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FGB-LM MKIII

An hybrid Dynamic Stochastic GE model for LM policy evaluations

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Outline

- FGB-LM MKIII: an hybrid structure model
- Policy evaluation: the need for a structural approach
- Background and related literature
- FGB-LM MKIII: general structure
- What FGB-LM MKIII can address
- Model parameterization
- Policy simulation experiments

The hybrid structure of FGB-LM MKIII: *core-satellite* relations

- A “core” - or "pilot“ - model block defines the evolution of the fundamental domestic and foreign macro-variables (GDP, consumption, investment, wages, prices, interest rates, employment, unemployment, hirings, firings etc.)
  - *Core*: relations among macro-aggregates derived from hard theory, i.e. from households and firms' optimality conditions in imperfect goods and labor markets (NK-DSGE)
- “Satellite” blocks of equations define the breakdown by region, sector, age, profession, education level and contract typology
  - *Satellites*: detail relations derived from estimated statistical relations and transition probabilities

Policy evaluation and alternative structural models

- SEMs
  - Large use of weak extraneous information (Sims' incredible restrictions)
  - May result unidentified, since their coefficients are mixtures of behavioral parameters and expectational terms (Lucas)
- SVARs/SBVARs
  - Weakly or only locally identifiable (for a limited set of shocks)
  - The voracity of VARs in terms of degrees of freedom preclude the viability of the methodology for medium scale models

Policy evaluation and DSGE models

- Do not suffer the Lucas-Sims critiques: a) model equations are behavioral; b) DSGEMs display RE in that representative agents form expectations from the knowledge of the system itself (MCE)
- Theory-consistent representation of the main relations among variables. Theoretical identification allows to perform policy simulations, optimal policy-making design and policy communication transparency
- Do not require large samples: structural parameters can be obtained by Bayesian estimation or by calibration

DSGE models in the face of the crisis

- The standard DSGE approach was unable to predict the crisis and, most importantly, resulted unable to provide guidance in the management of the economic events:
  - The operation of the ZLB and the impossibility of credible commitments to inflationary targets imply that standard authomatic interest rate rules are uneffective (Sims, 2011)
  - Ricardian equivalence of fiscal policy over-emphasized by the assumption of constant degrees of liquidity contraints: credit crunch, unemployment and the operation of the ZLB make fiscal multipliers state-dependent, i.e. substantially stronger when the economy is operating below full-capacity (Gordon and Krenn, 2010)
  - Over-simplistic representation of credit markets neglect or under-emphasize the role played by the term structure of interest rates and the term spreads. Monetary pass-through issues often neglected
  - The two extreme hypotheses of small and large economy generally adopted in DSGEs lead to neglect the role of international monetary-fiscal policy coordination

Essential literature background

- Standard NK-DSGE structure except for LM design: Smets and Wouters (2007); Christiano *et al.* (2005)
- Open economy framework: Adolfson *et al.* (2008)
- Labor market: Diamond (1982); Mortensen and Pissarides (1994); Gertler *et al.* (2008); Beqiraj and Tancioni (2013)
- Fiscal policy: Drautzburg and Uhlig (2011)

General structure of the model: overview

- Open economy DSGE *core* model with nominal and real frictions and a special focus on labor market functioning and on fiscal policy.
- Perfectly competitive intermediate goods sector. Monopolistic competition in final goods sector
- Four agents: Households, Unions, Firms and Policy makers (monetary and detailed fiscal policy)
- Nominal frictions: price and wage setting subject to Calvo-scheme and indexation
- Real frictions: convex private and public investment adj. costs, consumption habits, liquidity constraints. Endogenous demand elasticity à la Kimball. Costs in varying the utilization rate of K
- *Satellite* model structure for regional/sectoral breakdows of macro-variables and of labor market variables (based on ARDL eqs and transition probabilities)

Core model: focus on the labor market

- Labor market à la Mortensen and Pissarides (1994). Working age population and labor force are described by stochastic exogenous processes (i.e. the participation rate)
- Search and matching frictions make the model consistent with unvoluntary unemployment (Blanchard and Galì, 2010; Riggi and Tancioni, 2010)
- Staggered Nash-wage bargaining between Unions and Firms (Gertler *et al.*, 2008; Gertler and Trigari, 2009)
- Discrimination between incumbent workers and new entrants in Nash bargaining (Beqiraj and Tancioni, 2013)
- Introduction of hiring and wage subsidies from the government makes firms non-neutral in labor costs with respect to new hires and the firing process (Beqiraj and Tancioni, 2013)

Labor market continued - the fundamental stock-flow relation and the separation rate

- Model design allows the explicit derivation of stock-flow relations among employment, unemployment, firings and hirings of new labor. The basic aggregate relation is the following:

$$N_t = (1 - \delta_t) N_{t-1} + H_t$$

  where N_t is employment, δ_t is the (stochastically exogenous) separation rate and H_t denotes hiring of new labor

- Elementary data allow the identification of five different events of separation: firings δ_t^f, retirement δ_t^r, end of temporary contract δ_t^e, work-related injury and illnes δ_t^i and other causes δ_t^o
- The basic relation thus becomes:

$$N_t = \left(1 - \delta_t^f - \delta_t^r - \delta_t^e - \delta_t^i - \delta_t^o\right) N_{t-1} + H_t$$

Labor market continued - the matching process

- Hirings of new labor are the result of a matching process between vacancies and unemployment
- The matching function is assumed to be of a Cobb-Douglas form, i.e.:

$$H_t = \sigma^m \left(\psi U_t\right)^{\gamma} + V_t^{1-\gamma}$$

where σ^m is a mismatch parameter, ψ denotes the search effectiveness index and γ is a standard Cobb-Douglas coefficient

Labor market continued - staggered Nash wage bargaining in the presence of subsidies/benefits

- Hiring subsidies (fiscal contribution to training and ALMPs subsidies in general): affect hiring costs k_t and hence affect the firm job creation condition:

$$\frac{(1-hs_t)k_t}{q_t} = \theta_w J_t\left(w_{t-1}\right) + \left(1-\theta_w\right) J_t\left(w_t^*\right)$$

  where hs_t is the hiring subsidy, θ_w the probability of non-reoptimizing the wage in t, q_t is the job vacancy filling rate and J_t the firm value function of a filled vacancy.
- Wage subsidies (fiscal contribution to firms employing new labor): affect the wedge between the MPL and the wage cost of new entrants, i.e the unit cost of labor. In other terms, it affects the firm value function of a filled vacancy J_t
- Unemployment benefits (PLMPs): affect labor supply via the workers' surplus, i.e. the value of being unemployed (reservation wage)

Core model: focus on government policies

- Highly detailed fiscal policy with distortionary taxation:
  - Expenditures: gov. consumption, transfers, fixed investments, ALMPs (labor subsidies), PLMPs (unemployment benefits), interest payments on issued bonds (public debt)
  - Revenues: direct taxes on labor and firm incomes, indirect taxes on consumption, capital taxes, social contributions
- All revenue and expenditure components are (partially) endogenous and their rates deviate from S/S values according to variations in the government financial need (Drautzburg and Uhlig, 2011)
- Public investment is chosen by rational policy makers by maximizing private output subject to the public budget constraint (Beqiraj and Tancioni, 2013)

Satellite model: focus on LM regional/sectoral breakdowns

- Regional/sectoral breakdowns are obtained by estimating systems of $R \times S$ regional/sectoral ARDL equations (Giuli and Tancioni, 2009; Ciccarone and Tancioni, 2012)
- If regional/sectoral and aggregate variables are CI, the ARDL model has a long-run equilibrium (CI) and an ECM representation. For each generic variable x_t, and each k-th $R \times S$ combination:

$$\begin{aligned} \Delta x_t^k &= c_k + \sum_{i=1}^{p} \beta_i^k \Delta x_{t-i}^k + \sum_{j=o}^{q} \gamma_{k,j} \Delta \mathbf{z}_{t-i}^k + \\ &+ \alpha^k \left(x_{t-1}^k - \widehat{\varphi}_0^k - \widehat{\varphi}_1^k (t-1) \widehat{\boldsymbol{\theta}}^k \mathbf{z}_{t-1} \right) + \varepsilon_t^k \end{aligned}$$

where $\mathbf{z}_t$ is a vector of weakly exogenous variables in the core model. c_k and φ_0^k φ_1^k are deterministic terms for the dynamic and static relations, respectively

- To account for latent regional/sectoral correlation, the systems of $R \times S$ equations are estimated with the SUR technique

Satellite model: focus on LM age/professional/educational/contractual profiles

- Detail labor market variables are obtained by splitting the sectoral variables across age cohorts, professions, educational levels and contract typologies. Formally, for a given region/sector combination k, cohort c, profession p, education e and contract typology ct, the decomposition is obtained using deterministic relations based on transition matrices of the kind (considering hirings H):

$$H^k_{c,p,e,ct,t} = \omega^k_{c,p,e,ct} H^k_t$$

whose elements are calculated outside the model using discrete choice models on LMS elementary data (Bagnai *et al.*, 2006).

What FGB-LM MKIII can address

- Calibration and simulation of ALMPs/PLMPs affecting hiring costs, the unit cost of new labor, the matching efficiency, the reservation wage
- Calibration and simulation of policies affecting social contributions and social benefit expenditures
- Calibration and simulation of policies affecting the separation rate (reforming the eligibility conditions for transition to retirement)
- Detailed calibration and simulation of fiscal policy instruments

Model estimation/calibration

- 23 time series are used fort the Bayesian estimation of the model (23 structural shocks to avoid stochastic singularity)
- From identification analysis (Iskrev, 2010) the subset of empirically identifiable deep parameters are selected. The other parameters are calibrated. Estimated parameters are:
  - *Labor market parameters*: unemployment benefit, union's bargaining power, Calvo parameter
  - *Production*: private K share, private K depr. rate, private investment adj. cost, private K utilization curvature, public K depr. rate, public investment adj. cost
  - *Consumption*: habits, fraction of rule-of-thumbers
  - *Foreign sector*: elasticities of subst. btw. foreign and domestic goods, home bias, sensitivity of NEER to int. rate differential and NFA
  - *Policy coefficients*: Taylor rule coefficients, elast. of tax rates to the financial need, memory coefficients for fiscal policy exogenous processes
- The parameter space upon which the estimate is initialized is derived from stability mapping (Ratto, 2008)

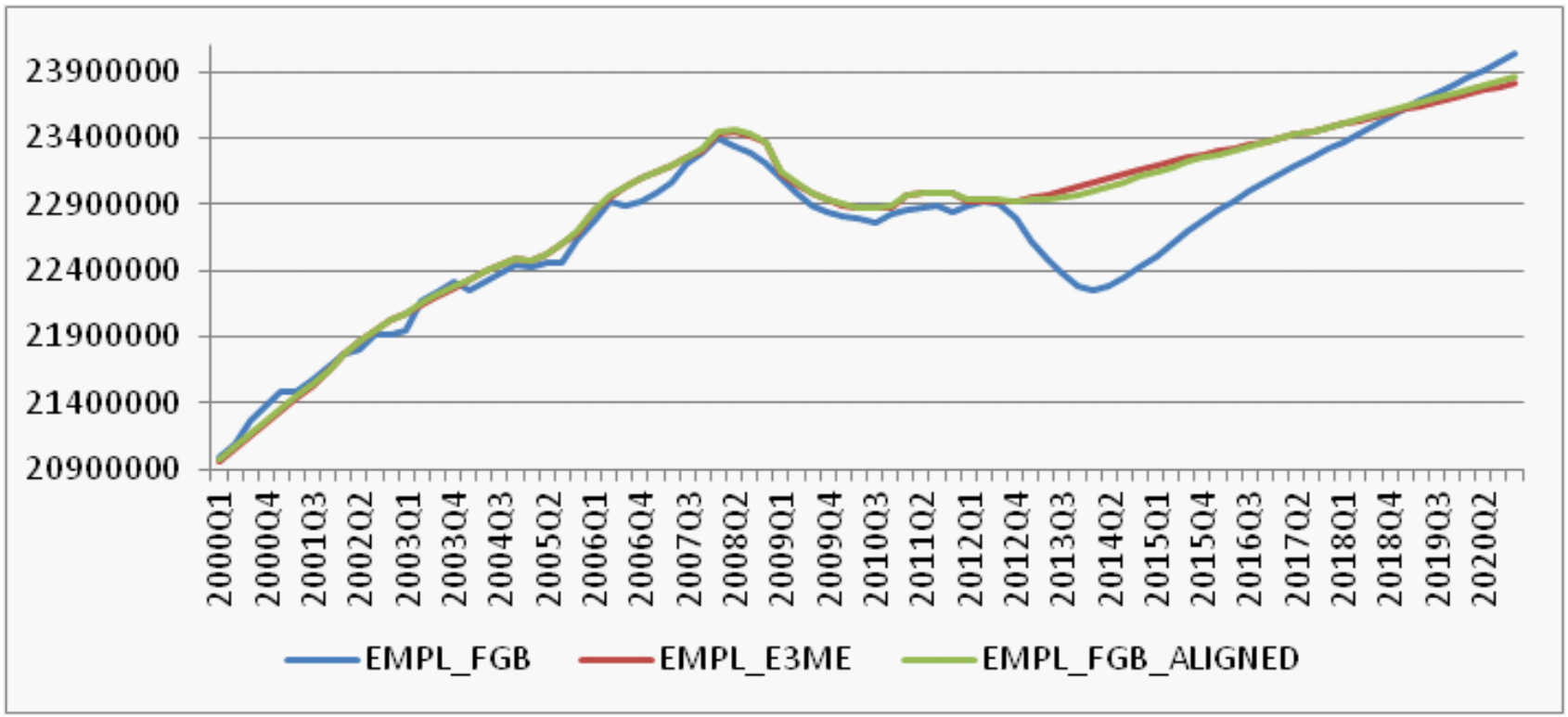
Model Alignment to E3ME

- Alignment of the FGB-LM model to the E3ME's forecasts obtained with a Simulated Moment Matching (SMM) algorithm for a subset of the FGB-LM deep parameters space
- SMM provides a calibration of the estimated parameters that minimizes the squared distance between the FGB-LM and the reference model (E3ME) simulations, ensuring the highest level of alignment between the two models.

Model Alignment to E3ME

- Since the structure of the two models is different, a complete overlap of the projections can be obtained only in the highly unprobable circumstance that E3ME can be considered a transformation/re-parameterization of the FGB model.

Figure 1 - E3ME and FGB model



LM reform: 0.78% increase in social contributions of NHs (FTCs, PrjCs)

Table 1 - Simulated effects of the LM reform: % deviations from benchmark

Variable	2012	2013	2014	2015	2016
Real GDP	-0.011	-0.018	-0.018	-0.018	-0.018
Real private consumption	-0.009	-0.019	-0.023	-0.025	-0.027
Hiring rate	-0.846	-0.589	-0.574	-0.567	-0.565
Hire of new labor	-0.291	-0.028	-0.021	-0.021	-0.022
Employment	-0.017	-0.024	-0.024	-0.024	-0.023
Unemployment	0.201	0.470	0.470	0.463	0.459

LM reform: 1.94% wage subsidies for new hires (ICs, OJTCs de-contr)

Table 2 - Simulated effects of the LM reform: % deviations from benchmark

Variable	2012	2013	2014	2015	2016
Real GDP	0.018	0.030	0.029	0.029	0.029
Real private consumption	0.017	0.032	0.037	0.042	0.046
Hiring rate	1.287	0.883	0.841	0.828	0.826
Hire of new labor	0.468	0.060	0.035	0.033	0.036
Employment	0.026	0.040	0.040	0.039	0.039
Unemployment	-0.257	-0.669	-0.681	-0.671	-0.663

LM reform: 15% transitory hiring subsidy (S/S hiring cost = 9%)

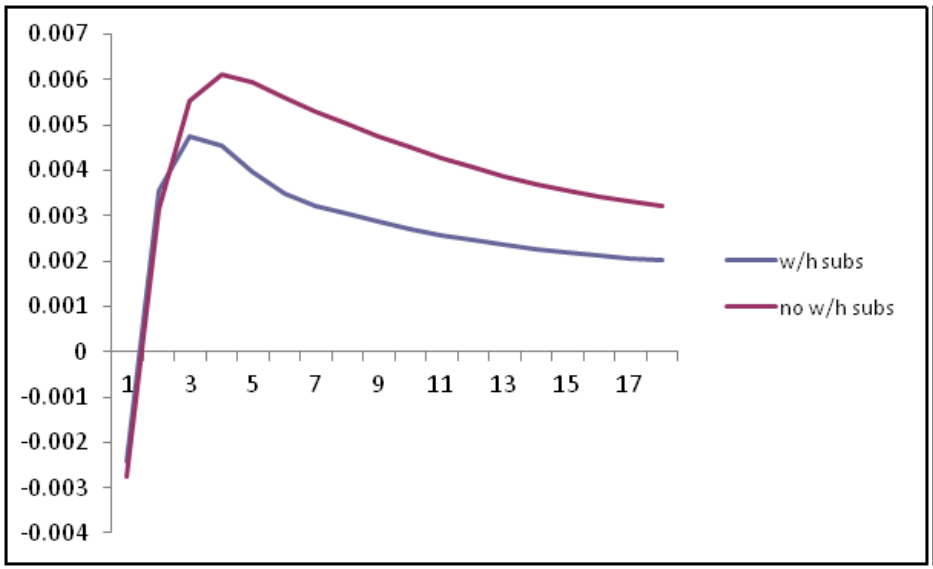
Table 3 - Simulated effects of the LM reform: % deviations from benchmark

Variable	2012	2013	2014	2015	2016
Real GDP	0.026	0.014	0.004	0.003	0.003
Real private consumption	0.004	0.009	0.008	0.007	0.006
Hiring rate	1.601	-0.318	-0.078	-0.017	-0.000
Hire of new labor	0.575	-0.316	-0.064	-0.009	-0.001
Employment	0.041	0.017	0.002	-0.000	-0.000
Unemployment	0.004	0.009	0.008	0.007	0.006

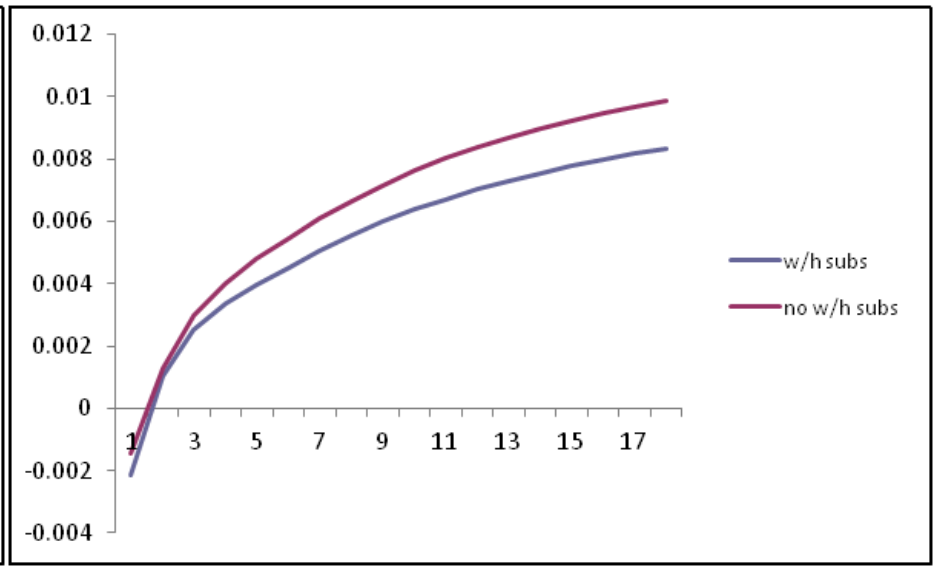
LM reform: 1% shock in TFP and H/W subsidies: distorsion

Figure 2 - Simulated effects of the LM reform: % deviations from benchmark

Employment



Private consumption



Pension reform: reduction in retirement rate and in social benefits expenditure

Table 4 - Simulated effects of the pension reform: % deviations from benchmark

Variable	2013	2014	2015	2016	2017	2018
Real GDP	-0.022	-0.020	-0.014	-0.006	0.000	0.003
Real wage	0.146	0.152	0.114	0.072	0.039	0.017
Employment	-0.013	-0.011	-0.003	0.006	0.013	0.017
Unemployment	0.992	1.420	1.481	1.367	1.119	1.001

Youth Guarantee

- YG designed as a targeted intervention: only in MS with more than 25% of youth unemployment (Ireland, Italy, Latvia, Lithuania, Portugal, Slovakia and Spain) and for unemployed people in the 15-25 age cohort.
- Recommended measures favor Germany-oriented structural LM reforms, i.e., ALPMPs, public employment services, training and apprenticeship schemes, supporting the transition school/work with vocational training systems, facilitate labor mobility
- Limited amount of resources (less than 0.05% of GDP per year, or slightly above EUR 800 per young European)
- The share of the European YG funds assigned to Italy amounts to nearly 1.5 billion Euros, one for 2014 and 2015 and half billion in subsequent years (2016-2020). Additional 0.8 billion Euros available by the Italian government within the Employment Package Act (EP), expected to be directed to the reduction of the labor cost of newly hired workers.

Youth Guarantee in the simulation excercise

- The policy simulation exercise is here developed along two main lines: 1) a permanent reduction in the general hiring costs through structural LM reforms; 2) a persistent, albeit not permanent, reduction of the labor cost of newly hired workers through transitory wage subsidies
- Calibration of measure 1) highly problematic. We assume that, given the monetary amount of the estimated equilibrium hiring cost parameter, the structural measures are expected to induce a permanent reduction of this specific cost for an amount equivalent to the YG funds spent
- Measure 2) more easily implementable, as its monetary amount, timing and duration can be precisely defined. To simplify the analysis and better appreciate the relative effectiveness of the alternative measures, we consider a transitory (four quarters half life persistence) wage subsidy reducing the wage cost for an amount consistent with the YG funds being spent in each period

Scenarios

- S1: 100% of YG funds to reduction of hiring cost (hiring subsidy). Fiscal financing
- S3: 100% of YG funds to new entrants' wage subsidization. Fiscal financing
- S5: 50% of YG funds to reduction of hiring cost, 50% of YG funds to new entrants' wage subsidization. Fiscal financing

Macroeconomic effects of the alternative scenarios

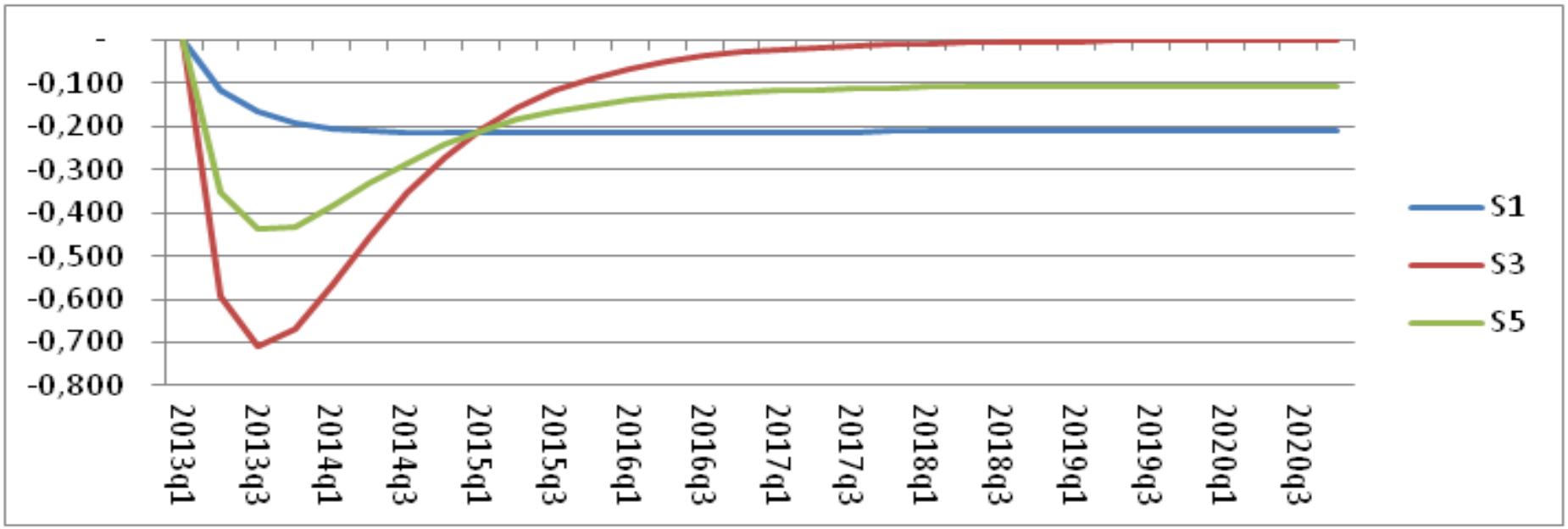
Table 5 - Macroeonomic effects of the alternative policy scenarios.
% deviations from control

	GDP			CONS			INV			X-M		
	S1	S3	S5	S1	S3	S5	S1	S3	S5	S1	S3	S5
2013q4	0.000	0.013	0.007	0.002	0.022	0.012	0.008	0.062	0.035	0.019	0.073	0.046
2014q4	0.001	0.009	0.005	0.004	0.013	0.008	0.014	0.049	0.032	0.019	0.016	0.017
2015q4	0.002	0.005	0.003	0.004	0.004	0.004	0.015	0.024	0.020	0.019	0.006	0.012
2016q4	0.002	0.004	0.003	0.004	0.002	0.003	0.016	0.008	0.012	0.019	0.006	0.012
2017q4	0.003	0.003	0.003	0.004	0.002	0.003	0.016	0.000	0.008	0.018	0.007	0.013
2018q4	0.003	0.002	0.003	0.005	0.001	0.003	0.016	-0.004	0.006	0.018	0.008	0.013
2019q4	0.003	0.002	0.003	0.005	0.001	0.003	0.016	-0.005	0.006	0.018	0.008	0.013
2020q4	0.003	0.002	0.002	0.006	0.001	0.003	0.017	-0.006	0.005	0.017	0.007	0.012

Source: FGB-LM model simulations

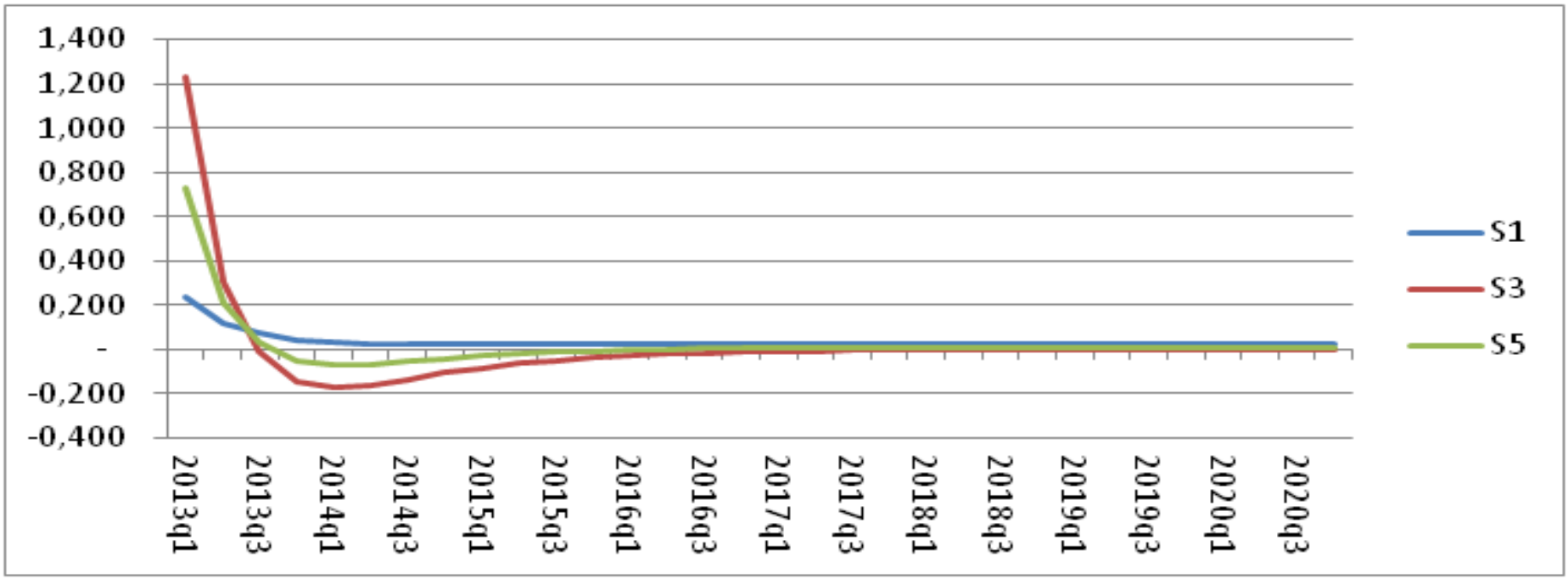
Unemployment response

Figure 3 - UR response to the policy scenarios. % deviations from control



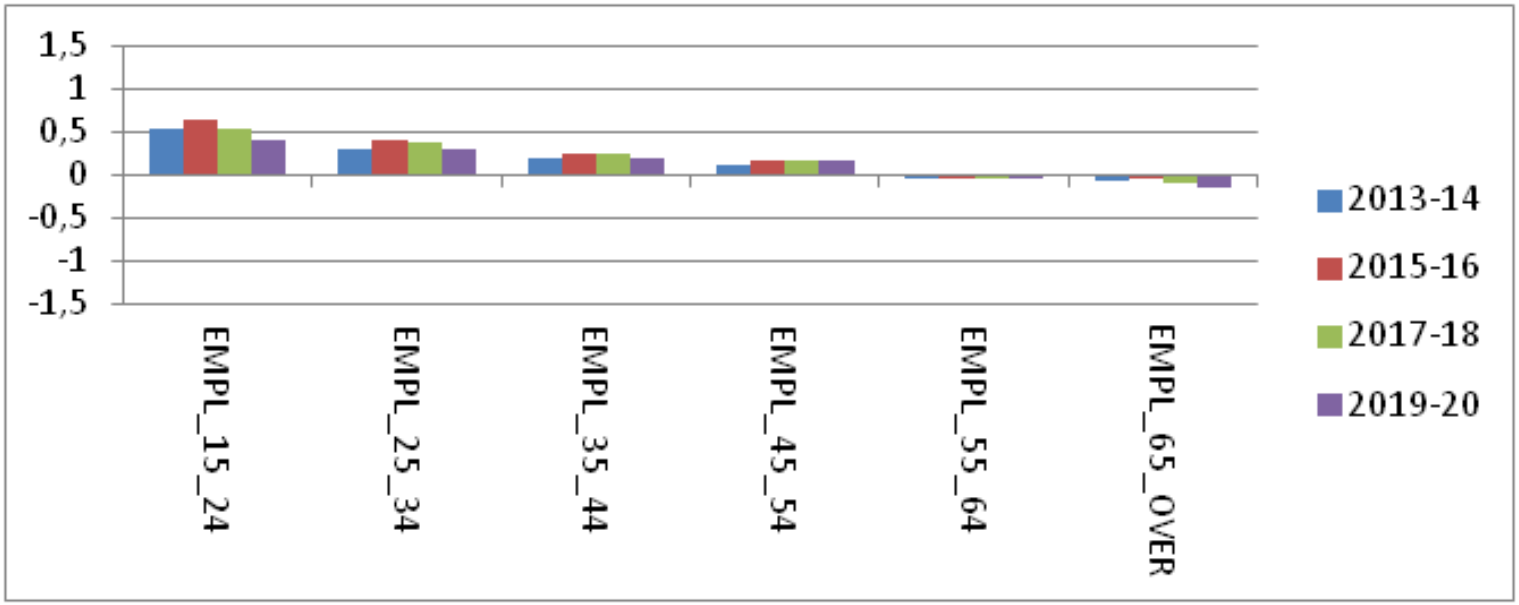
Hiring rate response

Figure 4 - HR response to the policy scenarios. % deviations from control



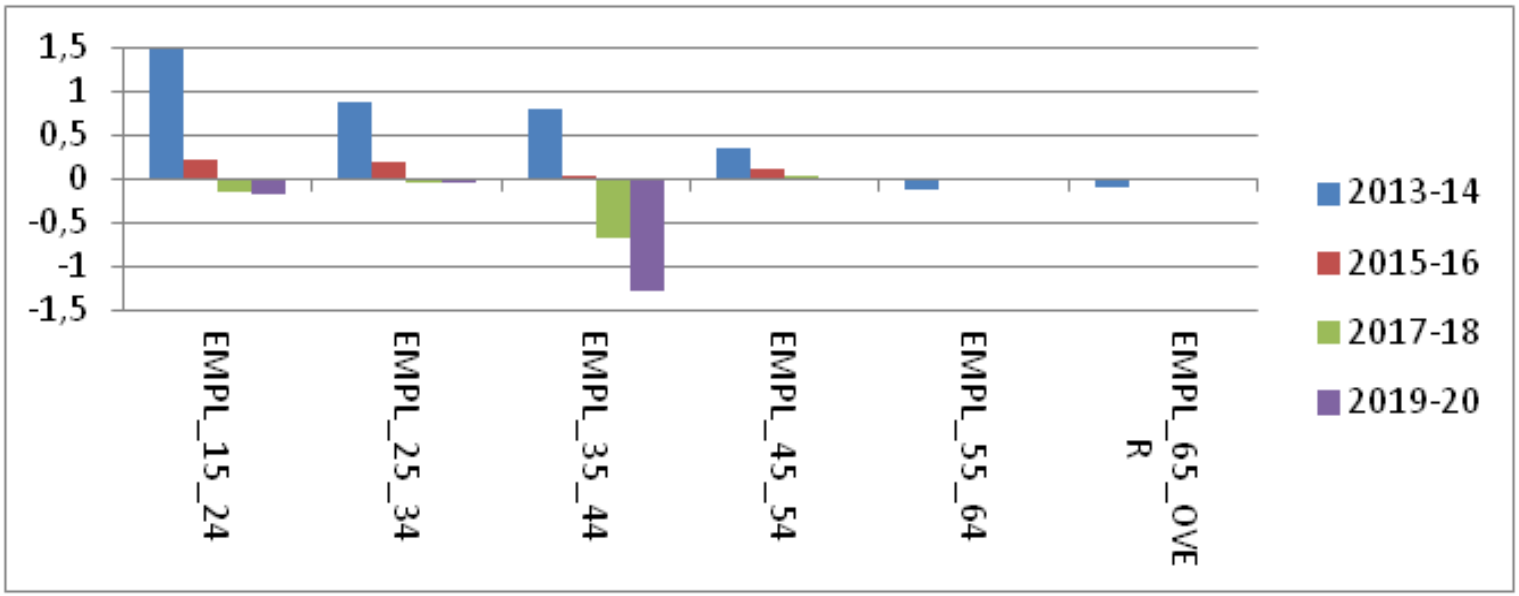
Cohort-specific effects on employment stocks

Figure 5 - Percentage employment level variations in scenarios: Measures reducing the hiring cost



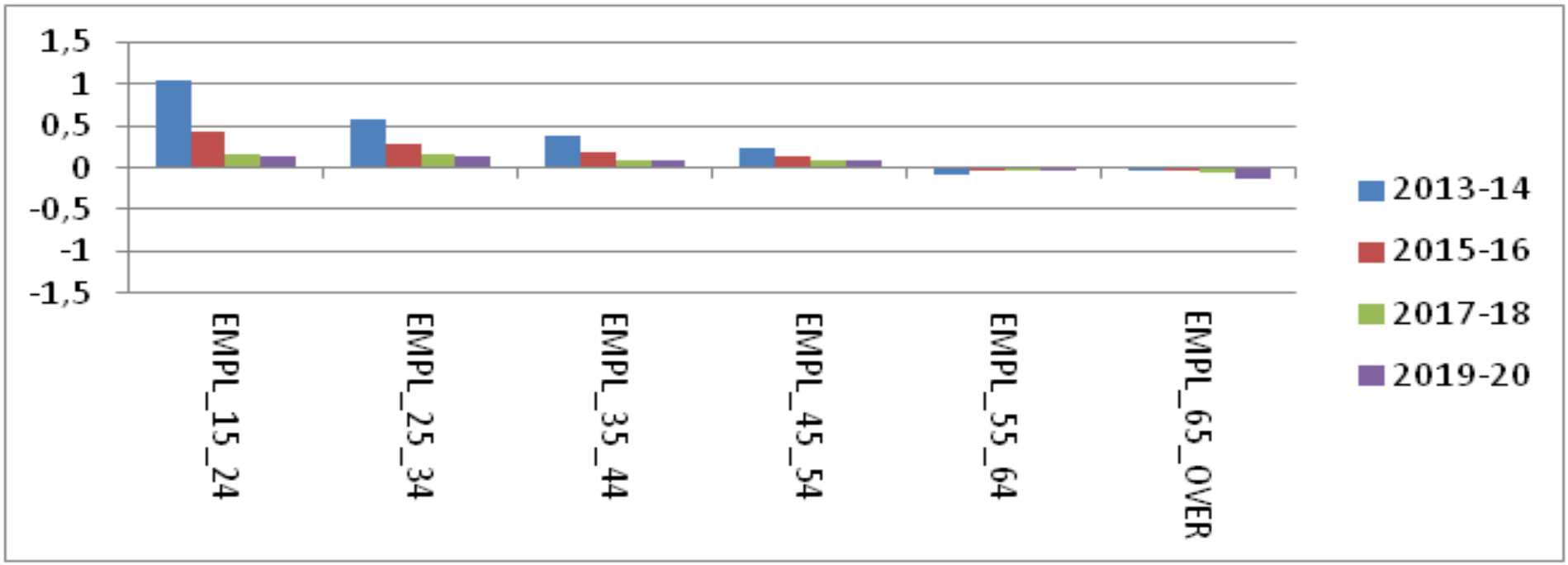
Cohort-specific effects on employment stocks

Figure 6 - Percentage employment level variations in scenarios: Wage subsidy for new hires



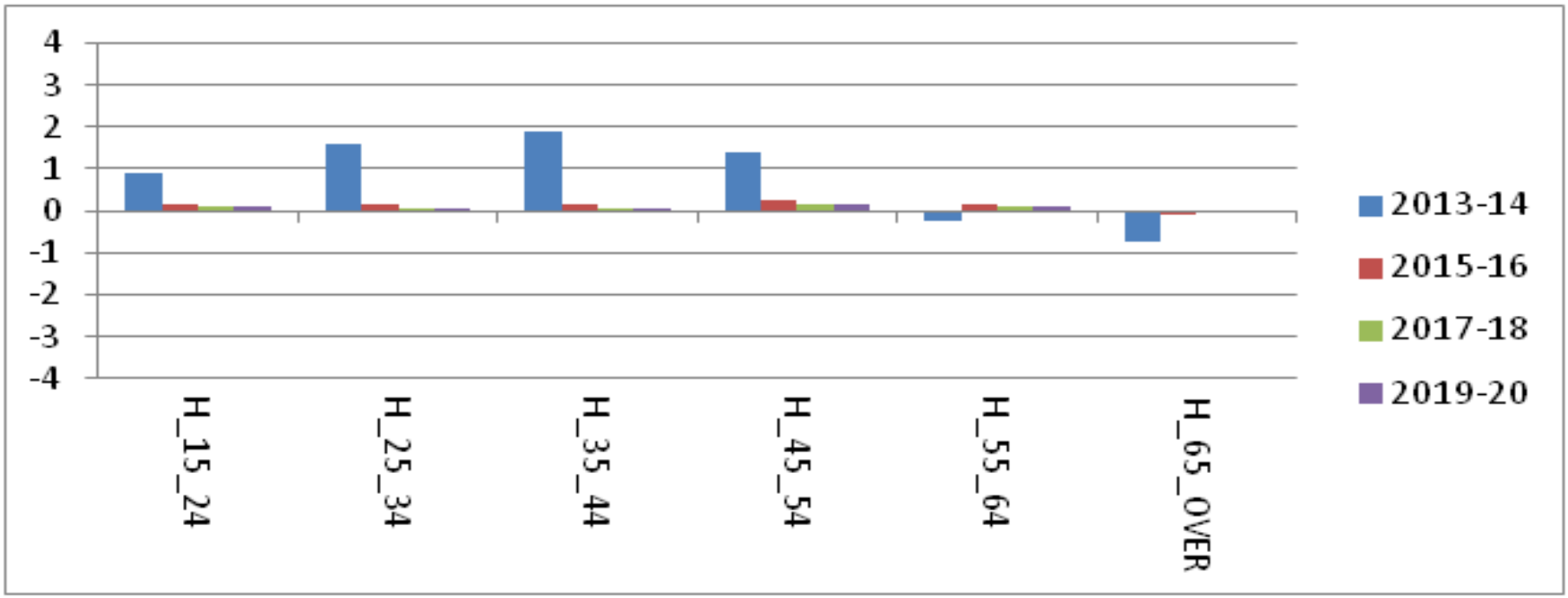
Cohort-specific effects on employment stocks

Figure 7 - Percentage employment level variations in scenarios: Mixed Policy



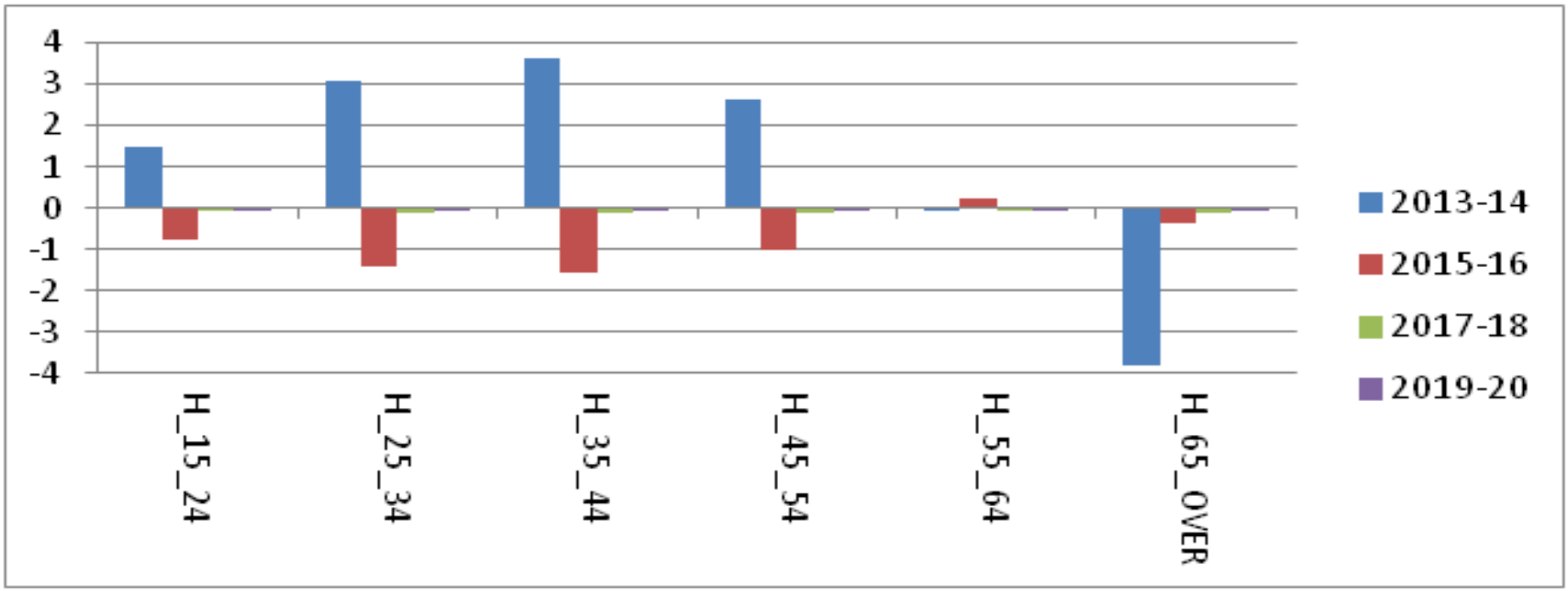
Cohort-specific effects on hiring flows

Figure 8 - Percentage hiring level variations in scenarios: Measures reducing the hiring cost



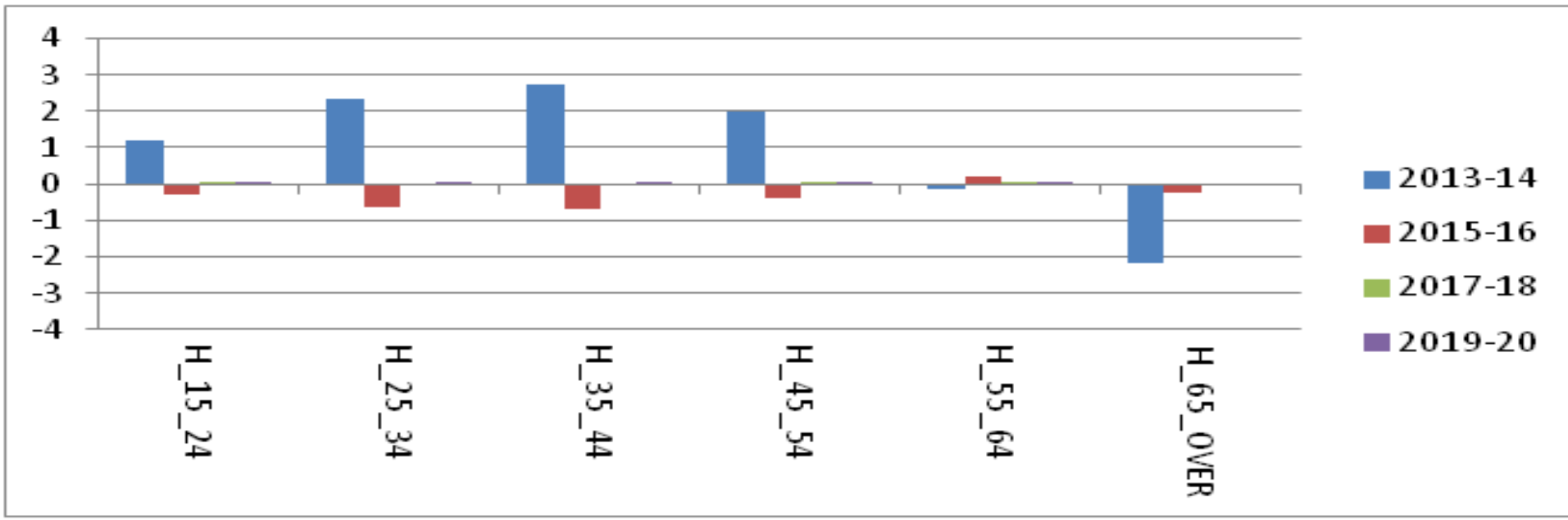
Cohort-specific effects on hiring flows

Figure 9 - Percentage hiring level variations in scenarios: Wage subsidy for new hires



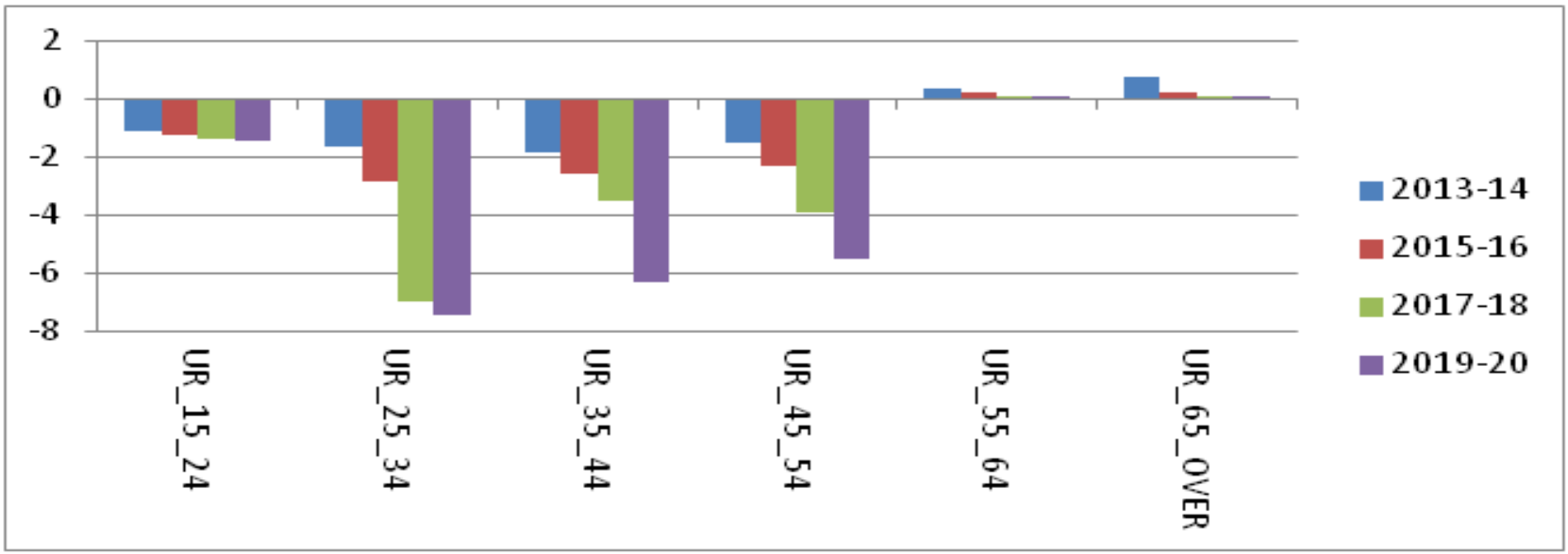
Cohort-specific effects on hiring flows

Figure 10 - Percentage hiring level variations in scenarios: Mixed policy



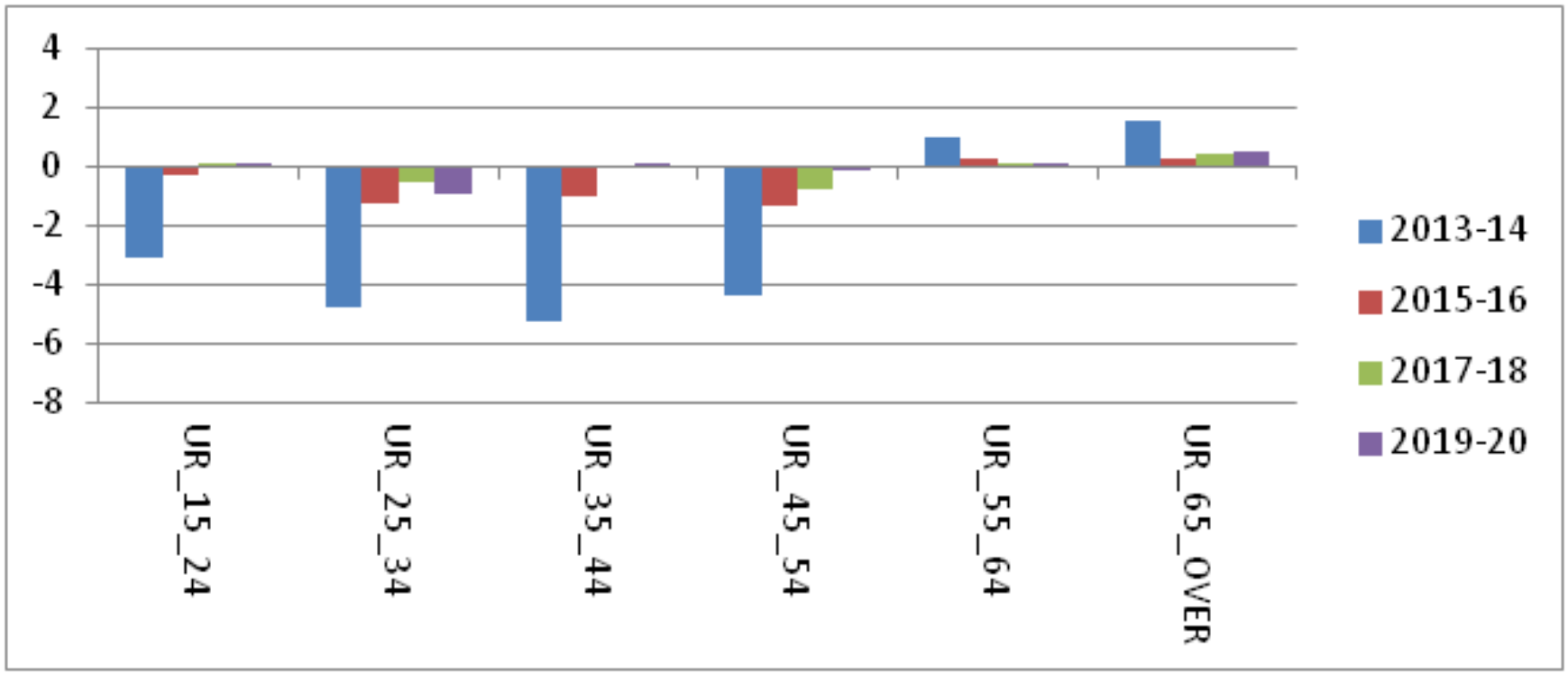
Cohort-specific effects on unemployment stocks

Figure 11 - Percentage unemployment level variations in scenarios: Measures reducing the hiring cost



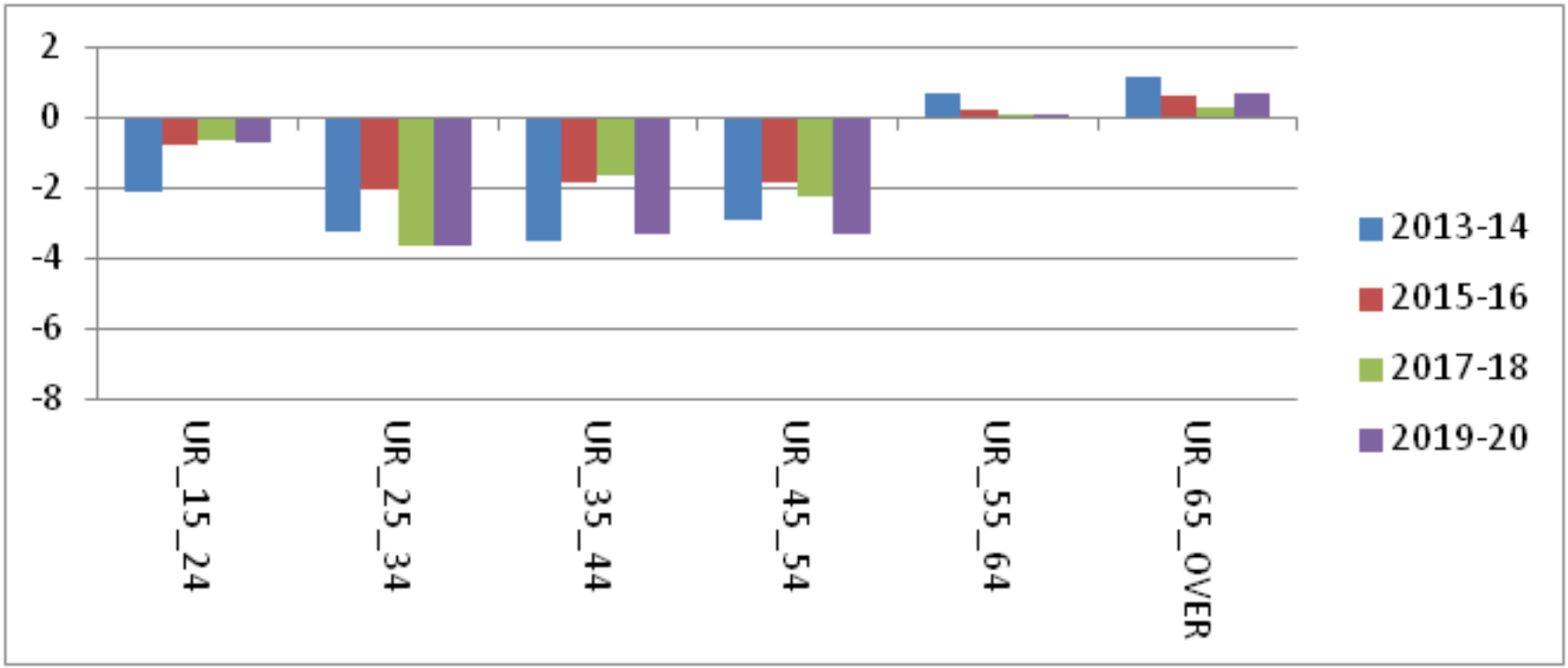
Cohort-specific effects on unemployment stocks

Figure 12 - Percentage unemployment level variations in scenarios: Wage subsidy for new hires



Cohort-specific effects on unemployment stocks

Figure 13 - Percentage unemployment level variations in scenarios: Mixed policy



Why a multi-country extension

- The European perspective of Cedefop's project goals makes the small open economy hypothesis somewhat restrictive, at least for larger EU countries, for which the developments in the other member economies cannot reasonably be considered as exogenous, i.e. independent of the domestic developments.
- Such a change of perspective requires the modification of the present structure of the FGB-LM model towards an extended structure describing the multiple foreign relations of each country with its EU and non EU partners, i.e., a fully specified multi-country DSGE model.
- The European set-up requires to consider the distinction between the group of countries sharing the single currency (thus the monetary authority) and the group of countries outside the EZ. Moreover, within the latter group, an additional distinction for the countries that are in the process of joining the single currency and those that are not under this process.

How to implement it

- In a multi-country model the foreign relations of each country are described by the set of bilateral trade and foreign assets positions with all the remaining countries, regulated by movements in the nominal and thus the real exchange rate and in the uncovered interest rate relations.
- The distinction between EU-non-EZ and non EU countries can be implemented considering an opportunely differentiated import/export adjustment cost and/or by distinguishing between consumption and import taxes in the aggregate sale tax rates.
- The further distinction between EU-non-EZ and non EU countries can be implemented considering an opportunely differentiated import/export adjustment cost and/or by distinguishing between consumption and import taxes in the aggregate sale tax rates.
- Considering N countries, of which i are EZ countries, N+1-i uncovered interest parities (UIPs) and no exchange rate arbitrage conditions (NERACs) need to be considered.

How to implement it

- With respect to the latter conditions, an intuitive example of their derivation is the following: denote the bilateral log exchange rate of country j with respect to country k with y s_t^{jk}, and the bilateral log exchange rate of country j with respect to country l with s_t^{jl}.
- It is easy to verify that$s_t^{jl} = s_t^{jk} - s_t^{kl}$.
- The NERAC just described is ensured by assuming long-run efficient Foreign Exchange Market (FX).

How to implement it

- The foreign relations of each country are in this case described by the set of bilateral trade positions only, in this case regulated by movements in the set of domestic to foreign relative price relations defining the set of bilateral real exchange rates.
- The fact that the theoretical prediction of zero government bond interest rate differentials under single currency is strongly rejected by the data can be taken into account by considering a country-specific default risk channel driven by the deficit/debt to GDP ratio, or by introducing measurement errors allowing for the presence of a wedge between theoretical and observed interest rate parities.
- Such an interest rate wedge also allows the consideration of the countries in the process of joining the EZ within the group of the incumbent EZ countries, because of the constraints imposed to the policy conduct, basically equivalent to those characterizing the EZ member states.

How to implement it

- The main source of complexity here comes from the need to derive the multiple relative price relations defining the domestic, import and export price dynamics, and thus the single countries price indexes.
- The country-specific models defining the domestic economies will thus also include some key multi-country equations such as 12xN+1-i relative price equations, N+1-i uncovered interest rate parities (UIPs) determining the N+1-i nominal bilateral exchange rates, N+1-i NERACs and a real effective exchange rate equation.
- As mentioned above, the multiple price equations emerge as a result of the three sectors model economy considering the domestic, the import and export sectors for consumption and investment goods.
- We have verified that, in a simplified framework considering four countries (two sharing the single currency, one belonging to the non-EZ EU and one outside the EU), the multi-country extension is a viable, albeit complex, option.