of the average squared error from the model average fit and is an unbiased estimate of the expected squared error ([Hansen, 2007](#)). The method thus targets least squares regressions, and our local projections happen to be them. Uncovered weights are optimal in the sense of asymptotic minimization of conditional squared error (with no restrictions on the largest model). [Wan et al. \(2010\)](#) show that there is an alternative proof compared to the one proposed by [Hansen \(2007\)](#) in which the optimality of the Mallows’ criterion is preserved for continuous model weights and under a non-nested model environment that allows any linear combination of regressors in the approximating models that make up the model average estimator. This property is particularly useful in our environment and makes the methodology widely applicable in other circumstances.

Some caveats of our joint approach, which uncovers dynamic paths of reforms and model uncertainty, are as follows. First, Mallows’ criterion depends on unknown variance,  $\sigma^2$ , which needs to be estimated and thus a bias may be introduced. The Mallows’ criterion assumes homoskedasticity. [Liu et al. \(2016\)](#) consider generalized least squares in the presence of heteroskedasticity, as it is well known that they have smaller variances. The authors use Mallows’  $C_p$  weights of various GLS estimators where each model uses different set of regressors. [Liu and Okui \(2013\)](#) extend the method of [Hansen \(2007\)](#) to models with heteroskedastic errors. [Hansen and Racine \(2012\)](#) propose jackknife model averaging that is also robust to heteroskedasticity. Jackknife model averaging is extended to the case of dependent data by [Zhang et al. \(2013\)](#). Inference about uncertainty using model average estimates is difficult, however. There are no useful standard errors for the model average estimators. The estimates have non-standard distributions and are non-pivotal. It is also unclear how to form confidence intervals from the estimates. Despite these limitations,

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Alternatives include inverse probability estimators and matching, as well as a combination of these methods. They, however, require an existence of a policy model which is used to predict a reform and is later used to weigh treated and non-treated variables. As our “treatment” is continuous, applies to all countries and is observable, we instead rely on main macro variables and unobserved heterogeneity (fixed effects) as sufficient controls, and rather focus on non-linear effects and model uncertainty.

<sup>11</sup>This guess is confirmed in our robustness checks where we expand our baseline model to address announcement effects.

however, our approach provides gains on robustness, in particular when it comes to misspecification errors and empirically important non-linear effects.

## 2.3 Data Description

Before delving into the results, we shall briefly review the data. We run a panel model that includes the following euro-area members: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Spain. Basic summary statistics for each economy are reported in Table 2.1. Note that we deal with the quarterly changes in log variables, namely quarterly growth rates. Expenditure on active labor market policies was growing for all economies but Finland and Germany. Unemployment benefits were mainly on the rise except for Belgium, Germany and the Netherlands. Finally, employment protection was declining – labor markets were more liberalized – everywhere except for Belgium.

Figure 2.1 describes spatial patterns of labor market institutions, namely expenditure on active labor market policies, replacement rates and an index of employment protection legislation. Absent spatial correlation, coloring is supposed to be random. This does not seem to be the case: Northern Europe (except for the Baltics) is the largest spender, with the Central and South-East European countries having the lowest expenditures on activation schemes. Replacement rates are highest in the South-West and lowest in the North-East, whereas regulation is most stringent in Central Europe with the periphery being more liberal.

## 2.4 Baseline Model and Extensions

Since local projection methodology (Jordà, 2005) permits simple nonlinear modeling, we use interest rate variable as an interaction term, both as a level variable and as a dummy, to explore differences in macroeconomic responses to labor market reforms. We shall consider one baseline model and its five extensions (A-E):<sup>12</sup>

$$\begin{aligned}
\Delta y_{i,t+k} = & \alpha_i + \beta' \mathbf{X}_{it} + \gamma' X_{i,t-1} + \delta_1 \Delta \ln LMP_{it} + \delta_2 \Delta \ln LMP_{i,t-1} + & k = 1, \dots, 12, \\
& + \delta_3 \Delta \ln LMP_{it} \times \mathbb{I}_{\Delta i_{it} < 0} + u_{i,t+k} & \text{Model A,} \\
& + \delta_3 \Delta \ln LMP_{it} \times \mathbb{I}_{\Delta^a i_{it} < 0} + u_{i,t+k} & \text{Model B,} \\
& + \delta_3 \Delta \ln LMP_{it} \times \Delta i_{it} + u_{i,t+k} & \text{Model C,} \\
& + \delta_3 \Delta \ln LMP_{it} \times \Delta^a i_{it} + u_{i,t+k} & \text{Model D,} \\
& + \delta_3 \Delta \ln LMP_{it} \times \mathbb{I}_{\Delta i_{it} < 0} + \delta_4 \Delta \ln LMP_{it} \times \Delta i_{it} + & \\
& \delta_5 \Delta \ln LMP_{it} \times \Delta i_{it} \times \mathbb{I}_{\Delta i_{it} < 0} + u_{i,t+k} & \text{Model E,} \\
\end{aligned} \tag{2.1}$$

where  $\Delta y_{it}$  stands for a change in either log inflation, log real GDP, log real effective exchange rate or log unemployment, a set of controls  $\mathbf{X}_{it}$  include two lags of a change in log inflation, log real GDP, log real effective exchange rate, log unemployment and short nominal interest rate,  $\Delta \ln LMP_{it}$  refers to a change in log labor market policies (expenditure on active labor market policies, replacement rate and employment protection legislation index) and  $u_{i,t+k|t}$  stands for the forecast error at time  $t$  for forecasting  $k$  periods ahead. A quarterly change in the interest rate is denoted by  $\Delta i_{it}$ , whereas an annual change is written as  $\Delta^a i_{it}$ . A baseline

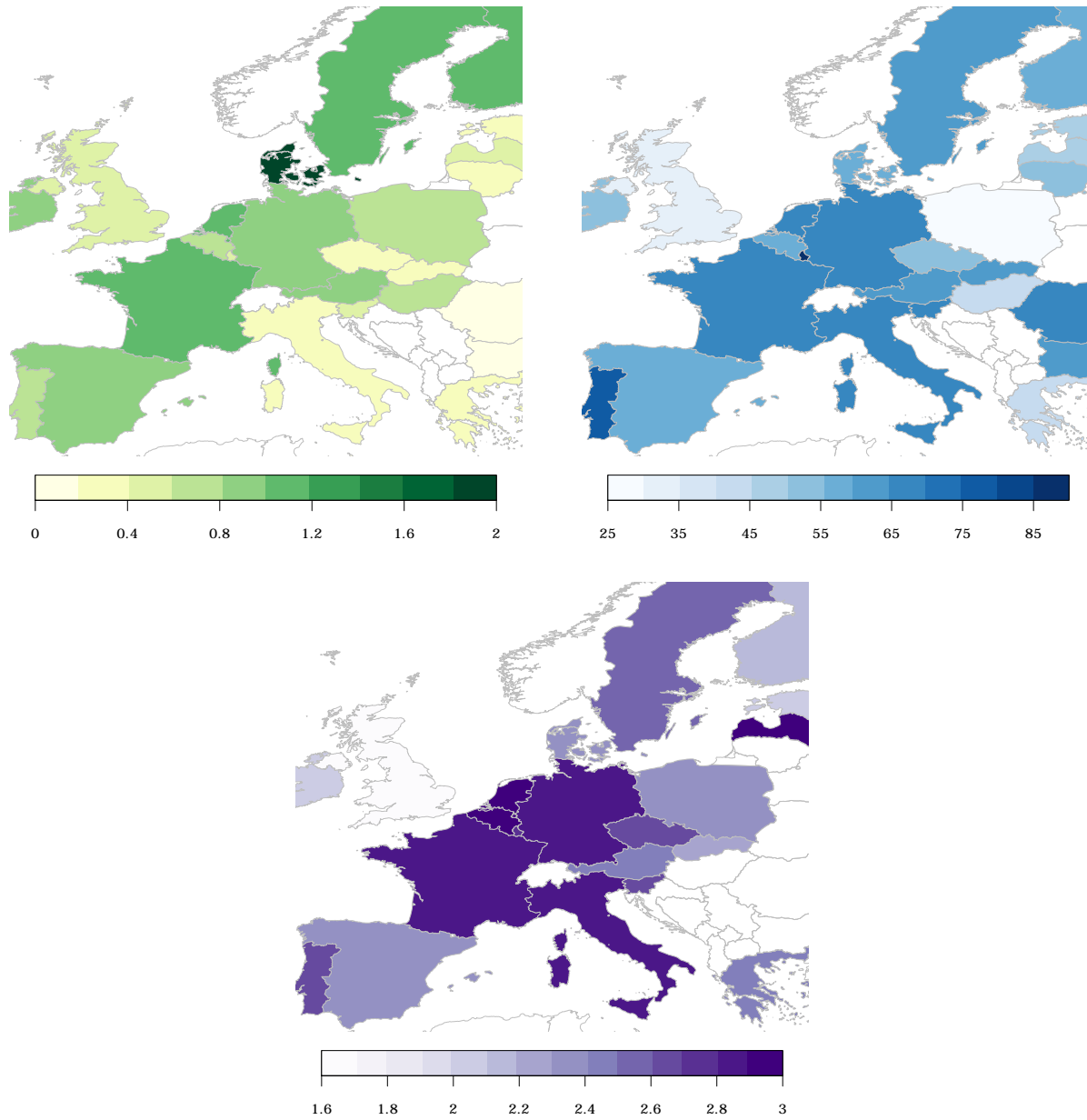
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<sup>12</sup>Note important differences compared to the current literature on labor market reforms such as Duval and Furceri (2018). In our model, unlike theirs, there is no contemporaneous effects from explanatory variables; i.e., they are predetermined from the outcome variable's perspective. Therefore, any concerns about simultaneity or contemporaneous determination of variables are absent in our case.

Table 2.1: Basic summary statistics of model variables

Country	GDP		Inflation (CPI)		Unemployment		REER		Short interest rate		ALMP		UB		EPL	
	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Austria	0.56	1.00	-0.00	0.34	0.09	5.19	0.00	1.23	-0.06	0.50	0.71	6.32	0.08	1.15	-0.14	0.89
Belgium	0.50	0.76	-0.01	0.45	-0.28	4.13	0.22	1.30	-0.09	0.57	0.68	2.95	-0.04	0.51	0.05	0.76
Finland	0.53	1.47	0.00	0.42	0.46	6.13	-0.23	3.18	-0.12	0.92	-0.07	5.83	0.00	0.84	-0.20	0.89
France	0.45	0.54	-0.01	0.33	-0.12	2.34	0.05	1.39	-0.09	0.64	0.48	3.13	0.15	0.86	-0.04	0.66
Germany	0.46	0.93	-0.00	0.42	-0.19	2.95	-0.07	1.95	-0.05	0.46	0.03	5.83	-0.22	0.89	-0.16	0.56
Greece	0.47	2.27	-0.04	0.74	0.54	3.38	0.19	2.29	-0.15	3.23	0.15	11.52	0.86	2.60	-0.16	0.91
Ireland	1.12	1.74	-0.01	0.48	-0.10	6.07	0.11	2.61	-0.13	1.43	-0.28	4.97	0.41	1.40	-0.10	0.75
Italy	0.34	0.72	-0.02	0.28	0.04	2.78	0.05	2.75	-0.15	0.82	0.44	3.97	4.44	13.92	-0.10	0.29
Netherlands	0.55	0.65	-0.00	0.37	-0.54	4.45	0.10	1.94	-0.05	0.47	0.87	5.78	-0.45	1.52	-0.10	0.40
Portugal	0.62	1.03	-0.05	0.55	0.30	5.12	0.43	1.52	-0.20	1.00	0.76	7.42	0.78	1.83	-0.23	0.60
Spain	0.64	0.59	-0.01	0.53	-0.00	4.21	0.38	2.04	-0.11	0.95	0.90	7.03	0.00	0.63	-0.36	2.03

Note: the variables are quarterly, spanning from 1985Q1 to 2010Q4. The summary statistics are calculated for 100\*log(quarterly changes), except for the interest rate which is simply a quarterly change.



**Figure 2.1: Spatial Distribution of Expenditure on Labor Market Policies in 2010 (upper left), Replacement Rates in 2009 (upper right) and Employment Protection Legislation in 2013 (down)**

model, for instance, for the real GDP looks like

$$\begin{aligned} \Delta \ln RGDP_{i,t+k} = & \alpha_i + \beta_1 + \\ & + \gamma' X_{i,t-1} + \delta_1 \Delta \ln LMP_{it} + \delta_2 \Delta \ln LMP_{i,t-1} + u_{i,t+k}. \end{aligned}$$

The power of the approach lies in the fact that an impulse response can be thought of as an average treatment effect, often the main object of interest.<sup>13</sup> Furthermore, note that we are dealing with a case when both outcome and policy (shock) variables are observed unlike, for instance, structural VAR literature. In such a case, the average (both over time and across countries) dynamic response of variable  $y_{it}$  to an initial shock to labor market policies,  $LMP_{it}$ , coined as impulse response function, is nothing else but a vector of 12 elements for each horizon that we consider:  $\tilde{\delta} = (\tilde{\delta}_1, \dots, \tilde{\delta}_{12})$ . Notice that in the linear world  $\tilde{\delta}_k$  represents a single parameter, whereas in the nonlinear applications  $\tilde{\delta}_k$  includes a number of other elements that capture interaction and other terms ( $\partial \Delta y_{i,t+k} / \partial \Delta \ln LMP_{it} = \delta_1$  for the baseline model, but this is no longer true for the extensions). Once (2.1) is run for each horizon, we obtain Jordà's local projection IRF, which is a consistent estimate of the impulse response. Single response is still prone to the functional form uncertainty. In fact, uncertainty regarding multi-step forecasts has led to a large literature on forecast combination, initiated by Bates and Granger (1969) and Granger and Ramanathan (1984). Our motivation revolves around model uncertainty for policy evaluation, but the theoretical basis are alike: impulse responses are functions of multi-step forecasts and, as such, all the issues surrounding forecast combinations are applicable to our context too.

### 3 Local Projections

Though economic theory suggests that employment should increase with subsidies and decrease with benefits, we lack knowledge of *a priori* effects on other macro variables. We cover all five models in Figures 3.1-3.5 and focus on those instances when responses are visually different for different monetary policy environments. The focus is on visual differences in macroeconomic reactions, with the formal test being introduced later.

#### 3.1 Before and After The Euro

As covered in the literature section, recent theoretical contributions predict that labor reforms interact with the business cycle conditions, we conjecture that independent monetary policy may have yielded different outcomes compared to the monetary union member. This is because one policy tool for all member-states is likely to fail to address individual country needs, absent perfect business cycle synchronization. In Figures 3.1-3.5, monetary policy is modeled by introducing an indicator function that changes a slope parameter for labor market policies, depending on the positive or negative change in the short interest rate, for the two periods, before and after introduction of euro (1985-1998 and 1999-2010, respectively). Firstly, we focus on Model A results. As for the replacement rate, after an introduction of euro, reactions become strikingly similar, independent of the monetary policy stance. Before 1999, changes in the replacement rate triggered quite diverse responses. Notably, however, replacement rate results in substantially larger effect (note scale differences in graphs) for the period of the monetary union. This difference is not so clear for other policy variables.

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<sup>13</sup>There is no accepted equivalent of the Taylor rule for labor market policies, we thus resort to the

Therefore, unemployment benefits are more effective and do not depend as much on the cyclical component.

In a more recent period, changes in the generosity of unemployment benefits are more deflationary, at least on impact and over the long run, they tend to reduce real GDP, increase REER on impact with a dying-out effect and increase unemployment. The long-run effect on unemployment is less pronounced for loose monetary policy. It is likely that the credit channel is at work: an increase in unemployment benefits makes the employees' outside option more attractive, which places pressure on prices. In a cheap lending environment, unemployment rate increases to a lesser extent than in a costly credit environment.

Expenditure on active labor market policies (ALMP) is more deflationary in the euro area than before euro, with real GDP reducing and unemployment increasing patterns, in contrast to pre-euro times. This can, at least to a certain extent, contribute to the literature that fails to find positive effects of ALMP, especially at the aggregate level. This result can be partially attributed to the monetary policy stance, something to be confirmed by testing. Changes in the real effective exchange rate (REER) are also remarkably different for the two periods. Finally, an increase in the employment protection legislation index (EPL) – leading to more rigid labor market – yields substantially more inflationary pressures after 1999, especially if implemented during times of tightening monetary policy. Interestingly, higher rigidity happened to be associated with higher unemployment (over the longer run) before the euro introduction, but it can be unemployment-reducing if implemented at the same time as the tightening monetary policy, after the euro has been introduced.

Other variants regarding monetary policy include an average (annual) change in the short interest rate, entering as an indicator function (Model B), a quarterly and four-quarter changes, entering multiplicatively (Models C and D), and the model that combines indicator function and multiplicative effects (Model E). We report results for the cases when changes in short interest rates have corresponded to the first and third historical quartiles (in particular, they refer to -0.40 and 0.23 p.p. and -1.35 and 0.66 p.p. for quarterly and annual frequencies, respectively) for Models C, D and E. Though dynamic responses are quite comparable, there are notable differences, too. An increase in EPL during the pre-euro time yields considerably different reactions in Model B compared to the model A. For instance, EPL is deflationary and makes REER appreciate in Model B, unlike Model A. Model D, for example, delivers inflationary effects of replacement rates for both loosening and tightening monetary policies as well as longer-run reductions in unemployment before the euro. Model E provides evidence for expansionary and contractionary effects of ALMP, depending on the monetary policy stance, before 1999. These differences illustrate uncertainty about the true effects of labor market policies on the macroeconomy, and thus necessitate a framework which takes all of that into account. Before addressing these concerns, we shall first discuss results for the combined sample.

## 3.2 Full Sample

Figures 3.6-3.10 report responses for the entire sample period, 1985-2010. Model A tells that the replacement rate is deflationary on impact, tends to be contractionary, is associated with the appreciated REER and a rise in unemployment (unless implemented under loosening monetary policy). ALMP is also deflationary on impact, and surprisingly contractionary with reductions in unemployment being realized over the medium run only (again,

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regression control strategy.

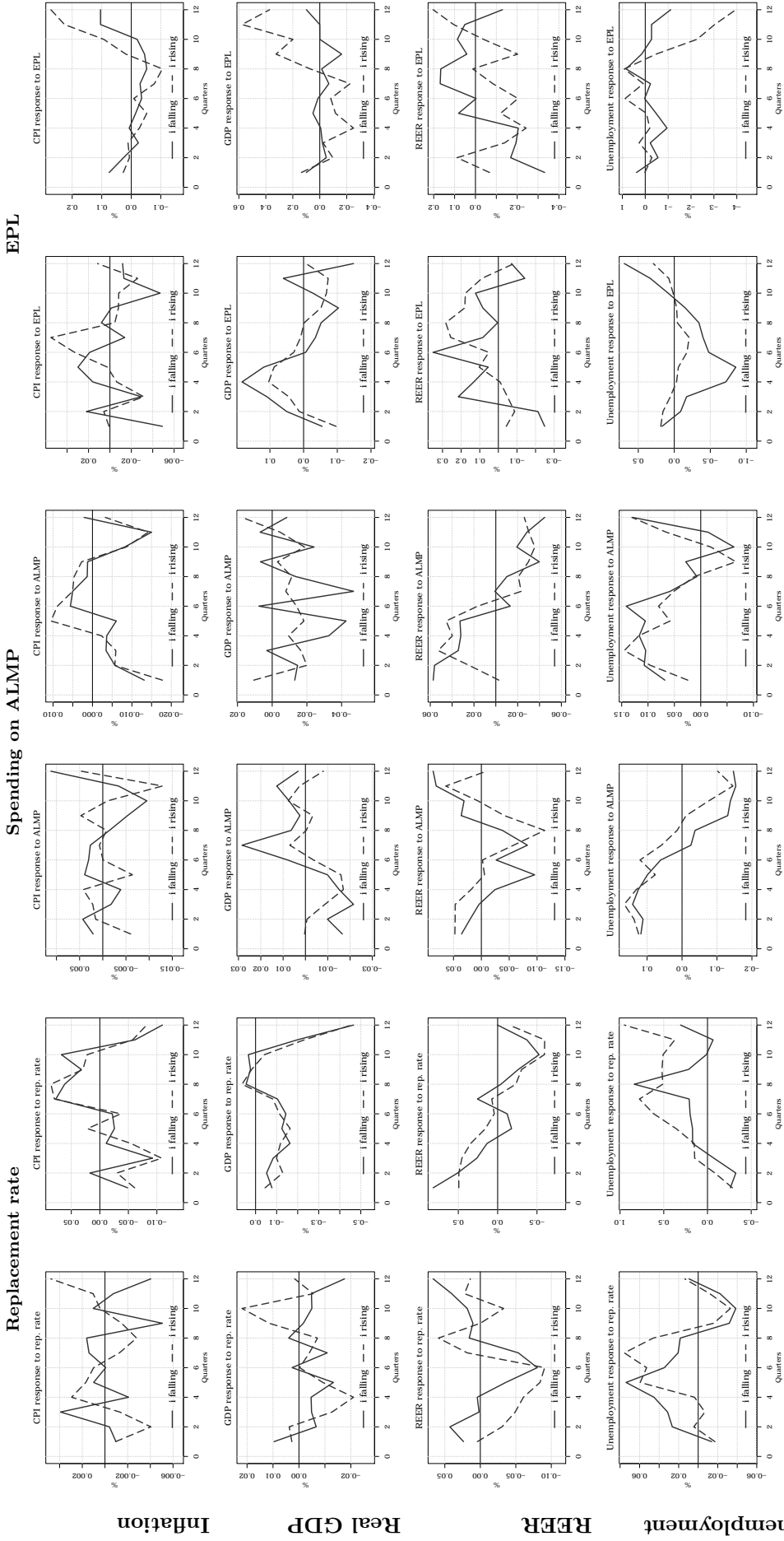


Figure 3.1: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), 1985-1998 (left) and 1999-2010 (right), model A



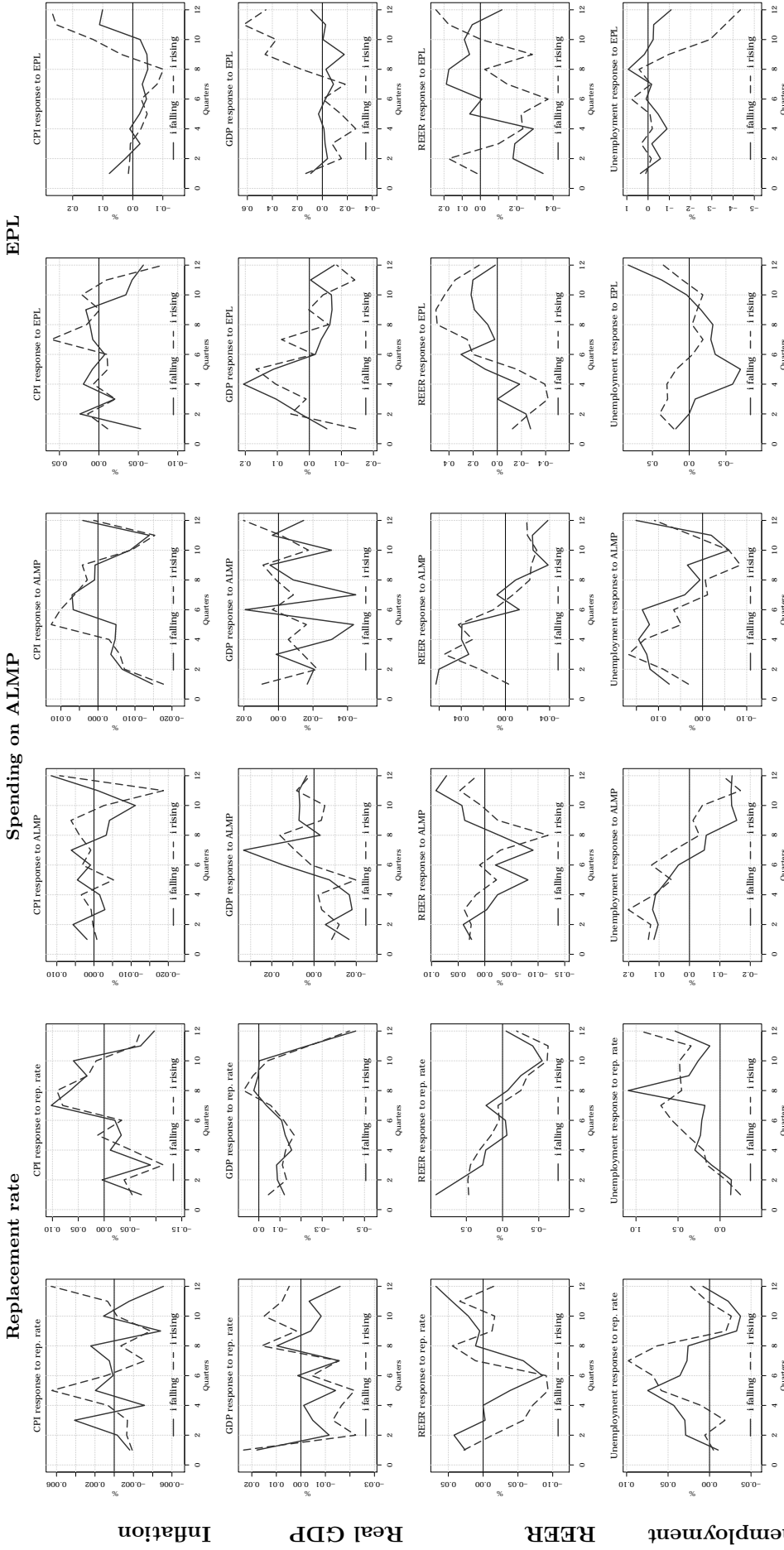


Figure 3.2: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), 1985-1998 (left) and 1999-2010 (right), model B

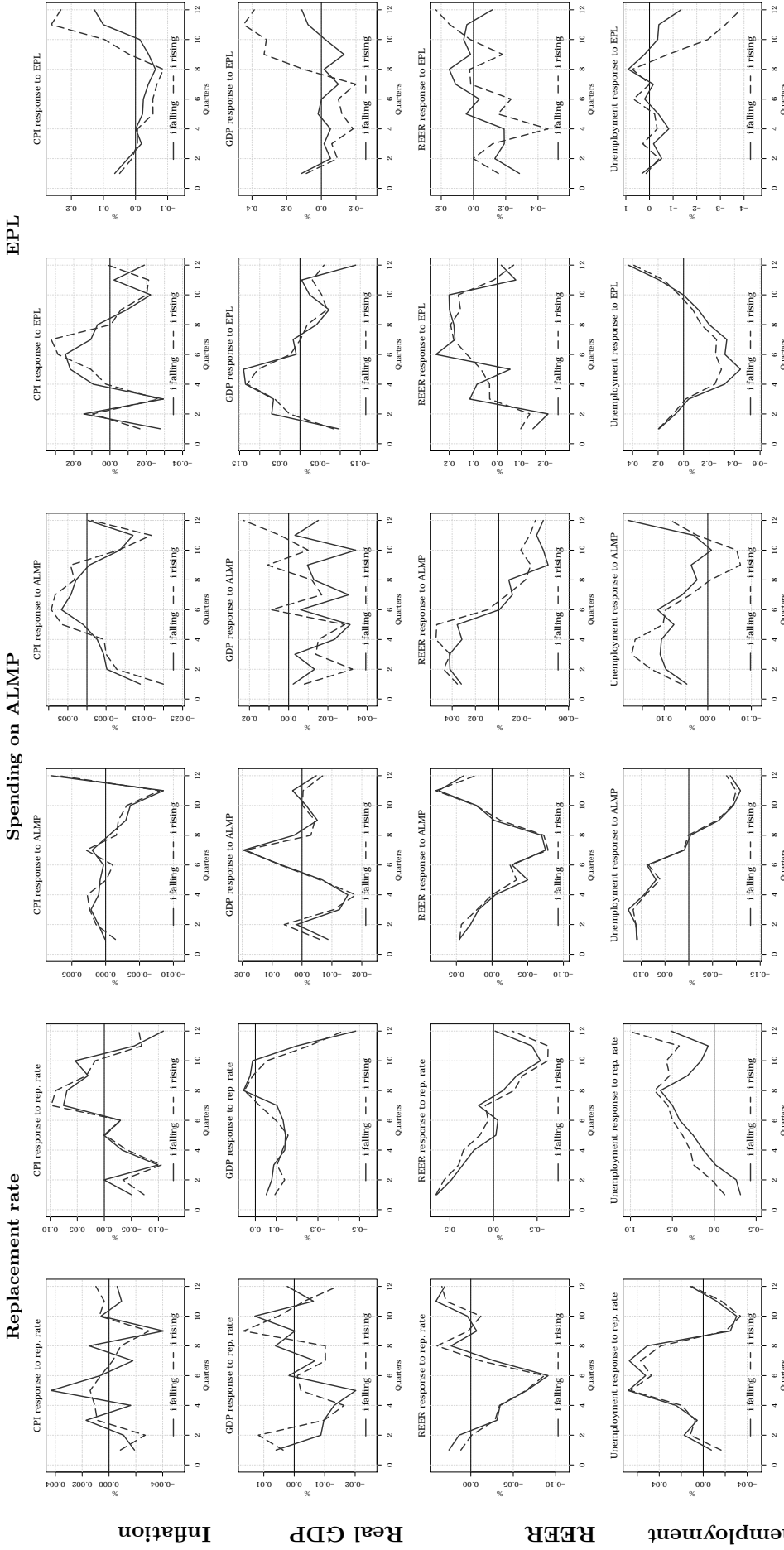


Figure 3.3: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), 1985-1998 (left) and 1999-2010 (right), model C

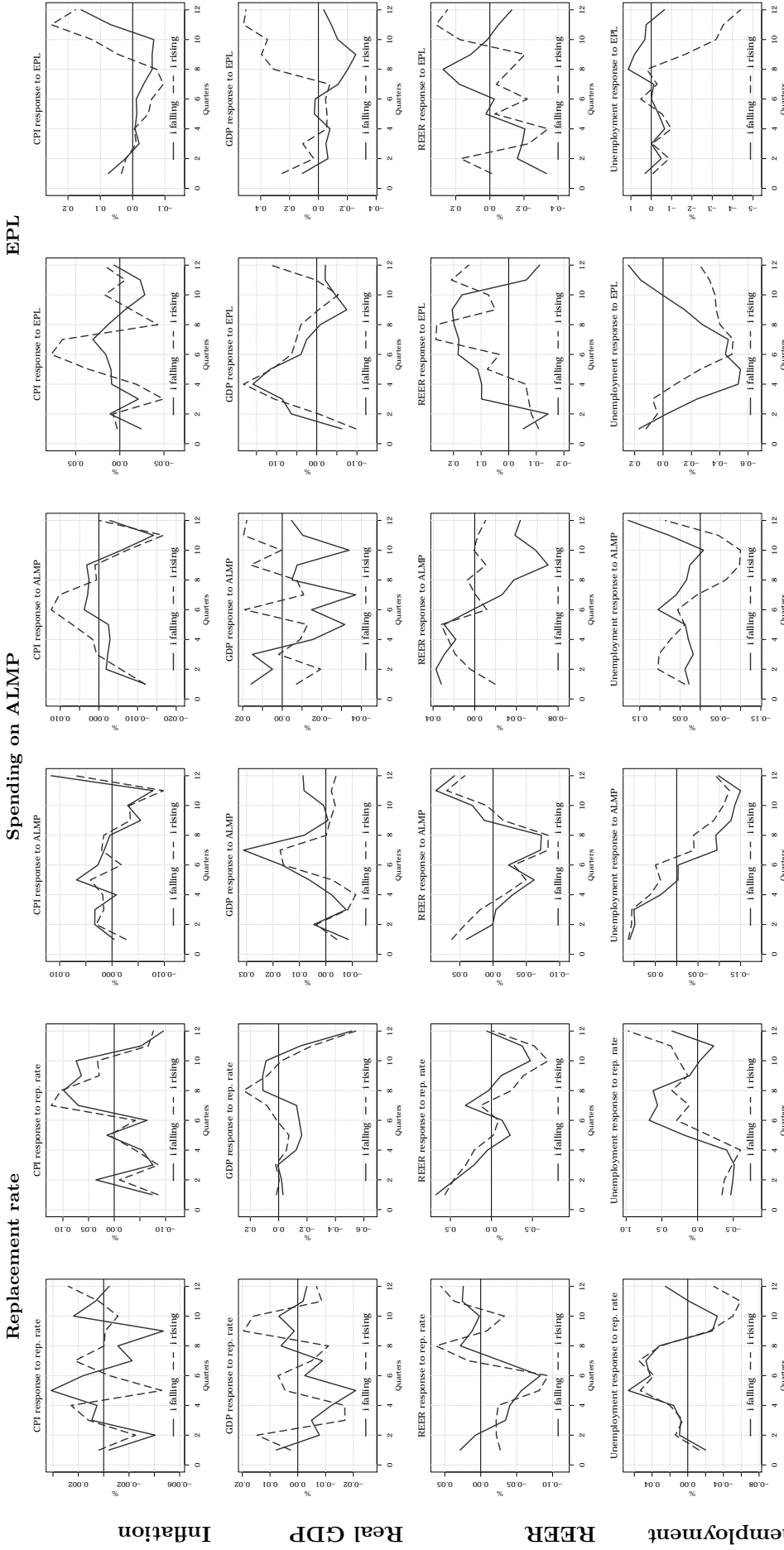


Figure 3.4: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), 1985-1998 (left) and 1999-2010 (right), model D

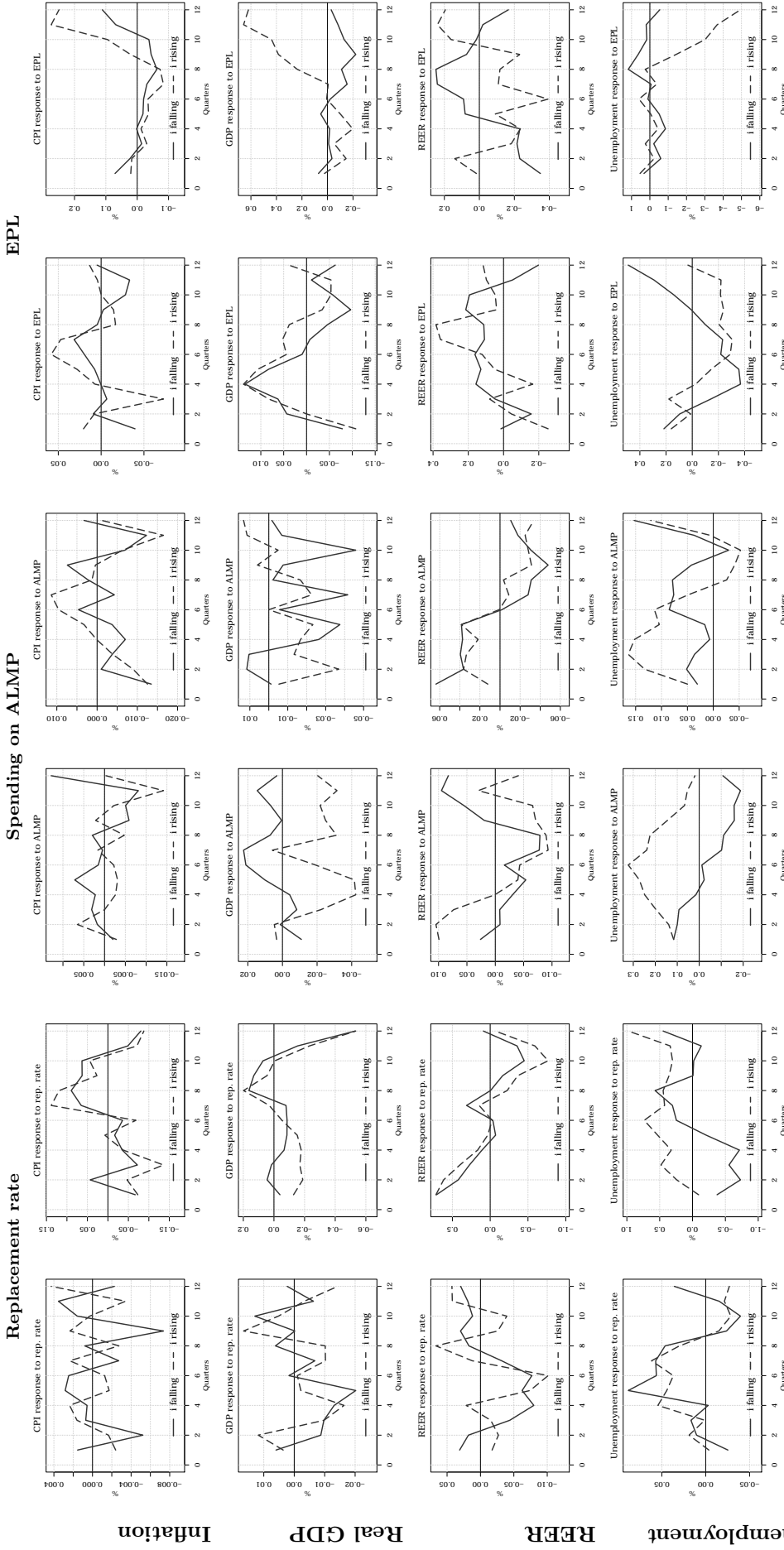


Figure 3.5: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), 1985-1998 (left) and 1999-2010 (right), model E

implementation during loosening monetary policy times receives more support to fight unemployment). The latter observation can be rationalized by the demand-side arguments: lowering interest rates usually coincides with insufficient demand and poor expectations, then expenditure shock (e.g. in terms of wage subsidies) would be more efficient than in the environment where the economy may be overheated. This result is important in explaining an observed failure in the literature to find a robust effect of expenditure on activation schemes. Business cycle conditions and monetary policy stance seem to be causing heterogeneity in outcome, at least over the medium run. The falling interest rate environment does not only attenuate an unemployment-increasing effect of the replacement rate but is also conducive to unemployment-reducing effect of ALMP (though ALMP is not modeled directly, these results can be viewed from the lenses of a simulation of fiscal interventions and accommodative monetary policy in [Coenen et al., 2012](#)).

EPL (an increase in rigidity), on the contrary, is more inflationary, and also contractionary (unless implemented during a tightening monetary policy), with a competitiveness gain on impact and an increase in international prices (REER) being realized over time, and unemployment first plummeting and then starting to increase. This may capture the fact that firing becomes more difficult but the adverse effect on the intensity of hiring kicks in with a lag only.

As before, though responses are quite comparable across models, there are also non-negligible differences, such as EPL being contractionary for loosening and expansionary for tightening monetary policies after the euro in Models A, B and E, but merely contractionary or merely expansionary in models C and D, respectively. Model C seems to deliver small differences for different monetary policy regimes, unlike other models. This hints that, economically if not statistically, quarterly changes are not as important as a sign of a change (Model A and B), which captures a monetary policy trend. Model D is also interacted with the annual change, thus providing some support to the monetary policy trend interpretation. Of course, the combination of two time intervals helps with some uncertainties by making use of more degrees of freedom (at a cost of homogeneous responses), but it does not resolve uncertainty in macroeconomic reactions fully, an undertaking that we pursue next.

## 4 Least-Squares Model Averaging

As shown above, different modeling strategies yielded a number of non-negligible differences, especially for policy purposes, and the monetary policy environment throughout which reforms get implemented happened to be an important factor in picking up effects of labor market policies on the macroeconomy. Unfortunately, economic theory can hardly narrow down potential effects of the monetary policy environment on the efficacy of labor market reforms. We thus develop a framework to uncover a dynamic path of reform effects which admits a number of different channels for the labor and monetary policies to interact.

Let us rewrite the model in [\(5.1\)](#) as

$$y_{t+k}(m) = z_t(m)' a(m) + u_{t+k}(m), \quad (4.1)$$

where all variables are combined into

$$z_t(m) = (1, X_t, X_{t-1}, \Delta \ln LMP_t, \Delta \ln LMP_{t-1}, g(\Delta \ln LMP_t(m)), \dots)', \quad (4.2)$$

and  $m$  denotes one of the models (A-E) that are covered in specifications [\(2.1\)](#). To pin down the optimal averaging, we apply the Mallows' criterion for the weight of each model, given

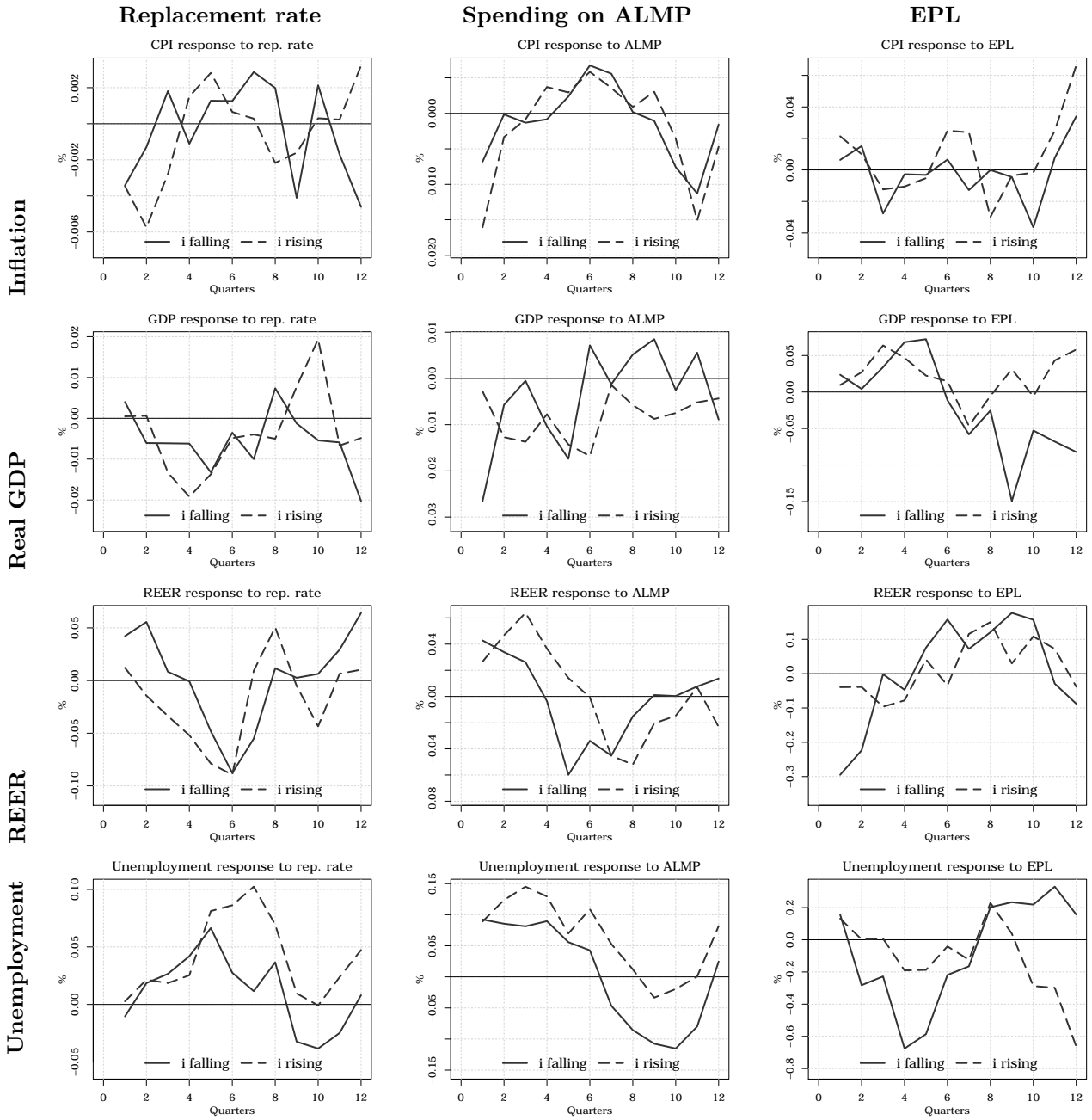


Figure 3.6: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), 1985-2010, model A

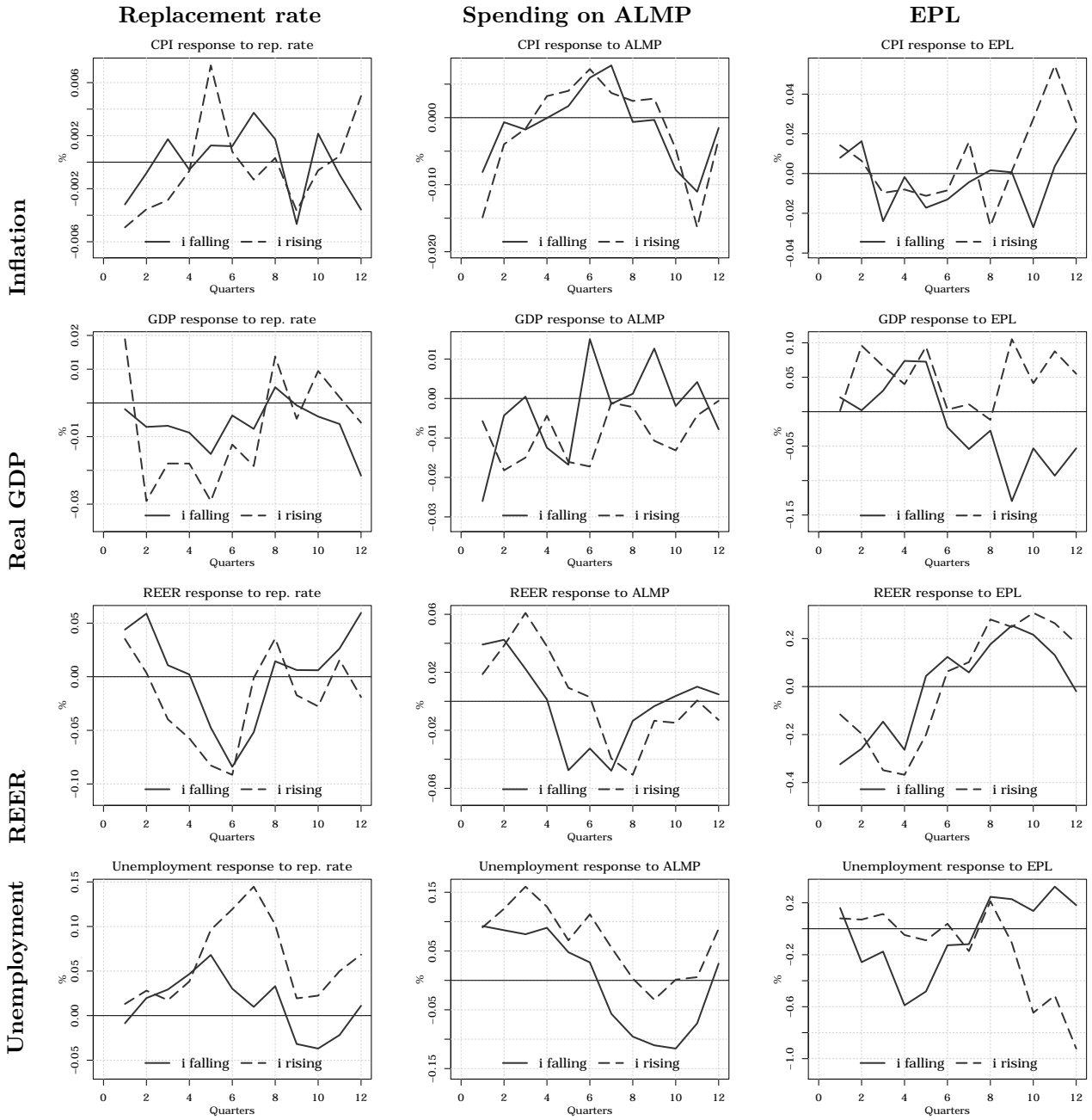


Figure 3.7: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), 1985-2010, model B

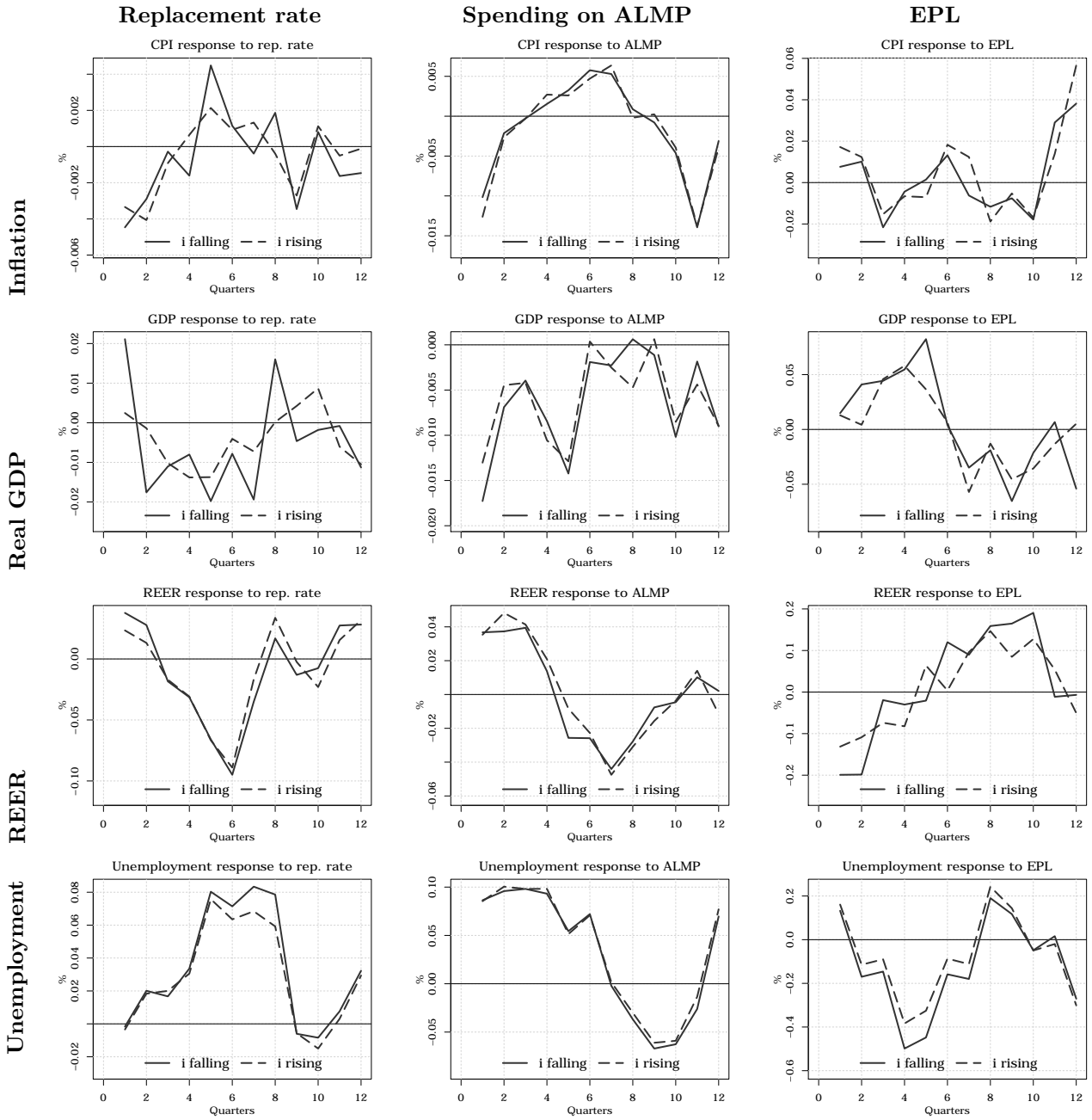


Figure 3.8: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), 1985-2010, model C



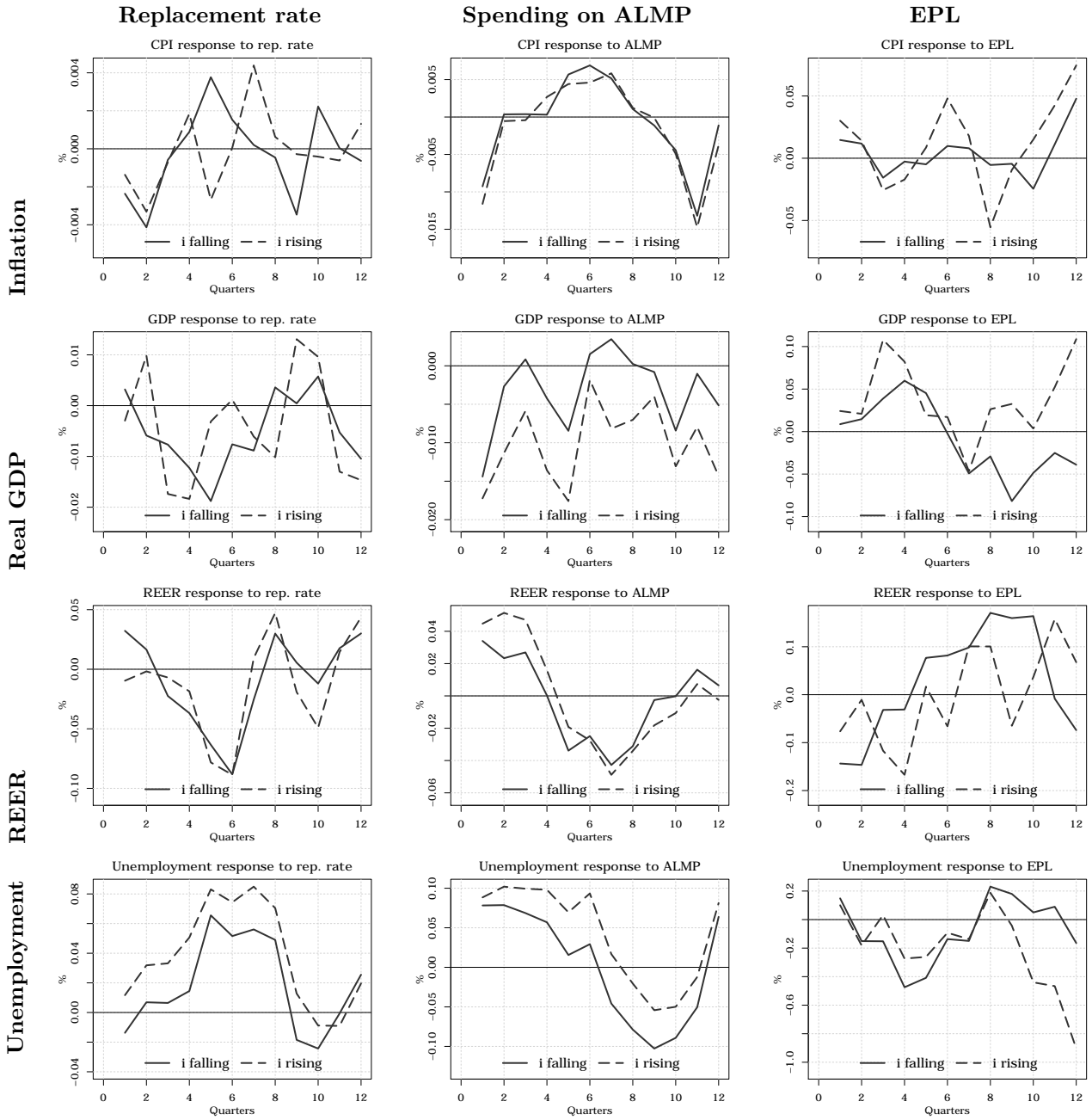


Figure 3.9: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), 1985-2010, model D

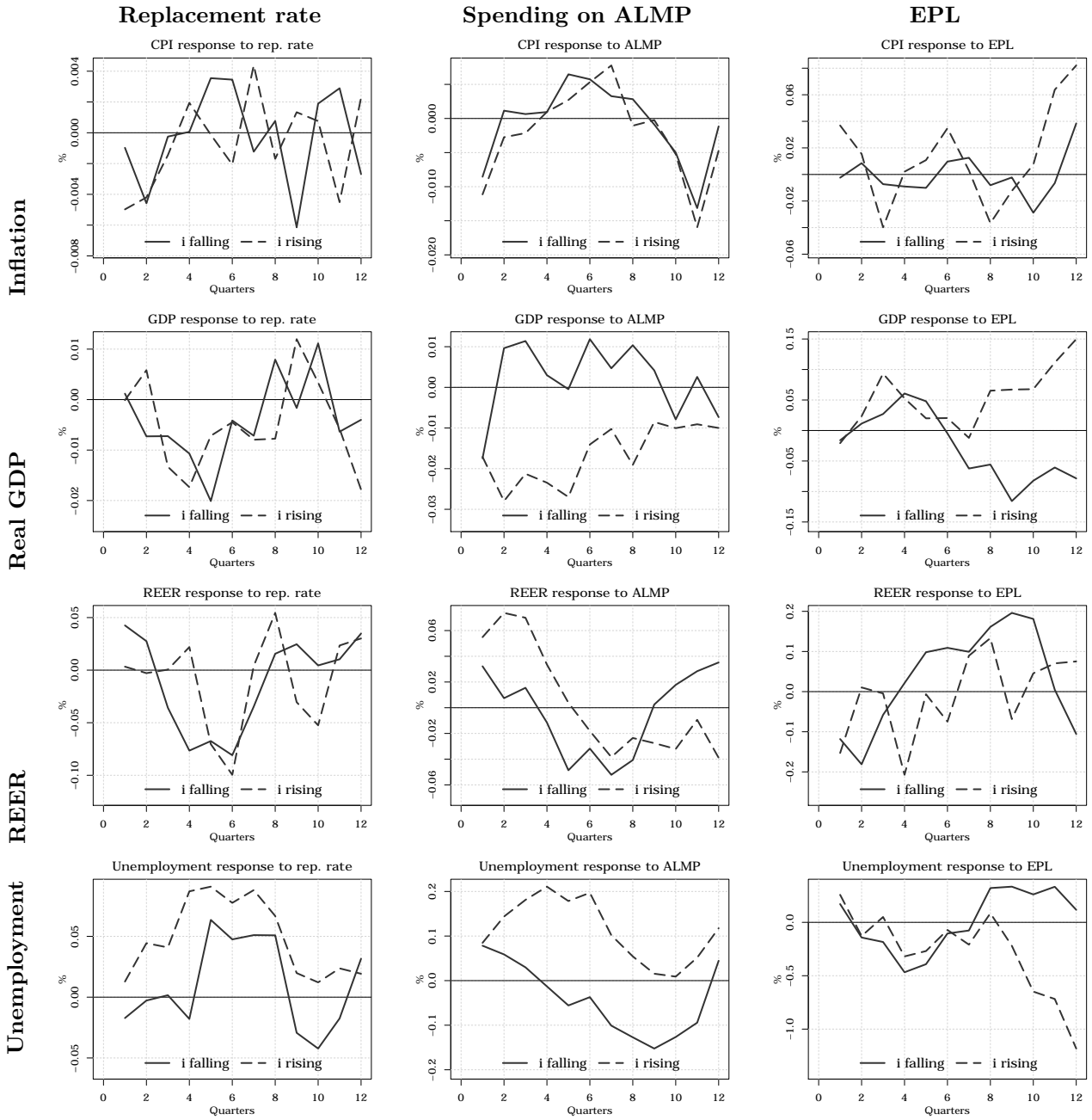


Figure 3.10: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), 1985-2010, model E

by

$$C_T(w) = \frac{1}{T} \sum_{t=1}^T \left( \sum_{m=1}^5 w(m) \hat{u}_t(m) \right)^2 + \frac{2\hat{\sigma}_T^2}{T} \sum_{m=1}^5 w(m) \dim(z_t(m)), \quad (4.3)$$

such that  $\hat{w} = \arg \min C_T(w)$ ,  $0 \leq w(m) \leq 1$ ,  $\sum_m w(m) = 1$ , with the average local projection given by  $\hat{y}_{t+k}(\hat{w})$  for each horizon (with  $T$  depending on the exact horizon considered). It is clear that the criterion requires one to estimate  $\hat{\sigma}_T^2$ , residual variance estimate, which can be done, following Hansen (2008), by  $\hat{\sigma}_T^2 = (T - \dim(z_t(M)))^{-1} \sum \hat{u}_t^2(M)$ , where  $M$  stands for the largest fitted model. Hansen (2008) provides a simple proof to demonstrate that the expectation of the Mallows's criterion is asymptotically unbiased for stationary dependent data (Hansen (2007) established this result for IID observations). The main difference between our approach and the methodology in Cheng and Hansen is that we apply Mallows's criterion for each horizon, thus making it possible for a dynamic response to be determined flexibly at each point in time, with different weights assigned to different models. In the robustness checks, we will also admit a factor structure *unique* to each time horizon. Unlike Cheng and Hansen (2015), therefore, our approach does not suffer from the fixed (unknown) number of factors issue. Cross-validation techniques have also been developed for further robustness issues.<sup>14</sup>

**Proposition 1.** *Impulse response function, measured by local projection and weighted by Mallows's weights  $C_T(w)$ , is asymptotically unbiased in the sense that such averaging delivers asymptotically unbiased estimator of the mean squared (forecast) error in the presence of stationary, dependent data, and even a multi-factor error structure.*

*Proof.* The result follows by combining Theorem 1 in Hansen (2008) and Theorem 1 in Cheng and Hansen (2015) (along with the assumptions R and F, for the case without and with multi-factor error structure, respectively) with the definition of the local projection as proposed by Jordà (equation 2, 2005). Local projections are conducted at each horizon separately, and the proof follows from the theory developed in Hansen to one-step forecasts applied separately for each horizon.<sup>15</sup> As for the factor, given  $N, T \rightarrow \infty$ , the estimated factor (estimated principal component) issue is negligible and the Mallows's weights minimize mean squared (forecast) error. For a full discussion and implementation, refer to Appendix.  $\square$

Asymptotic unbiasedness does not guarantee good behavior in small samples, nor does it establish asymptotic efficiency. For the former, however, Monte-Carlo small-sample evidence in Hansen (2008, 2010) is encouraging for one and multi-step forecasts; as for the latter, Cheng and Hansen (2015); Hansen (2008) conjecture that the result in Ing and Wei (2005) where Mallows's criterion leads to asymptotic optimality given autoregressive process with IID

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<sup>14</sup>Following Hansen and Racine (2012), one can introduce a leave-1-out cross-validation criterion  $CV_1(w) = \frac{1}{T} \sum_{t=1}^T \left( \sum_{m=1}^5 w(m) \hat{u}_{t,k}(m) \right)^2$ , where  $\hat{u}_{t,k}$  is the residual obtained by the least-squares omitting one observation  $T$  times, or extending this approach to the leave- $k$ -out cross-validation criterion. As demonstrated analytically by Hansen (2010), this is a robust criterion once heteroskedasticity and serial correlation are severe. As our approach is direct for each horizon, and we focus on local effects with a large number of considered angles (split in time, horizon-specific error factor structure, results for each response variable and each policy variable), we leave these computational exercises for future explorations on robustness and optimality.

<sup>15</sup>Notice that projection is over observed variables, unlike, for instance, practices in recursive multi-step forecasting when predicted values are used to construct future values. As noted by Chevillon (2007), model mis-specification (in particular, mis-specified unit roots, neglected serial correlation and location shifts) is better handled when different forecasting models are used for each forecast horizon (the so-called direct multi-step forecasting). Impulse responses are nothing but functions of multi-step forecasts.

errors may be extended to more general cases. We leave a fully fledged simulation exercise for future research, but our framework seems to build on encouraging grounds, established in the literature.

## 4.1 Weights

We move to reporting weights, calculated following criterion (4.3). Figure 4.1 is particularly revealing: weights to combine impulse responses vary substantially across macro variables, policy variables and horizons. Our methodology easily admits this heterogeneity. For instance, model D is particularly well suited for modeling responses in inflation and unemployment (with model B being its major rival) but totally marginal when it comes to the real effective exchange rate where the choice of models is quite erratic across horizons and labor market policies. Interestingly, data prefer delayed or averaged effects of monetary policy with the most recent changes carrying lower weight. We combine those flexible weights, reported in Figure (4.3), and move to the averaged responses.

## 4.2 Average Models

A combination of the local projections is visualized in Figure 4.2. Both the replacement rate and the ALMP reduce inflation on impact, as opposed to the employment protection. Prices do not seem to depend on the monetary policy environment in any fundamental way, except for the EPL, when tightening monetary policy delivers more inflationary result. Real GDP increases with the replacement rate on impact if the monetary policy was tightening but, independent of the monetary policy stance, the ultimate effect is contractionary. The aggregate economy (real GDP) reacts more positively to changes in the ALMP if expenditure is increased when a loosening monetary policy is in place. An increase in labor market rigidity can be supported if implemented during a tightening monetary policy as it is associated with an increase in real GDP over the longer run. Similarly to inflation, the real effective exchange rate goes up on impact and depreciation takes time to realize for the replacement rate and ALMP, unlike EPL, which depreciates on impact and mimics a J curve over time. Long-run effects differ depending on the monetary policy stance once labor reform has been initiated.

The replacement rate seems to be increasing unemployment, as predicted by economic theory, but the negative effect fades out if an increase in unemployment benefits is implemented in the loosening monetary policy environment. Similarly, ALMP seems to help to reduce unemployment if monetary policy is loose. This effect may also shed light on why the previously quoted empirical literature fails to find a desirable aggregate effect of ALMP when it does not differentiate between other events, such as the monetary policy regime. Finally, employment protection does not deliver an increase in unemployment if initiated simultaneously with a tightening monetary policy. An increase in replacement rate and ALMP requires financial inputs, whereas EPL is usually conducted by changing law and financial requirement, if any, is experienced only later. It thus seems that expenditure-increasing policies work during an economic downturn when loose monetary policy is in place whereas institutional changes are favored during economic booms, in line with the current, IMF or ECB, suggestions to use fiscal expansions during recessions and conduct reforms during (and thus capitalize on) good times (IMF, 2018, ECB, 2017).

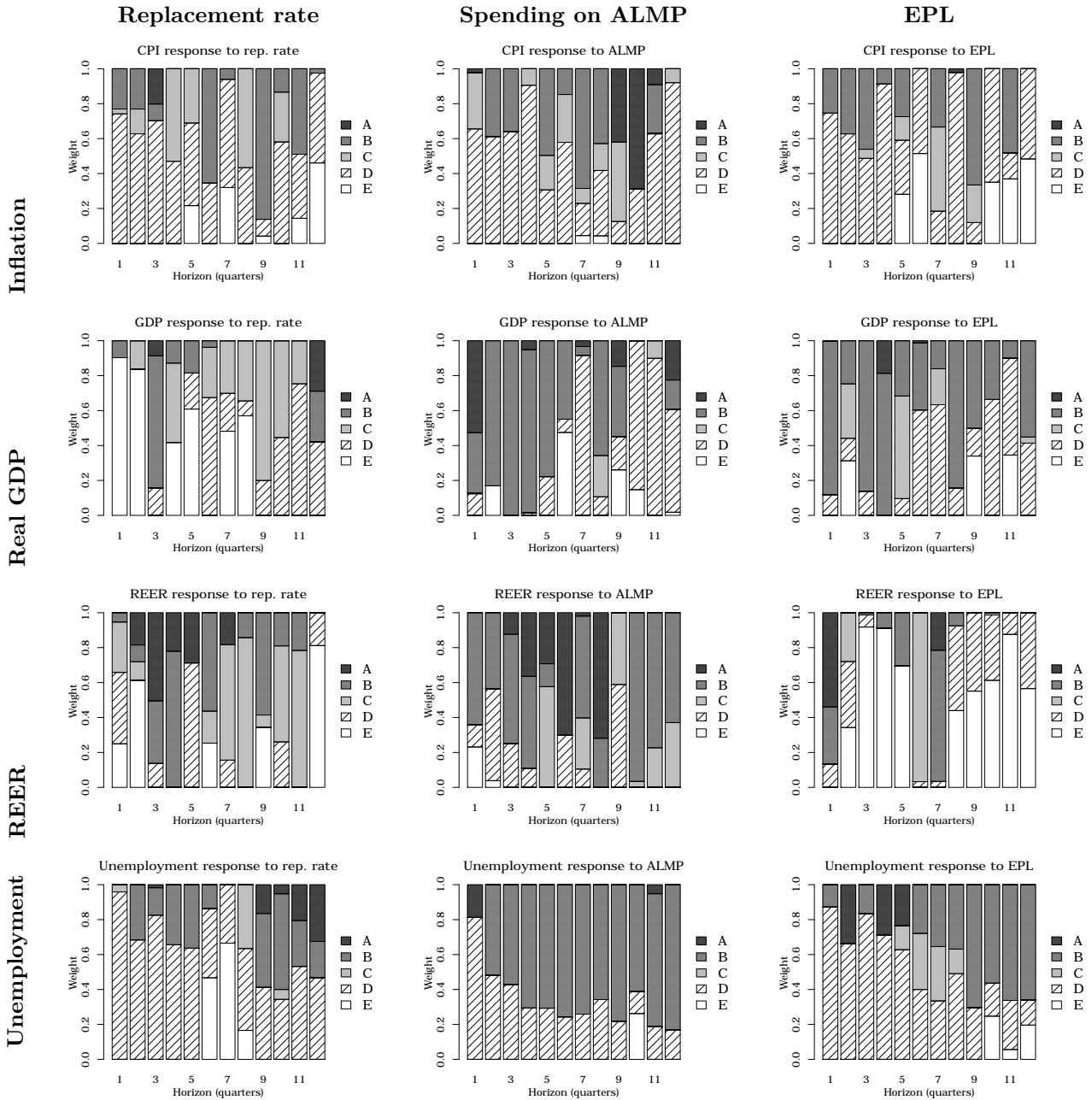


Figure 4.1: Average model weights for each horizon, impulse and response variables (Mallow's criterion)

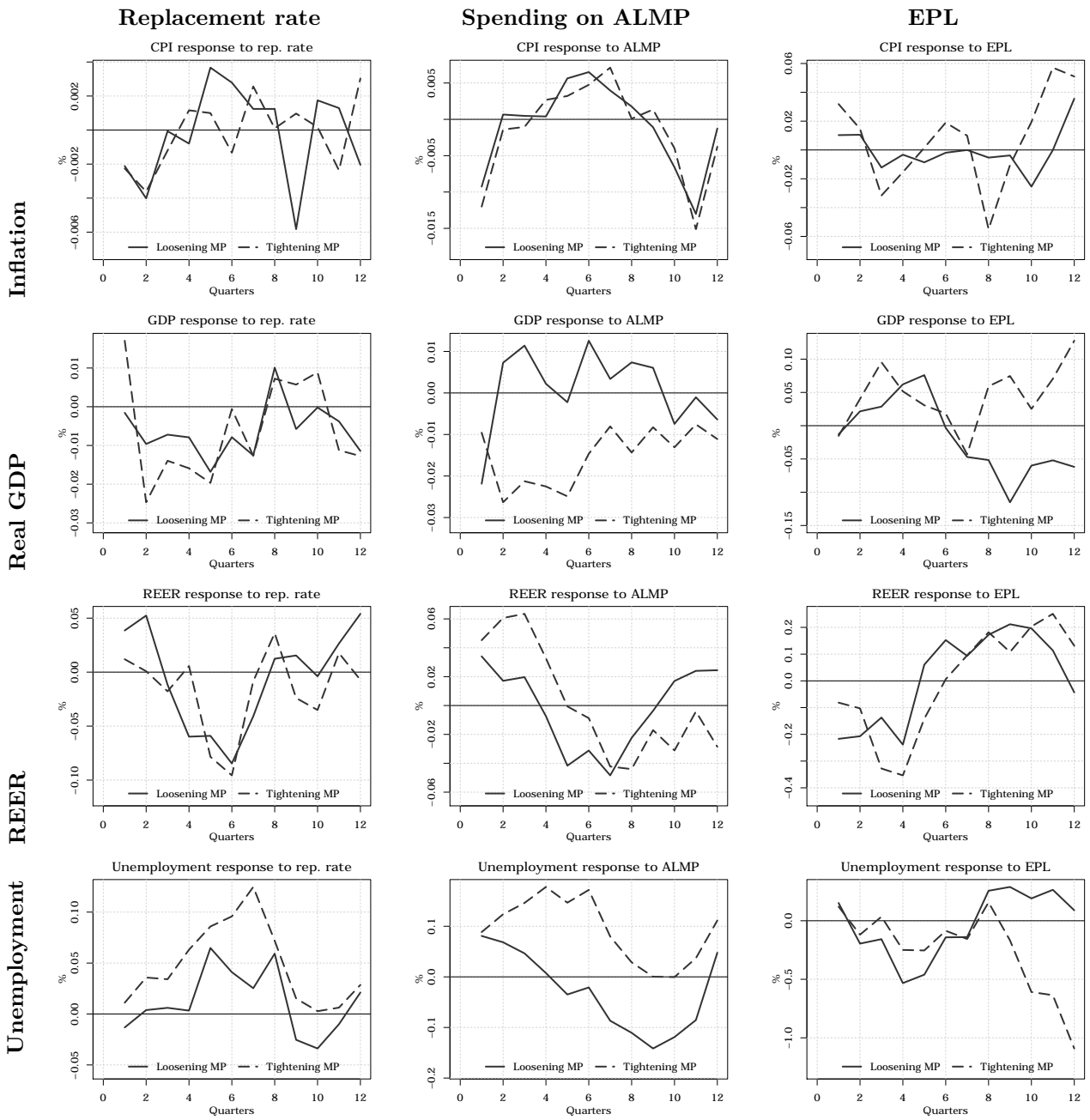


Figure 4.2: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), weighted (Mallow's averaging) impulse responses (local projections)

### 4.3 Test on the Importance of Monetary Policy

Though differences in reactions are captured visually, we also devise a test to evaluate whether macroeconomic responses to labor market policies react to monetary policy or not. We test whether  $H_0 : \tilde{\delta}_k - \delta_k = 0$  against a two-sided alternative. Though the test can distinguish whether the Models A-E add *additional information* about labor market effects on macroeconomic aggregates, it does not tell us whether the benchmark model is correct or not. With that caveat in mind, we report a fraction of occasions when t-test has been accepted for the Mallow’s averaged model in Table 4.1, where the chosen p-value was 0.1 (so we report a fraction for which p-value are larger than 0.1). For instance, the ALMP parameter in the equation of the real GDP cannot be differentiated from the baseline model when none of the extensions in Models A-E are included for the first period after a shock but only 31% of the cases are registered for the second period. The test is horizon-specific and distinguishes between informational advantages of an inclusion of monetary policy variables for the entire dynamic path of responses.

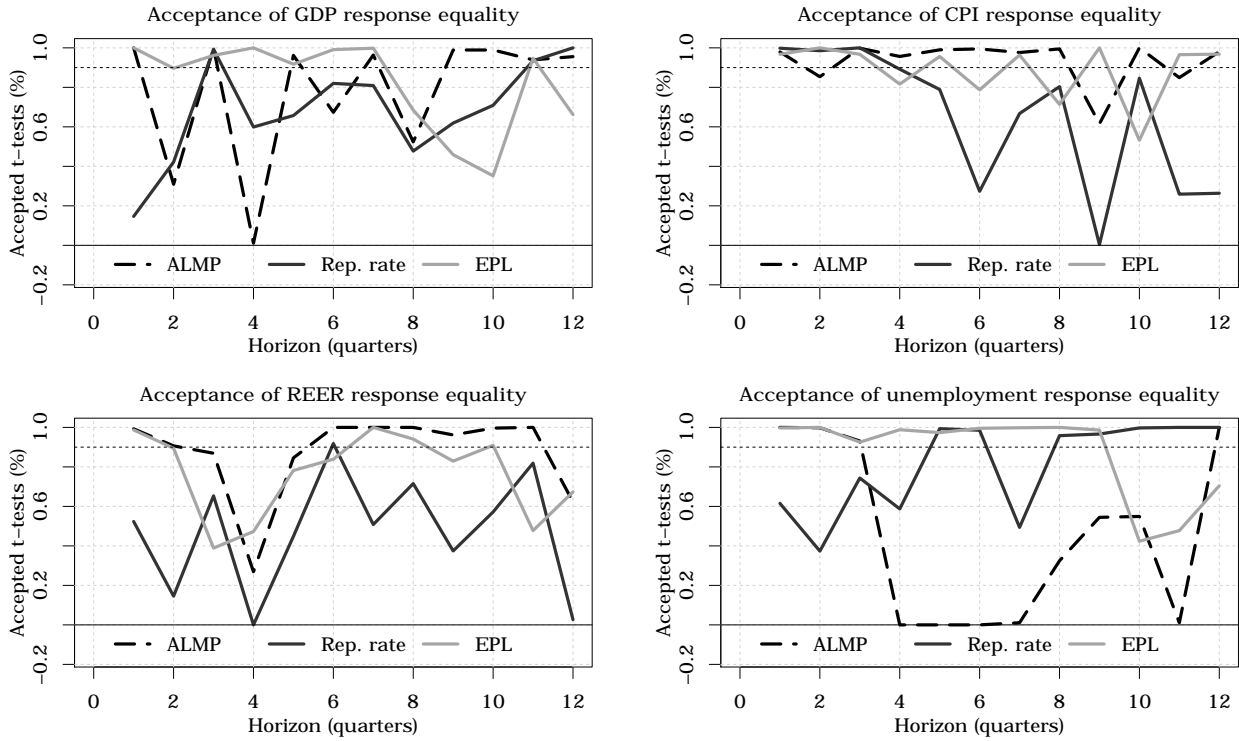
#### 4.3.1 Horizon-specific Results

To ease reading of the results, we also depict proportions for each horizon (quarter) graphically in Figure 4.3. If the parameters were identical to the specification with no monetary policy effects, we would expect the proportion to be close to 1 (or if, say, 10 times out of 100 equality occurs by chance, the no-effect conclusion, or acceptance of the null hypothesis, would be made for the cases when proportion is equal to or larger than 0.9). Many cases fall below 0.9 threshold, indicating important interactions and channels that make labor markets affect the macroeconomy differently, depending on the monetary policy stance. In particular, ALMP interactions with monetary policy are crucial for real GDP and unemployment whereas changes in unemployment benefits deliver different results on international prices and domestic inflation, depending on the monetary policy stance.

**Table 4.1: Proportion of accepted t-tests**

		1	2	3	4	5	6	7	8	9	10	11	12
Real GDP	ALMP	1	0.31	1	0.01	0.96	0.67	0.96	0.52	0.99	0.99	0.94	0.96
	Rep. rate	0.15	0.42	0.99	0.6	0.66	0.82	0.81	0.48	0.62	0.71	0.93	1
	EPL	1	0.9	0.96	1	0.92	0.99	1	0.68	0.46	0.35	0.95	0.66
Inflation	ALMP	0.98	0.85	1	0.96	0.99	0.99	0.98	0.99	0.62	1	0.85	0.98
	Rep. rate	1	0.99	1	0.89	0.79	0.27	0.67	0.8	0	0.85	0.26	0.26
	EPL	0.97	1	0.97	0.82	0.96	0.79	0.96	0.71	1	0.53	0.97	0.97
Unemployment	ALMP	1	1	0.93	0	0	0	0.01	0.32	0.54	0.55	0.01	1
	Rep. rate	0.62	0.37	0.74	0.59	0.99	0.99	0.49	0.96	0.97	1	1	1
	EPL	1	1	0.93	0.99	0.97	1	1	1	0.99	0.42	0.48	0.7
REER	ALMP	0.99	0.91	0.87	0.27	0.85	1	1	1	0.96	1	1	0.62
	Rep. rate	0.52	0.15	0.65	0	0.45	0.92	0.51	0.72	0.37	0.57	0.82	0.03
	EPL	0.99	0.89	0.39	0.47	0.78	0.84	1	0.94	0.82	0.91	0.47	0.67

Acceptance proportions for the real GDP indicate no significant difference for the ALMP on impact but this is no longer true later, substantial difference for the reform of the replacement rates, and differences for the EPL over the longer run, but not initially (Table 4.1). Inflation seems to display quite erratic patterns – consistent differences are registered for the



**Figure 4.3: Acceptance regions of  $H_0 : \tilde{\delta}_k - \delta_k = 0$  for the replacement rate, ALMP and EPL in models for inflation, real GDP, REER and unemployment**

replacement rate from the third period onwards. Interestingly, the ALMP starts displaying different results, depending on the monetary policy, for unemployment, which is the ultimate objective of this policy measure. This finding connects to the puzzle of ALMP that has been found in the literature: ALMP does not display consistent results on unemployment and varies substantially across countries and time periods, with rather limited evidence on its efficacy. We thus demonstrate one additional channel that can rationalize such varying results, and call for the use of confounding events, such as monetary policy interventions, to uncover the true effects of labor market policies.

The replacement rate has different effects on unemployment in the beginning, whereas the EPL has such effects at a very late stage, depending on the interest rate environment. The replacement rate is also channeled to REER differently in tightening and loosening interest rate environments. The EPL seems to also affect the REER differently, especially from the second to the sixth, and from the ninth to the twelfth periods. The ALMP varies across a few horizons but has limited support for consistently different effects.

### 4.3.2 Multiple Testing

The test above has considered each horizon separately. We now take into account the fact that each variable and each policy measure require twelve tests (one for each horizon), thus requiring us to control the family wise error rate (the probability of at least one type I error)

<sup>16</sup>Though we concern ourselves with the probability of the entire impulse response function, we refer to [Lütkepohl et al. \(2015\)](#), who argue that Bonferroni method may be useful to construct bands around estimated impulse response functions, based on the estimated parameters and their empirical distributions. We see an interesting research direction to develop more clear guidance to uncover optimal *joint* confidence bands of different horizons.



**Table 4.2: Proportion of the Equality Rejection with Adjusted  $p$ -values (left: averaging over  $h$ , right: averaging over  $h$  and  $t$ )**

		Bonferroni	Holm	Benjamini & Yekutieli	Bonferroni	Holm	Benjamini & and Yekutieli
Real GDP	ALMP	0.99	0.99	0.99	1	1	1
	Rep. rate	0.79	0.78	0.79	0.9	0.9	0.83
	EPL	0.92	0.92	0.93	0.99	0.99	0.97
Inflation (CPI)	ALMP	0.99	0.99	0.99	1	1	1
	Rep. rate	0.89	0.88	0.9	0.97	0.97	0.94
	EPL	0.96	0.96	0.97	0.99	0.99	0.98
Unemployment	ALMP	0.81	0.8	0.81	0.99	0.99	0.89
	Rep. rate	0.94	0.93	0.94	0.98	0.98	0.97
	EPL	0.95	0.95	0.96	1	1	1
REER	ALMP	0.99	0.99	0.99	1	1	1
	Rep. rate	0.65	0.62	0.62	0.77	0.77	0.68
	EPL	0.92	0.92	0.92	0.96	0.96	0.96

or the false discovery rate (where some false positives are allowed for). We choose three results – a standard Bonferroni adjustment, the Holm’s method, which is valid under quite arbitrary assumptions, and the Benjamini and Yekutieli method, which controls the expected proportion of false findings among the rejected hypotheses.<sup>16</sup> Ultimately, we take all the  $p$ -values for all horizons (separately for each macroeconomic variables and labor market policy), and compute adjusted  $p$ -values (overall, there are 12  $p$ -values in each such testing for each time period, over which we will be averaging). For instance, a standard Bonferroni method, reported in the first column of Table 4.2, postulated a new significance level  $0.1/12=0.0083$  for the null hypothesis to be rejected for each time period.<sup>17</sup> We recomputed proportions for the entire impulse response function: if the null is rejected for the majority of horizons, the response function is considered different once monetary policy is taken into account.

It is clear that using a threshold of at least one significant difference, all macro variables and all policy reforms pass it. Sticking to the 10% tolerance level, we find that monetary policy delivers different impulse response functions if replacement rate policies are evaluated for the real GDP, inflation and REER. When it comes to unemployment, however, differences are significant for the active labor market policies. Hence, if the entire dynamic path was of interest about the real GDP, monetary policy did matter least for the ALMP reforms (similarly to responses in inflation and REER). The most significant result is with regards to the replacement rate (unemployment benefits) reforms and competitiveness, that is, REER. Despite horizon adjustments, our results remain largely intact compared to the horizon-specific tests above. Finally, if we pooled over  $h$  and  $t$ , the second part of the Table 4.2, the most robust result for the entire period is obtained with regards to unemployment benefits and real GDP as well as REER. The monetary policy effect of ALMP on unemployment remains even after double averaging in the case of the Benjamini and Yekutieli method.

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<sup>17</sup>Note that changes in interest rates depend on time; therefore, the  $t$ -tests are conducted for each time period (in fact, the tests are conducted for all  $t$  time periods and all  $i$  countries, so reported tests are averaged over both these dimensions).

## 5 Extensions

To conserve space, we report 90% confidence intervals in Section B.2 with three sets of the results (sub-sample 1985-1998 in Section B.2.1, sub-sample 1999-2010 in Section B.2.2 and the overall sample in Section B.2.3). Unlike the main text, where we tested  $H_0 : \tilde{\delta}_k - \delta_k = 0$ , we also test  $H_0 : \tilde{\delta}_k = 0$  against a two-sided alternative. We report probability values from all the models separately in Appendices, Section B.3. All the models and all the extra parameters, in addition to the first two lags of the labor market policies, are visualized for each horizon in Figures B.16-B.17. We create time series for all the variables with and without monetary policy interactions, reported for the first, fourth and eighth quarters, in Section B.4 whereas density functions are presented for the first, fourth and eighth quarters in Section B.5. Instead, we move to two extensions: one where a horizon-specific error factor structure is taken into account and another where anticipation about the future is dealt with.

### 5.1 Anticipation Effects and Aggregate Demand Fluctuations

Even though we control for the history of macroeconomic dynamics, past reforms, and aggregate shocks, one may nevertheless be concerned that pre-determinedness of controls in equations (2.1) or (5.1) may not hold due to the anticipated component. Following [Auerbach and Gorodnichenko \(2012\)](#), [Duval and Furceri \(2018\)](#), we introduce the OECD forecast for year  $t$  GDP growth, made at  $t - 1$ , as an additional variable that controls for agents' expectations about the evolution of an economy. We have manually extracted projections from the OECD Economic Outlook June and December editions. Note that due to the quarterly nature of our exercise, the construction of anticipated controls is more nuanced in our case. In the first and the second quarters, we included the current year's GDP forecast published in the previous year's OECD's December edition, whereas in the third and the fourth quarters we included next year's GDP forecast published in the current year's June edition. Conditional on past information set, we now control for any expectations about the economic environment that may be correlated with the policy reforms. In addition to anticipation effects, and even though we are dealing with changes in variables (growth rates if levels are measured in logarithms), we also introduce an output gap (constructed using a standard HP filter)<sup>18</sup> to control for the unemployment and other macro effects of aggregate demand fluctuations over the business cycle.<sup>19</sup>

Figure 5.1 collects weighted local projections with additional controls for anticipation and output gaps. As before, the replacement rate and the ALMP tend to reduce whereas EPL tends to increase inflation on impact. A more inflationary result may be achieved by increasing labor market rigidity in the tightening monetary policy environment. Unemployment benefits may have expansionary effect only in the short run. ALMP supports aggregate economy when a loosening monetary policy is in place; in contrast, EPL is more inflationary and expansionary under increasing interest rates. Changes in the real effective exchange rate resemble results from before with a J curve dynamics for the EPL. Finally, unemployment suffers less from an increase in the replacement rate and goes down due to the ALMP expenditure if monetary policy is loose. We find the same narrative for the EPL which supports the macroeconomy when interest rates are higher. The story about the expenditure-increasing policies delivering during an economic downturn when loose monetary policy is in place whereas institutional changes being favored during economic booms

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<sup>18</sup>We use  $\lambda = 1600$  for our quarterly data as originally suggested by [Hodrick and Prescott \(1997\)](#).

<sup>19</sup>To alleviate notation, these additional variables are not accounted within  $\mathbf{X}_{it}$  in the model (2.1).

is supported by accounting for anticipation effects and aggregate demand fluctuations.

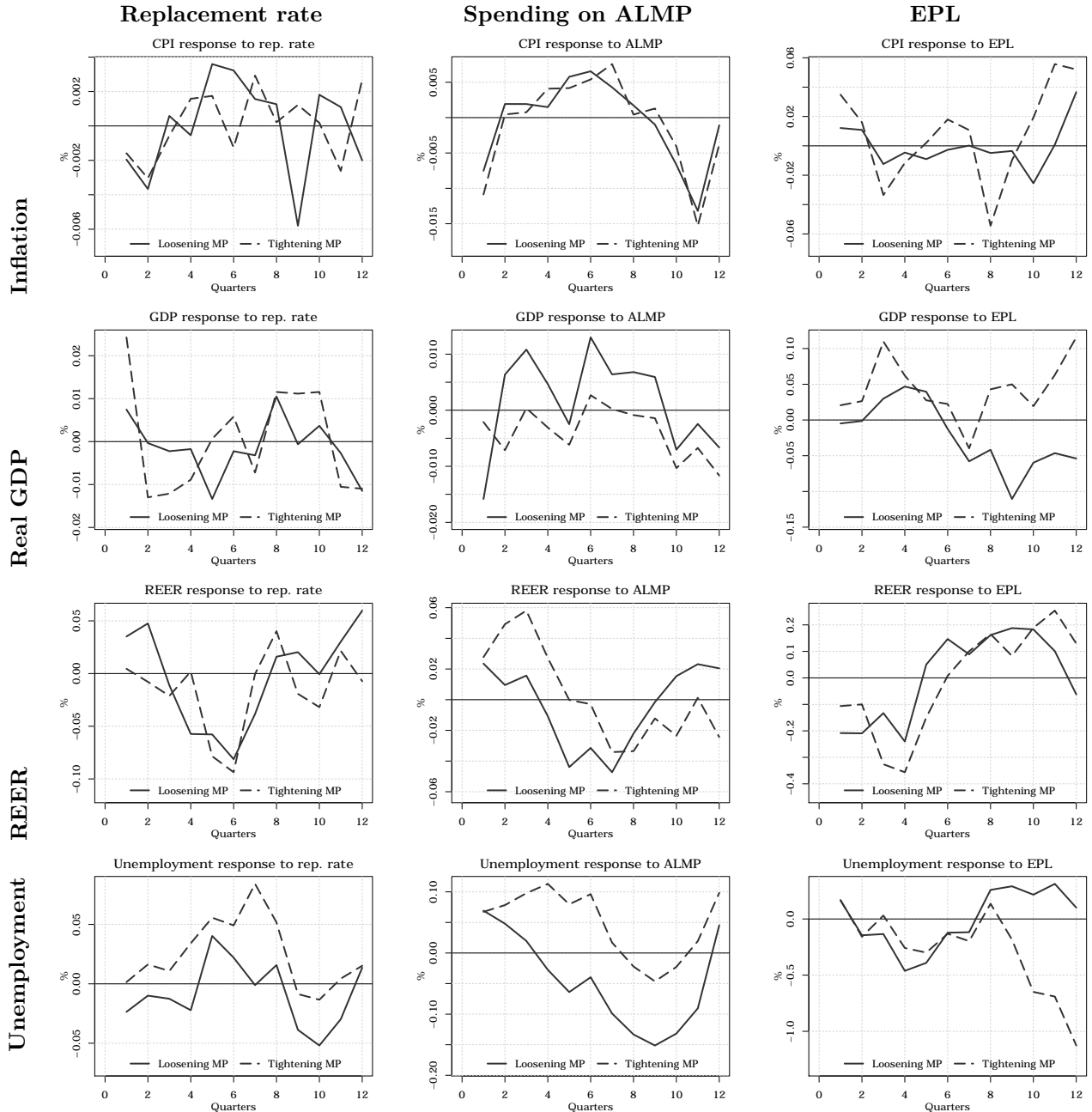


Figure 5.1: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), weighted (Mallow's averaging) impulse responses (local projections) with OECD GDP forecasts and HP-filtered output gaps

## 5.2 Cross-Sectional Dependence

In addition to taking care of a rich set of observables, one could argue that, despite taking past values of macroeconomic variables, some factor structure (cross-sectional dependence) still remains in the error term. To ensure that our results are robust to such data generating process, we follow Bai (2009) and Bada and Kneip (2014), and let the error term to be

subject to the multi-factor structure:

$$\begin{aligned}
\Delta y_{i,t+k} &= \alpha_i + \beta' \mathbf{X}_{it} + \gamma' X_{i,t-1} + \delta_1 \Delta \ln LMP_{it} + \delta_2 \Delta \ln LMP_{i,t-1} & k = 1, \dots, 12, \\
&+ \delta_3 \Delta \ln LMP_{it} \times \mathbb{I}_{\Delta i_{it} < 0} + \sum_{\ell} \lambda_{i\ell} f_{\ell t} + u_{i,t+k} & \text{Model A,} \\
&+ \delta_3 \Delta \ln LMP_{it} \times \mathbb{I}_{\Delta^a i_{it}} + \sum_{\ell} \lambda_{i\ell} f_{\ell t} + u_{i,t+k} & \text{Model B,} \\
&+ \delta_3 \Delta \ln LMP_{it} \times \Delta i_{it} + \sum_{\ell} \lambda_{i\ell} f_{\ell t} + u_{i,t+k} & \text{Model C,} \\
&+ \delta_3 \Delta \ln LMP_{it} \times \Delta^a i_{it} + \sum_{\ell} \lambda_{i\ell} f_{\ell t} + u_{i,t+k} & \text{Model D,} \\
&+ \delta_3 \Delta \ln LMP_{it} \times \mathbb{I}_{\Delta i_{it} < 0} + \delta_4 \Delta \ln LMP_{it} \times \Delta i_{it} + & \\
&\delta_5 \Delta \ln LMP_{it} \times \Delta i_{it} \times \mathbb{I}_{\Delta i_{it} < 0} + \sum_{\ell} \lambda_{i\ell} f_{\ell t} + u_{i,t+k} & \text{Model E.}
\end{aligned} \tag{5.1}$$

As before, let us rewrite the model in (5.1) as  $\Delta y_{t+k}(m) = z_t(m)' a(m) + u_{t+k}(m)$ , where all variables along with the factors are combined into

$$\begin{aligned}
z_t(m) &= (1, X_t, X_{t-1}, f_t(m), \dots, f_{t-p_{max}}(m), \\
&\Delta \ln LMP_t, \Delta \ln LMP_{t-1}, g(\Delta \ln LMP_t(m)), \dots)', \tag{5.2}
\end{aligned}$$

and  $m$  denotes one of the models (A-E) that are covered in specifications (2.1) (zero factors) and (5.1), where error factor structure applies. Notice that the models may include a number of factors or none at all; also, there is no requirement for the models to be nested. To make the procedure feasible, one can substitute unobserved factors with their principal components, control for their existence by cross-sectional averages or estimate them along with other parameters. None of the above addresses simultaneously parameter identification and a number of factors, something of crucial importance in establishing an average model. We follow [Bada and Kneip \(2014\)](#) and estimate each model with an integrated penalty term in the objective function with an iterative procedure to avoid under- or over-parameterization. Effectively, the fitting procedure is a penalized least squares method with iterations to establish an optimal dimension of the factor structure.<sup>20</sup> The factors are estimated by the first eigenvectors that correspond to the first largest eigenvalues, an exact number determined during the estimation procedure.

Resorting to Proposition 1 and [Cheng and Hansen \(2015\)](#), we know that, since factors are generated from the same variables, Mallor's optimality condition can be extended to models with factor structure (recall that Mallor's criterion is directly applicable to any context where fitted values are a linear function of the dependent variable). Accounting for the factor structure arguably makes homoskedasticity assumption, used in proving optimality of Mallor's averaging, hold in more cases than otherwise. Dynamic regression, as is ours, poses some challenges since  $\mathbf{X}$  includes lags of the dependent variable, thus invalidating linearity assumption. Fortunately, [Cheng and Hansen \(2015\)](#) demonstrate that Mallor's averaging remains valid for dynamic models, too. Despite a multi-factor error structure, the least squares methodology still applies; it is just conducted iteratively with the penalization for the uncertainty about a number of factors (also refer to discussion in Appendix A). This opens up vistas to apply a least squares penalization as is done in the Mallor's combination weights criterion, something missing in the policy evaluation literature ([Gobillon and Magnac \(2016\)](#) consider policy evaluation with the factor structure, yet they abstract from model uncertainty or locally robust dynamic paths of policy changes).

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<sup>20</sup>The procedures by [Bada and Kneip \(2014\)](#) are rooted in the parameter cascading strategy, put forward by [Cao and Ramsay \(2010\)](#) to estimate models with multi-level parameters.

### 5.2.1 Results for the Baseline

Figure 5.2 visualizes Mallows' weights for the impulse response averaging, once error factor structure is incorporated into the weight-selection algorithm. Compared to Figure 4.1, factor structure makes weights somewhat less dispersed across horizons and models. Inflation, however, still requires us to apply all the models, across labor market policies, though Model D dominates, as in Figure 4.1. The average response of real GDP to the replacement rate first relies on Model D and moves to Model B, though averaging is more dispersed for other labor market policies. The most stark difference, compared to Figure 4.1, relates to the REER: Model D clearly dominates across all the macro responses and labor variables. Unemployment also prefers Model D, thus creating a difference to the situation when factor structure was ignored as then Model B was preferred for the shock in the ALMP. Data favor specifications with annual rather than quarterly changes or signs of an annual change, supporting our interpretation of the monetary policy trend. Yet, convergence to one particular model across response and shock variables, also horizons, indicates that the prior substantial heterogeneity can be attributed to the existence of unobserved factors, which drive response variables and potentially correlate with the policy variables.

Average responses are depicted in Figure 5.3. The most important difference is the reduced importance of monetary policy stance for the macroeconomic effect of reforms. Though the role of monetary policy does not disappear, it seems that the growth rates across open and integrated European economies are driven by common factors, and they potentially correlate with the joint labor and monetary policy actions. In other words, interactions between labor and monetary reforms are driven substantially more by time-varying component than by an idiosyncratic component. Since the euro was first introduced in 1999, a substantial portion of our sample actually reflects a joint monetary policy. The only question, then, remains about whether changes in labor market policies happened to be alike. If the answer was positive, we would expect that parameters  $\delta_1$  and  $\delta_2$  in the equation (5.1) would also be affected (and not only the interaction terms). In fact, the scales in Figures 4.2 and 5.3 are substantially different, thus suggesting that a great deal of variation in labor market policies are actually attributable to a common factor. We interpret this result as a confirmation that not only monetary policy became euro area specific but also changes in labor market policies tend to be driven more by a common cyclical factor rather than country-specific components.

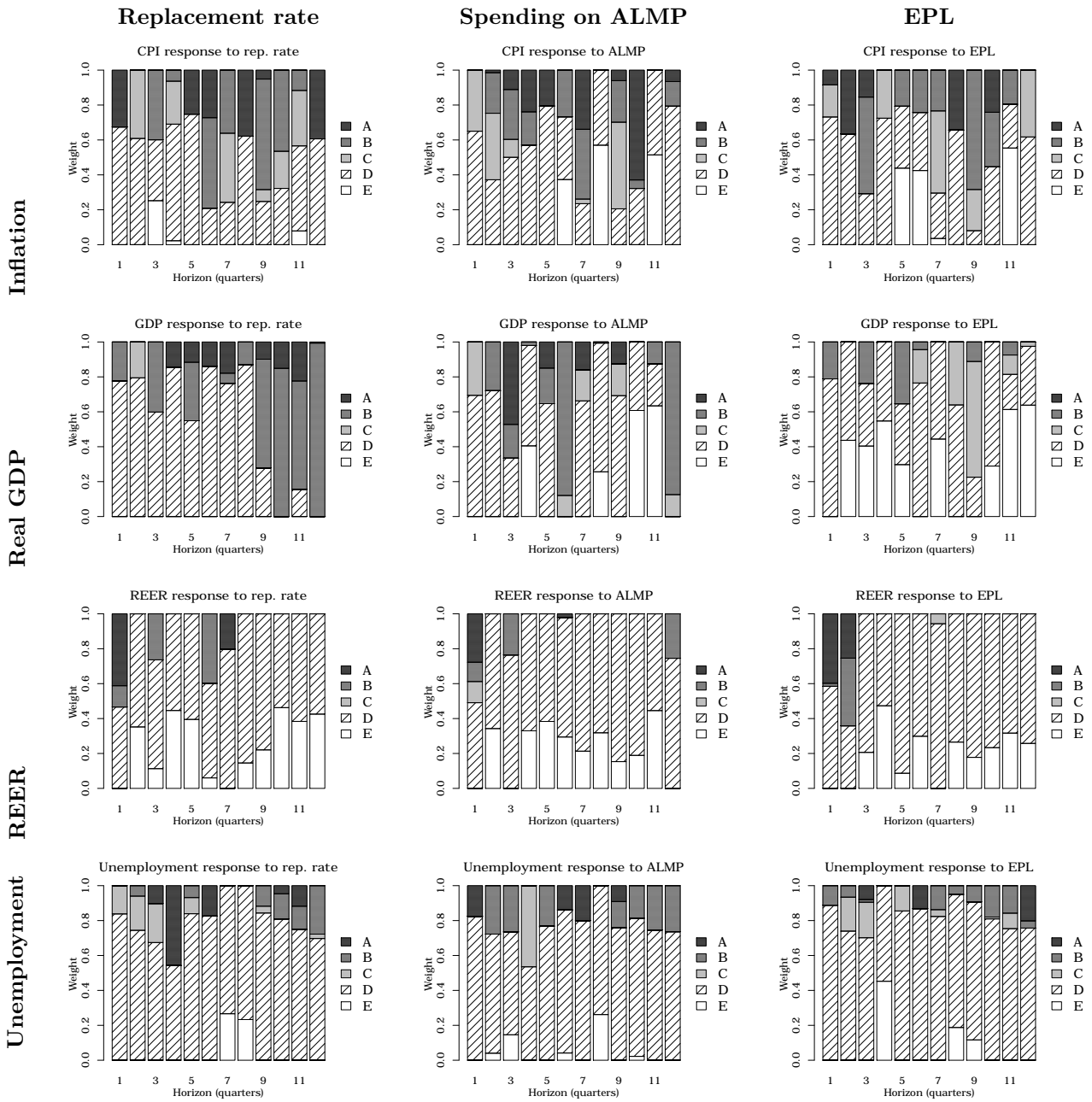


Figure 5.2: Average model weights for each horizon, impulse and response variables (Mallow's criterion with multi-factor error structure)

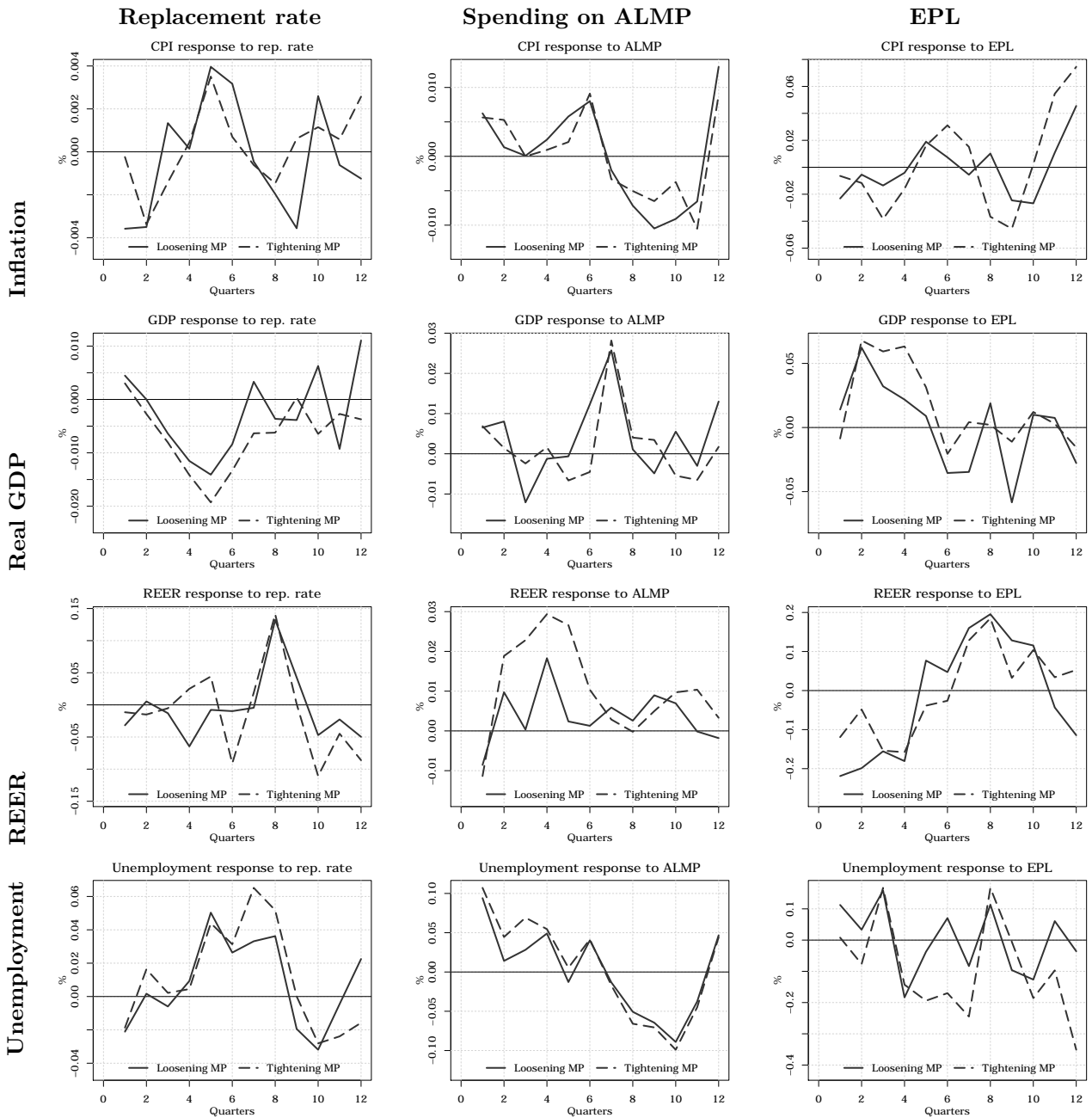


Figure 5.3: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), weighted (Mallow's averaging and multi-factor error structure) impulse responses (local projections)

## 5.2.2 Results for the Extended Model

In the final robustness check, we extend the set of controls to include GDP forecasts as well as output gaps, in addition to the multi-factor error structure. Figure 5.4 is largely comparable to 5.2 when additional controls were not taken into account. visualizes Mallow's weights for the impulse response averaging, once error factor structure is incorporated into the weight-selection algorithm. Model D carries most weight for all variables of interest, though dispersion is quite vast and is clearly horizon, policy and outcome variable specific.

Nevertheless, data clearly favor specifications the monetary policy trend rather than with more volatile alternatives.

The reported weights are used to construct average response functions, visualized in Figure 5.5. Unsurprisingly, since weights remained quite comparable, so are the responses (refer to Figure 5.3). Though much of variation in labor market policies is indeed attributable to a common factor, some visual differences remain. For instance, replacement rate is less detrimental whereas unemployment would decline faster and more strongly after an increase in ALMP if initiated during a loosening monetary policy period.

Figure 5.6 registers, as in the baseline case, many cases falling below 0.9 threshold. A notable difference is in the effect on GDP, which is no clearly different for the replacement rate, unlike previous dominance by ALMP. Other effects remain comparable: monetary policy plays a role for the impact of the replacement rate on inflation and real effective exchange rate, and ALMP on unemployment (for the horizon specific results also refer to Appendix C.1). Extending analysis to the multiple testing case, Table 5.1 documents substantial effects from the monetary policy for the replacement rate across all outcome variables dynamic paths and, to a lesser extent, for the EPL and a path of REER as well as real GDP. Pooling over  $h$  and  $t$  points to significant effects for the replacement rate and real GDP as well as REER. As before, there is evidence for the different unemployment reactions to ALMP if one of the multiple testing methods was used.

To save space, we report other results in Appendix C.<sup>21</sup> We find no qualitative difference compared to the baseline model with cross-sectional dependence. We conclude that neither anticipation nor aggregate demand fluctuations impact our results in any significant way. What matters is in fact an increasingly important common component, which may be driven by the joint monetary policy and intensified interactions across European economies, especially during the second part of our sample period.

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<sup>21</sup>Reader is referred to Appendix for results from the extended model, including probability values from all the models, all the models and all the extra parameters, in addition to the first two lags of the labor market policies, as well as time series for all the variables with and without monetary policy interactions, reported for the first, fourth and eighth quarters, density functions for the first, fourth and eighth quarters.



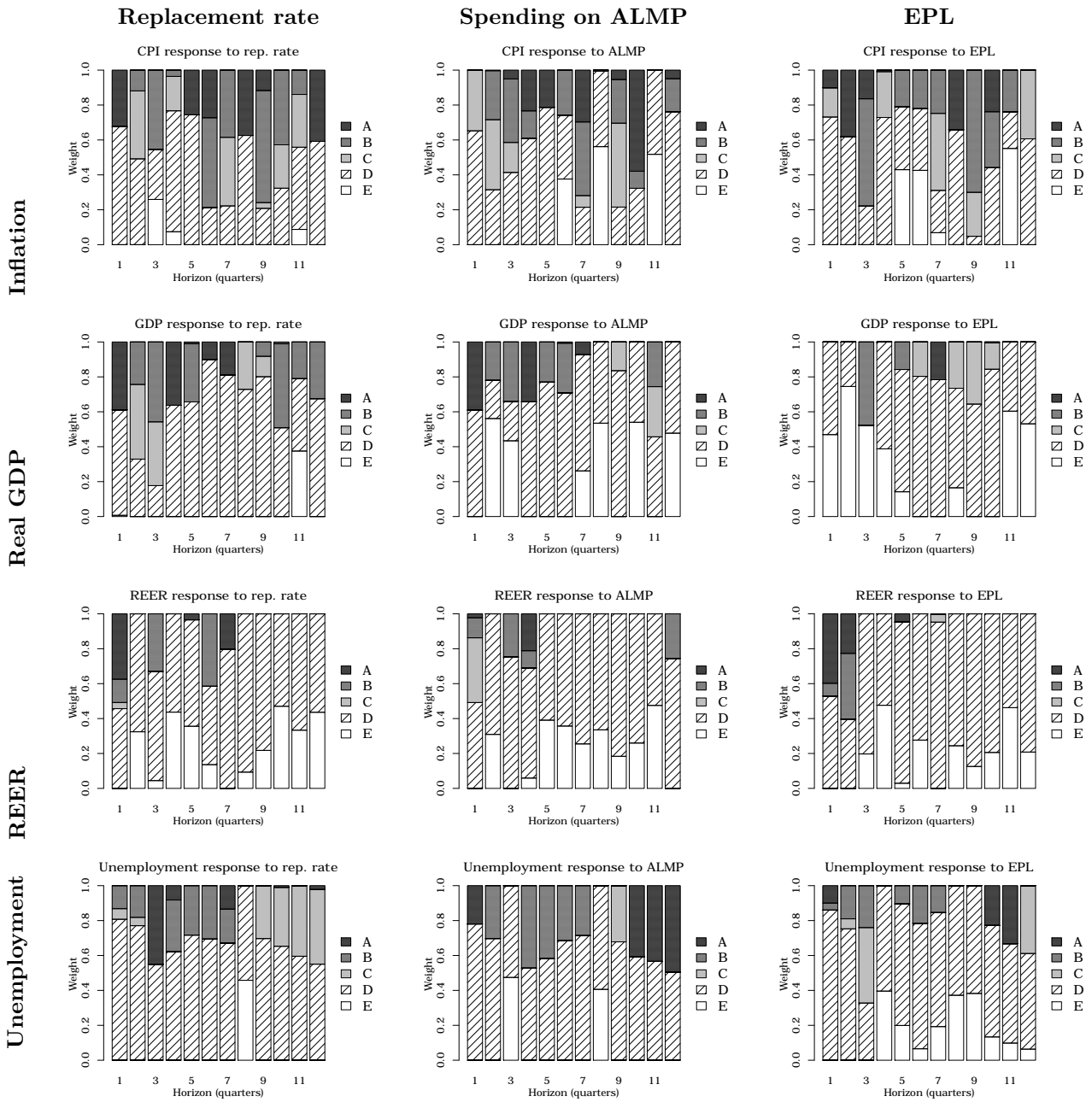


Figure 5.4: Average model weights for each horizon, impulse and response variables (Mallow's criterion with multi-factor error structure and additional controls)

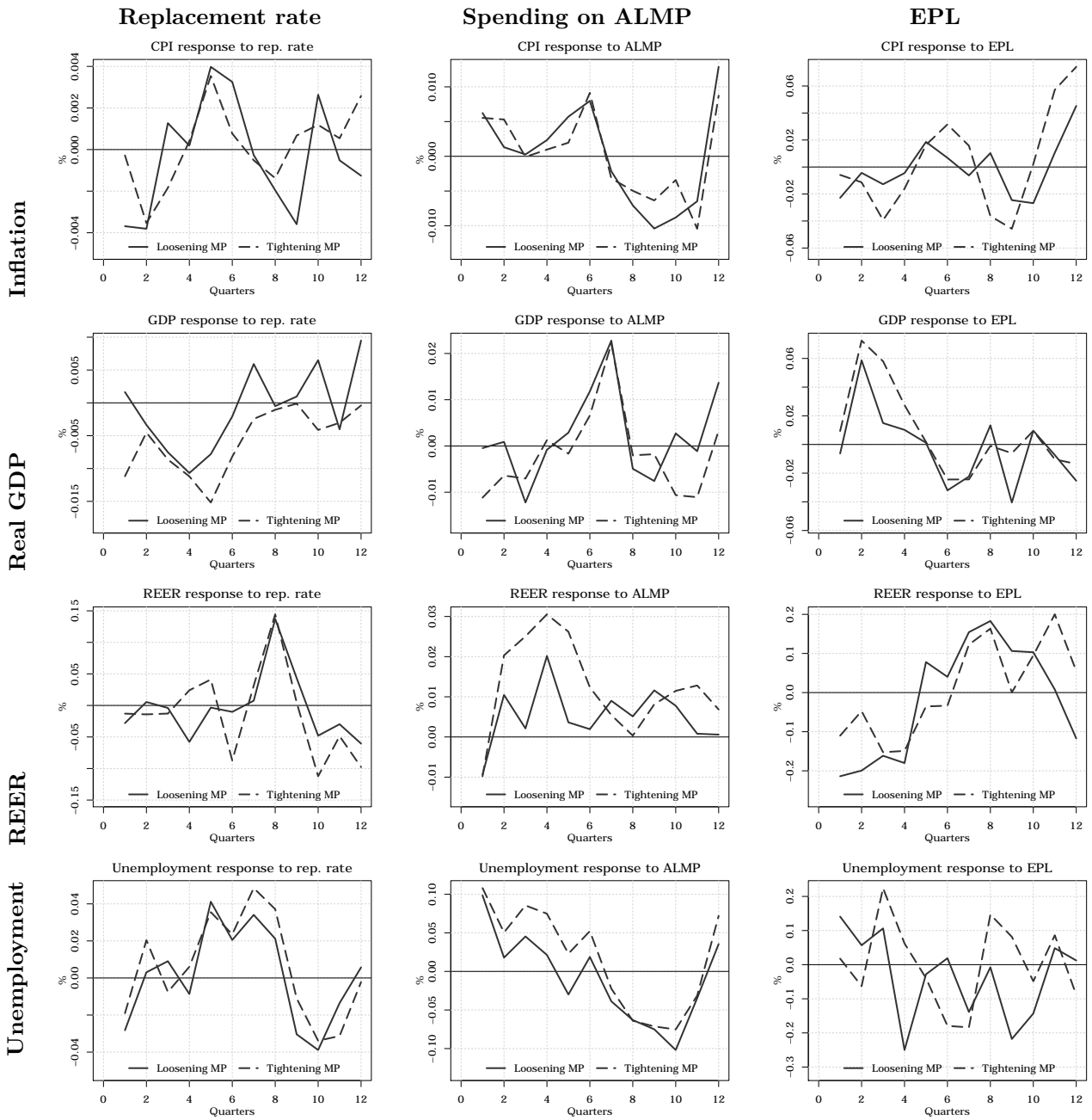


Figure 5.5: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), weighted (Mallow's averaging, additional controls and multi-factor error structure) impulse responses (local projections)

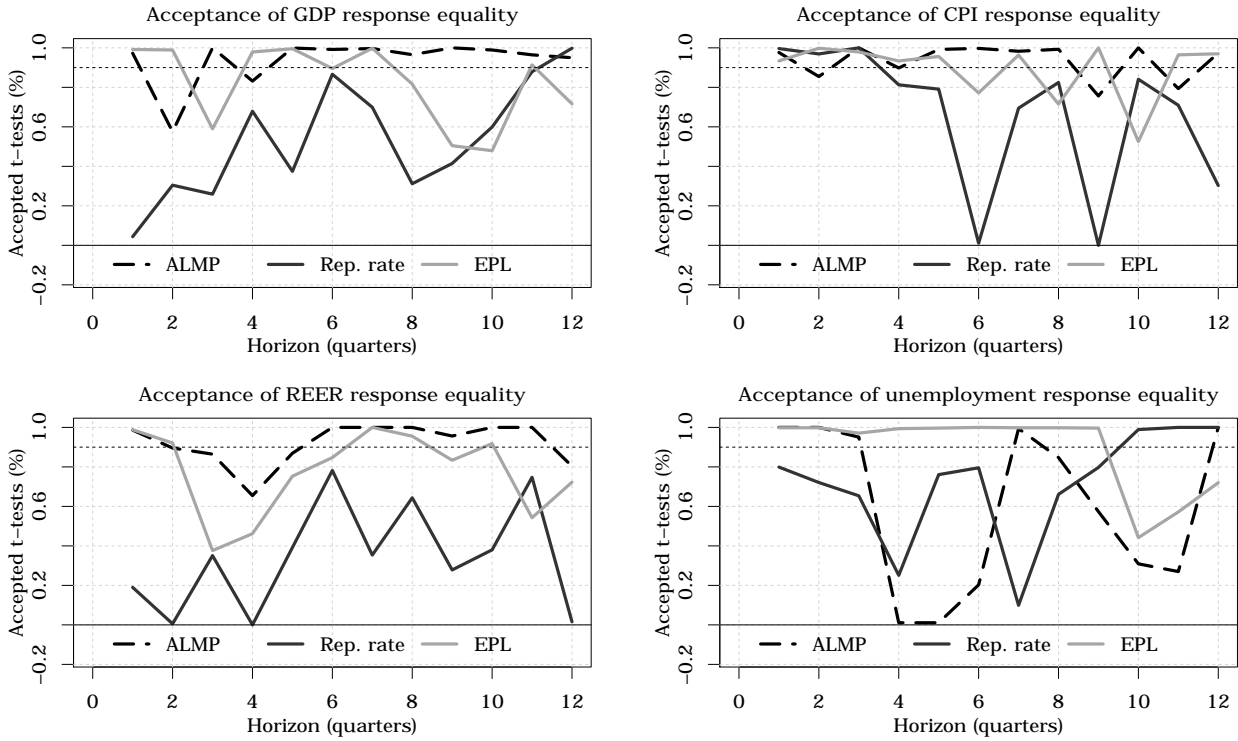


Figure 5.6: Acceptance regions of  $H_0 : \delta_k^{\tilde{\cdot}} - \delta_k = 0$  for the replacement rate, ALMP and EPL in models for inflation, real GDP, REER and unemployment

Table 5.1: Proportion of the Equality Rejection with Adjusted  $p$ -values (left: averaging over  $h$ ; right: averaging over  $h$  and  $t$ )

		Bonferroni	Holm	Benjamini & Yekutieli	Bonferroni	Holm	Benjamini & Yekutieli
Real GDP	ALMP	0.98	0.98	0.99	1	1	1
	Rep. rate	0.66	0.64	0.64	0.77	0.77	0.68
	EPL	0.94	0.94	0.94	0.99	0.99	0.98
Inflation (CPI)	ALMP	0.99	0.99	0.99	1	1	1
	Rep. rate	0.86	0.85	0.88	0.98	0.98	0.95
	EPL	0.96	0.96	0.97	0.99	0.99	0.98
Unemployment	ALMP	0.92	0.92	0.96	1	1	1
	Rep. rate	0.84	0.82	0.83	0.96	0.96	0.89
	EPL	0.97	0.96	0.98	1	1	1
REER	ALMP	0.99	0.99	0.99	1	1	1
	Rep. rate	0.49	0.45	0.45	0.67	0.67	0.51
	EPL	0.92	0.92	0.93	0.96	0.96	0.96

## 6 Conclusions

We considered the differential effects of labor market institutions on the macroeconomy in different interest rate environments. Though our proposed methodology, which merges local

projections with the Mallows's  $C_p$  criterion to average forecasts, does not require knowledge of the exact functional form, is robust to mis-specification, admits non-linearities, cross-sectional dependence (multi-factor error structure), and addresses uncertainty regarding interactions between labor reforms and the macroeconomy, it effectively relies on ordinary least squares and is thus very simple to implement. Policymakers are most interested in the dynamic path of a reform; this is our target, too. Due to the local nature of estimation, each period after a shock carries a specific parameter. Its applicability thus goes well beyond our application, in particular, where heterogeneous responses are suspected.

Our hypothesis that the effects of labor reforms initiated in periods of loose monetary policy differ from the effects of those initiated when monetary tightening prevails was largely confirmed. We developed a test that can shed light both on significant differences due to monetary policy over any chosen horizon and the entire impulse response function. We found that monetary policy carries unequal significance for different horizons but is particularly important for the effect of the replacement rate across responses in macroeconomic variables and active labor market policies on unemployment. This contributes to the solution of the empirical puzzle, found in the labor literature, that the activation policies may not have aggregate effects on the reduction of unemployment once monetary policy regimes or business cycle conditions are ignored. We also found evidence of monetary policy trend specifications being favored by data and increasing synchronized monetary and labor market policies across European countries. Though anticipation and aggregate demand fluctuations have not significantly impacted our results, we found that ignoring unobserved interdependencies across macroeconomic variables may be quite consequential for the implications.

A number of promising research directions remain. On the methodology side, we see developments on the ways to calculate robust standard errors and optimal joint confidence bands of different horizons particularly useful for empirical applications. On the literature of labor market reforms side, we foresee applications of our methodology on an even larger set of countries (a major obstacle so far remains data availability), exploring even more layers of heterogeneity and interactions. Our framework which jointly models dynamic paths of reforms and model uncertainty is particularly well suited for multi-country reforms at the business cycle frequency. Additionally, more granular data applications would be of interest as well as a larger set of reforms, such as goods or financial markets. More theoretical contributions that combine business cycle fluctuations with labor reforms and monetary policy stance would be a fruitful avenue of study.

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# Appendix (Not for publication)

## A Discussion

**Proposition.** *Local projection, weighted by Mallows weights  $C_T(w)$ , is asymptotically unbiased in the sense that such averaging delivers asymptotically unbiased estimator of the mean squared (forecast) error in the presence of stationary, dependent data and even multi-factor error structure.*

Taken separately, results on the optimality of both, local projections and Mallows averaging, are already known in the literature. Our contribution is to combine them as well as to admit a common factor in the data generating process. We shall start with the assumptions about the data generating process: let the information set (filtration) be defined as  $\Omega_t = \sigma(y_t, \{z_t\}, y_{t-1}, \{z_{t-1}\}, \dots)$ , where  $\{z_t\}$  denotes a set already used in the equation (4.1) and defined in (4.2). Usual orthogonality condition  $\mathbb{E}(u_{t+h}|\Omega_t) = 0$ , strict stationarity and ergodicity of data, finite fourth moments ( $\mathbb{E}\|z_t\|^4 \leq C$ ,  $\mathbb{E}\|u_t\|^4 \leq C$  for a generic constant  $C$ ), (semi-)positive definiteness  $\mathbb{E}z_t z_t' \geq 0$ , and weak dependence ( $T^{-1/2} \sum_{t=1-h}^{T-h} z_t u_{t+h} \xrightarrow{d} N(0, \Sigma)$ , such that  $\Sigma = \sum_{|j|<h} \mathbb{E}(z_t z_{t-j}' u_{t+h} u_{t+h-j})$ ) are assumed to hold. For the factor-dependent data, we admit  $\{X_{it}\}$  and factors to explain  $y_t$ , also let factors be correlated with the regressors. An extreme of such dependence is the assumption that  $\{X_{it}\}$  are generated by  $\{f_t\}$  and idiosyncratic components. We shall not deviate from the literature or seek the smallest set of assumptions to justify the method; rather, our aim is to demonstrate how the proposed method fits within the existing body of knowledge and how to implement it.

Let a vector with factors  $\{f_t\}$  be a zero mean covariance stationary process with absolutely summable autocovariances, distributed independently of individual specific errors across cross-sectional units and time. Finite moments condition  $\mathbb{E}\|f_t\|^4 \leq C$ ,  $\sum_{t=1}^T f_t f_t' \xrightarrow{p} \Sigma_f > 0$  and deterministic factor loadings (or finite fourth moments) are assumed to hold. Though the method can be applied for non-stationary factors, we deal with the stationary setup (differenced variables) as it readily complies to the theory on the model averaging.

By (4.1),

$$y_{t+k}(m) = z_t(m)' a(m) + u_{t+k}(m),$$

and its least squares forecast is

$$\hat{y}_{T+k|T}(m) = \tilde{z}_T(m)' \hat{a}(m),$$

where  $\tilde{z}_T(m)$  has unobserved factors replaced by their estimates  $\tilde{f}_t$ . The combination of forecasts is given by

$$\hat{y}_{T+k|T}(w) = \sum_{m=1}^M w(m) \hat{y}_{T+k|T}(m),$$

and the error term of the combination of projections is given by  $u_{t+k}(w) = \sum_{m=1}^M w(m) \hat{u}_{T+k}(m)$ . The mean squared forecast error then follows almost immediately:

$$\begin{aligned} MSFE_T(w) &= \mathbb{E} \left( y_{T+k} - \hat{y}_{T+k|T}(w) \right)^2 \\ &= \mathbb{E} \left( u_{T+k} - \sum_{m=1}^M w(m) \left( \tilde{z}_T(m)' \hat{a}(m) - z_T(m)' a(m) \right) \right)^2 \\ &\simeq \mathbb{E} u_{t+k}^2 + \mathbb{E} \left( \sum_{m=1}^M w(m) \left( z_t(m)' a(m) \right) - \tilde{z}_t(m)' \hat{a}(m) \right)^2, \end{aligned}$$

where the result follows from the error term's orthogonality and stationarity (as well the fact that factors span the space of the same regressors, assumed to be stationary). Under homoskedasticity,  $\mathbb{E}(u_{t+k}^2 | \Omega_t) = \sigma^2$ , we have that

$$\begin{aligned} MSFE_T(w) &= \sigma^2 + \mathbb{E} \left( \sum_{m=1}^M w(m) \left( z_t(m)' a(m) \right) - \tilde{z}_t(m)' \hat{a}(m) \right)^2 \\ &= \sigma^2 + \mathbb{E} \left( \sum_{m=1}^M w(m) (u_t - \hat{u}_t(w)) \right)^2 = \sigma^2 + \mathbb{E} L_T(w), \end{aligned}$$

where the second equality follows from a decomposition of  $y_t = \hat{y}_t + \hat{u}_t$  and  $L_T(w) = \frac{1}{T} \sum_{t=1}^T (u_t - \hat{u}_t(w))^2$ , an in-sample squared error. The difference can be further simplified by invoking a projection operator  $P$  (where  $\tilde{P}$  denotes an estimated counterpart):

$$\begin{aligned} \hat{u}_t(w) &= u_t + \sum_{m=1}^M w(m) z_t(m)' a(m) - \sum_{m=1}^M w(m) \tilde{z}_t(m)' \hat{a}(m) \\ &= u_t + \sum_{m=1}^M w(m) z_t(m)' a(m) - \sum_{m=1}^M w(m) \tilde{P}(m) z_t(m)' a(m) - \sum_{m=1}^M w(m) \tilde{P}(m) u_t, \end{aligned}$$

which, using matrix notation, can be written as

$$\hat{u}(w) = u + (I - \tilde{P}(w)) z' a - \tilde{P}(w) u,$$

such that  $\tilde{P}(w) = \sum_{m=1}^M w(m) \tilde{P}(m)$  and  $\tilde{P}(m) = \tilde{z}(m) (\tilde{z}(m)' \tilde{z}(m))^{-1} \tilde{z}(m)'$ . We thus have

$$\hat{u}(w) = u + (I - \tilde{P}(w)) z(m)' a(m) - \tilde{P}(w) u.$$

Hence,

$$\begin{aligned} & \frac{1}{T} \hat{u}_t(w)' \hat{u}_t(w) \\ &= \frac{1}{T} u' u + \frac{1}{T} \left( (I - \tilde{P}(w)) z(m)' a(m) - \tilde{P}(w) u \right)' u + \frac{1}{T} u' \left( (I - \tilde{P}(w)) z(m)' a(m) - \tilde{P}(w) u \right) \\ & \quad + \frac{1}{T} \left( (I - \tilde{P}(w)) z(m)' a(m) - \tilde{P}(w) u \right)' \left( (I - \tilde{P}(w)) z(m)' a(m) - \tilde{P}(w) u \right) \\ &= \frac{1}{T} u' u + \frac{1}{T} \left( (I - \tilde{P}(w)) z(m)' a(m) - \tilde{P}(w) u \right)' u + \frac{1}{T} u' \left( (I - \tilde{P}(w)) z(m)' a(m) - \tilde{P}(w) u \right) \\ & \quad + \frac{1}{T} \left( \left( (I - \tilde{P}(w)) z(m)' a(m) \right)' (I - \tilde{P}(w)) z(m)' a(m) - \left( \tilde{P}(w) u \right)' (I - \tilde{P}(w)) z(m)' a(m) \right) \\ & \quad - \frac{1}{T} \left( \left( (I - \tilde{P}(w)) z(m)' a(m) \right)' \tilde{P}(w) u + \left( \tilde{P}(w) u \right)' \tilde{P}(w) u \right) \\ &= \frac{1}{T} u' u + \frac{1}{T} \left( (I - \tilde{P}(w)) z(m)' a(m) - \tilde{P}(w) u \right)' u + \frac{1}{T} u' \left( (I - \tilde{P}(w)) z(m)' a(m) - \tilde{P}(w) u \right) \\ & \quad + L_T(w) - \frac{1}{T} \left( \tilde{P}(w) u \right)' (I - \tilde{P}(w)) z(m)' a(m) - \frac{1}{T} \left( (I - \tilde{P}(w)) z(m)' a(m) \right)' \tilde{P}(w) u \\ & \quad = \frac{1}{T} u' u + 2 \frac{1}{\sqrt{T}} \left( \frac{1}{\sqrt{T}} \left( z(m)' a(m) \right)' (I - \tilde{P}(w))' u \right) - 2 \frac{1}{T} u' \tilde{P}(w) u + L_T(w), \end{aligned}$$

from the standard properties of the projection matrix (symmetry and idempotence). Following [Cheng and Hansen \(2015\)](#), call  $r_{1T}(w) = \frac{1}{\sqrt{T}} \left( z(m)' a(m) \right)' (I - \tilde{P}(w))' u$  and  $r_{2T}(w) = u' \tilde{P}(w) u - \hat{\sigma}_T^2 \sum_{m=1}^M w(m) \dim(z_t(m))$  (refer to the criterion in the equation (4.3)), it then follows that

$$C_T(w) = \frac{1}{T} u' u + 2 \frac{1}{\sqrt{T}} r_{1T}(w) - 2 \frac{1}{T} r_{2T}(w) + L_T(w).$$

What [Cheng and Hansen \(2015\)](#) prove is the convergence in distribution of  $r_{1T}(w)$  and  $r_{2T}(w)$  to mean-zero random variables. Using results in [Bai and Ng \(2006\)](#), estimated projection using unobserved factors may be approximated by the true projection and the estimated factors span column space of the true factors,  $u' \tilde{P}(w) u = u' P(w) u + o_p(1)$ . Clearly,  $r_{1T}(w) = O_p(T^{-1/2})$  and  $r_{2T}(w) = O_p(T^{-1})$ , whereas  $L_T(w)$  is non-zero for any  $w$  as long as we rule out a degenerate case with a true model receiving a full weight.

Two differences arise in our application. First, like proposed by [Jordà \(2005\)](#), we consider  $y_{T+k}$  and its projection onto the space, generated by the regressors in (4.2). Hence, the quality of the result depends on the choice of  $k$ , which limits the number of effective observations used for estimation. This is because for all projections the historical set remains the same. Unlike model averaging literature, we are interested in each horizon, one-by-one, with the horizon-specific impulse responses. This is not an issue for the point or well-defined forecasting exercises but is the main objective for the policy evaluation exercise for short, medium and long terms, as results of economic reforms usually deliver very different impacts over different time horizons ([Cacciatore et al., 2016b](#)). Another difference lies in the use of estimated unobserved factors, not considered in [Jordà \(2005\)](#). We follow [Bada and Kneip \(2014\)](#) in applying parameter cascading strategy to arrive at what the authors called entirely updated estimators. Unlike [Cheng and Hansen \(2015\)](#), we do not require to know the number of factors in empirical applications. It has been shown that the method by [Bada and Kneip \(2014\)](#) achieves more efficient estimates in terms of mean squared error than [Bai et al. \(2009\)](#) with an externally selected factor dimension; hence, it renders theoretical assumption on the known factor number closer to being true. We report the results from the panel criteria, as proposed by [Bai and Ng \(2002\)](#), which is integrated into a global estimation that alternates between an inner iteration of parameters, factors and their loadings, as functions of the factor dimension, and an outer iteration to select the optimal dimension. We implement all the procedures in R (codes are available upon request or on the corresponding author’s website).

# B Data

## B.1 Description and Sources

Table B.1: Data definitions and sources

Variable	Definition	Measure	Source	Adjustments
Public expenditure on active labor market policies	Expenditure on public interventions, which are explicitly targeted at groups of persons with difficulties in the labor market: the unemployed, the employed at risk of involuntary job loss and inactive persons who would like to enter the labor market. Total expenditure on active measures can be broken down into 7 categories, which include labor market policy (LMP) services (category 1) and LMP measures (categories 2-7). LMP measures cover activation measures for the unemployed and other target groups including the categories of training, job rotation and job sharing, employment incentives, supported employment and rehabilitation, direct job creation, and start-up incentives.	Expenditure per number of unemployed (we take the number of unemployed in the previous year) divided by GDP per capita	OECD, Eurostat	The main data source is Eurostat. For missing data entries, OECD data were used. Annual data were interpolated using Denton's method. The data were also logarithmically transformed
Population	Resident population, i.e. all persons, regardless of citizenship, who have a permanent place of residence in the country.	1000s	OECD	
Real effective exchange rate	Weighted average of a country's currency relative to an index or basket of other major currencies adjusted for variations in relative prices using unit labor costs in manufacturing (for Greece, we used HICP). The weights are determined by comparing the relative trade balances, in terms of one country's currency, with each other country within the index.	Index (2000=100)	OECD, Eurostat (for Greece)	The data were logarithmically transformed.
Output gap	Cyclical component of real gross domestic product filtered with the Hodrick Prescott filter ( $\lambda = 1600$ )	Source and definition of GDP as in this Table	Own calculations	
Short term interest rate	3-month money market rates	Percentage	Eurostat; Swedish data for 1982Q1 - 1986Q4 was taken from the OECD database	

Variable	Definition	Measure	Source	Adjustments
Real gross domestic product	Value of all final goods and services produced within an economy per quarter/year, taking into account changes in the general price level.	Index (2000=100)	GVAR database, IMF International Financial Statistics database, OECD National Accounts database, Eurostat	The primary source is the GVAR 2013 Vintage database. The IMF International Financial Statistics (IFS) database was also consulted for Portugal and Denmark, GDP Volume (2005=100). Data for Denmark were seasonally adjusted using the U.S. Census Bureau's ARIMA X12. Statistics for Luxembourg and Ireland, were obtained from the OECD National Accounts database. The most extensive adjustments were made to data pertinent to Greece. Data for 1980-1994 were obtained from the OECD National Accounts database. The base year was adjusted (2000=100) with a backward extrapolation until Q1 1980 using quarterly growth rates based on the OECD estimates. Data from 1995 onwards were extracted from Eurostat and seasonally adjusted with ARIMA X12. The data were also logarithmically transformed.
GDP forecast	The variable is used as an expectation measure for future GDP growth. Constructing the time series, in quarters 1 and 2, the measure is equal to the annual GDP growth forecast of the running year published in the previous year (last year's Economic Outlook issue 2). In quarters 3 and 4, the measure is equal to annual GDP growth forecast of the next year as projected in the running year's Economic Outlook issue 1.	Annual GDP change	Historical OECD Economic Outlook Issues 1 and 2	
EPL (employment protection legislation index)	A measure of procedures and costs involved in dismissing individuals or groups of workers and the procedures involved in hiring workers on fixed-term or temporary work agency contracts.	Index	OECD, own calculations	Separate EPL indices for regular and temporary workers were averaged according to shares of temporary/regular contract workers in the sample for a specific country.
Inflation (CPI)	Q-o-Q difference of consumer price index for all items	Index	OECD, own calculations	2010=100, seasonally adjusted using arima x12. The index was logarithmically transformed.



Variable	Definition	Measure	Source	Adjustments
Unemployment rate	Number of unemployed persons as a percentage of the labor force with a seasonal adjustment.	Percentage	Eurostat Labour Market database, IMF International Financial Statistics database, OECD Labour database	Q1 1983 - Q2 1998 data for Greece was interpolated from OECD annual data using Denton's interpolation method. For Austria, Finland and Germany, where Eurostat quarterly unemployment data were not available, it was constructed from annual IMF data using Chow-Lin interpolation method (quarterly indicator series was constructed from quarterly registered unemployed series and interpolated annual labor force series). In the case of Spain, as Eurostat and OECD annual data for this country exhibit certain differences, Eurostat annual data were extrapolated using annual OECD data and then the latter annual series was interpolated using Chow-Lin method (quarterly indicator series was constructed from quarterly registered unemployed series and interpolated annual labor force series). The data were also logarithmically transformed.
Unemployment replacement rate	Proportion of net in-work income that is maintained when unemployed. The OECD summary measure is defined as the average of the gross unemployment benefit replacement rates for two earnings levels, three family situations and three durations of unemployment. For further details, see OECD (1994), The OECD Jobs Study (chapter 8) and Martin J. (1996), 'Measures of Replacement Rates for the Purpose of International Comparisons: A Note', OECD Economic Studies, No. 26. Pre-2003 data have been revised.	Values between 0 and 1 (before log transformation)	OECD, Eurostat, <a href="#">van Vliet and Caminada (2012)</a>	Biannual data were interpolated to quarterly frequency using Denton's method. Data were spliced from two OECD measurements, keeping original data until 2005 and rescaling after 2005. The data were also logarithmically transformed. Data for the Baltic States for 2005-2014 were taken from the European Commission's Tax and benefits indicators database. Prior data come from <a href="#">van Vliet and Caminada (2012)</a> . Data were spliced keeping the original data from the European Commission and constructing earlier data using percentage point changes observed in the <a href="#">van Vliet and Caminada (2012)</a> dataset; Annual data were interpolated using Denton's method.

## B.2 90% Confidence Intervals

### B.2.1 Sub-sample 1985-1998

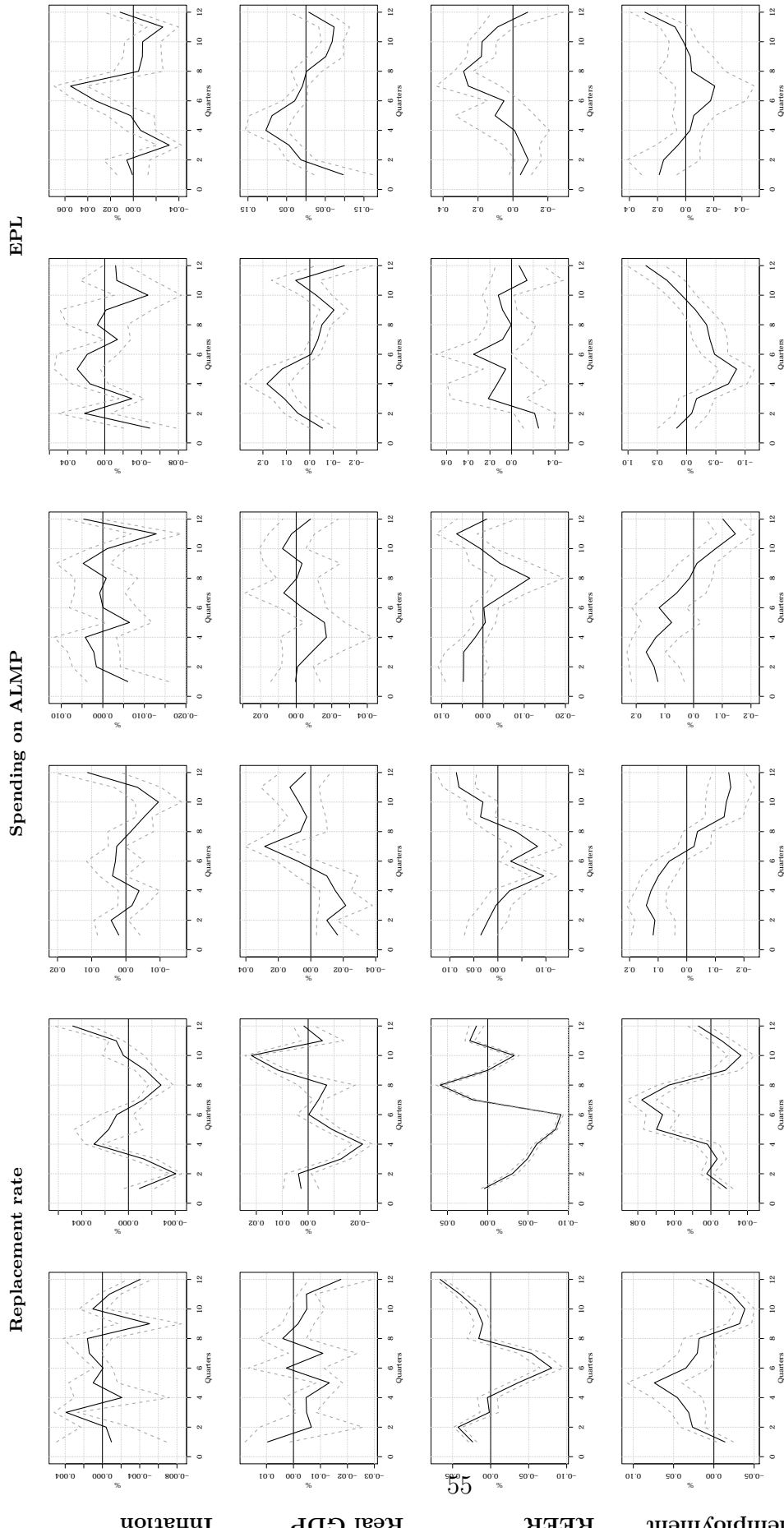


Figure B.1: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), falling interest rate (left) and rising interest rate (right), model A

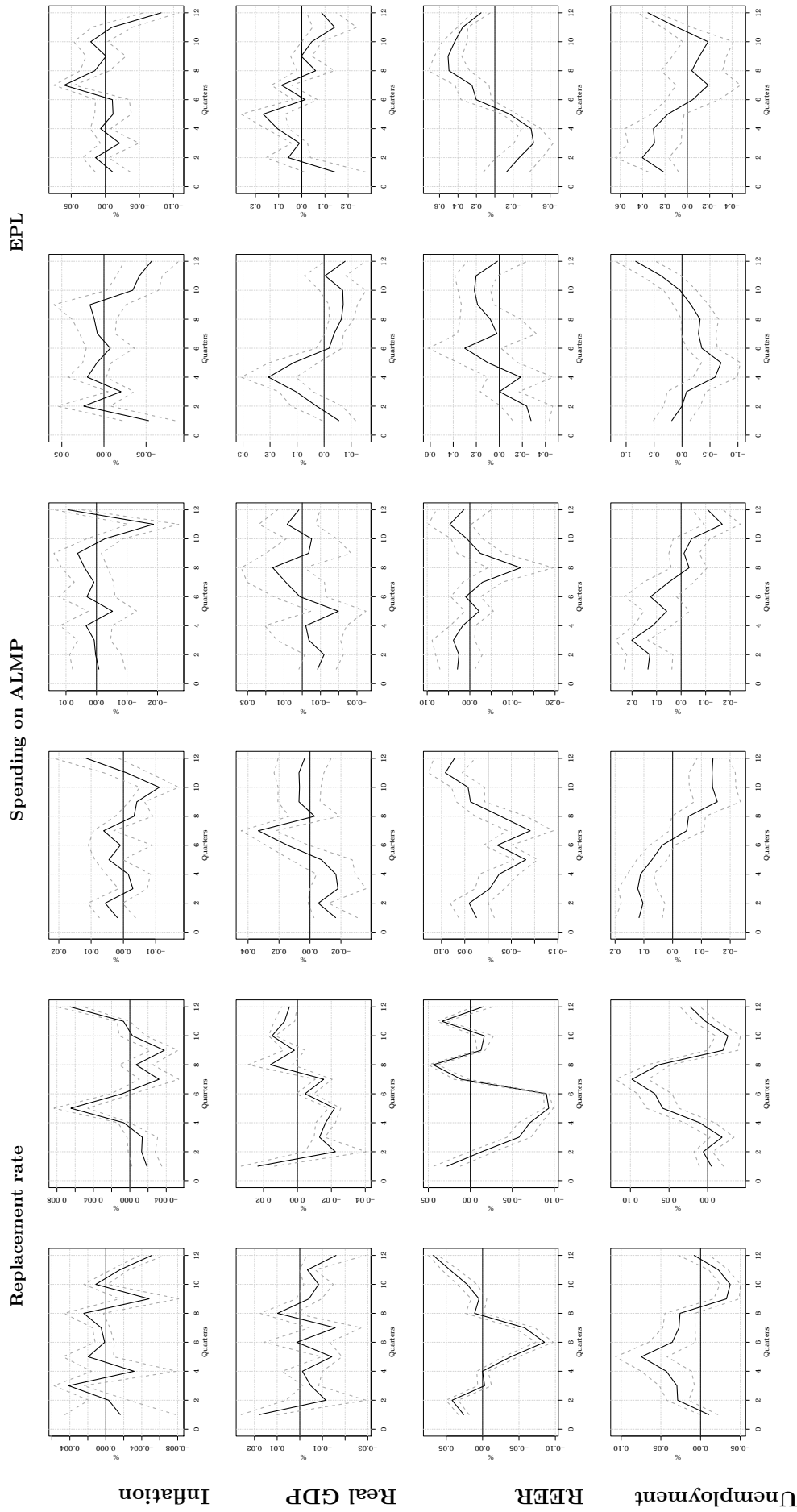


Figure B.2: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), falling interest rate (left) and rising interest rate (right), model B

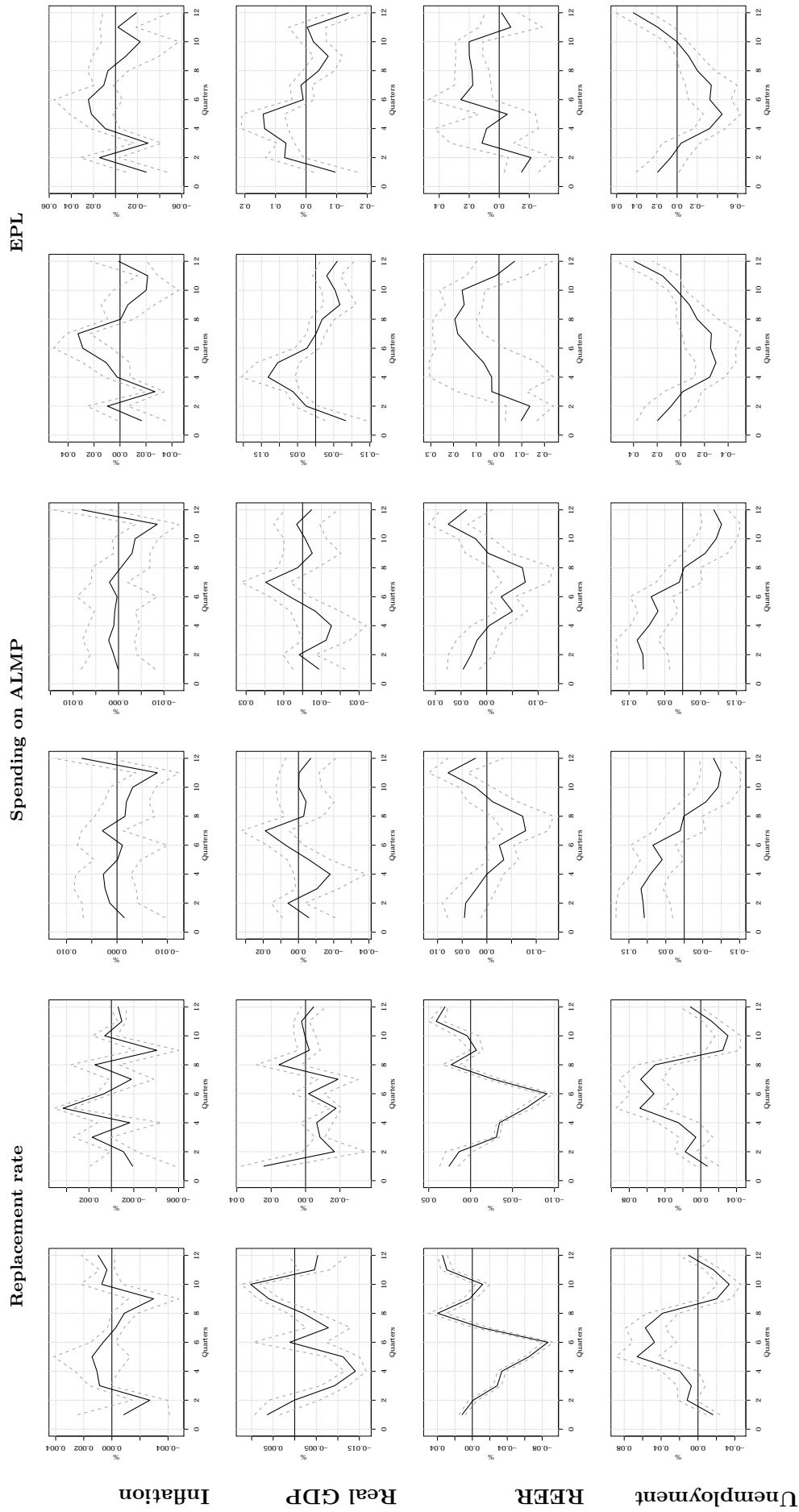


Figure B.3: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), first quarterly quartile (left) and third quarterly quartile (right), model C

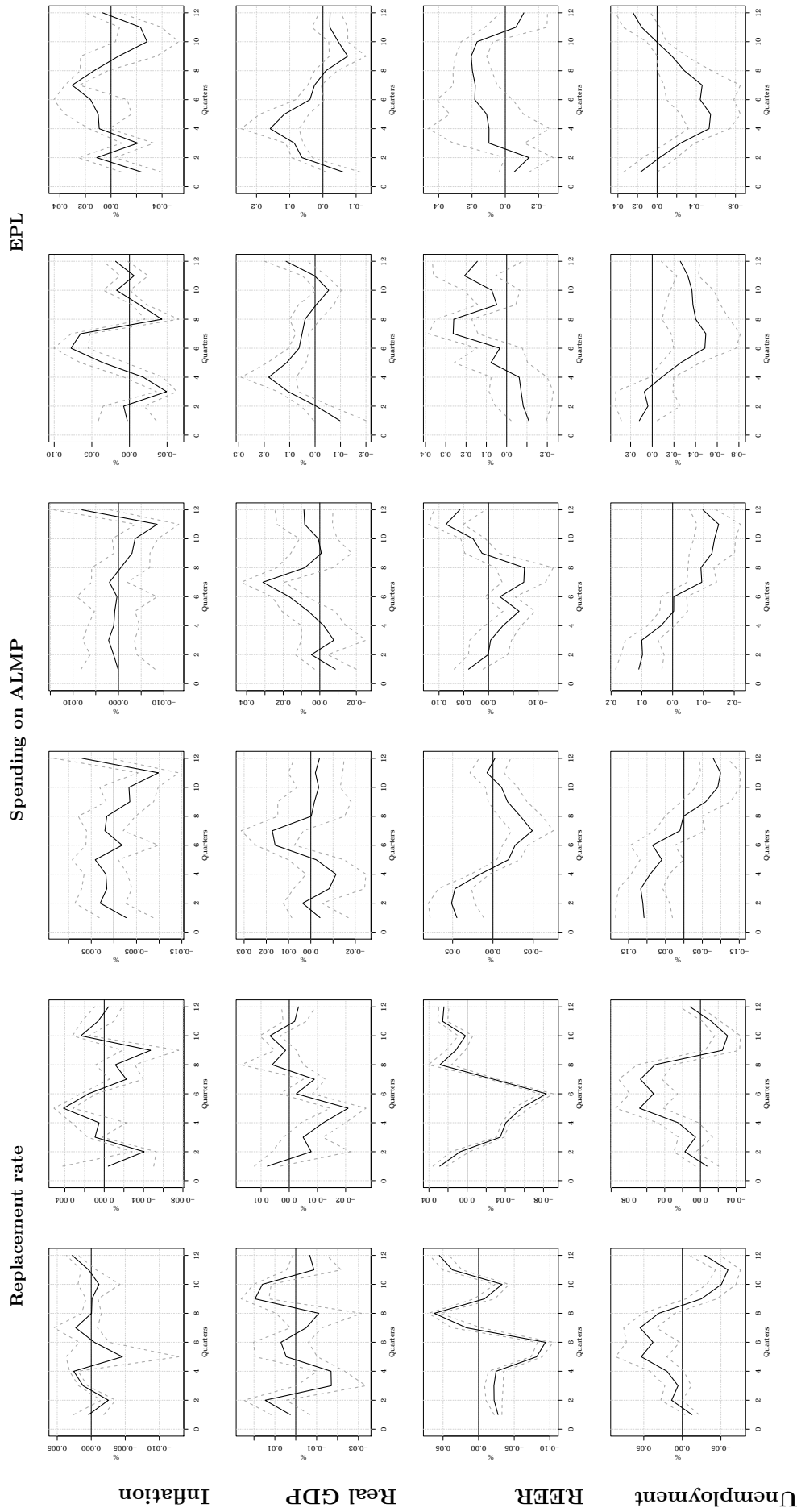


Figure B.4: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), first annual quartile (left) and third annual quartile (right), model D

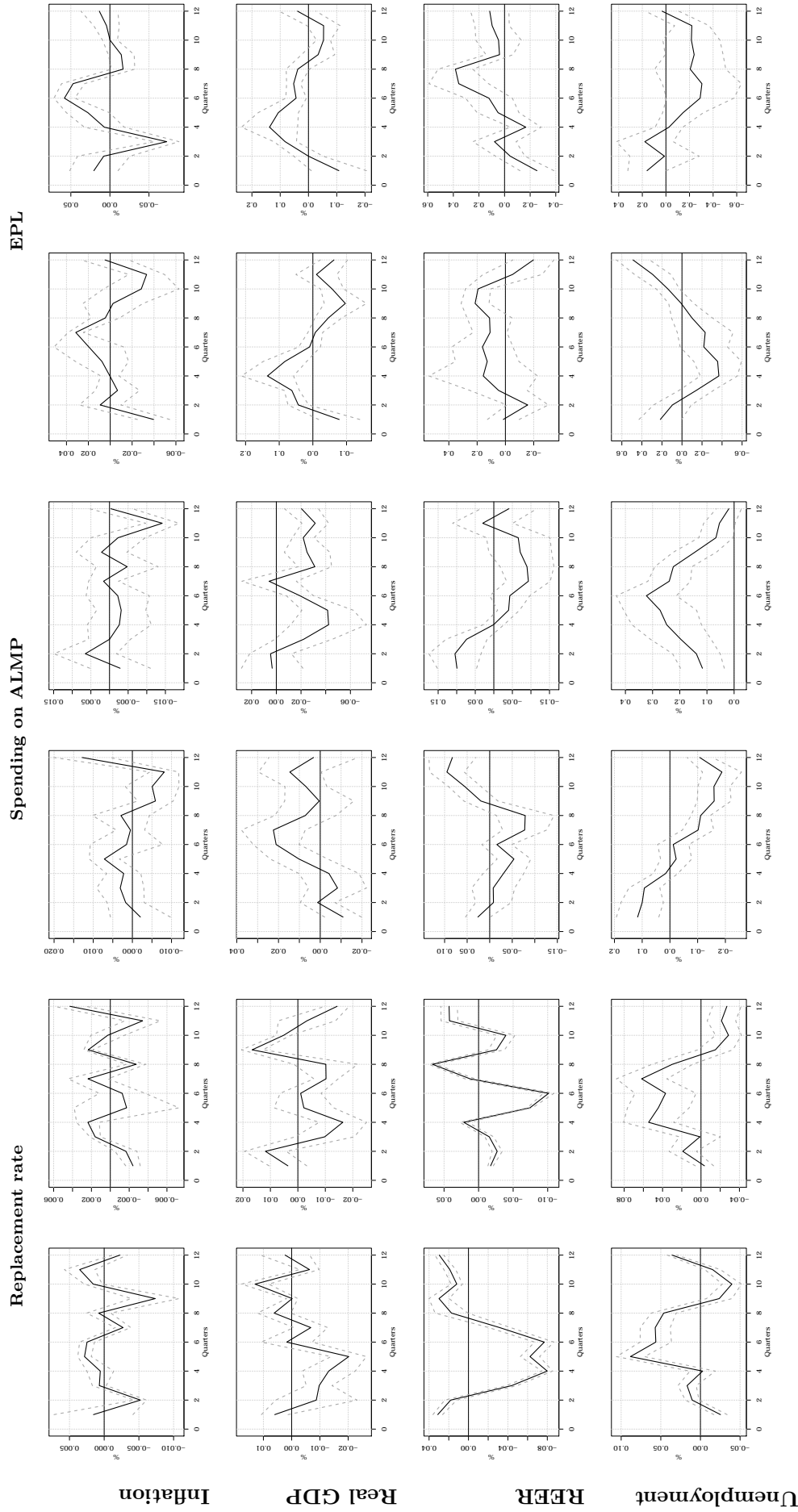


Figure B.5: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), falling interest rate (left) and rising interest rate (right), model E

## B.2.2 Sub-sample 1999-2010

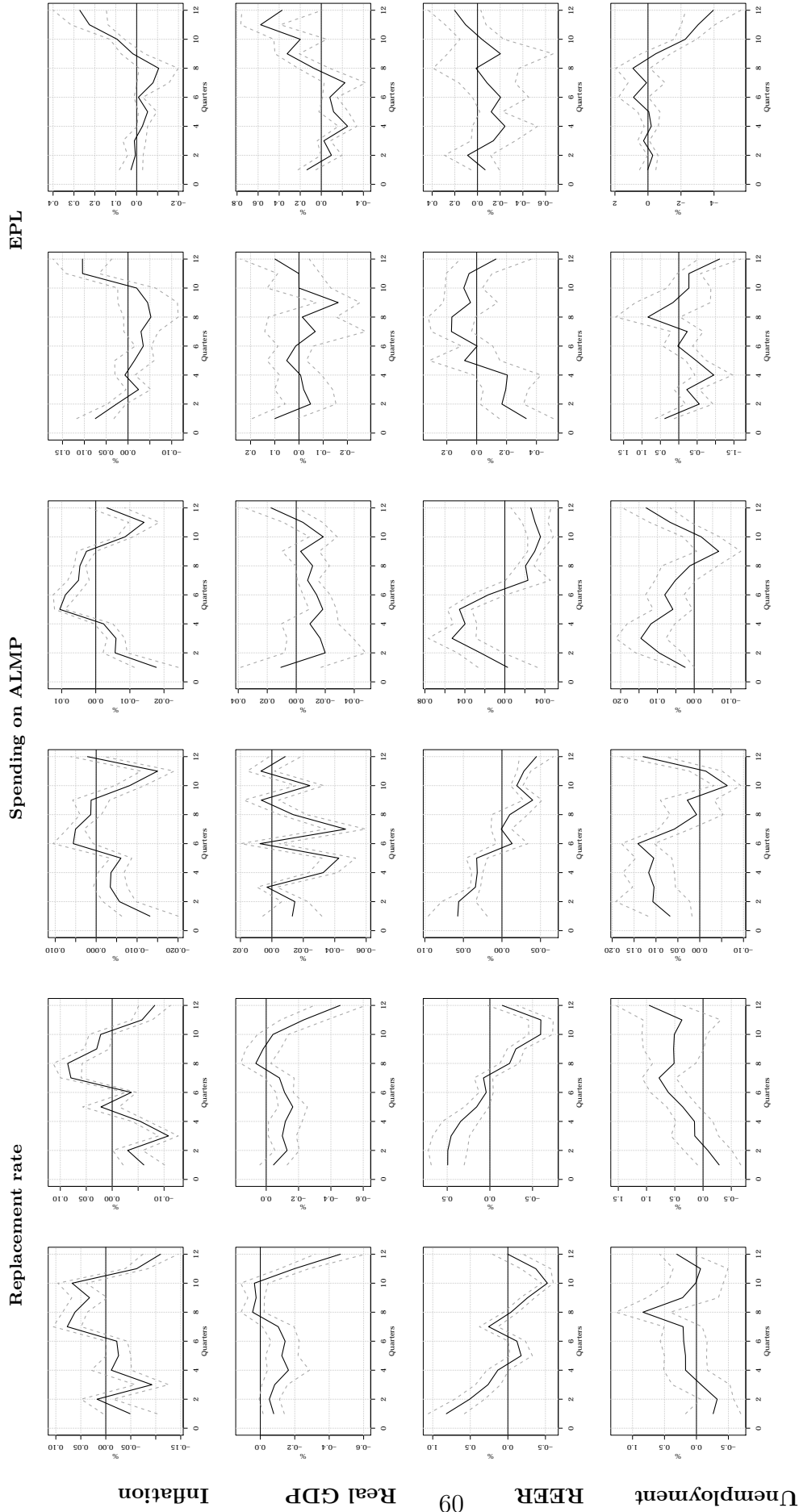


Figure B.6: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), falling interest rate (left) and rising interest rate (right), model A

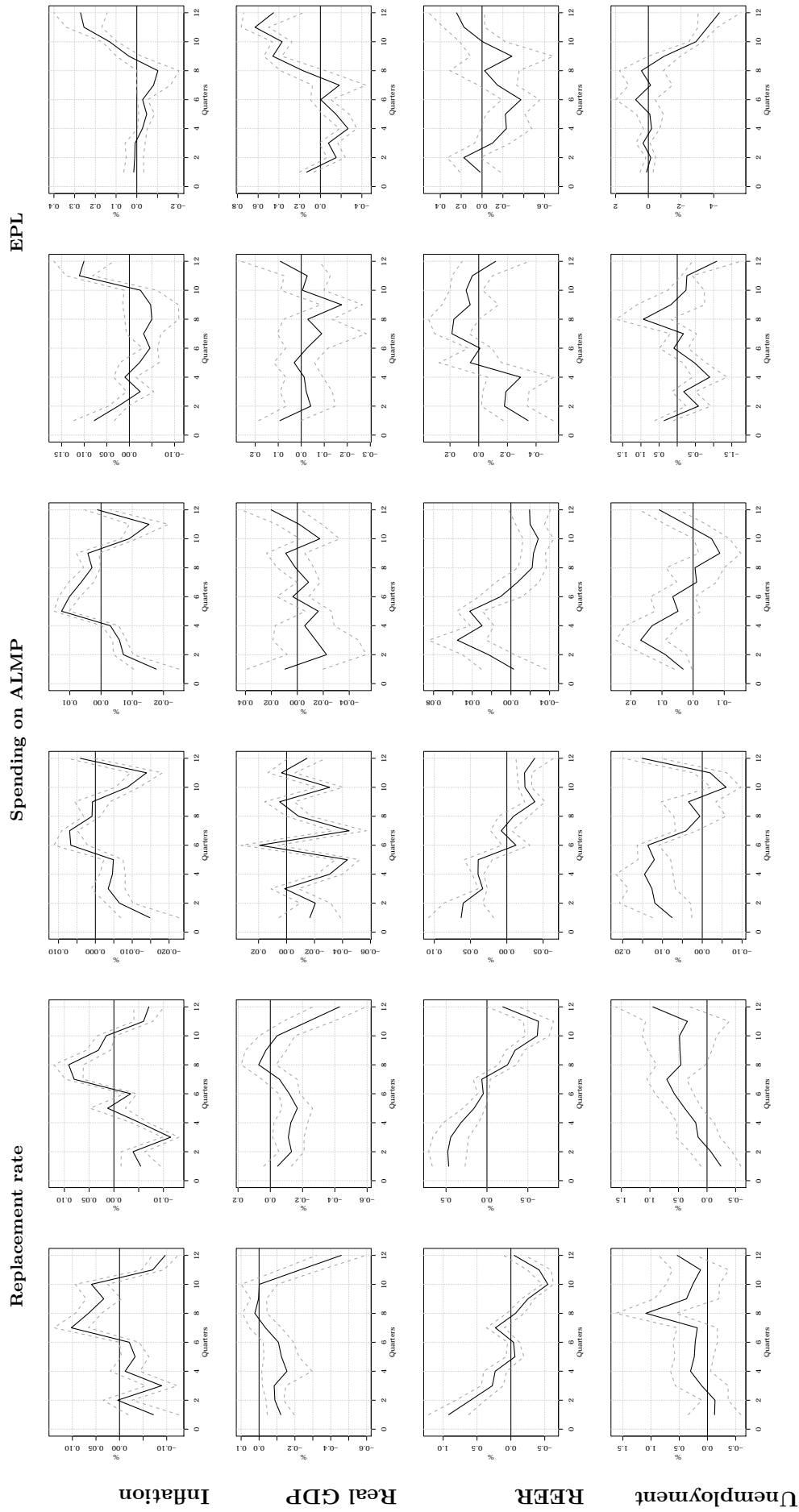


Figure B.7: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), falling interest rate (left) and rising interest rate (right), model B



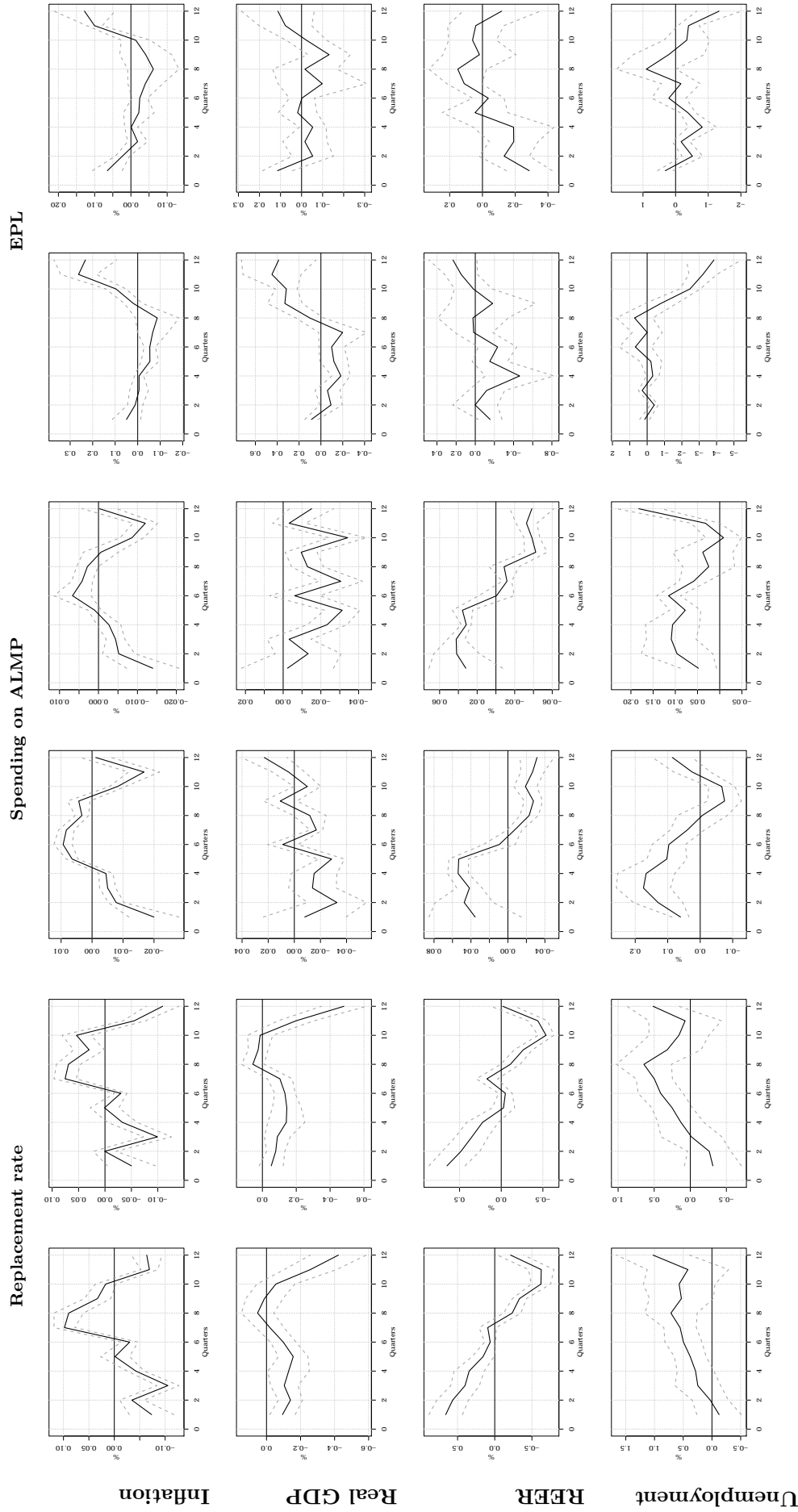


Figure B.8: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), first quarterly quartile (left) and third quarterly quartile (right), model C

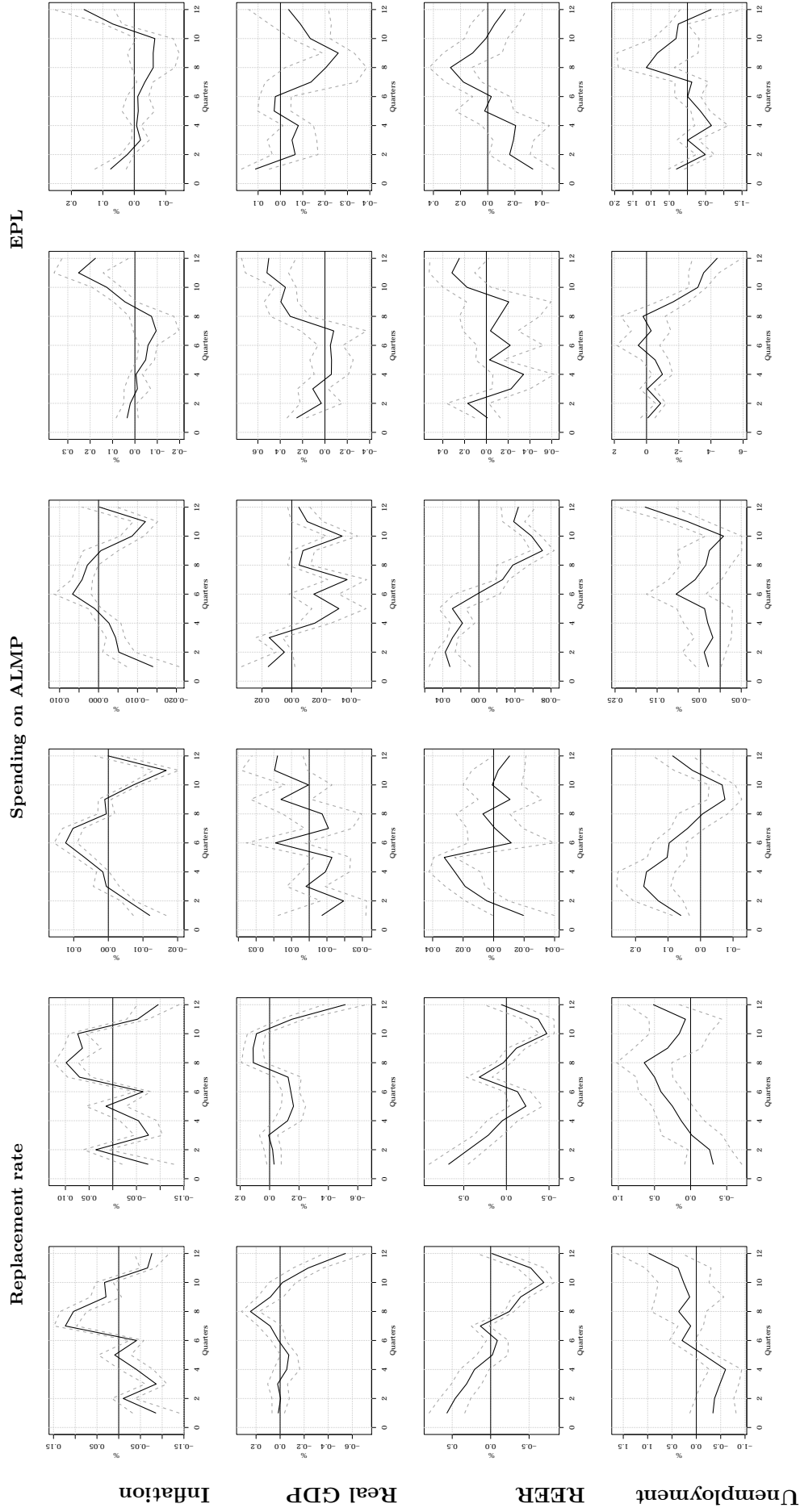


Figure B.9: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), first annual quartile (left) and third annual quartile (right), model D

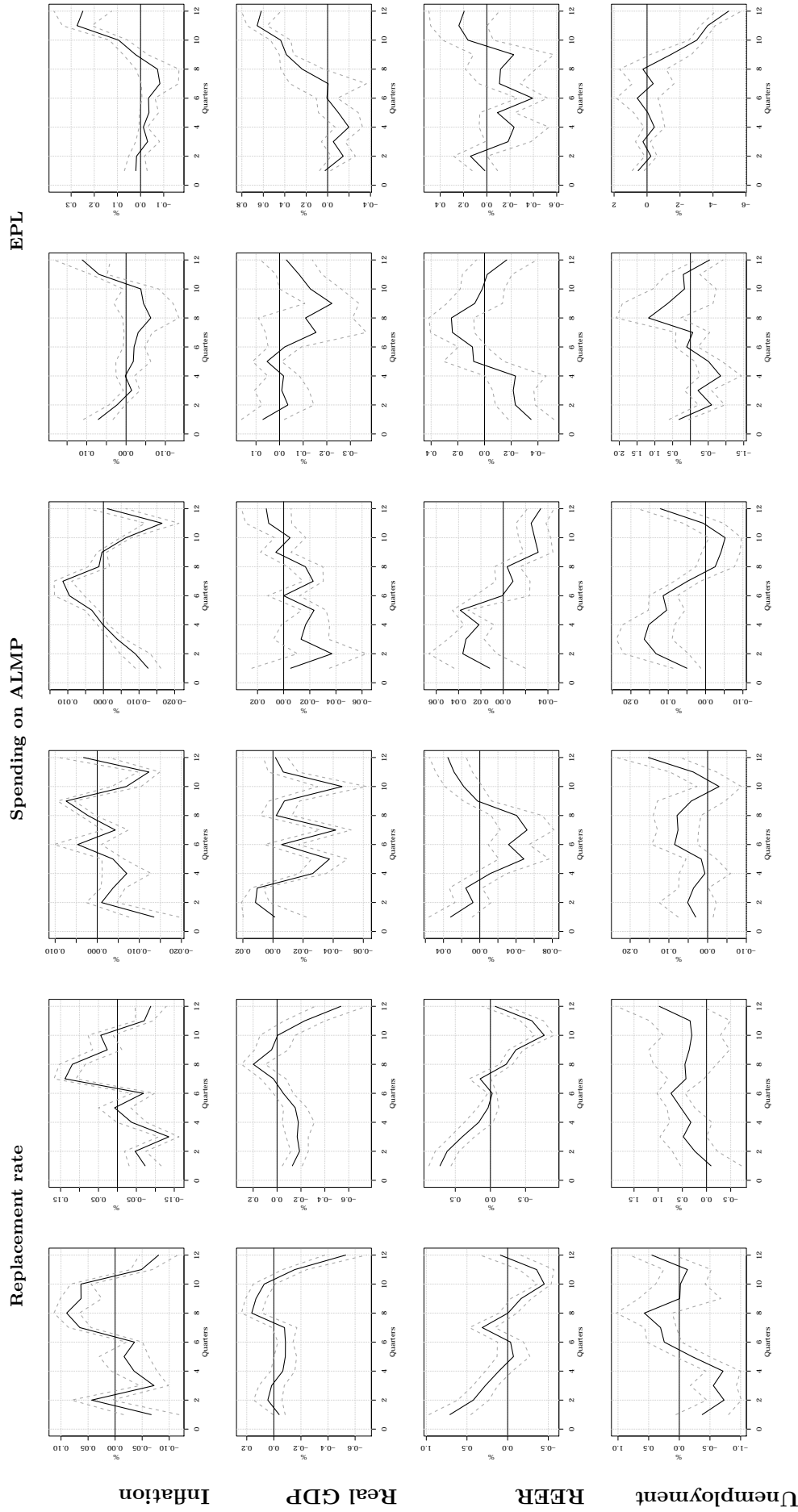


Figure B.10: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), falling interest rate (left) and rising interest rate (right), model E

## B.2.3 Full Sample

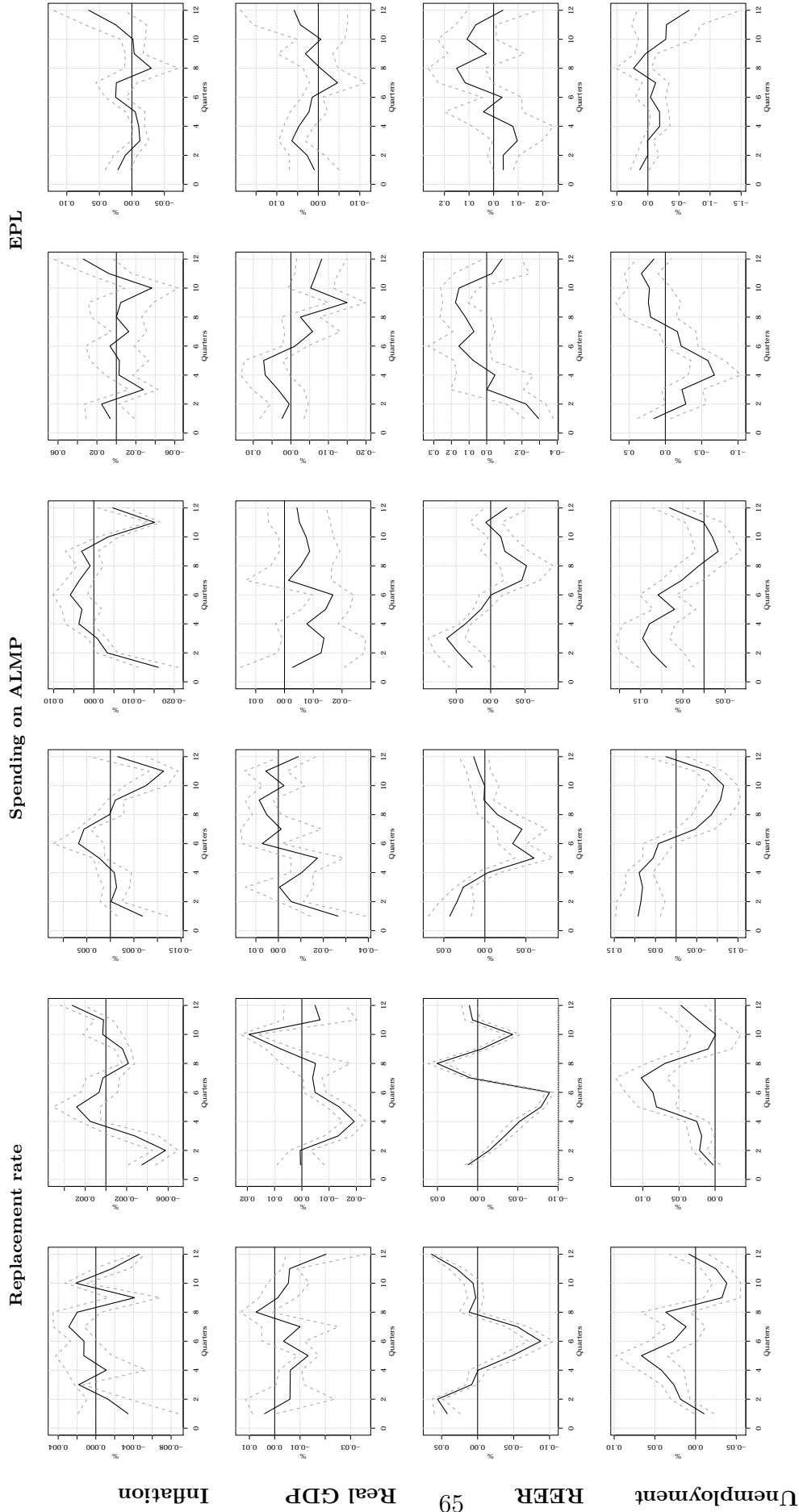


Figure B.11: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), falling interest rate (left) and rising interest rate (right), model A

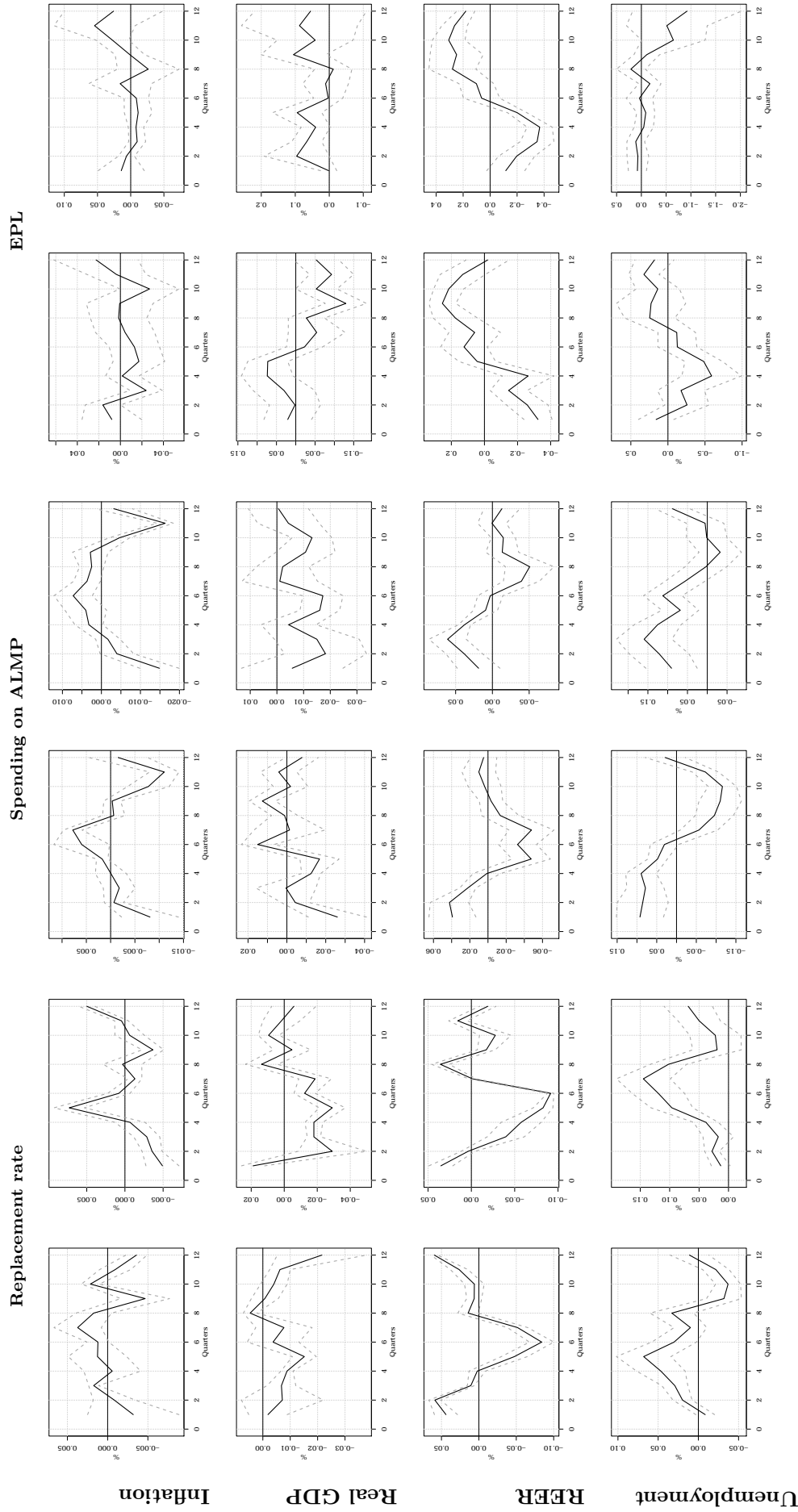


Figure B.12: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), falling interest rate (left) and rising interest rate (right), model B

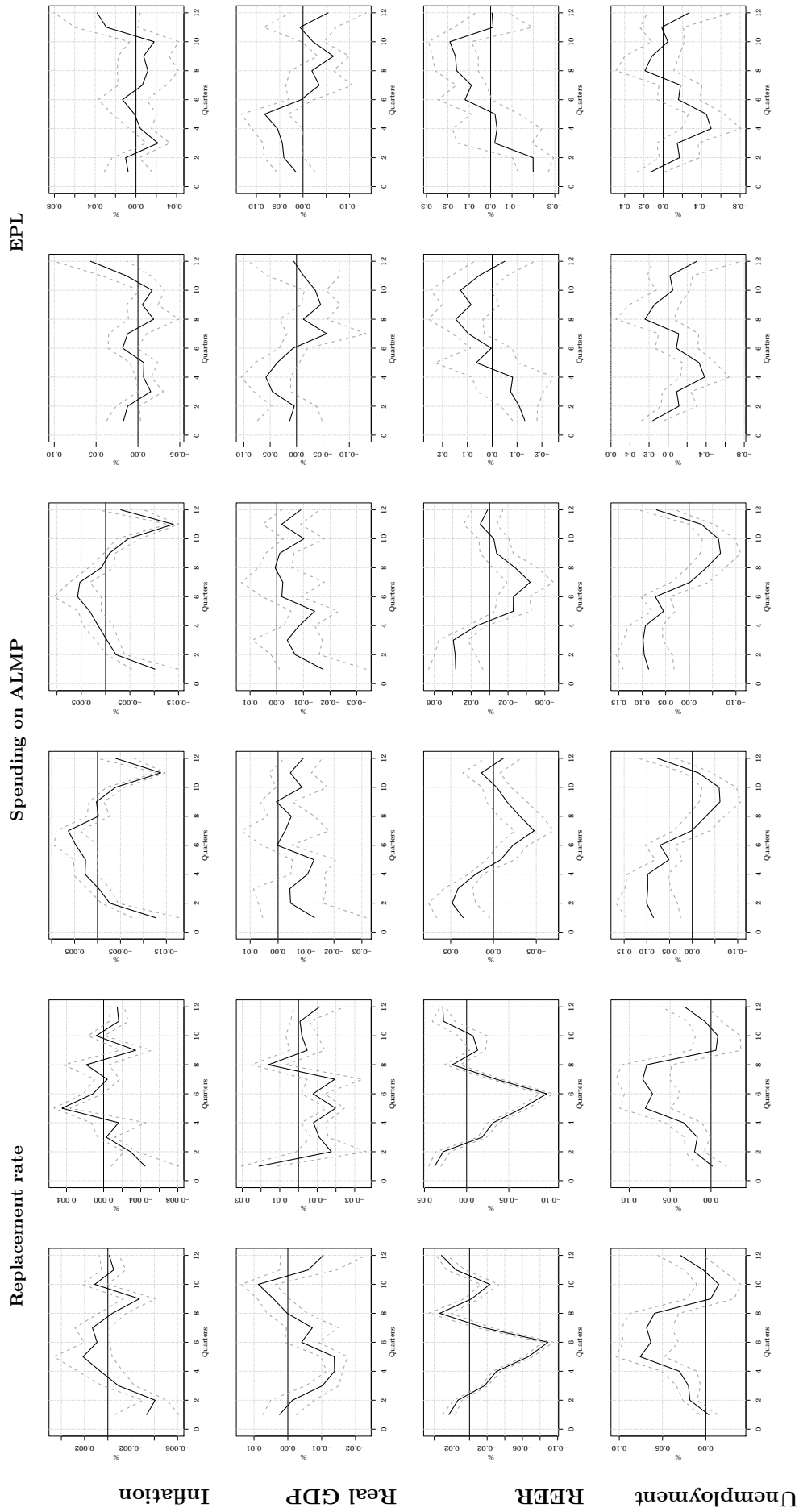


Figure B.13: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), first quarterly quartile (left) and third quarterly quartile (right), model C

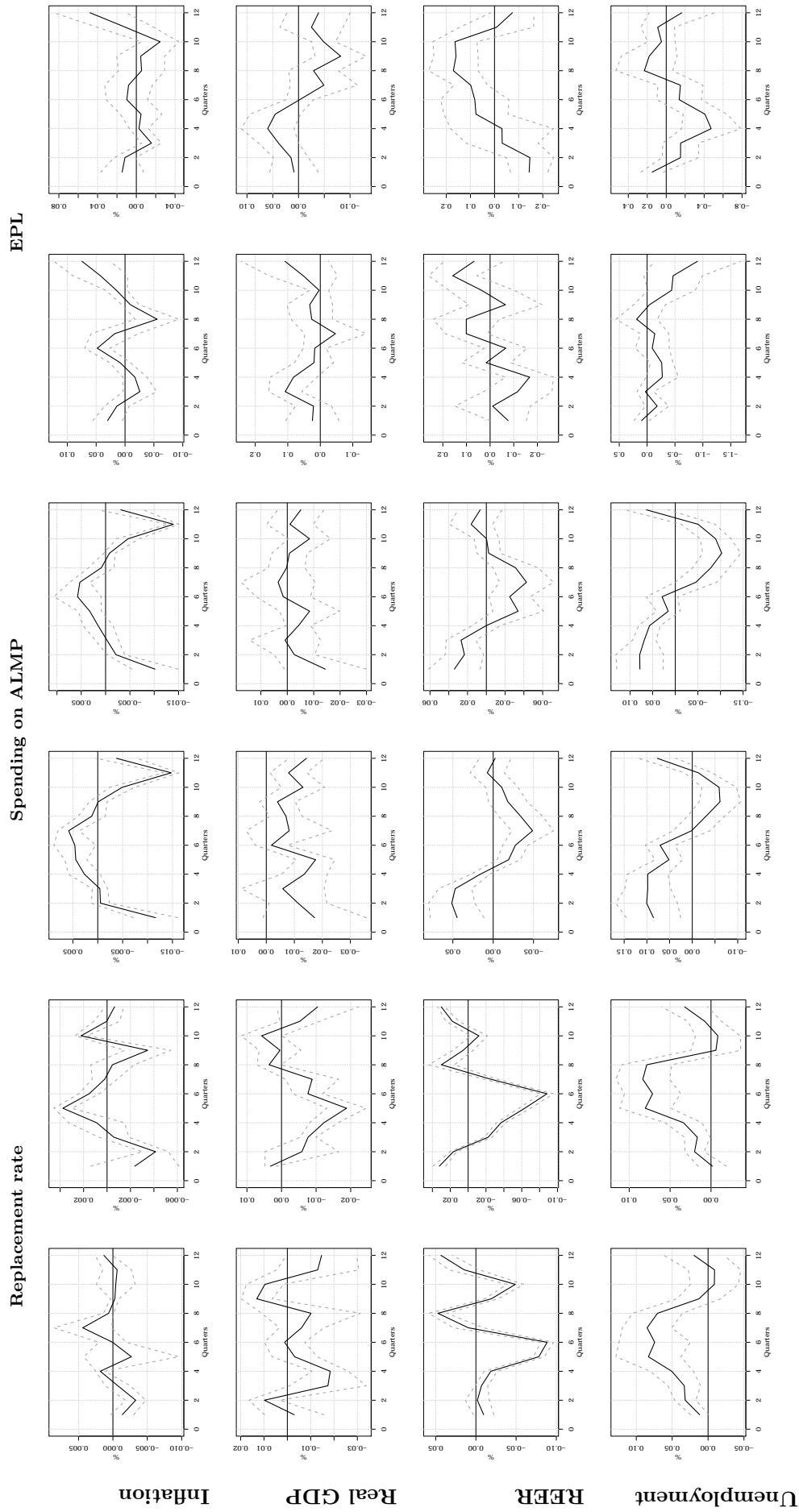


Figure B.14: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), first annual quartile (left) and third annual quartile (right), model D

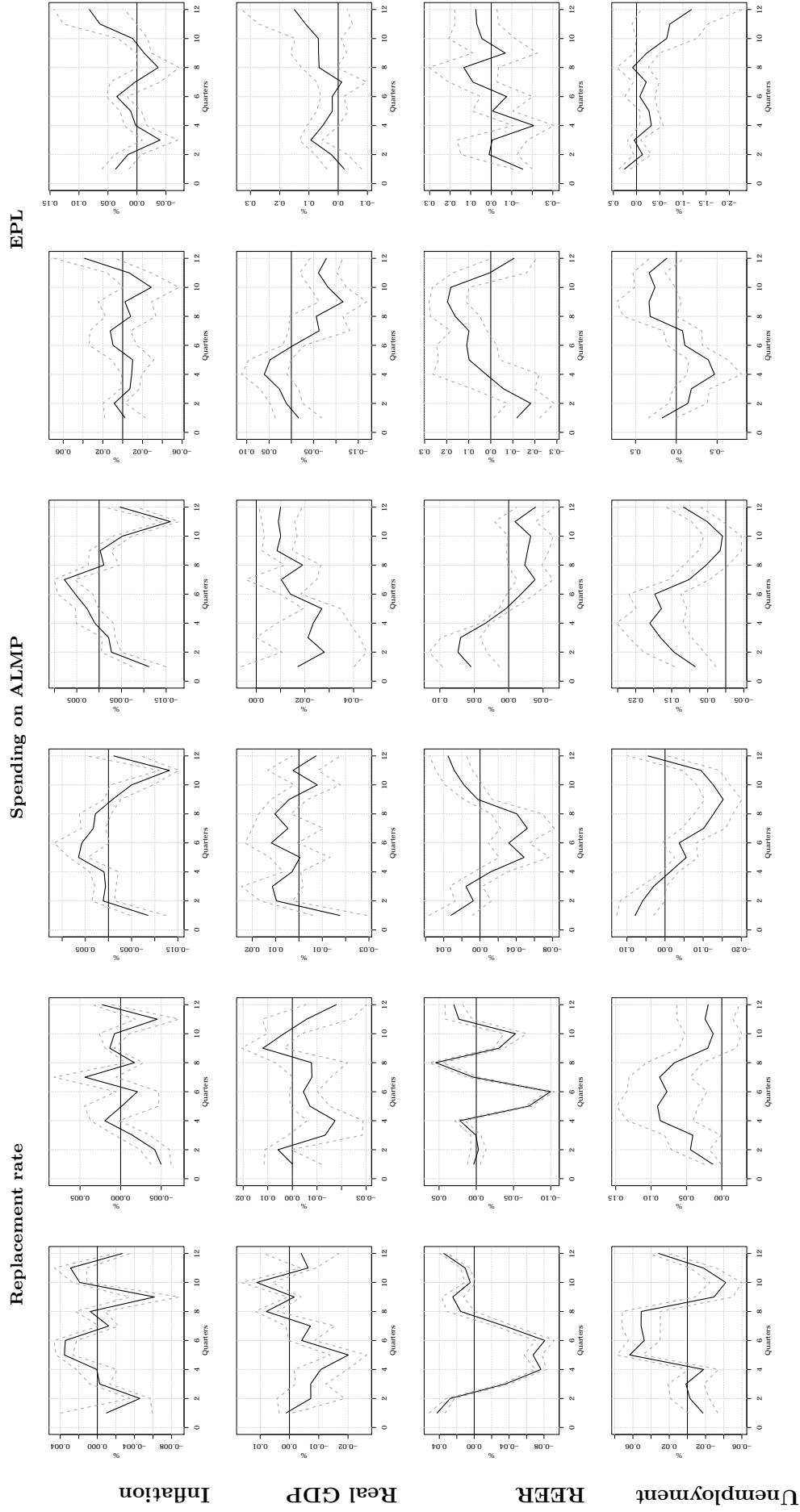


Figure B.15: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), falling interest rate (left) and rising interest rate (right), model E



## B.3 Probability Values

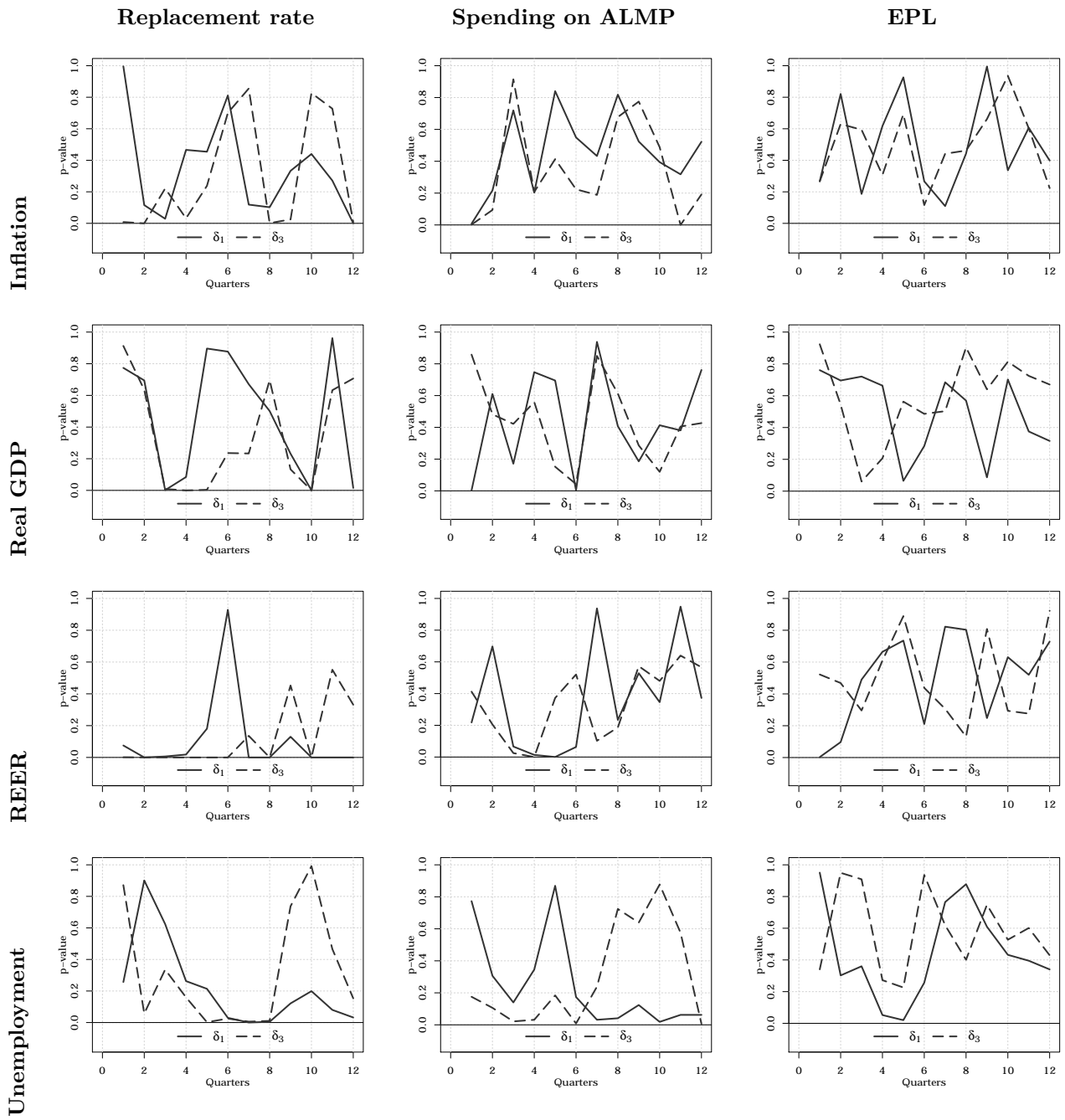


Figure B.16: P-values of the parameter equality, 1985-2010, model A

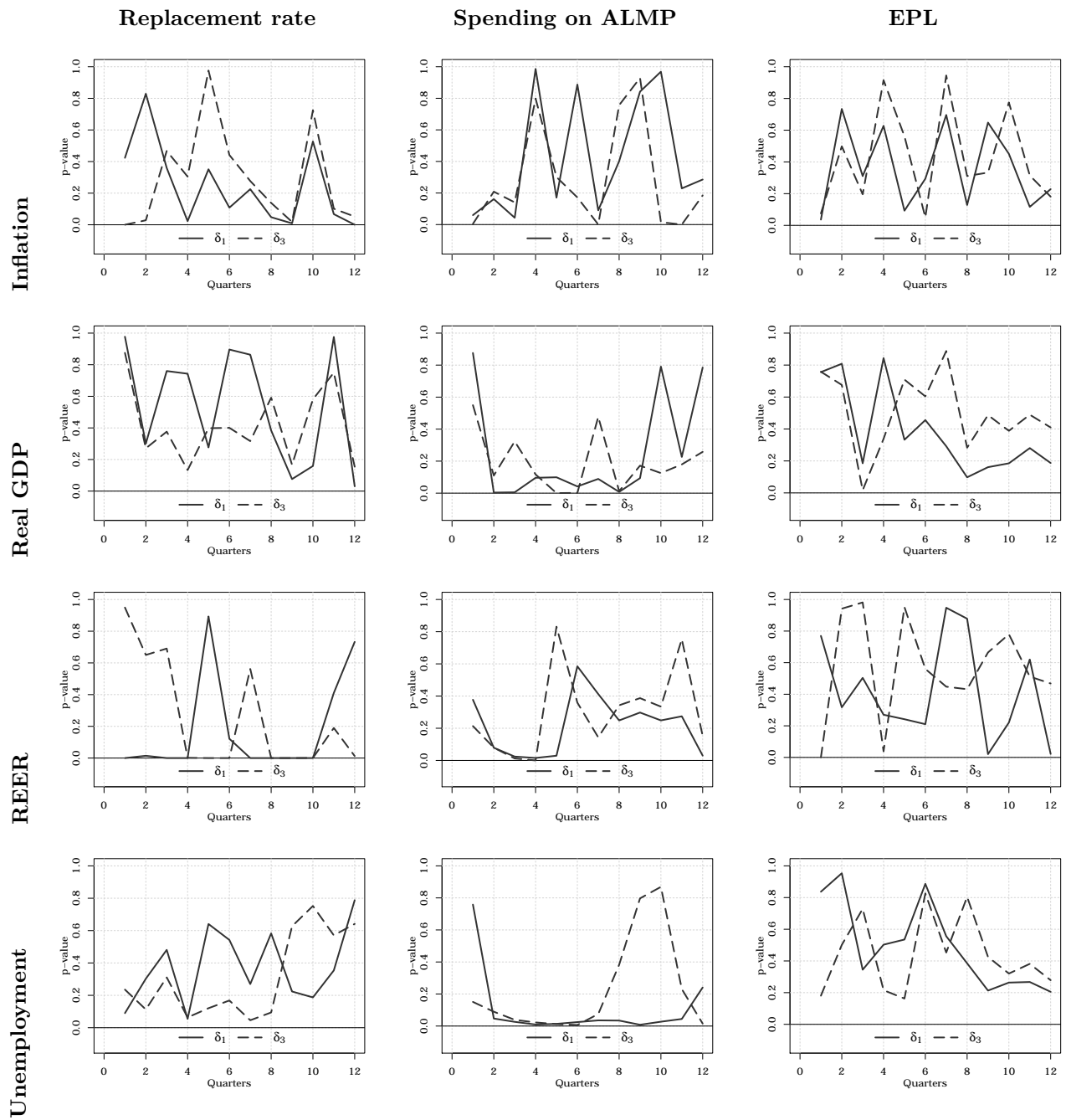


Figure B.17: P-values of the parameter equality, 1985-2010, model B

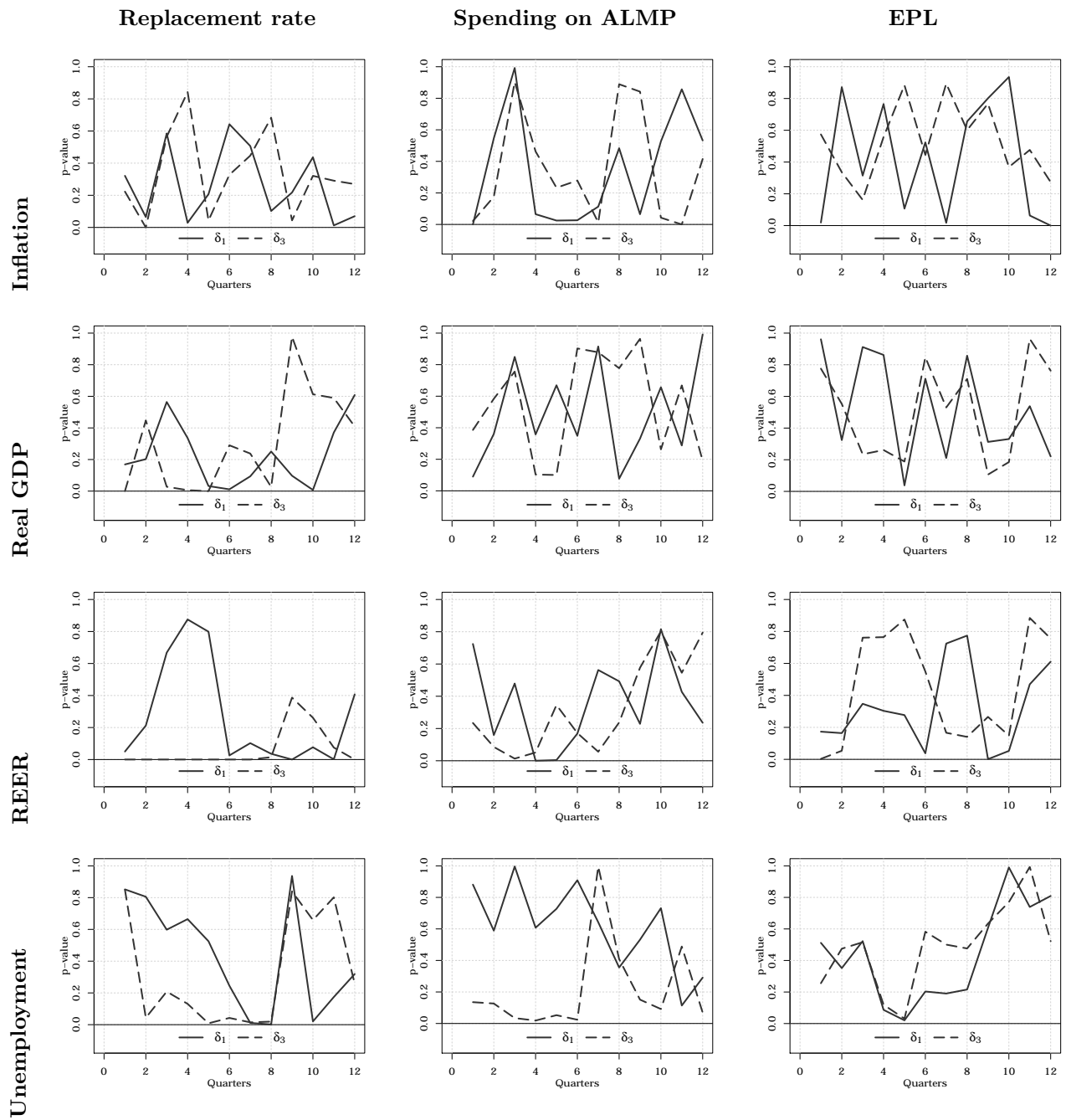


Figure B.18: P-values of the parameter equality, 1985-2010, model C

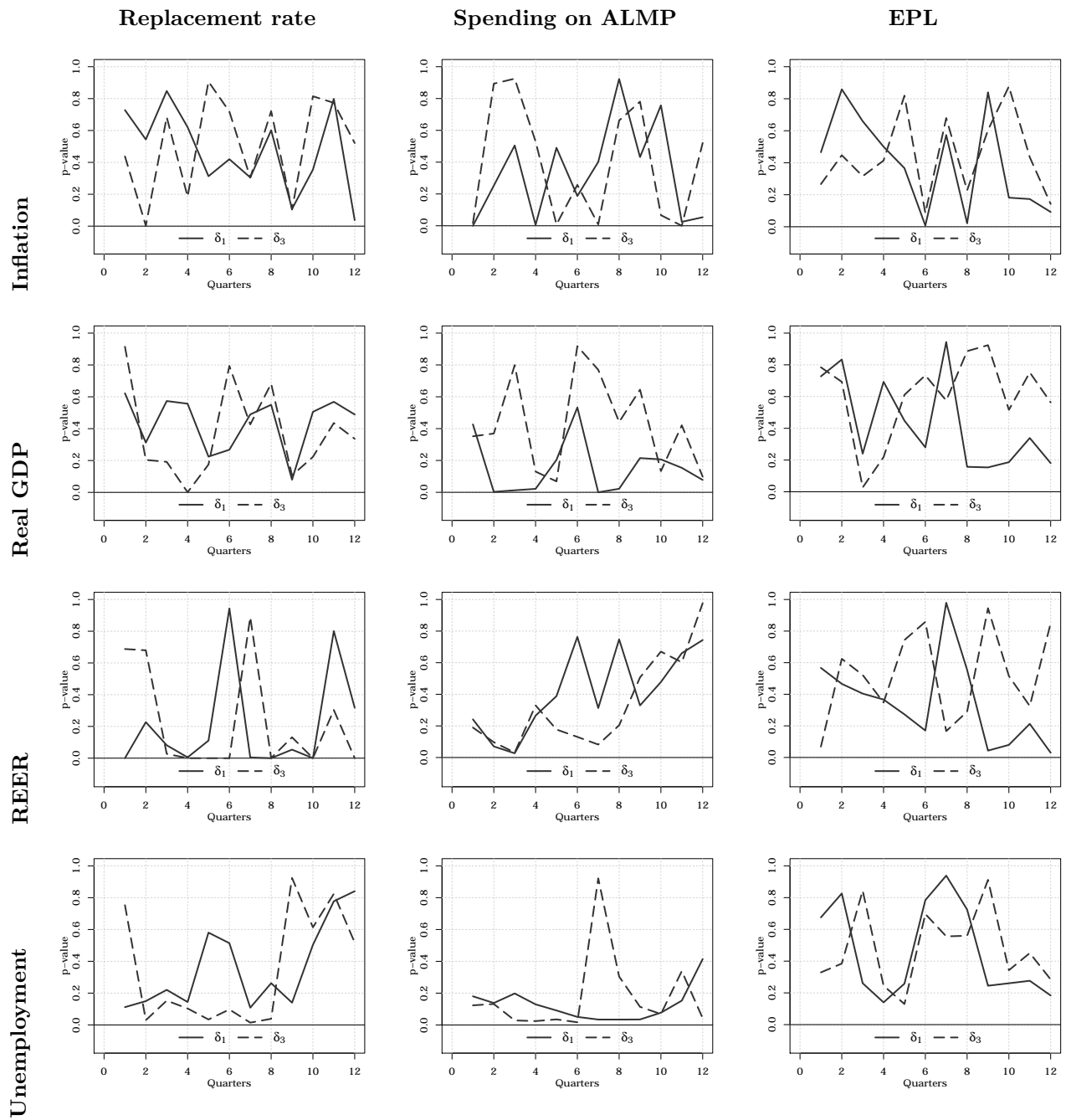


Figure B.19: P-values of the parameter equality, 1985-2010, model D

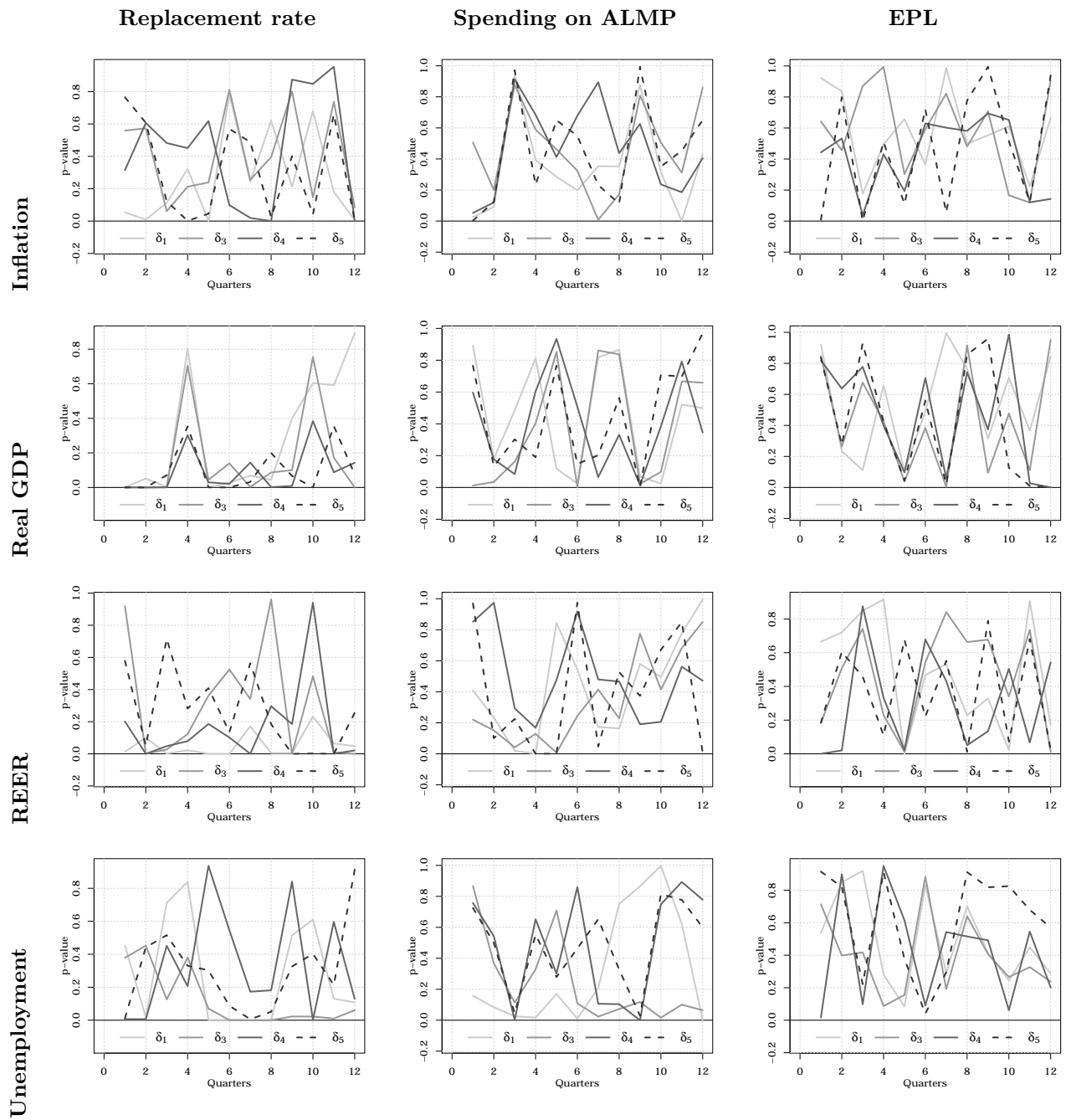


Figure B.20: P-values of the parameter equality, 1985-2010, model E

## B.4 Time Series

### B.4.1 Horizon: 1st Quarter

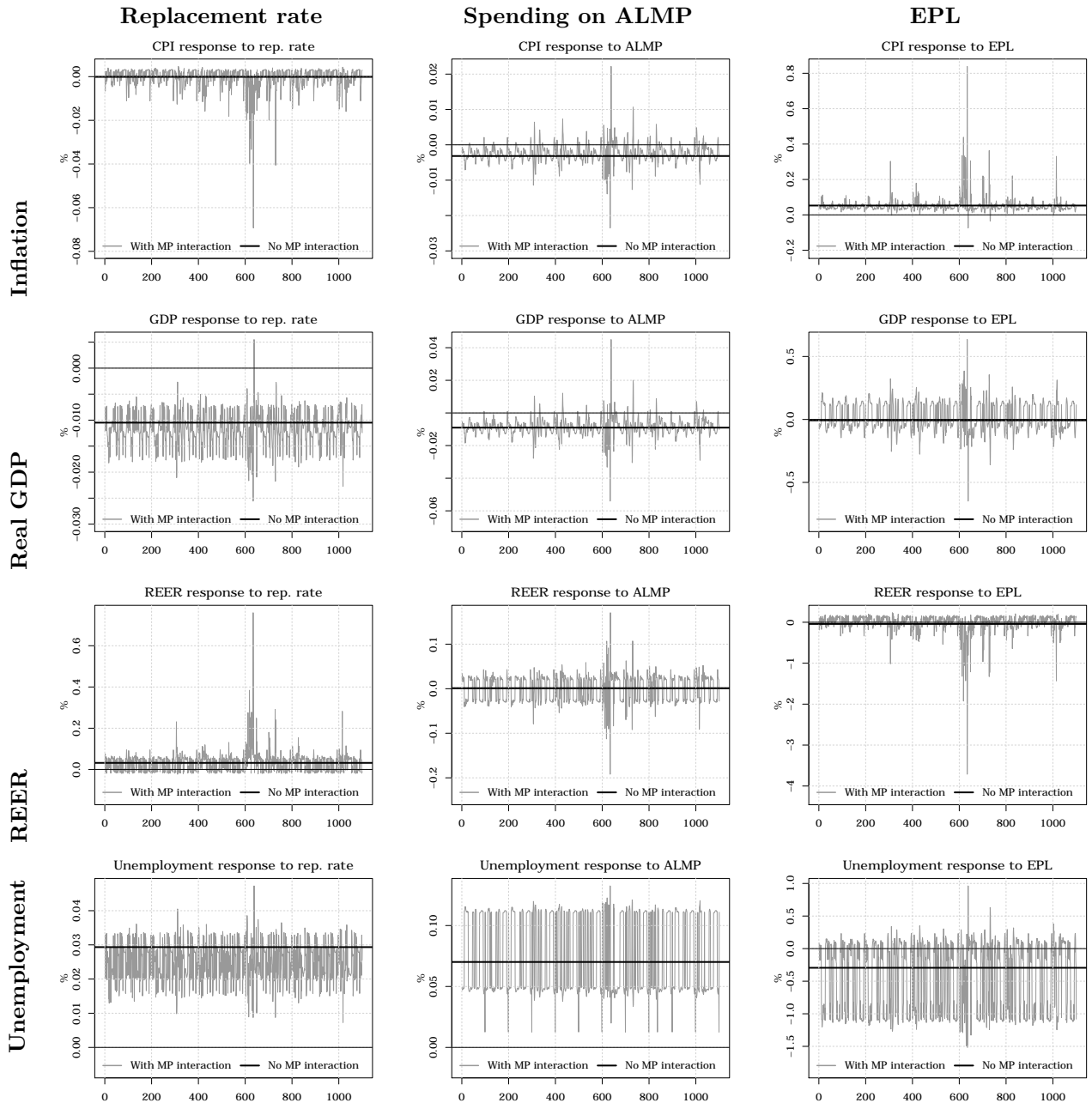


Figure B.21: Variation of average responses in macroeconomic variables to the 1% increase in labor market policies (replacement rate, ALMP and EPL), 1st quarter

## B.4.2 Horizon: 4th Quarter

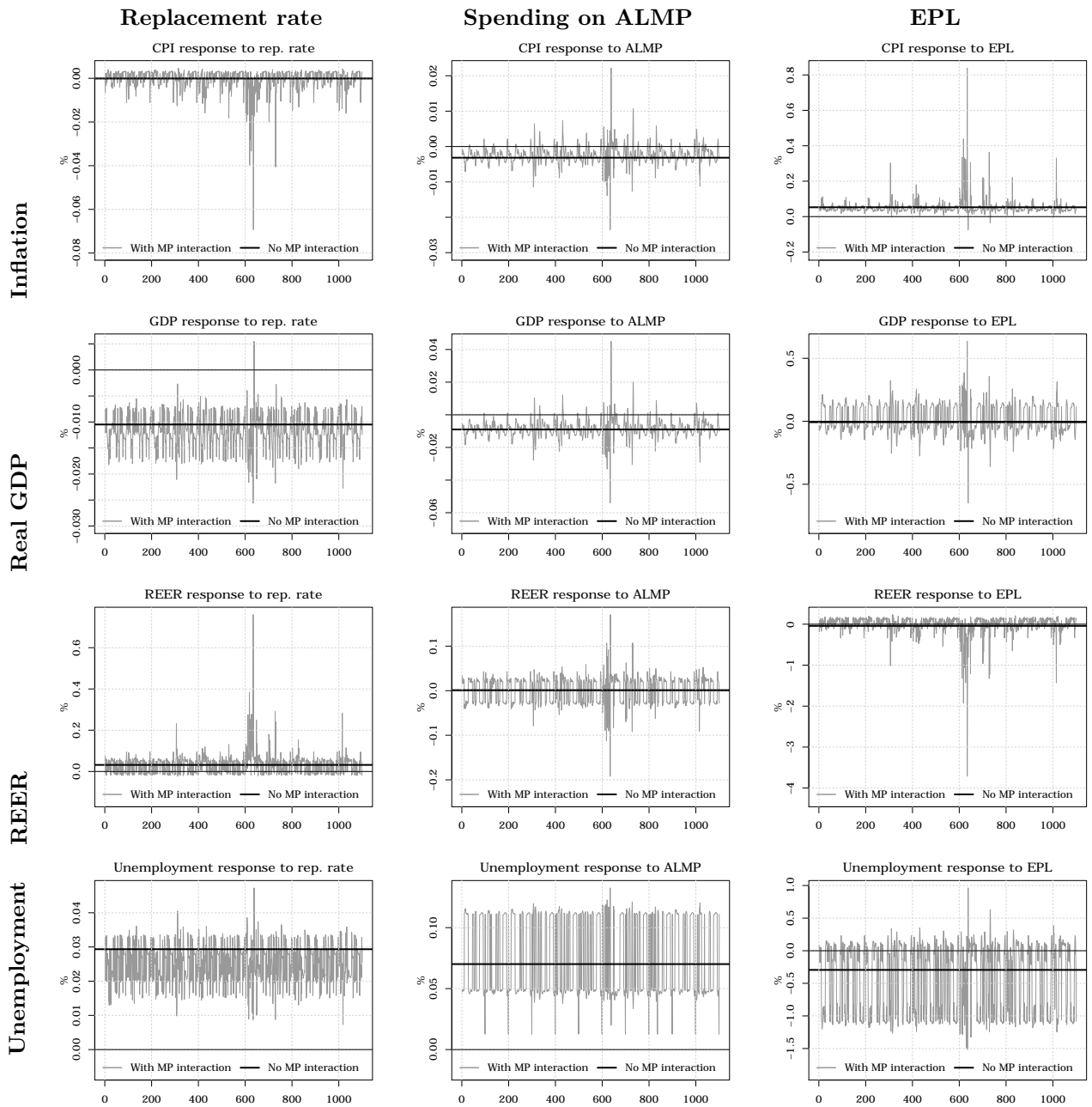


Figure B.22: Variation of average responses in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), 4th quarter

### B.4.3 Horizon: 8th Quarter

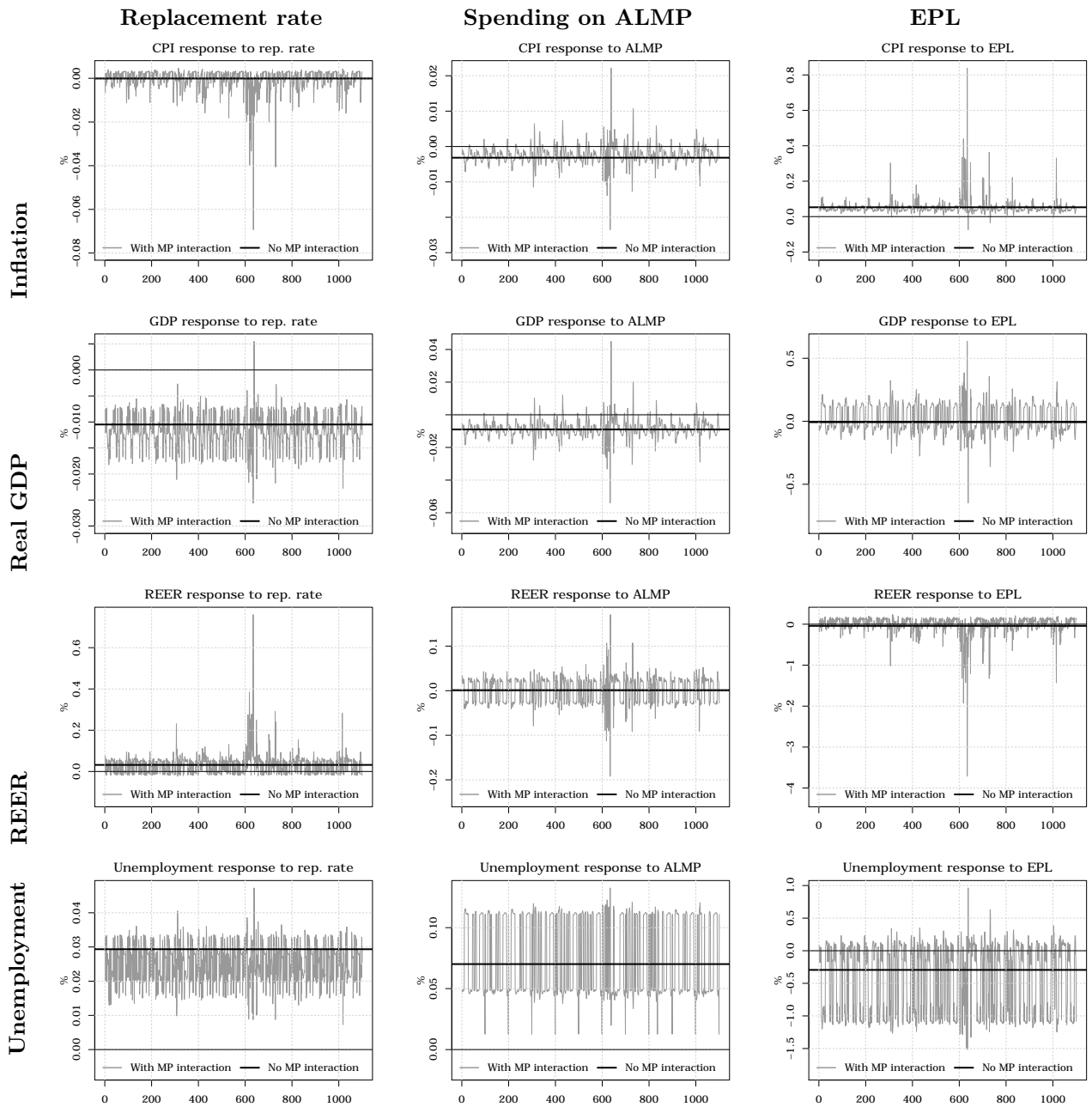


Figure B.23: Variation of average responses in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), 8th quarter



### B.4.4 Cross-sectional Dependence (Horizon: 4th Quarter)

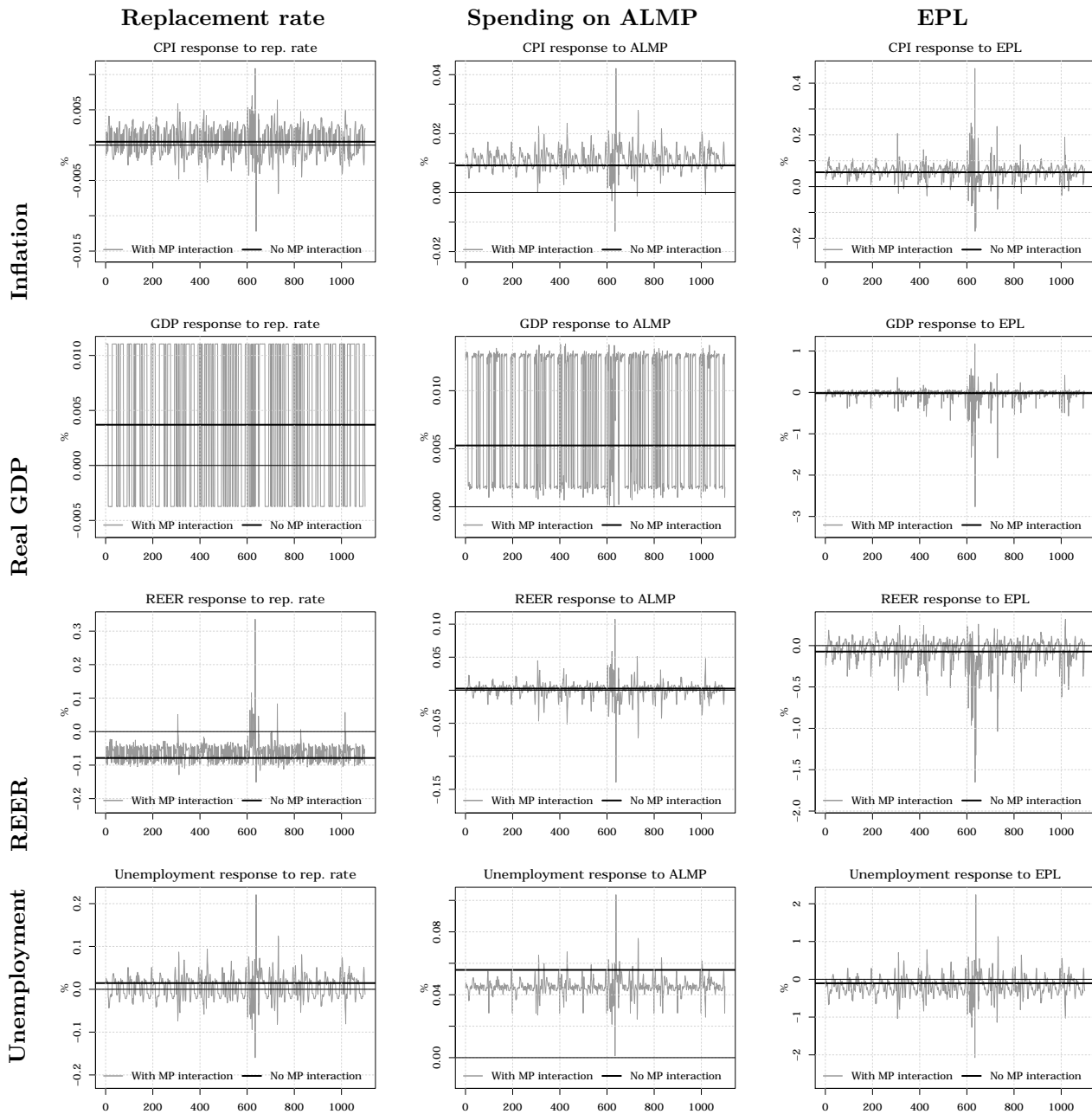


Figure B.24: Variation of average responses in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), multi-factor error structure, 4th quarter

## B.5 Densities

### B.5.1 Horizon: 1st Quarter

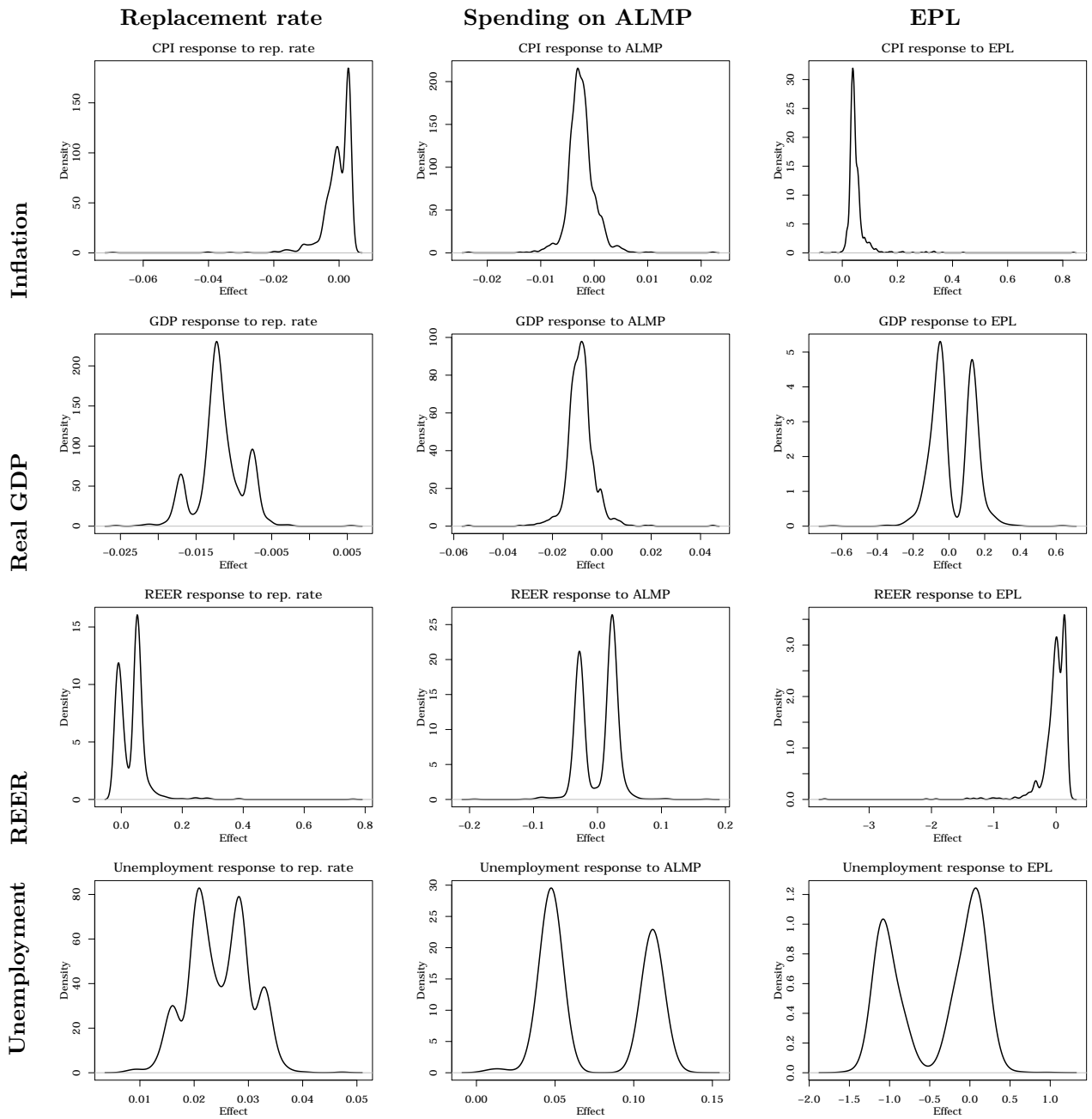


Figure B.25: Densities of average effects of macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), 1st quarter

## B.5.2 Horizon: 4th Quarter

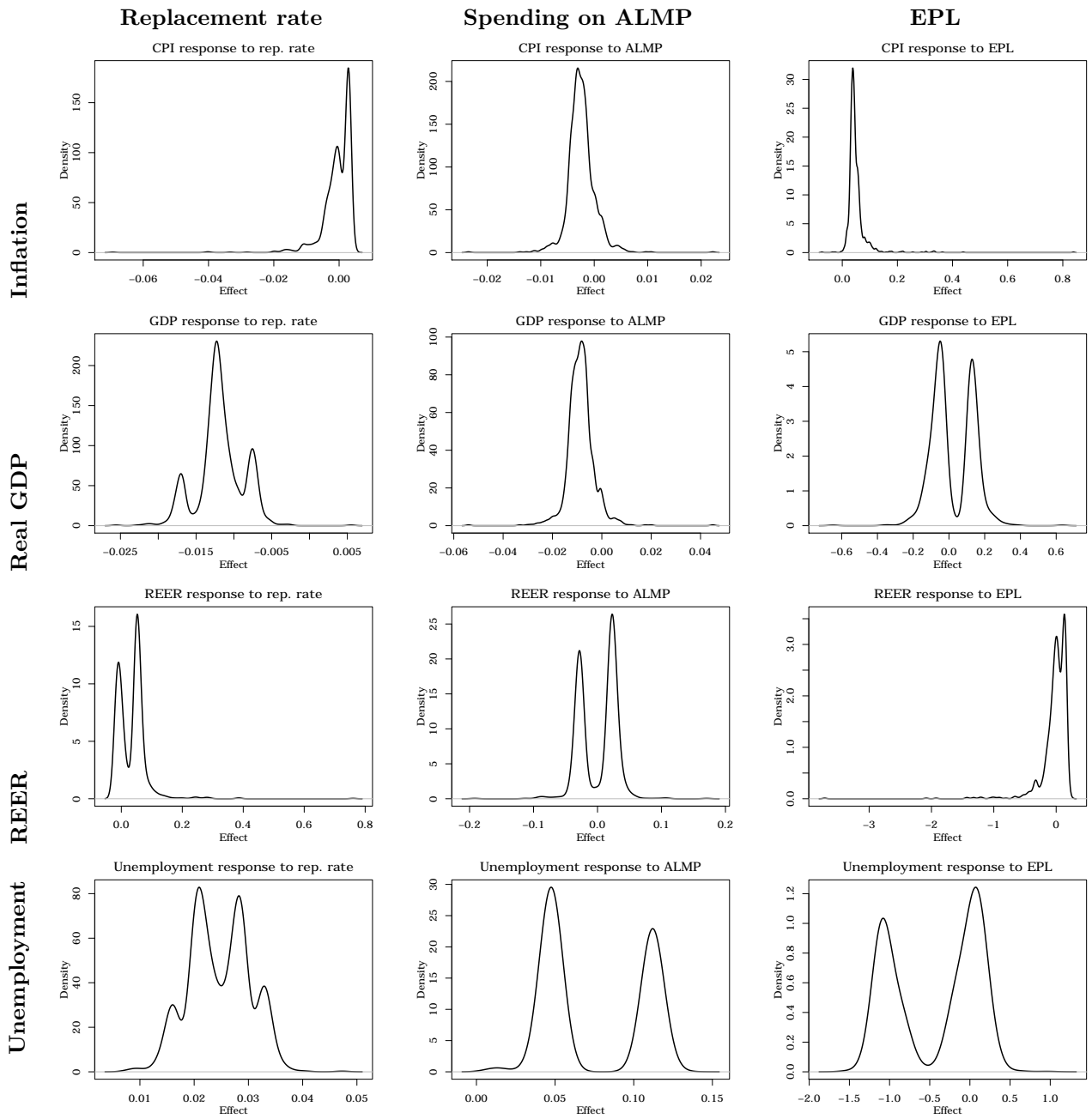


Figure B.26: Densities of average effects of macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), 4th quarter

### B.5.3 Horizon: 8th Quarter

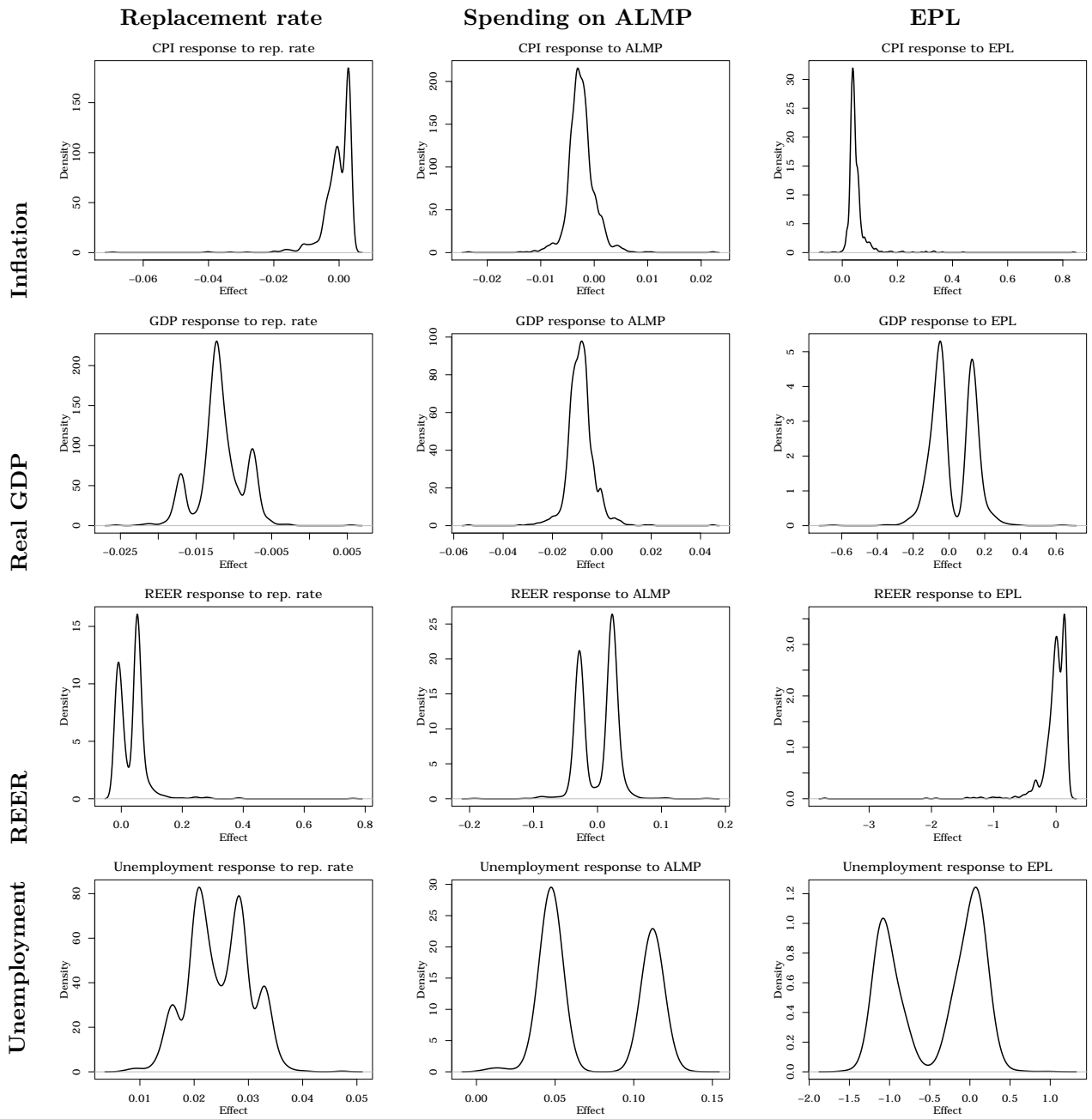


Figure B.27: Densities of average effects of macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), 8th quarter

### B.5.4 Cross-sectional Dependence (Horizon: 4th Quarter)

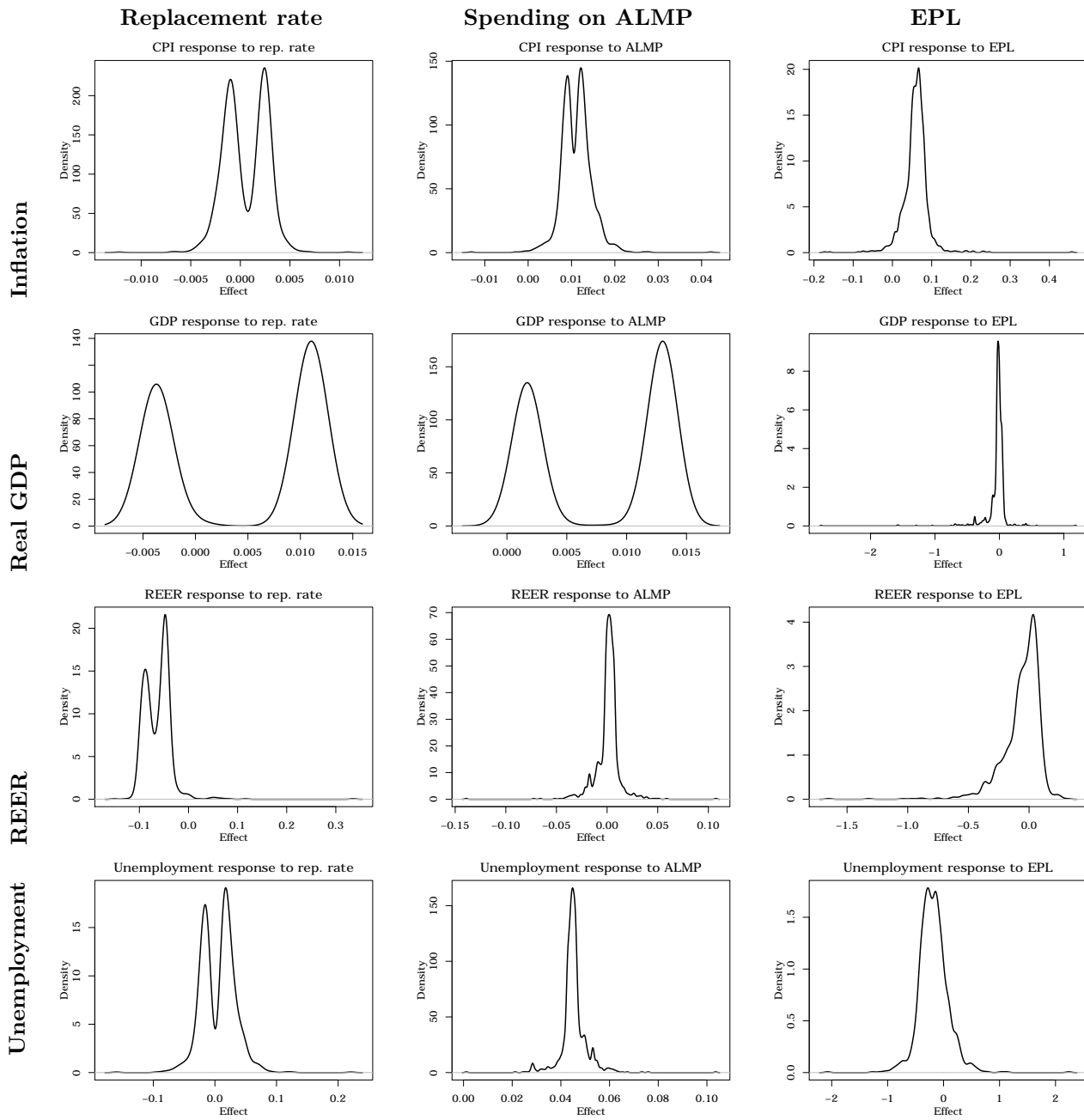


Figure B.28: Densities of average effects of macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), multi-factor error structure, 4th quarter

# C Robustness: Anticipation and Aggregate Demand Fluctuations

## C.1 Tests

Table C.1: Proportion of accepted t-tests

		1	2	3	4	5	6	7	8	9	10	11	12
Real GDP	ALMP	0.97	0.58	1	0.83	1	0.99	1	0.97	1	0.99	0.96	0.95
	Rep. rate	0.04	0.3	0.26	0.68	0.37	0.87	0.7	0.31	0.41	0.6	0.88	1
	EPL	0.99	0.99	0.59	0.98	1	0.9	1	0.82	0.5	0.48	0.91	0.72
Inflation	ALMP	0.98	0.85	1	0.9	0.99	1	0.98	0.99	0.76	1	0.79	0.97
	Rep. rate	1	0.97	1	0.81	0.79	0.01	0.69	0.82	0	0.84	0.71	0.3
	EPL	0.93	1	0.98	0.93	0.96	0.77	0.96	0.72	1	0.53	0.96	0.97
Unemployment	ALMP	1	1	0.95	0.01	0.01	0.2	0.99	0.85	0.57	0.31	0.27	1
	Rep. rate	0.8	0.72	0.65	0.25	0.76	0.8	0.1	0.66	0.8	0.99	1	1
	EPL	1	1	0.97	0.99	1	1	1	1	1	0.44	0.57	0.72
REER	ALMP	0.99	0.9	0.86	0.65	0.87	1	1	1	0.96	1	1	0.8
	Rep. rate	0.19	0.01	0.35	0	0.39	0.78	0.35	0.64	0.28	0.38	0.75	0.02
	EPL	0.99	0.92	0.38	0.46	0.75	0.85	1	0.96	0.83	0.92	0.54	0.72

## C.2 90% Confidence Intervals

### C.2.1 Sub-sample 1985-1998

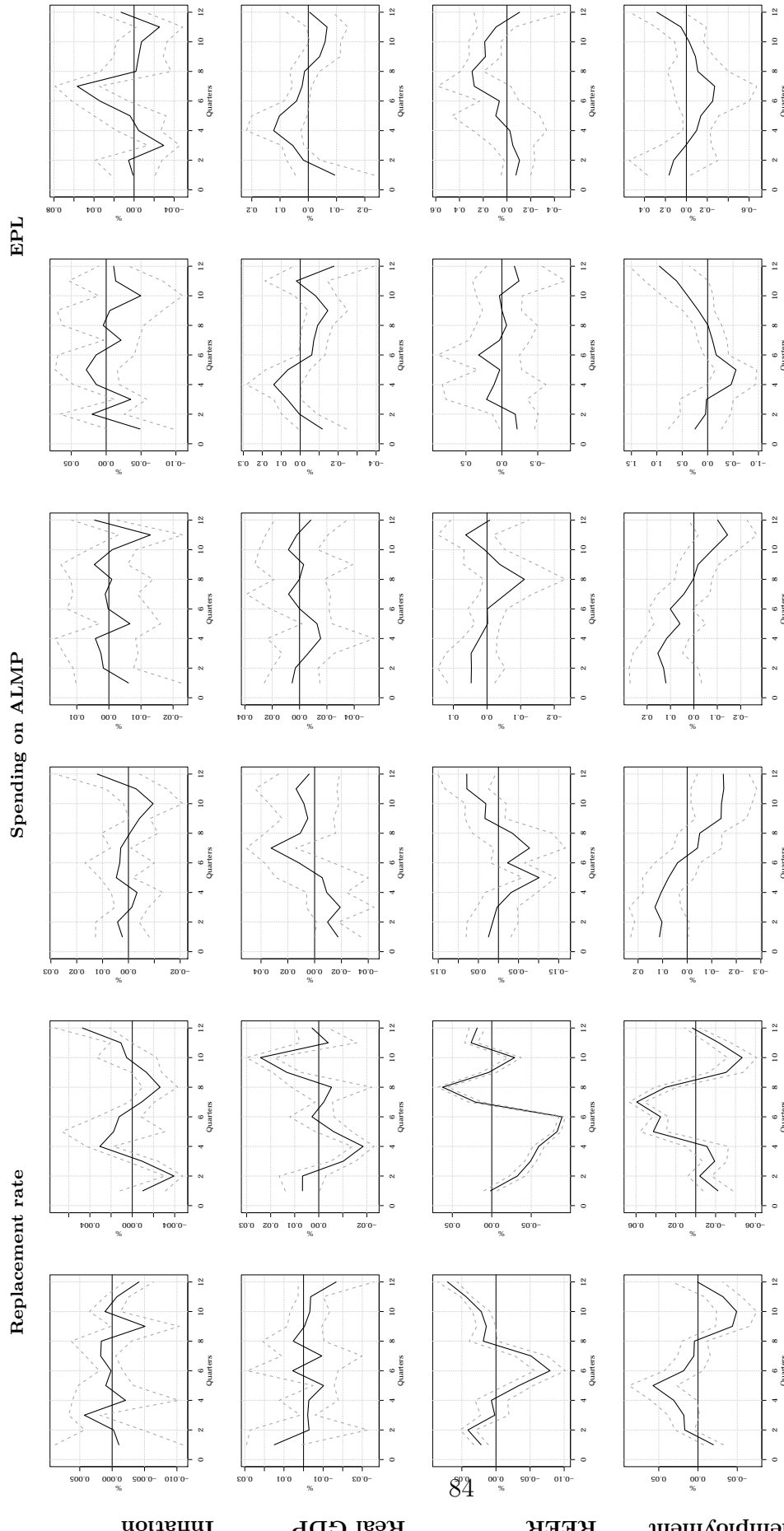


Figure C.1: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), falling interest rate (left) and rising interest rate (right), model A

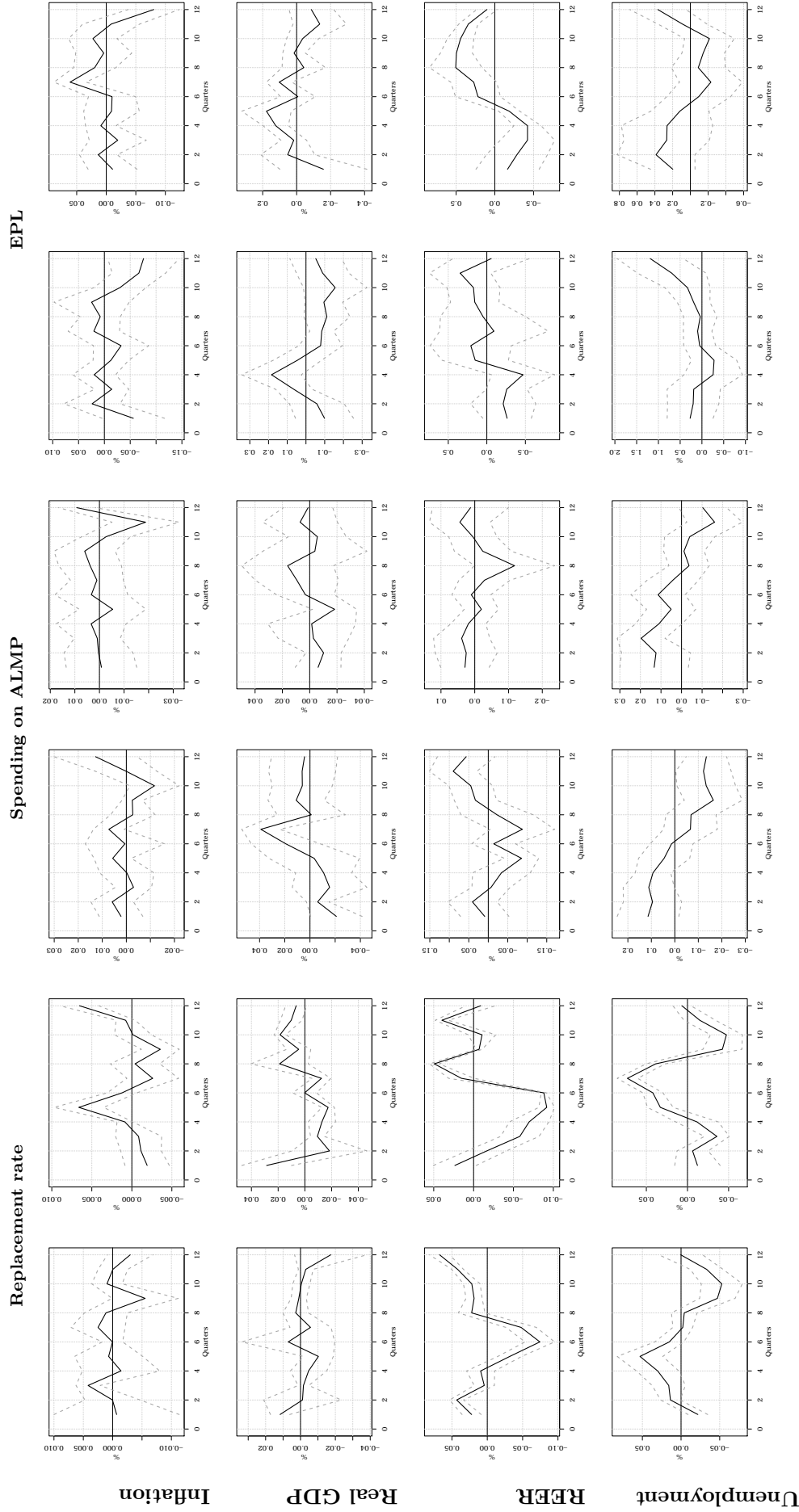


Figure C.2: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), falling interest rate (left) and rising interest rate (right), model B



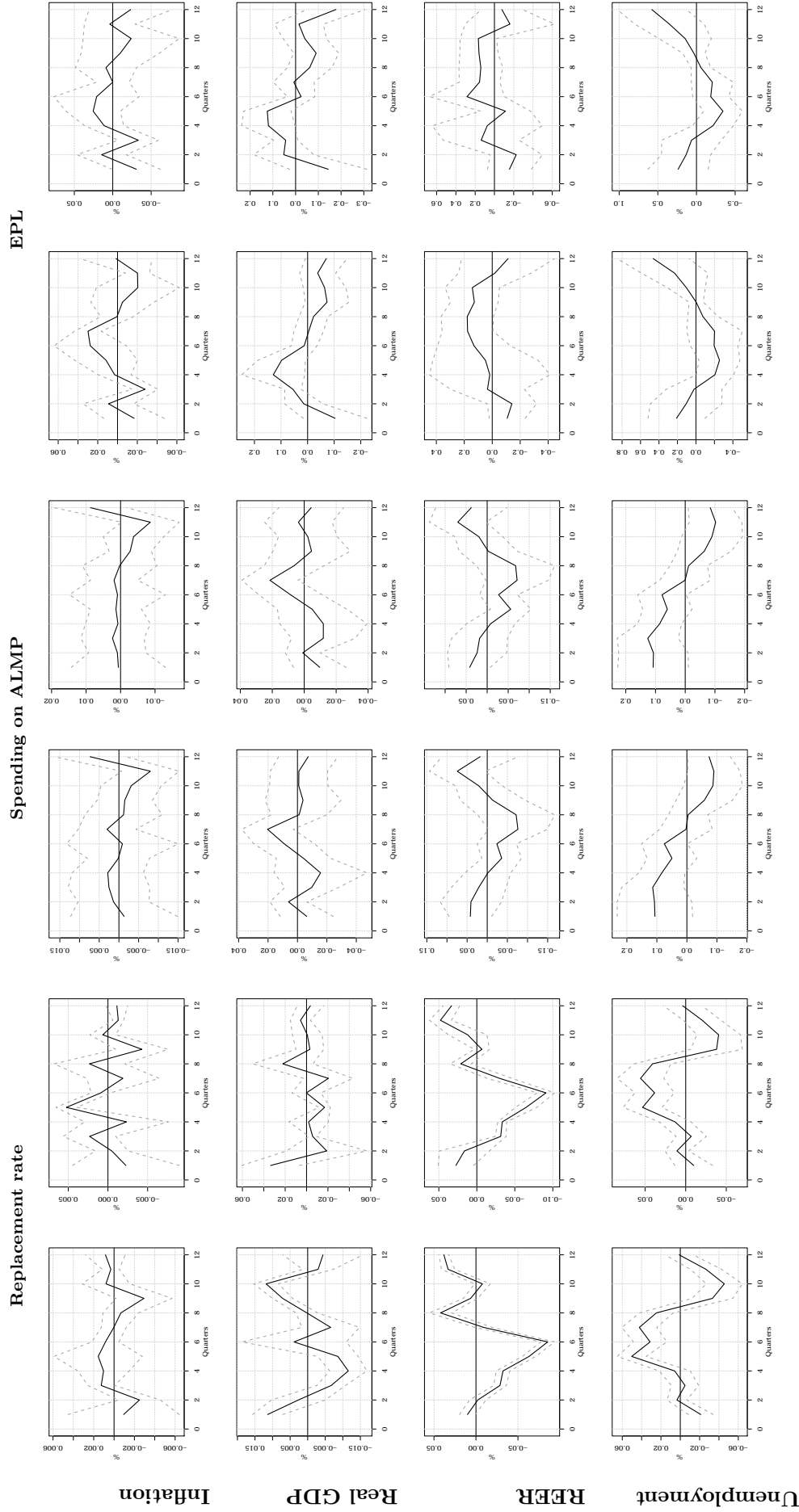


Figure C.3: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), first quarterly quartile (left) and third quarterly quartile (right), model C

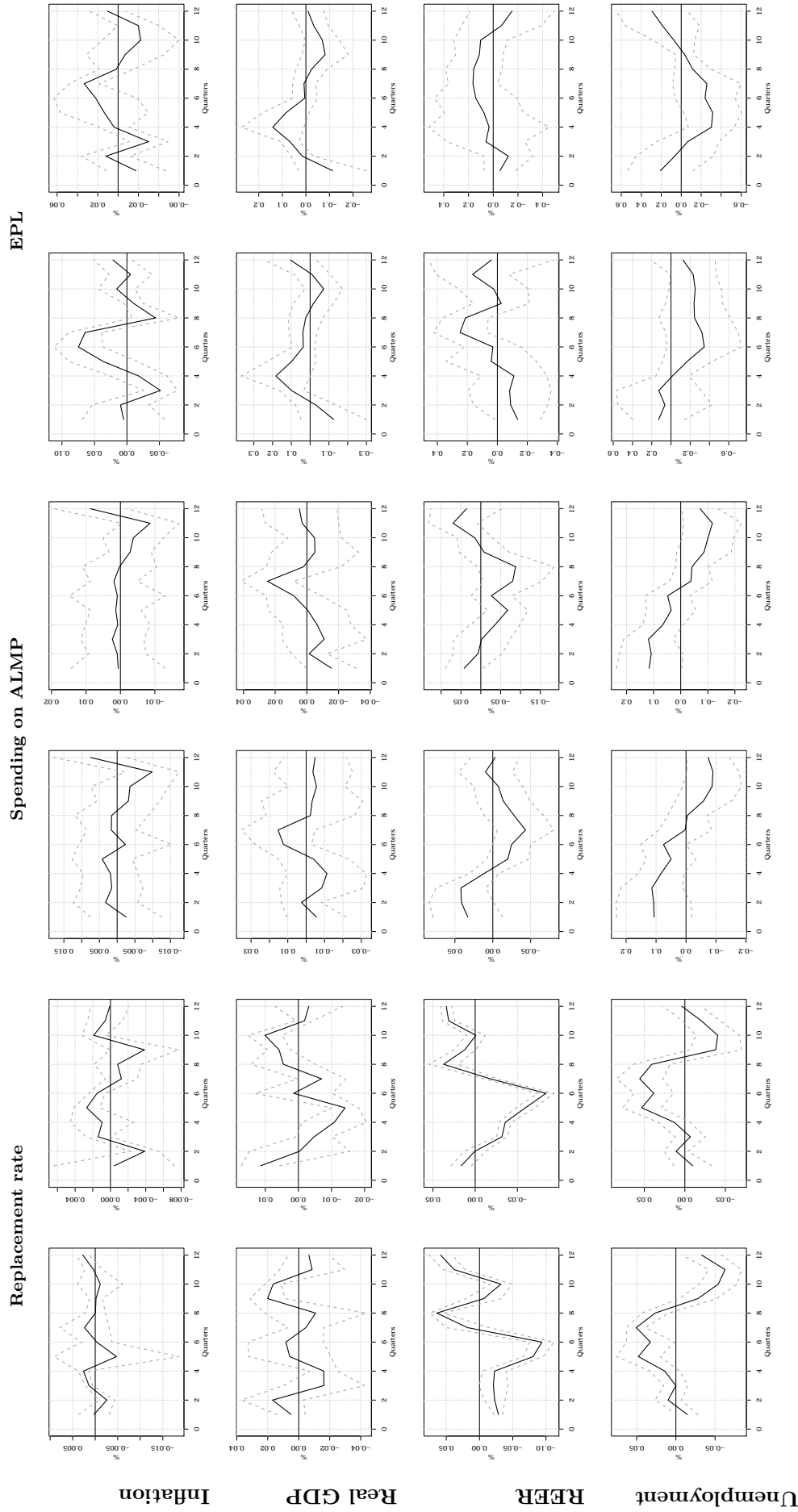


Figure C.4: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), first annual quartile (left) and third annual quartile (right), model D

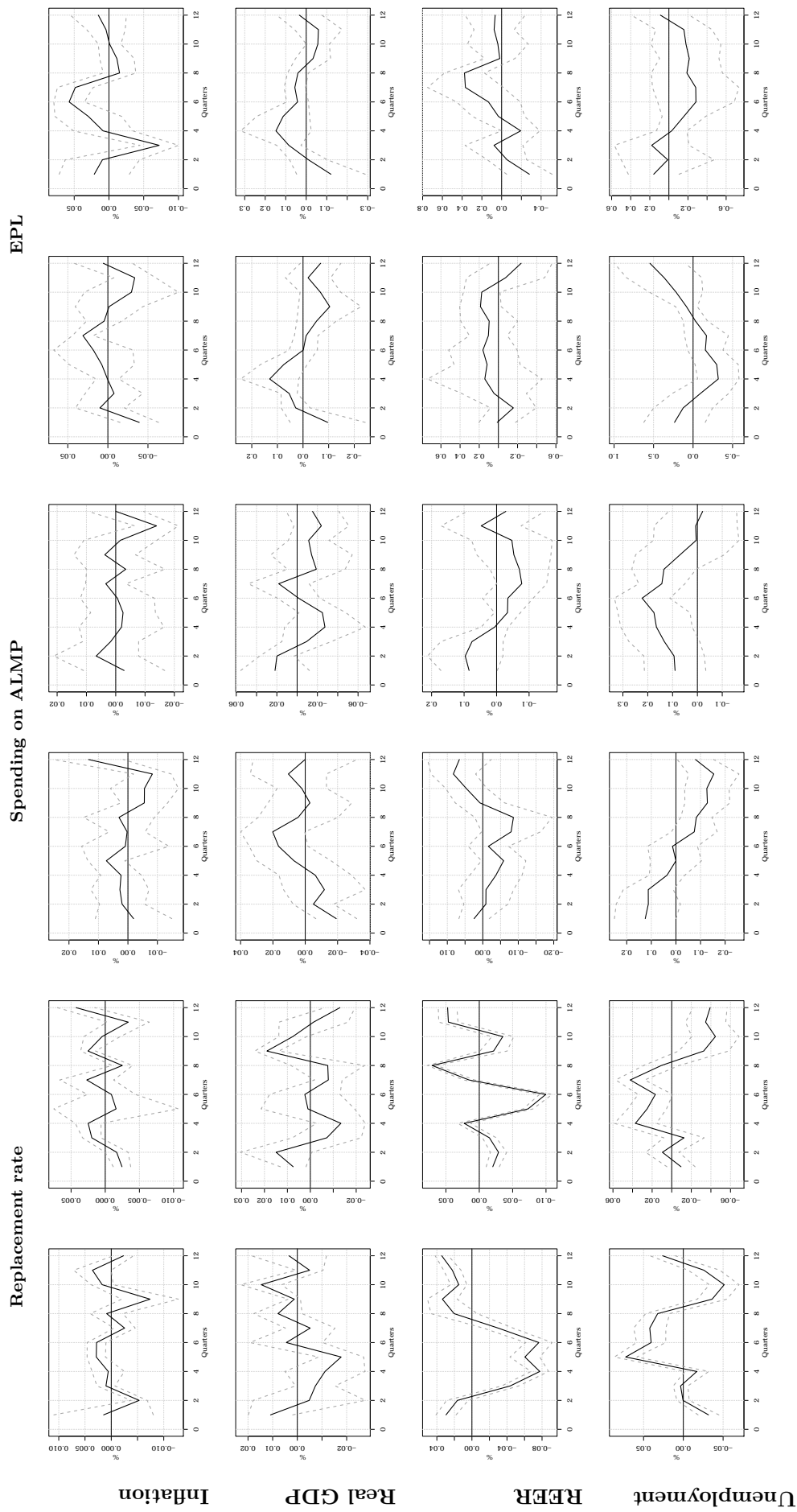


Figure C.5: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), falling interest rate (left) and rising interest rate (right), model E

## C.2.2 Sub-sample 1999-2010

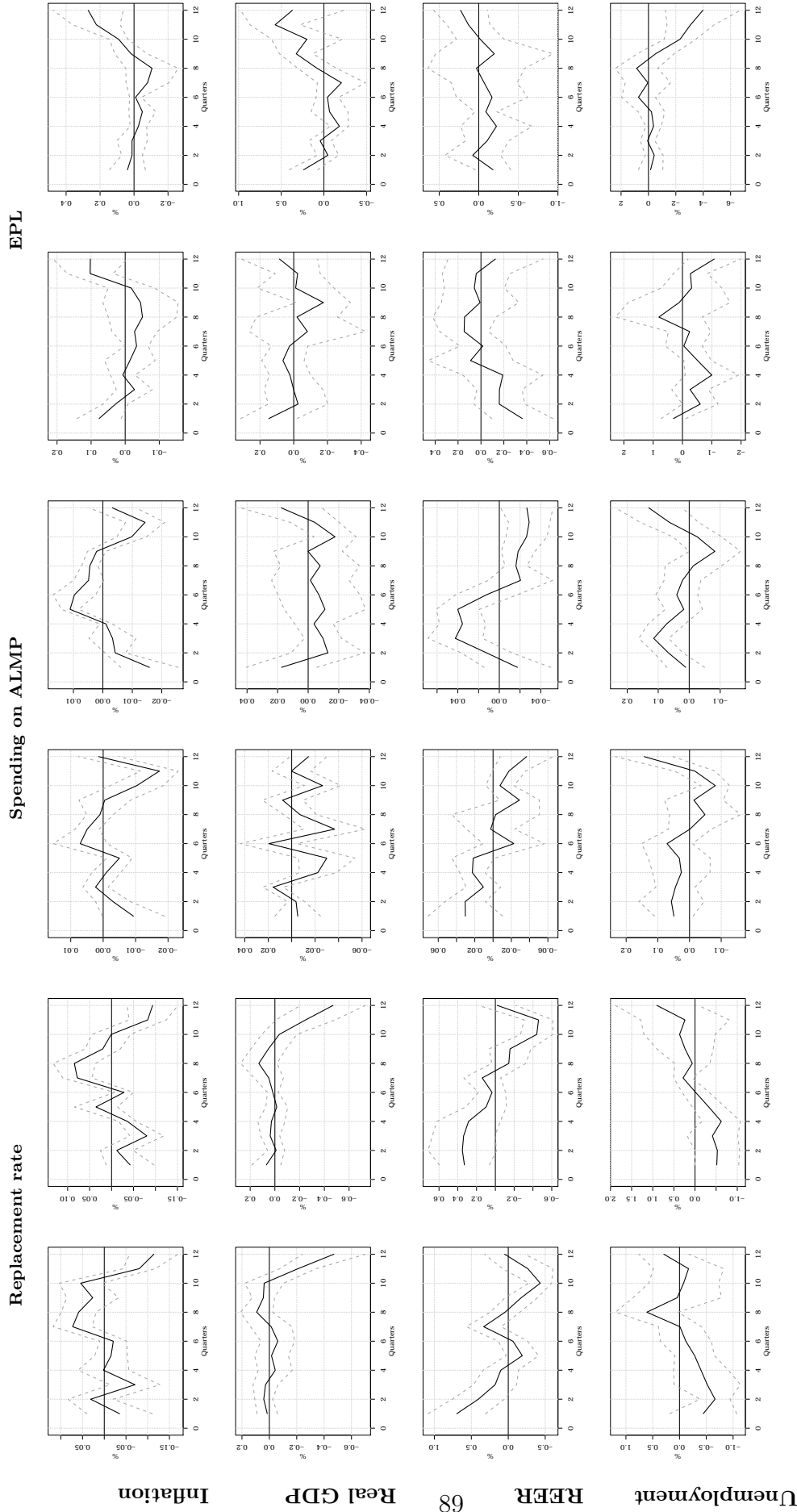


Figure C.6: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), falling interest rate (left) and rising interest rate (right), model A

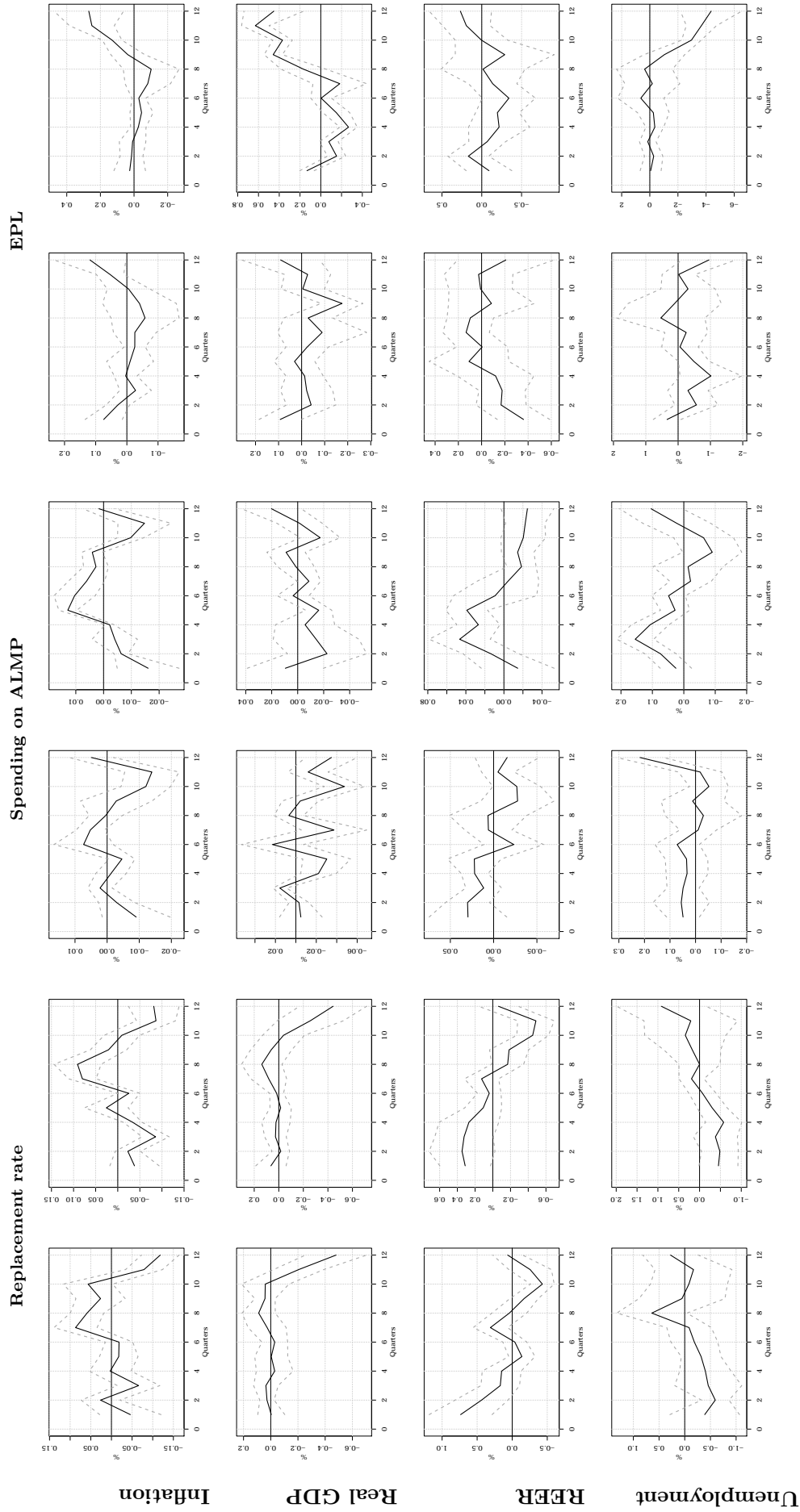


Figure C.7: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), falling interest rate (left) and rising interest rate (right), model B

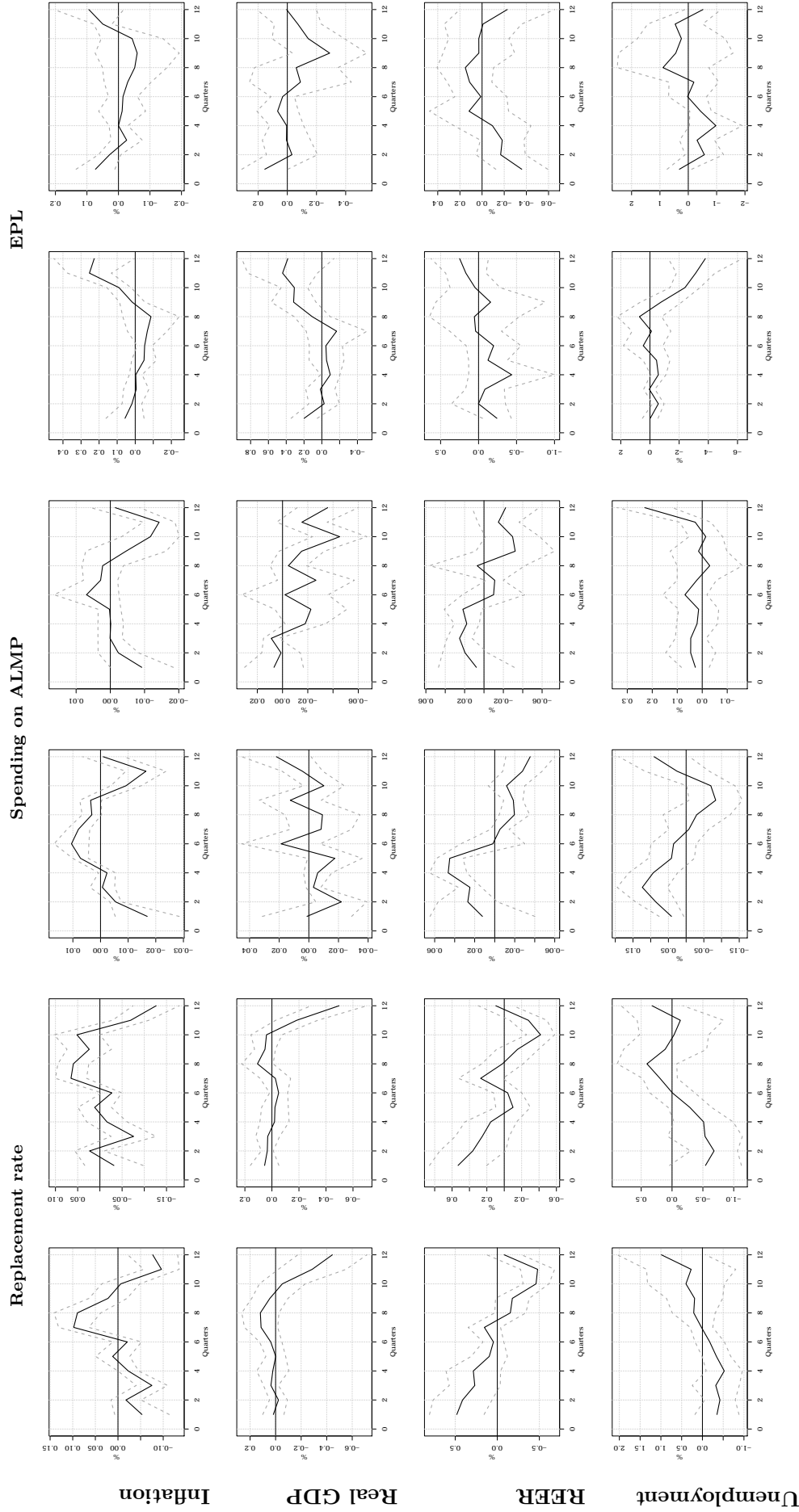


Figure C.8: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), first quarterly quartile (left) and third quarterly quartile (right), model C

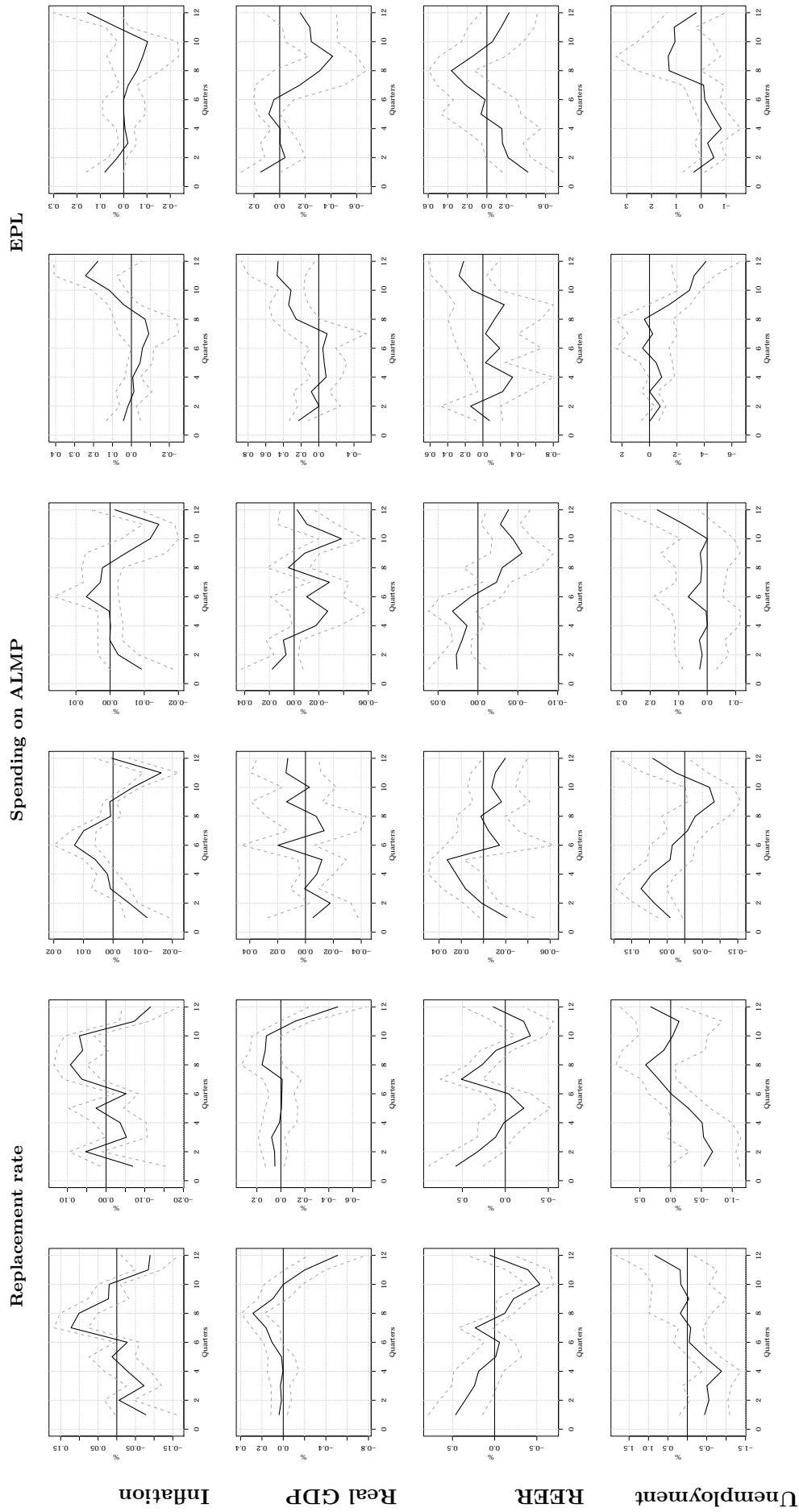


Figure C.9: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), first annual quartile (left) and third annual quartile (right), model D

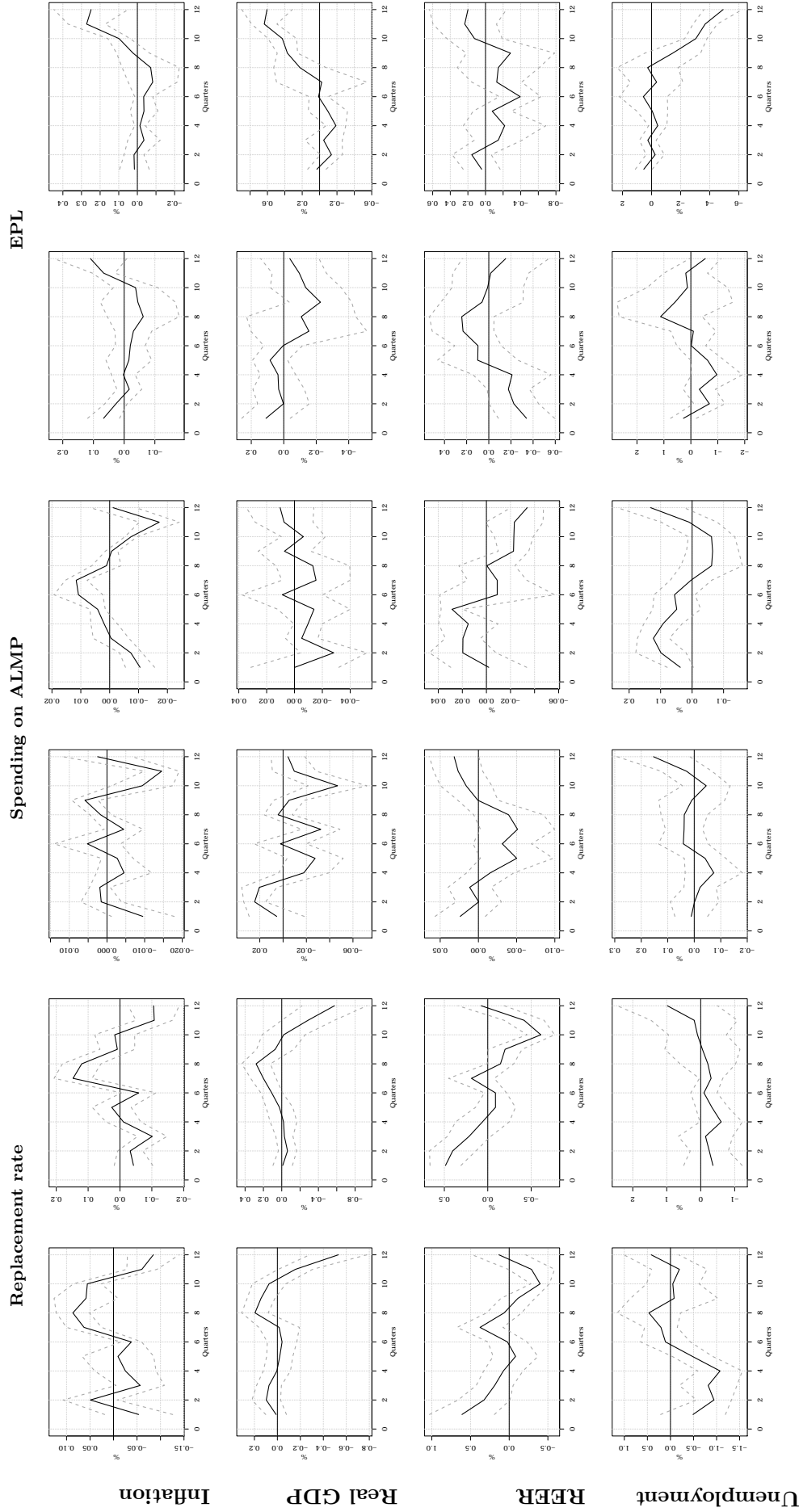


Figure C.10: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), falling interest rate (left) and rising interest rate (right), model E



### C.2.3 Full Sample

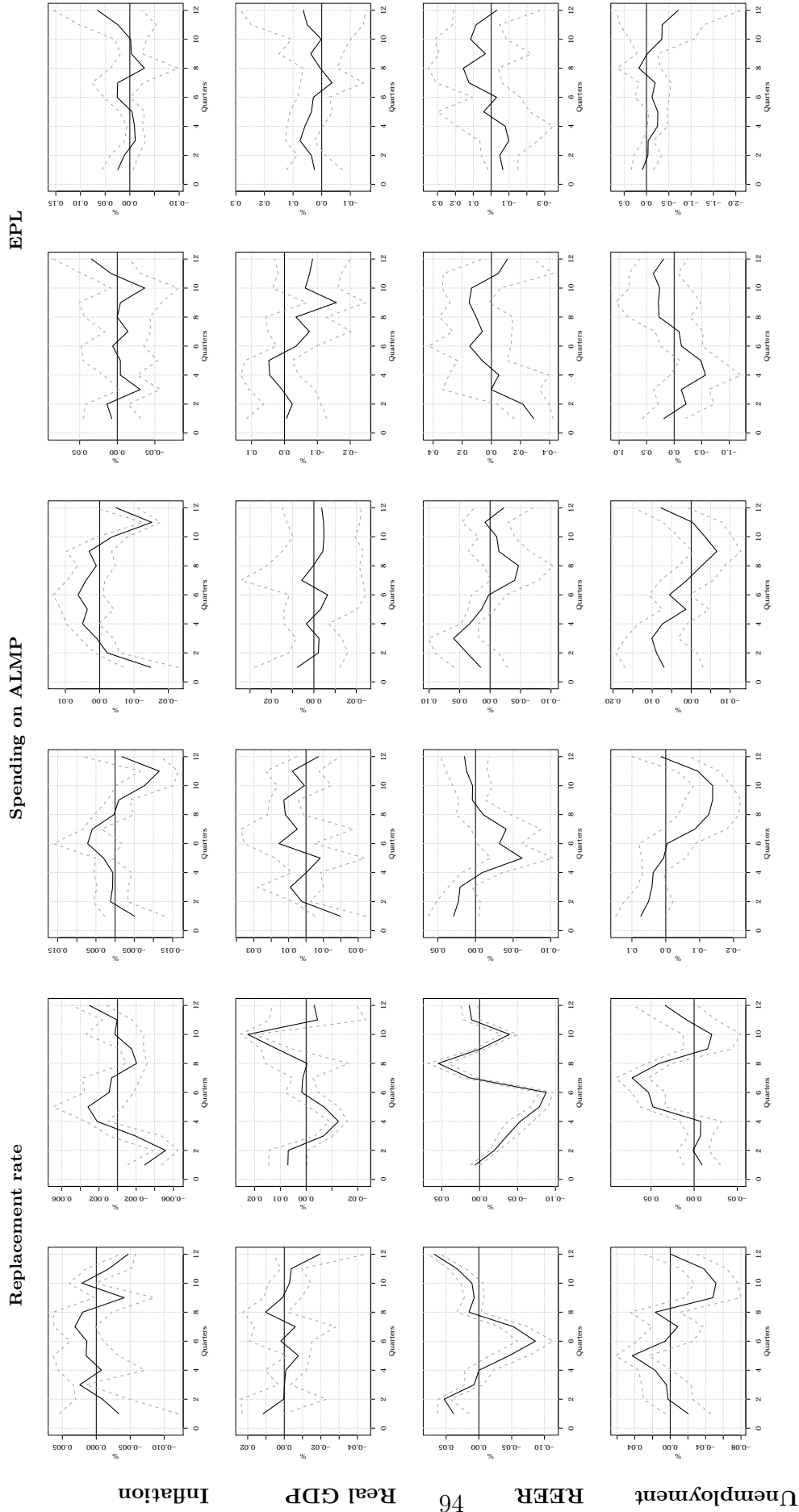
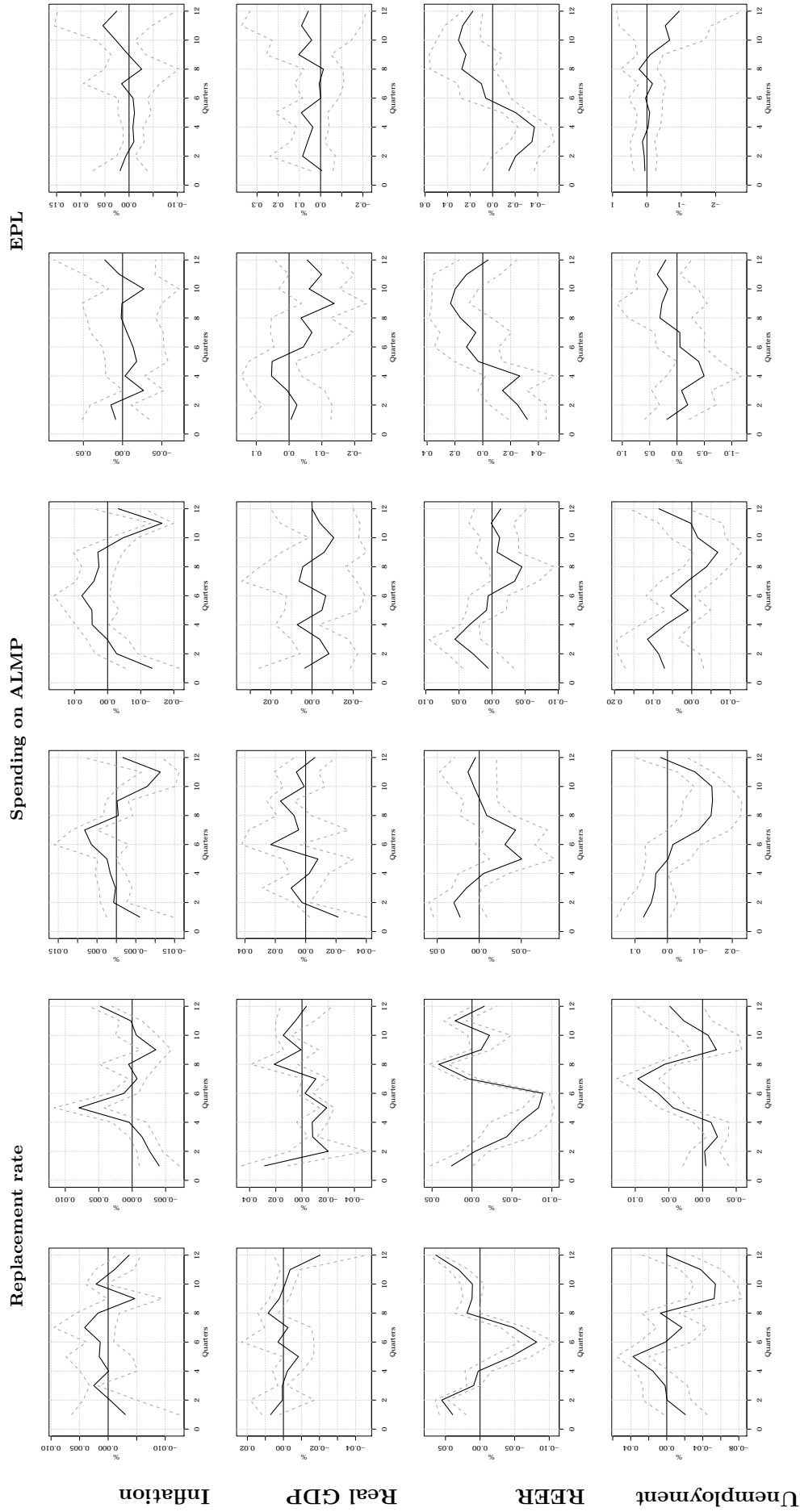


Figure C.11: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), falling interest rate (left) and rising interest rate (right), model A



**Figure C.12: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), falling interest rate (left) and rising interest rate (right), model B**

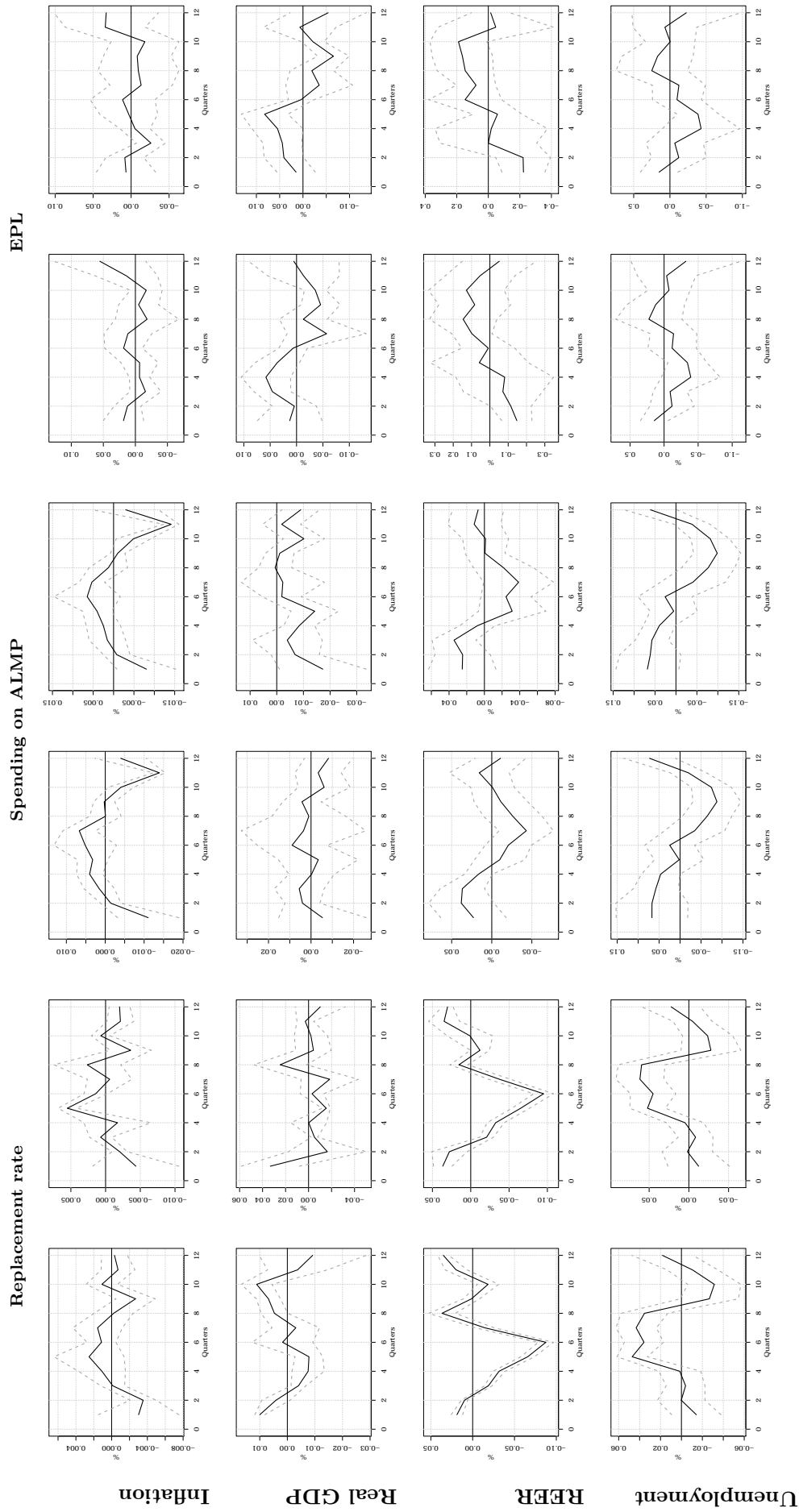


Figure C.13: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), first quarterly quartile (left) and third quarterly quartile (right), model C

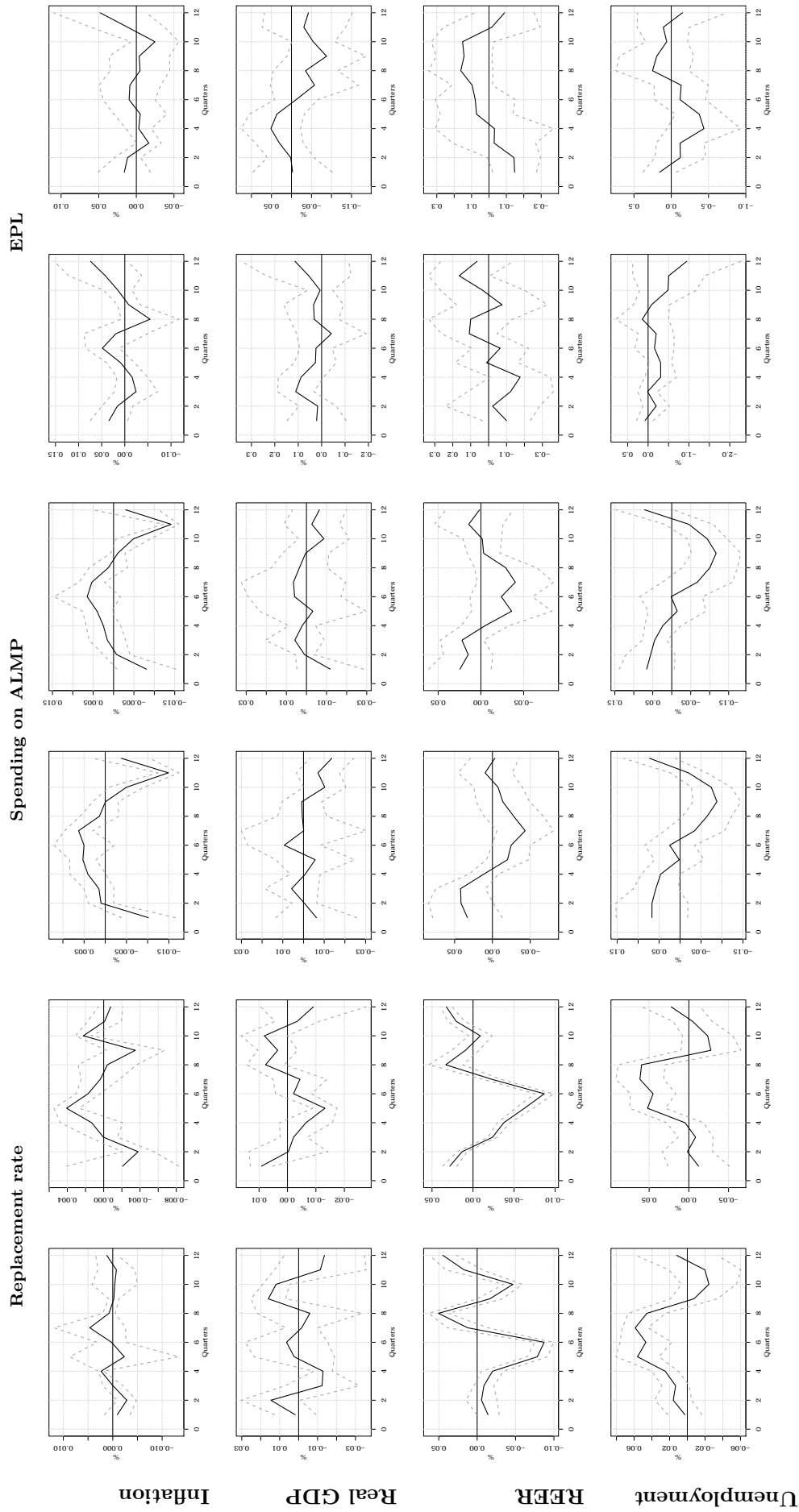


Figure C.14: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), first annual quartile (left) and third annual quartile (right), model D

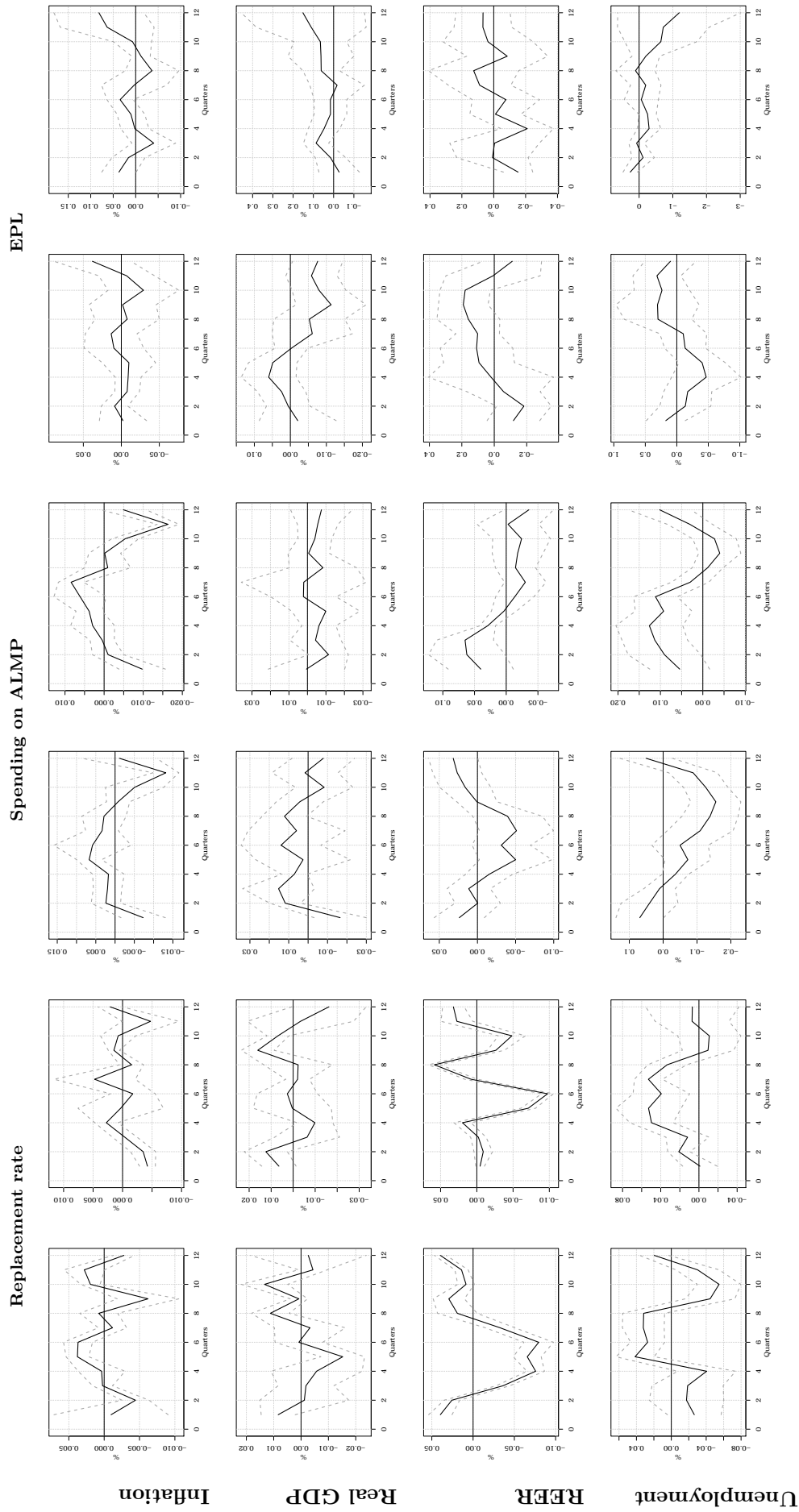


Figure C.15: Changes in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), falling interest rate (left) and rising interest rate (right), model E

### C.3 Probability Values

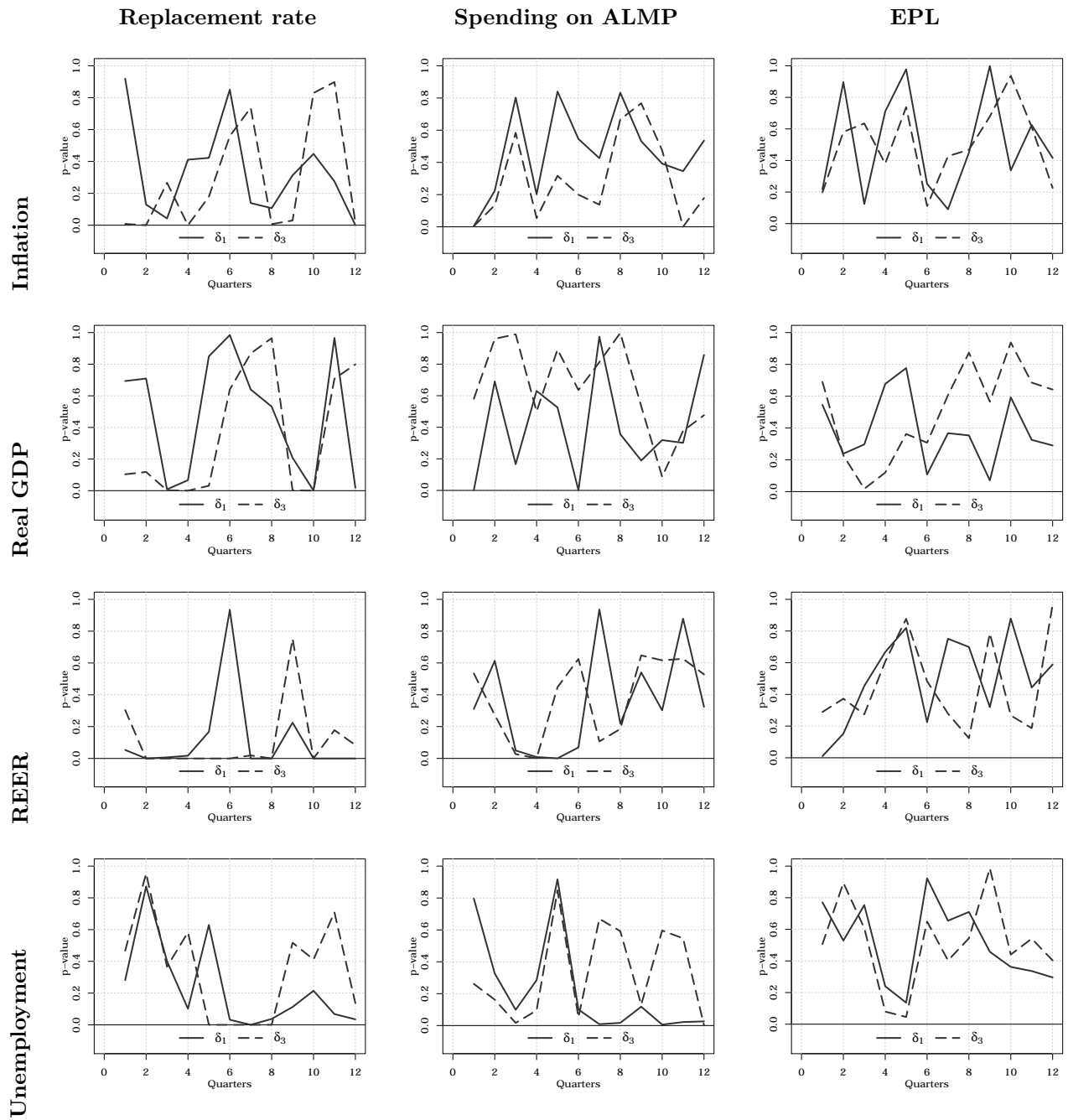


Figure C.16: P-values of the parameter equality, 1985-2010, model A

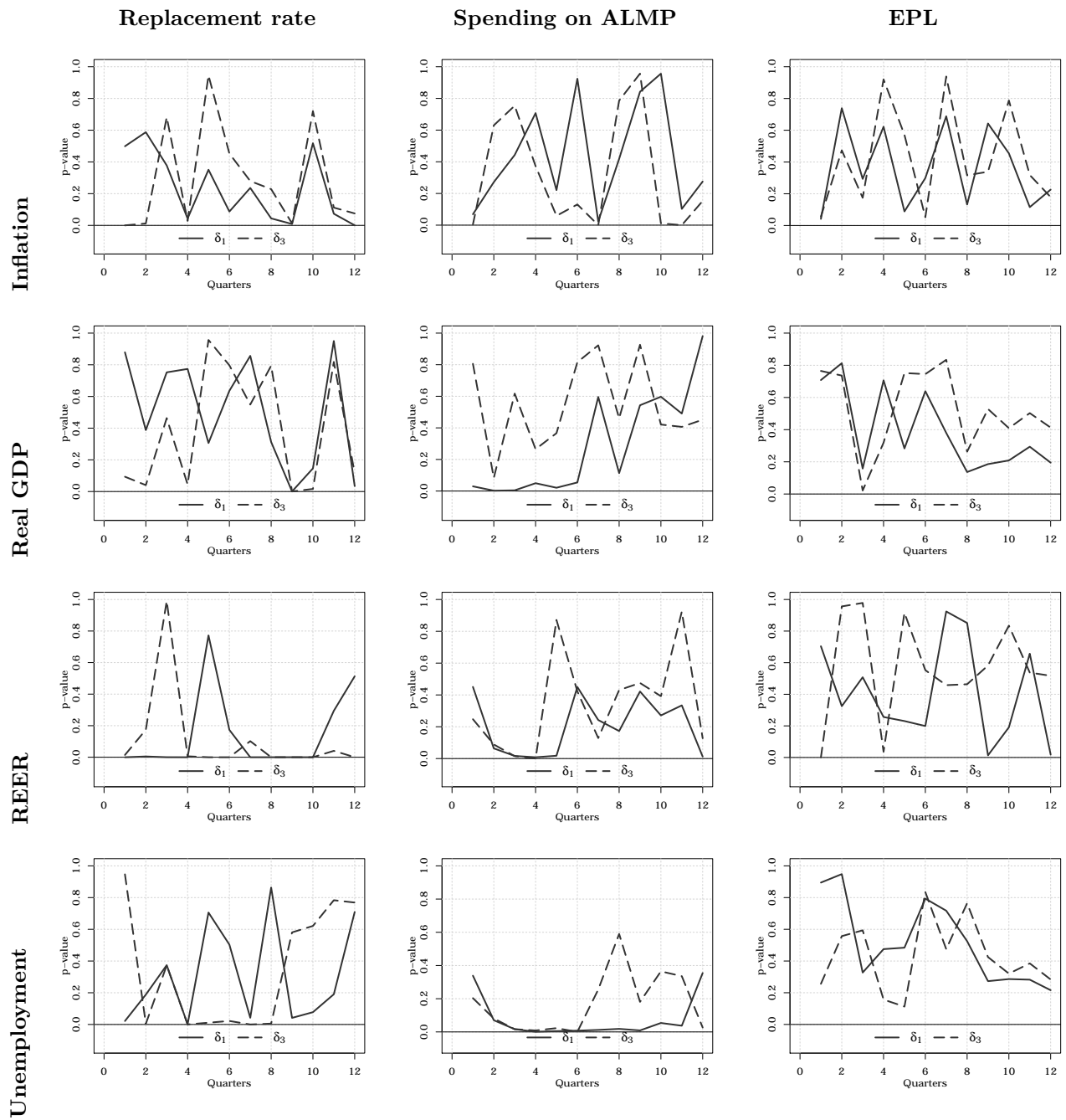


Figure C.17: P-values of the parameter equality, 1985-2010, model B

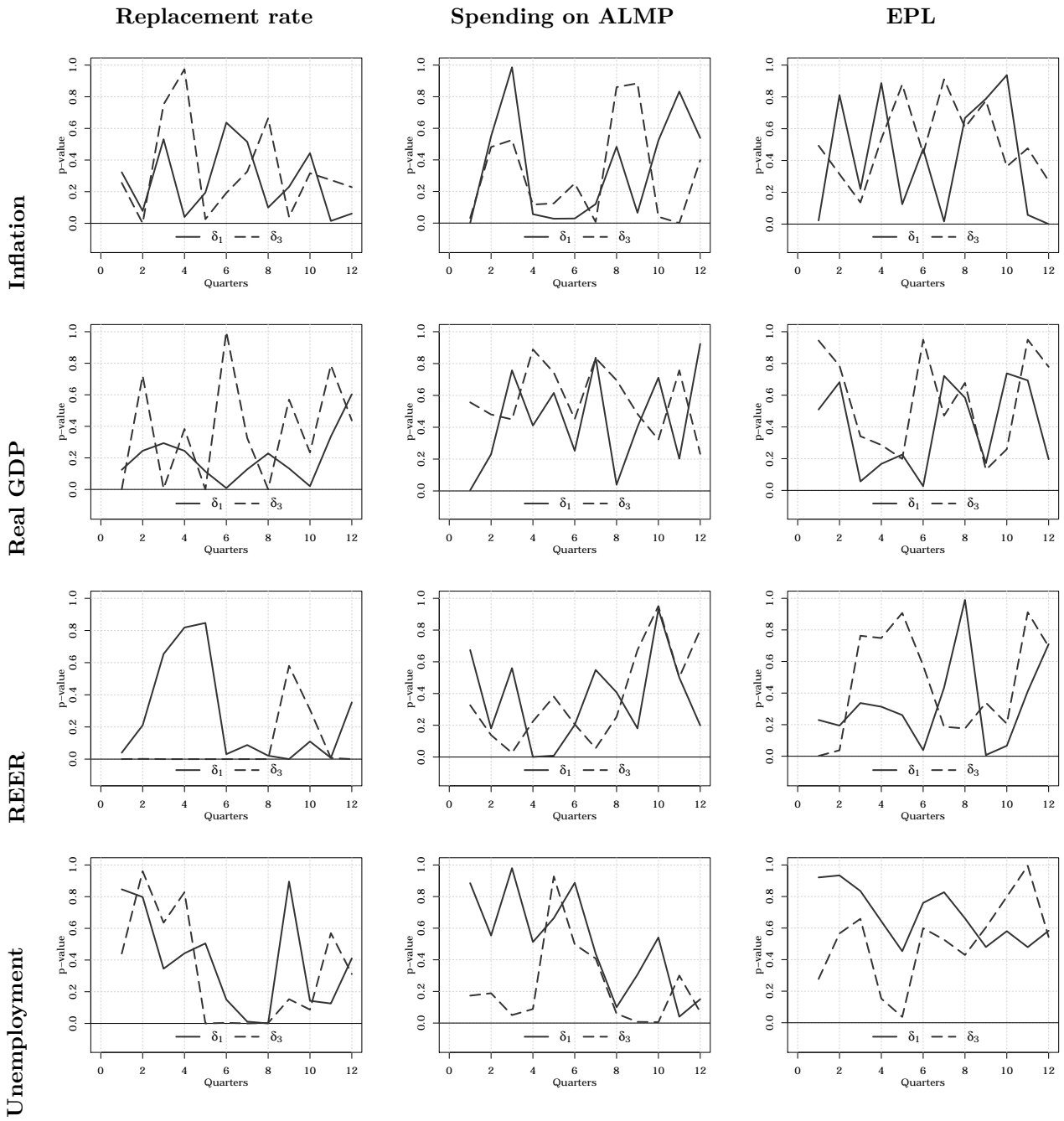


Figure C.18: P-values of the parameter equality, 1985-2010, model C



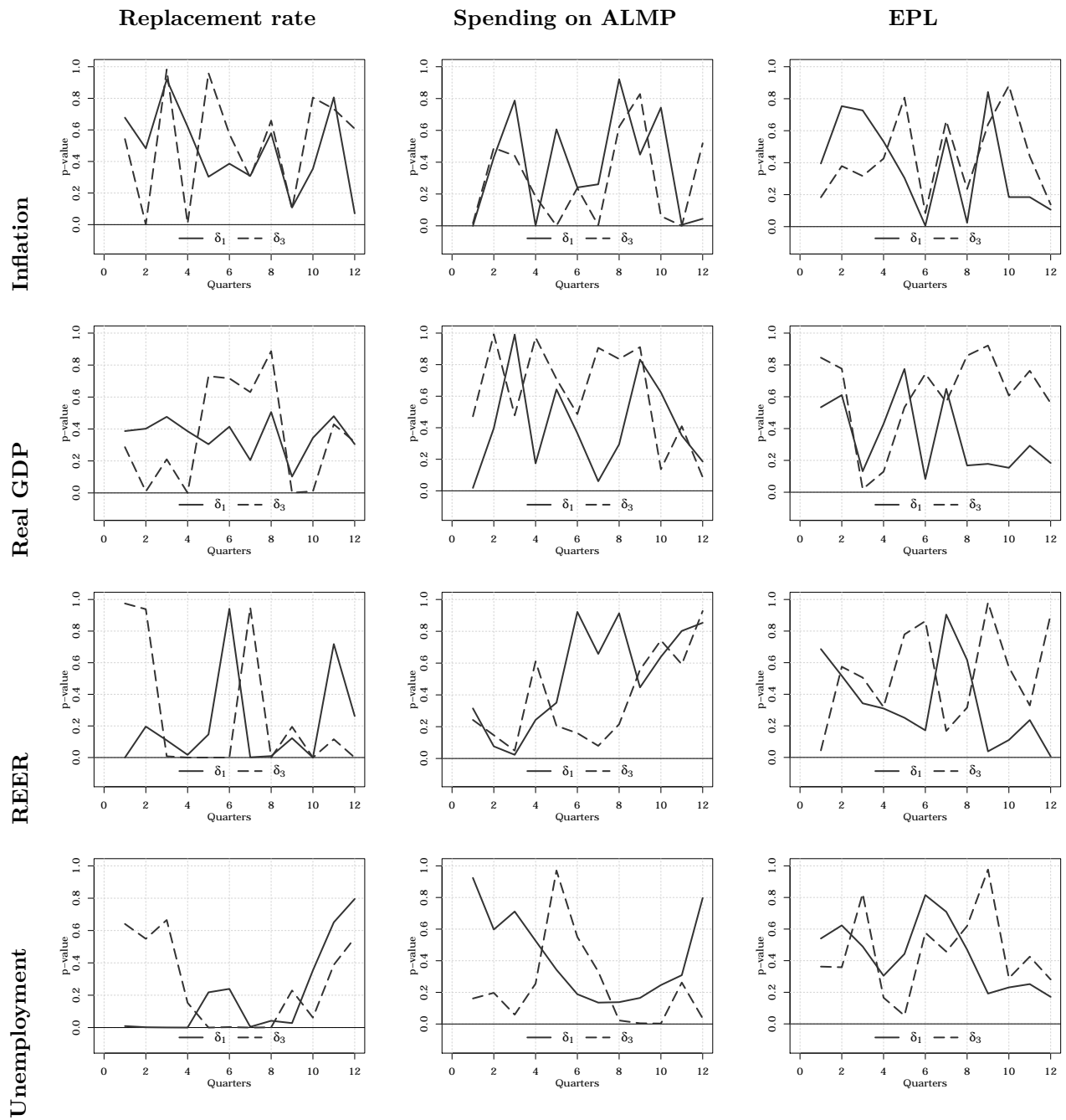


Figure C.19: P-values of the parameter equality, 1985-2010, model D

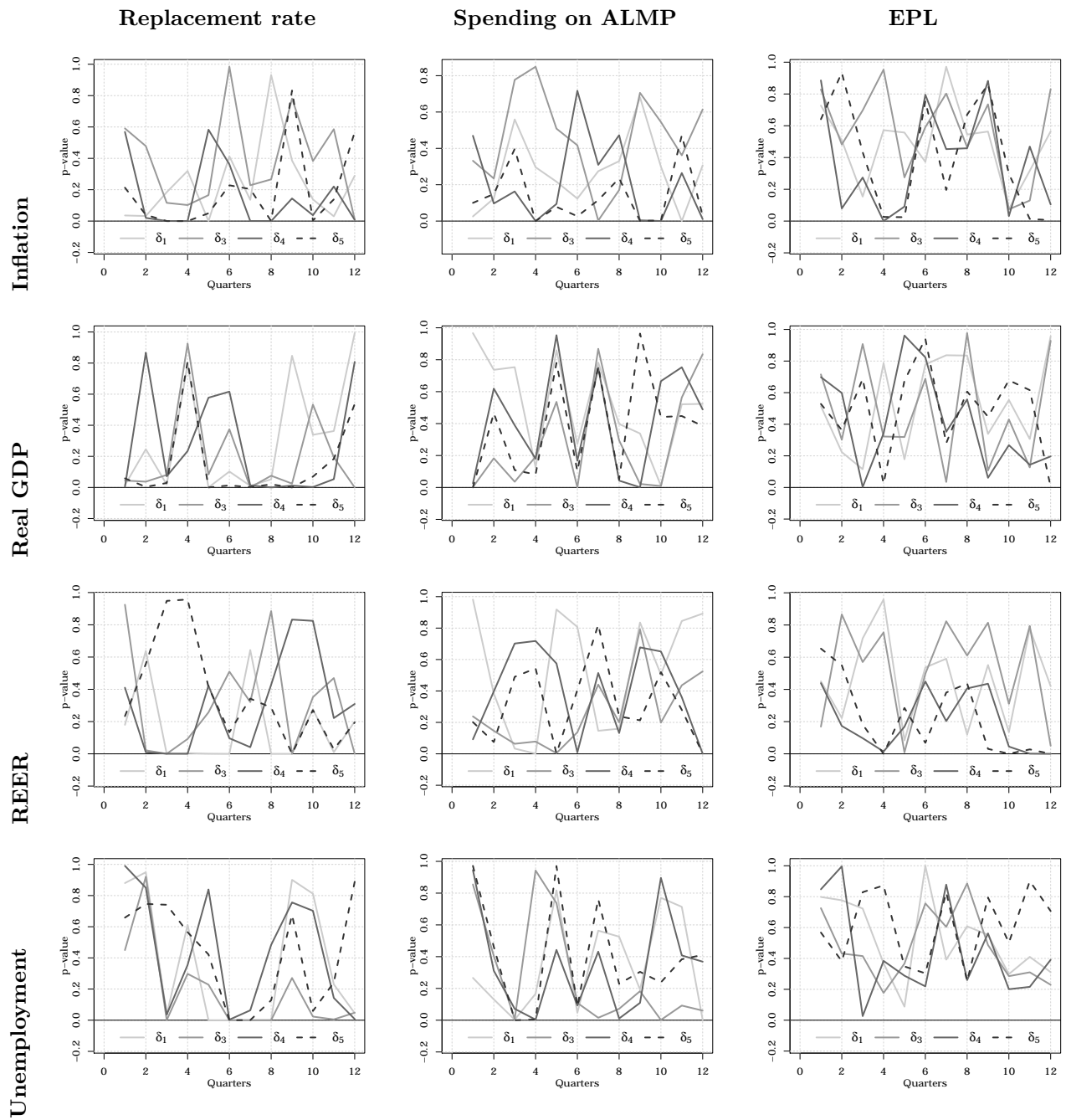


Figure C.20: P-values of the parameter equality, 1985-2010, model E

## C.4 Time Series

### C.4.1 Horizon: 1st Quarter

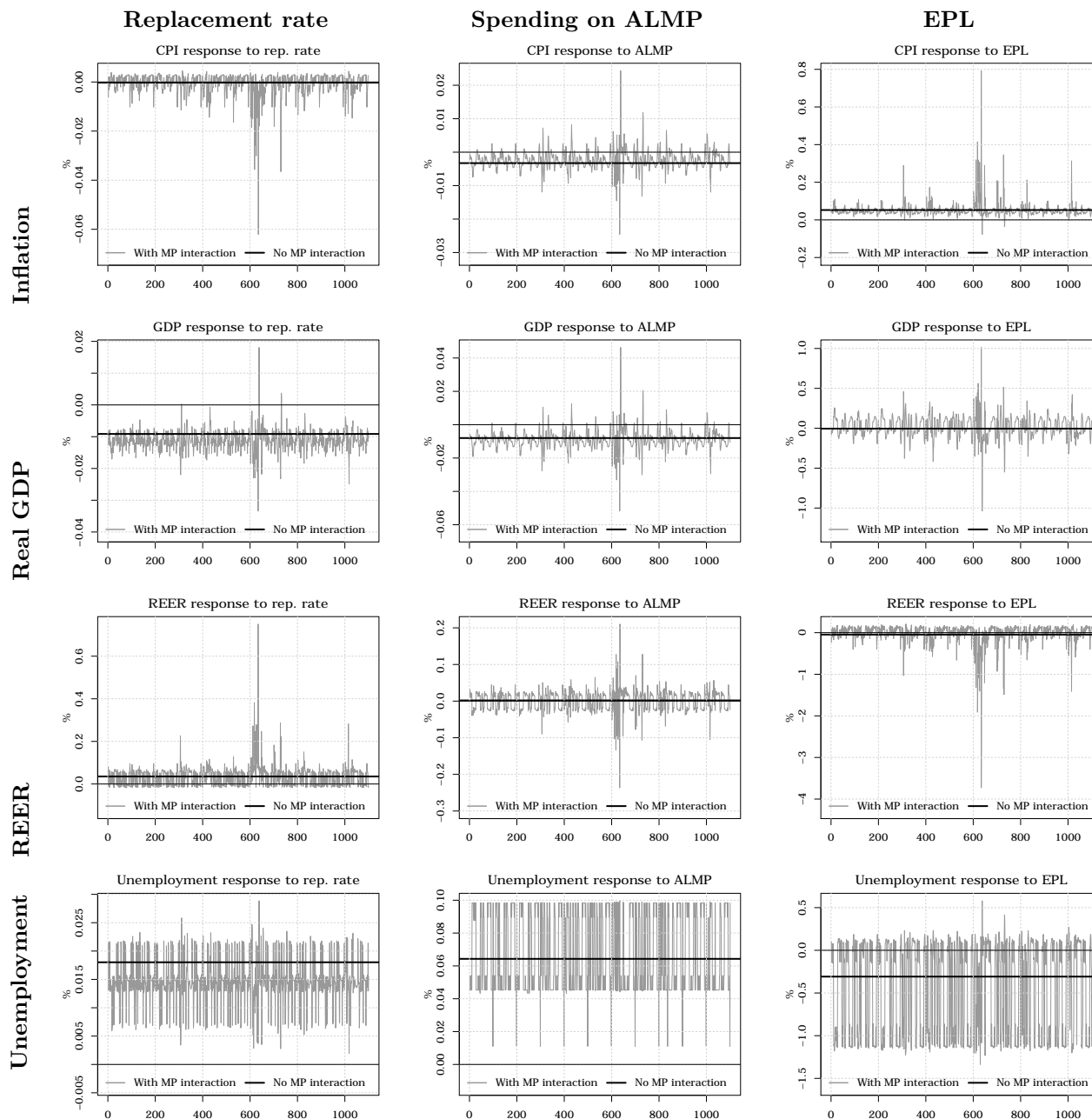


Figure C.21: Variation of average responses in macroeconomic variables to the 1% increase in labor market policies (replacement rate, ALMP and EPL), 1st quarter

### C.4.2 Horizon: 4th Quarter

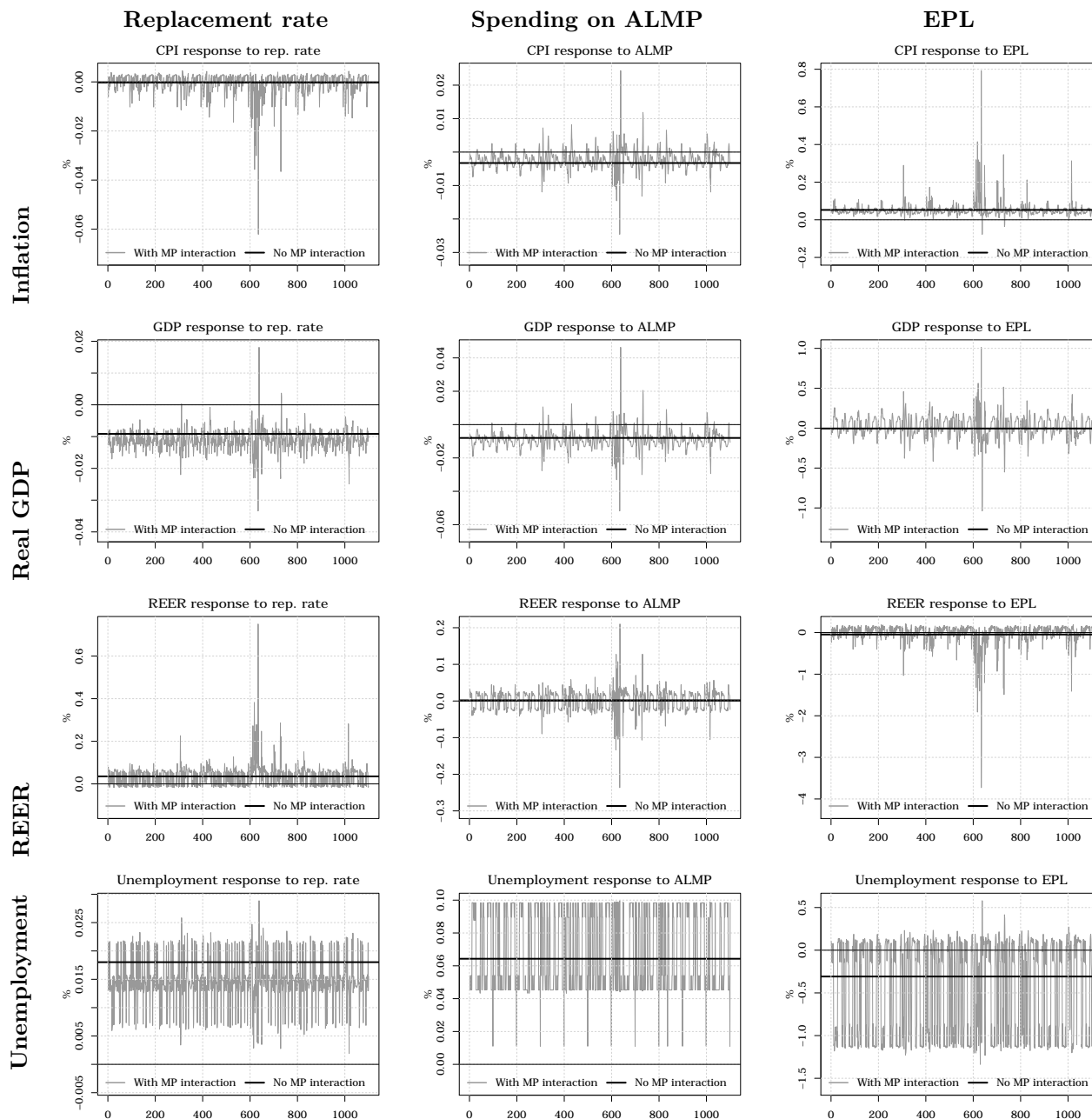


Figure C.22: Variation of average responses in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), 4th quarter

### C.4.3 Horizon: 8th Quarter

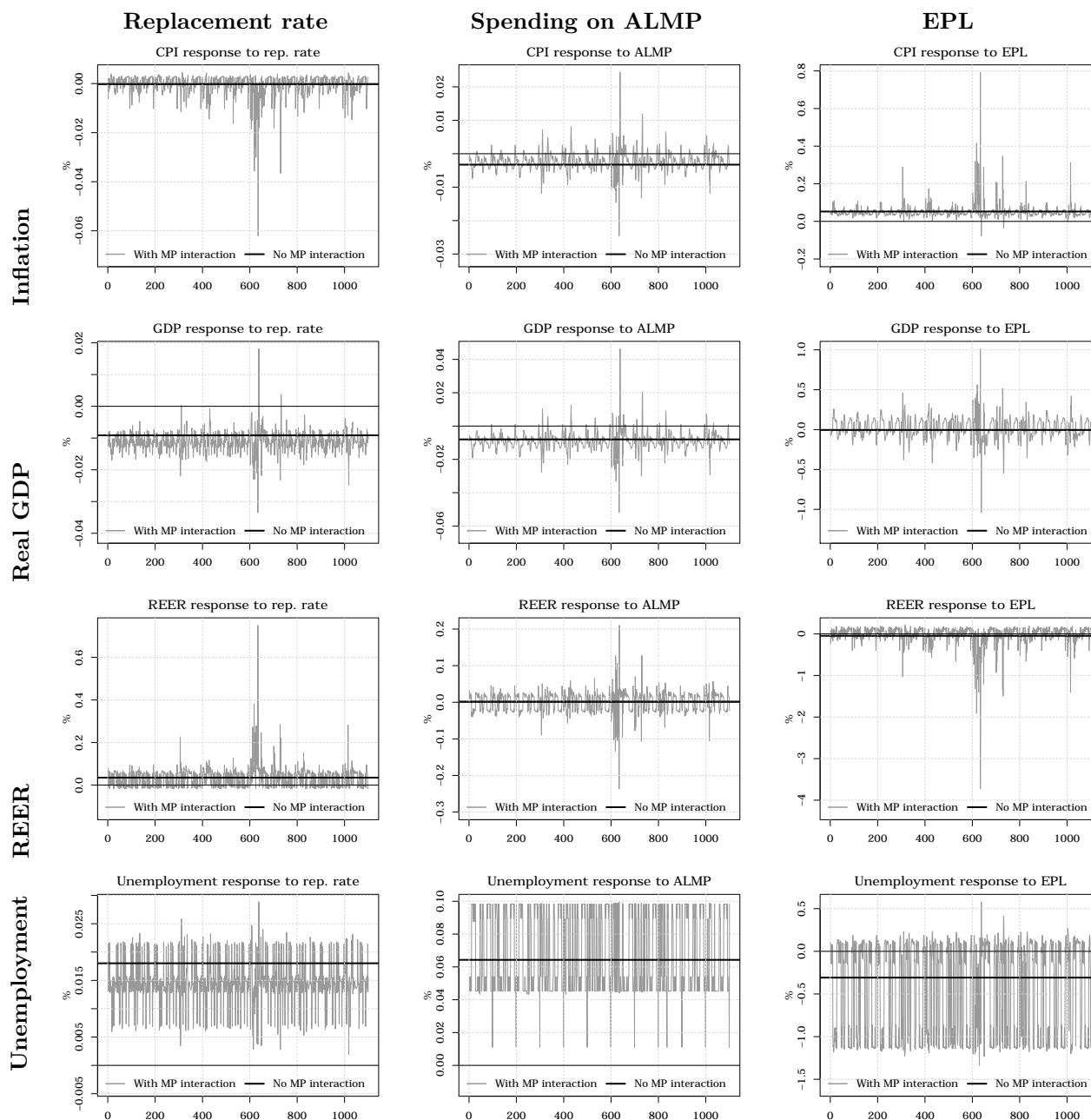


Figure C.23: Variation of average responses in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), 8th quarter

### C.4.4 Cross-sectional Dependence (Horizon: 4th Quarter)

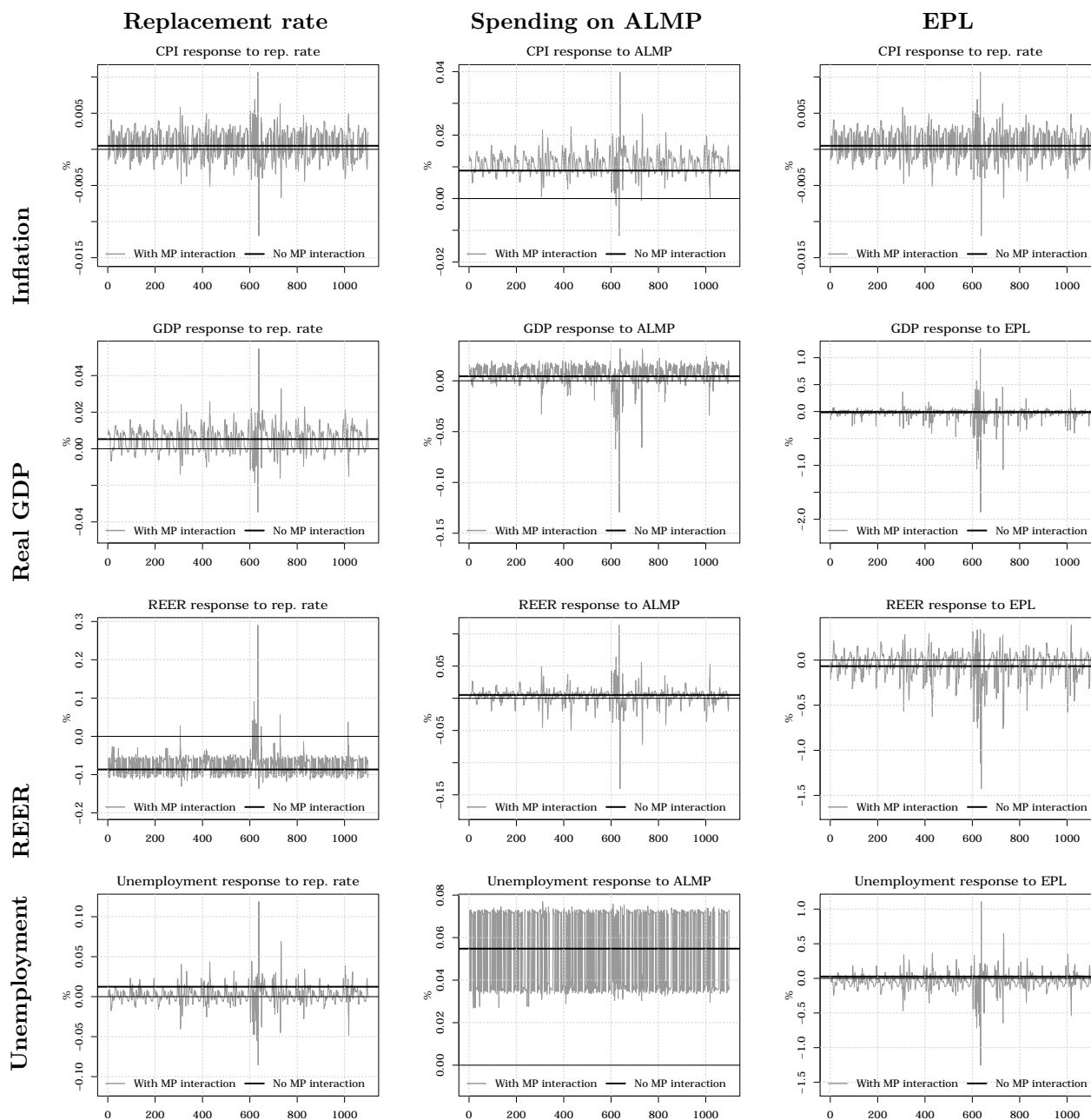


Figure C.24: Variation of average responses in macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), multi-factor error structure, 4th quarter

## C.5 Densities

### C.5.1 Horizon: 1st Quarter

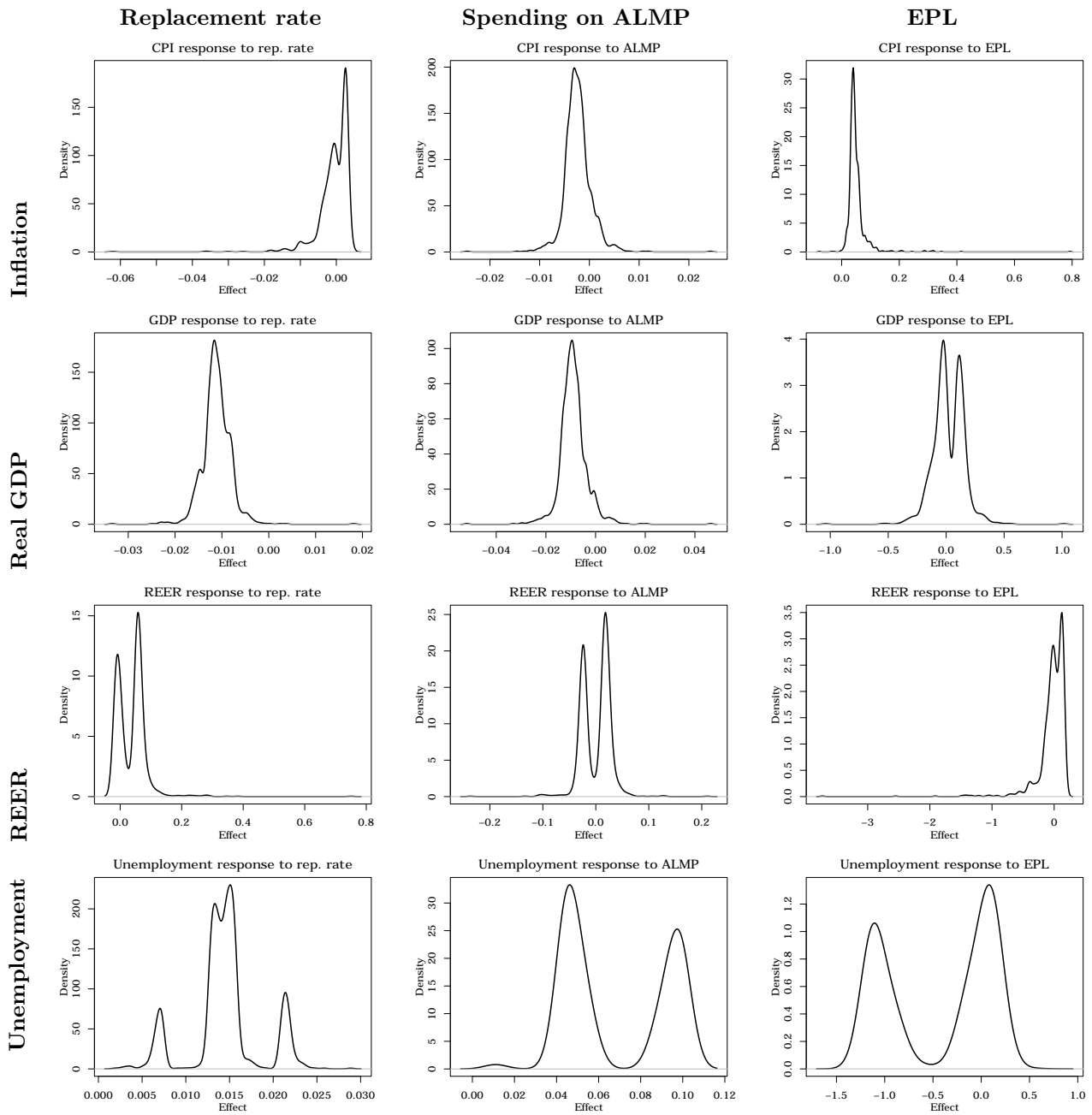


Figure C.25: Densities of average effects of macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), 1st quarter

### C.5.2 Horizon: 4th Quarter

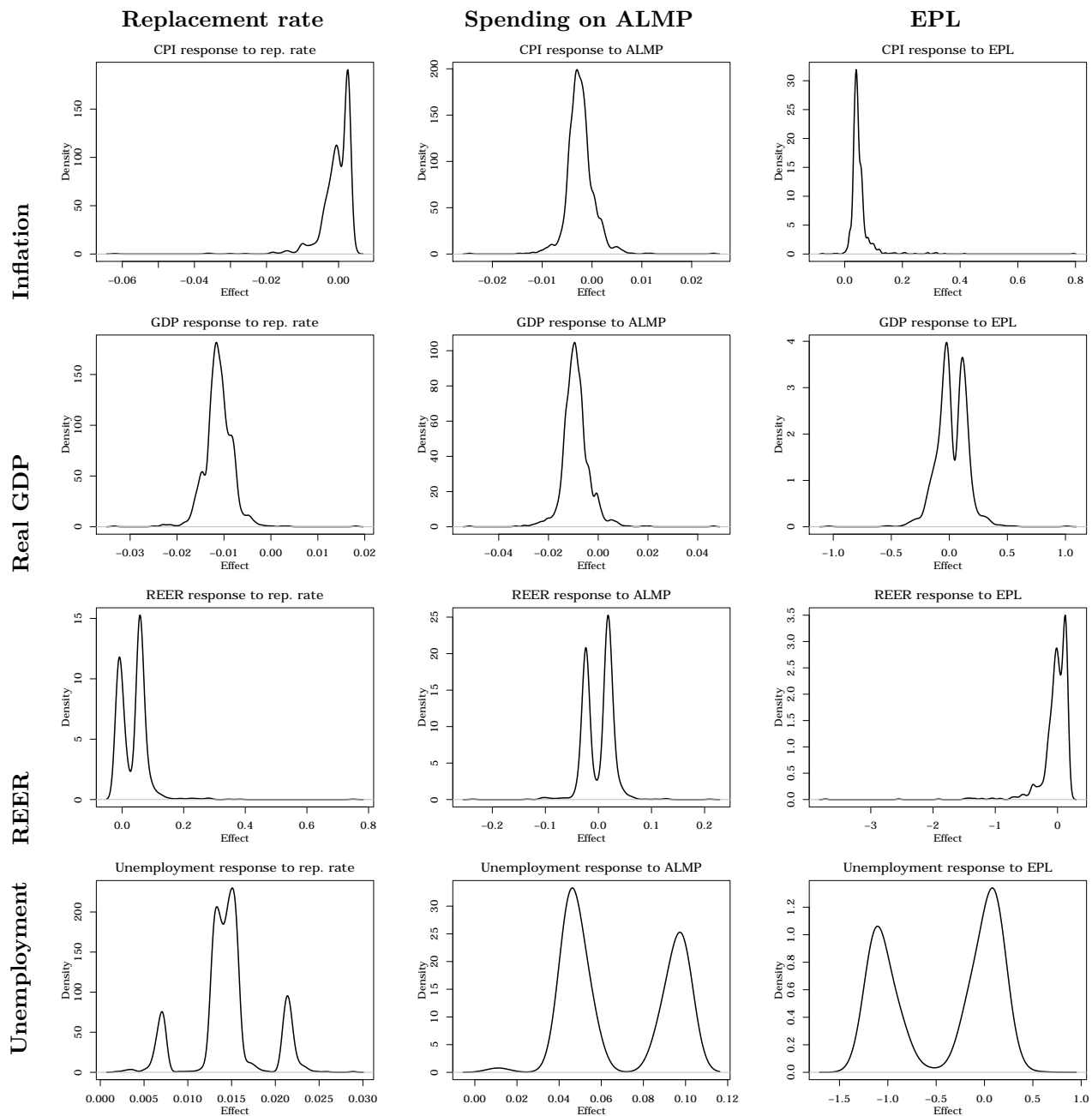


Figure C.26: Densities of average effects of macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), 4th quarter



### C.5.3 Horizon: 8th Quarter

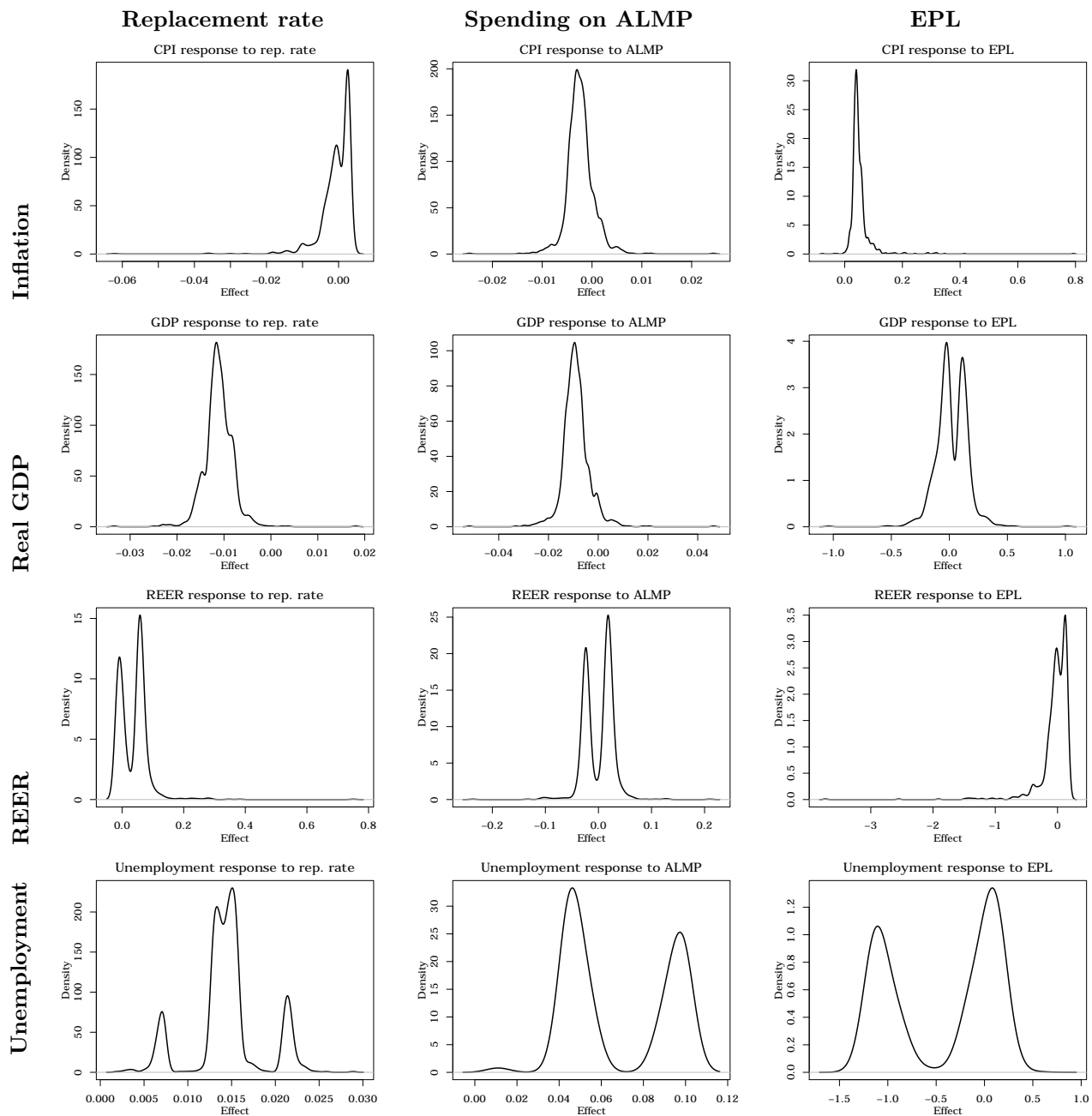


Figure C.27: Densities of average effects of macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), 8th quarter

### C.5.4 Cross-sectional Dependence (Horizon: 4th Quarter)

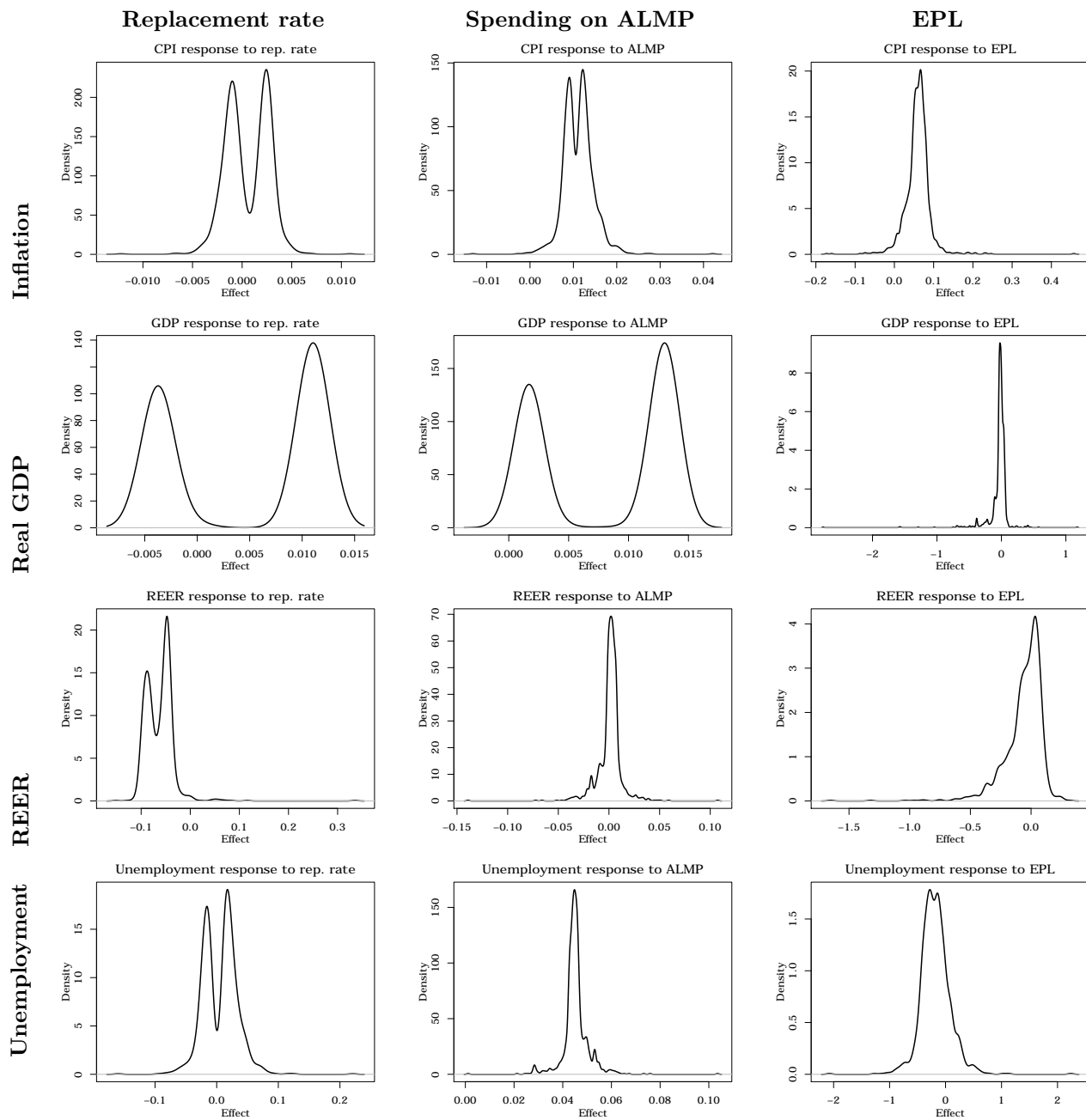


Figure C.28: Densities of average effects of macroeconomic variables due to the 1% increase in labor market policies (replacement rate, ALMP and EPL), multi-factor error structure, 4th quarter