The FGB-LM Simulation Model

Forecasting job and skill needs in Italy

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Model structure: "core" - "satellite" relations

- A “core” - or "pilot“ - model block defines the evolution of the fundamental macro-variables (GDP, consumption, investment, wages, prices, interest rates, employment, unemployment, hirings and firings)
- “Satellite” blocks of equations define the breakdown by sector, age, profession and skill

Modelling strategy: hybrid approach

- "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)
- "Satellites": Detail relations derived from statistical/empirical relations
- Literature background:
  - Mortensen, D.T. and Pissarides, C. (1994). "Job creation and job destruction in the theory of unemployment", *Review of Economic Studies*
  - Giuli, F. and Tancioni, M. (2009). "Il nuovo modello di previsione dei flussi del mercato del lavoro FGB-MDL: aspetti di metodo e di struttura", *Economia & Lavoro*
  - Riggi, M. and Tancioni, M. (2010). "Nominal v. real wage rigidities in new Keynesian models with unemployment: A Bayesian evaluation", *Journal of Economic Dynamics and Control*
  - Blanchard, O. and Galì, J. (2010). "Labor markets and monetary policy: A new-Keynesian model with unemployment," *American Economic Journal: Macroeconomics*

Input and output data

- Input: macroeconomic data from OECD-QNA, OECD-QLFS, IMF-IFS and the Italian National Statistical Office (Istat)
- Input: separation and hiring rates, (by age, profession, skill) from the LFS National Statistical Office's elementary data
- Output: forecasts for all variables in the model: macroeconomic aggregates, labor force and employment stocks and flows (separations and hirings) by age-class, sector, profession, skill

Why a theory-based "core" model?

- Lack of long time series for flow data makes data-intensive methods such as VARs not a viable option: need to anchor the simulations to hard theory
- The DSGE approach does not suffer the Lucas-Sims critiques since: *i*) model equations are behavioral and *ii*) DSGEMs display RE
- Transparency: the NK-DSGE approach offer a theory-consistent representation of the main relations among variables. Theoretical identification allows to perform *i*) policy simulations, *ii*) optimal policy-making design and *iii*) improve policy communication transparency

Model derivation (general)

- Representative agents face a problem of max utility/profits subject to budget and technical constraints
- Forward-looking behavior imply that the constrained max problem has to be solved intertemporally
- The dynamic laws of motion of the economy are derived from F.O.C.s. for utility/profit maximization. The resulting equations are behavioral, i.e. relations among variables are defined in terms of deep parameters (psicology and technology)

Model features: frictions

- Nominal/real frictions and monopolistic competition in the goods and labor markets makes the NK-DSGEM consistent with mid-term Keynesian features observed in the data. In particular:
  - Habits and rule-of thumb behavior in consumption for a fraction of households make the model consistent with the observed persistence in the data and with the Barro-Ricardo equivalence result
  - The presence of hiring costs makes the NK-DSGE model consistent with long-term (equilibrium) unemployment
- The labor market structure is modelled in the spirit of Mortensen-Pissarides (1994), such as in the NK-DSGE models of Blanchard and Galì (2009), Giuli and Tancioni (2009) and and Riggi and Tancioni (2010)
- Under these hypotheses, the methodology overcomes the separation among forecasting models (VARs, BVARs), maximizing the predictive performances, and theoretical models (RBC-CGE), mostly oriented to the evaluation of fully specified theories. The out of sample properties of NK-DSGEM are basically in line with those of reference forecasting

Model features: expectations formation

- In order to improve forecasting performances, the standard hypothesis of model-consistent expectations is replaced by that of data-consistent expectations.
- In practice: expectations are derived from an unrestricted VECM since:
  - The joint data density, under standard hypotheses (stationarity, linearity, normality), has a VAR representation. This ensures data consistency
  - Considering DSGE model stability properties (long-run balanced growth), a VECM ensures consistency among expectational variables and model properties
- The VECM is estimated and simulated before "core" model estimation, thus expectations are considered as exogenous at the beginning of the forecast

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 time-specific separation rate and H_t denotes hiring of new labor

- Elementary daya allow the identification of five different events of separation, completely specified in the simulations: 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:

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

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.:

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

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

- Also, and by definition it must be:

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

where $\left(\delta_t^f + \delta_t^r + \delta_t^m + \delta_t^i + \delta_t^o\right) N_{t-1}$ define the outflows from labor and $N_t - N_{t-1} = \Delta N_t$ is the net employment variation

The equations of the satellite blocks: sectoral breakdown

- For each macroeconomic variable of the pilot model, its sectoral breakdown is obtained by estimating a system of S sectoral Auto-regressive Distributed Lags equations (ARDL)
- If the regional/sectoral and aggregate variables are CI (long-run stability), the ARDL model has a representation in terms of the static long-run equilibrium relation and of the dynamic error-correction relation (ECM). For each sector s generic variable $x_{s,t}$:

$$\Delta x_t^s = c_s + \sum_{i=1}^{p} \beta_i^s \Delta x_{t-i}^s + \sum_{j=o}^{q} \gamma_{s,j} \Delta \mathbf{z}_{t-i}^s + \alpha^s \left(x_{t-1}^s - \widehat{\varphi}^s - \widehat{\boldsymbol{\theta}}^s \mathbf{z}_{t-1}^s \right) + \varepsilon_t^s$$

  where ${}_s\mathbf{z}_{s,t}$ is a vector of weakly exogenous variables that are present in the core model. c_s and φ^s are deterministic terms for the dynamic and static relations, respectively.
- To account for latent regional/sectoral correlation, the systems of S equations are estimated with the SUR technique

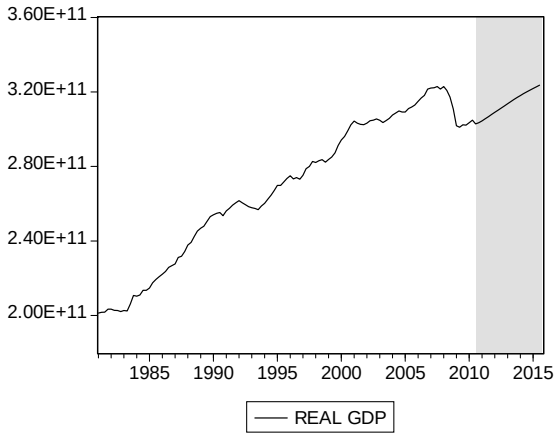
The equations of the satellite blocks: age/profession/skill breakdown

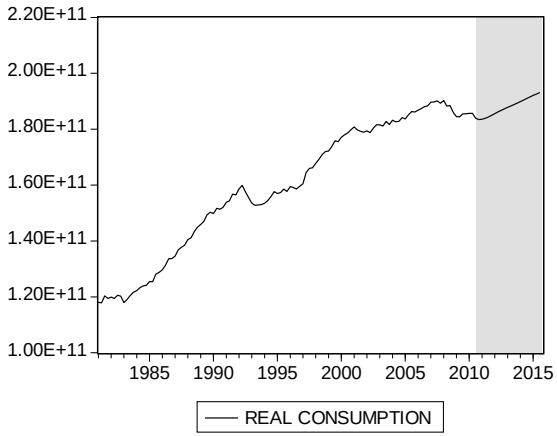
- Detail labor market variables are obtained by splitting the sectoral variables among age compositions, professions and skills. Formally, for a given sector s, the age cohort c, profession pr and skill sk decomposition is obtained by using deterministic equations of the kind (considering hirings):

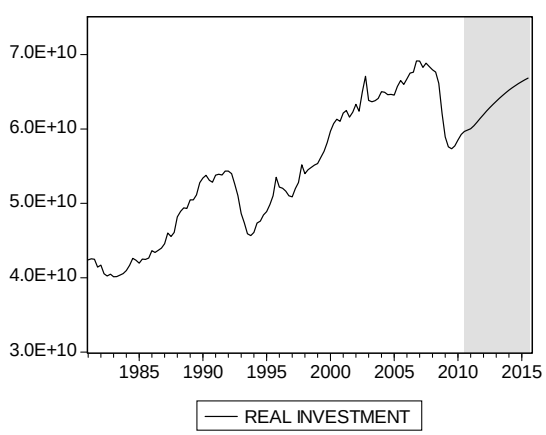
$$H^s_{c,pr,sk,t} = \omega^s_{c,pr,sk} H^s_{c,pr,sk,t}$$

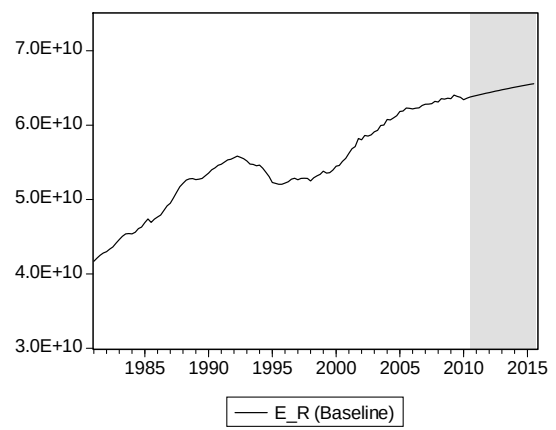
  whose coefficients are calculated outside the model through elaborations on elementary data
- Unfortunately, lack of reliable and sufficiently long time-series data forces the use of fixed weights. Scenario hypotheses on their evolution can be evaluated.

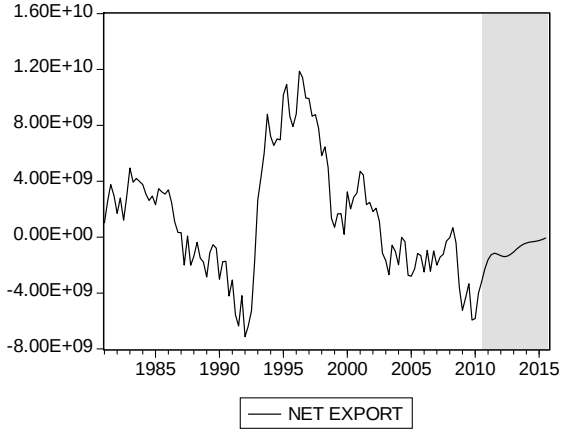
Italy: macroeconomic environment 1980-2015 (forecast period: 2010:3 2015:3)

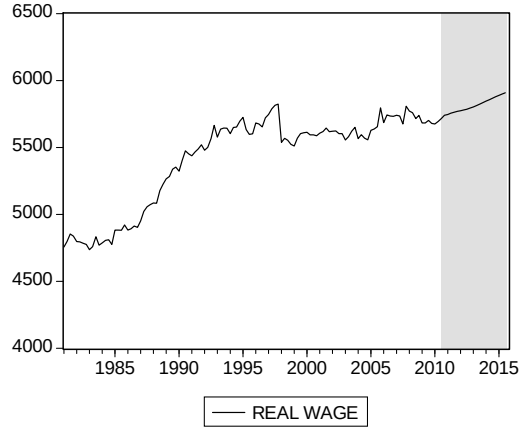








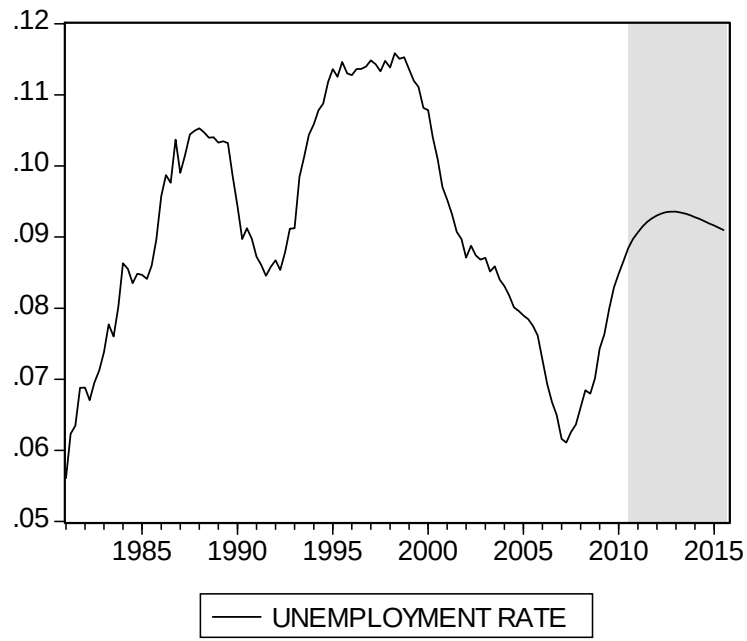




Italy: % growth rates in selected variables

	Variable						
Time	GDP	CONS	INV	GOV	EXP	IMP	WAGE
2010	0.96	−1.09	3.64	0.22	12.9	7.75	1.07
2011	1.45	0.81	2.59	0.63	5.03	3.69	0.52
2012	1.48	1.24	3.02	0.59	2.49	2.49	0.41
2013	1.44	1.08	2.43	0.54	4.30	3.46	0.70
2014	1.23	1.16	1.89	0.51	2.27	2.02	0.75

Italy: labor market aggregates 1980-2015 (forecast period: 2010:3 2015:3)



Italy: Outflows and hirings (thousands) 2010-2014

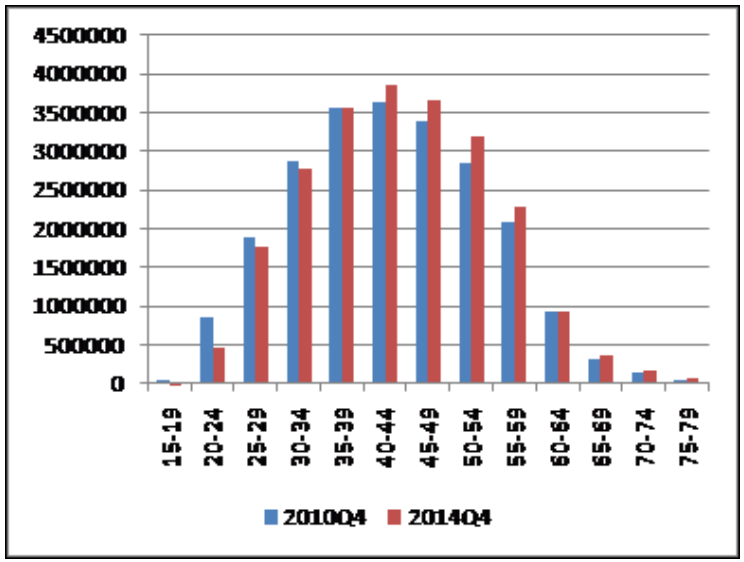
	Outflows						H	H - Out
Time	F	ETC	R	I/I	O	Tot		
2010	599	1271	638	41	219	2,770	2695	−74607
2011	646	1286	620	41	212	2,807	2866	58882
2012	709	1328	606	41	197	2,883	2964	81314
2013	780	1359	605	41	182	2,968	3129	161410
2014	862	1378	613	41	168	3,064	3225	161715

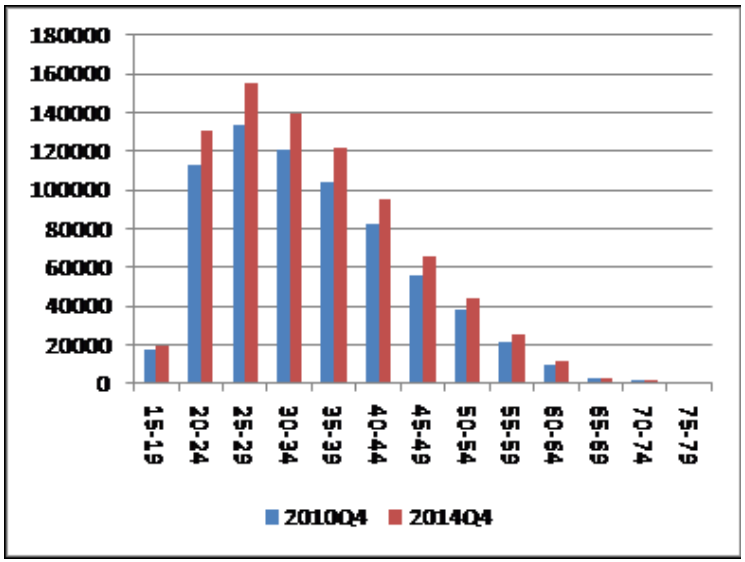
Notes: Hirings - outflows are in levels

F: firings; ETC: End of temporary contract; R: Retirement;

I/I: Injury/illness on the workplace; O: other

Italy: Employment and hirings by age class 2010 and 2014





Italy: Employment by skill level (thousands) - forecast 2010-2014

	Employment					
Time	SK1	SK2	SK3	SK4	SK5	SK6
2010	1437	7086	10146	3645	239	41
2011	1431	7058	10180	3698	242	41
2012	1425	7031	10225	3763	247	42
2013	1424	7021	10306	3847	253	43
2014	1422	7004	10387	3939	259	44
$\Delta\%$	-1.0	-1.1	2.4	8.1	8.3	8.8

Notes: $\Delta\%$ is employment: total change 2010-14

SK1: no education and primary; SK2: secondary school; SK3: high school; SK4: university grad; SK5: post-graduate master or specialization; SK6: Ph.D

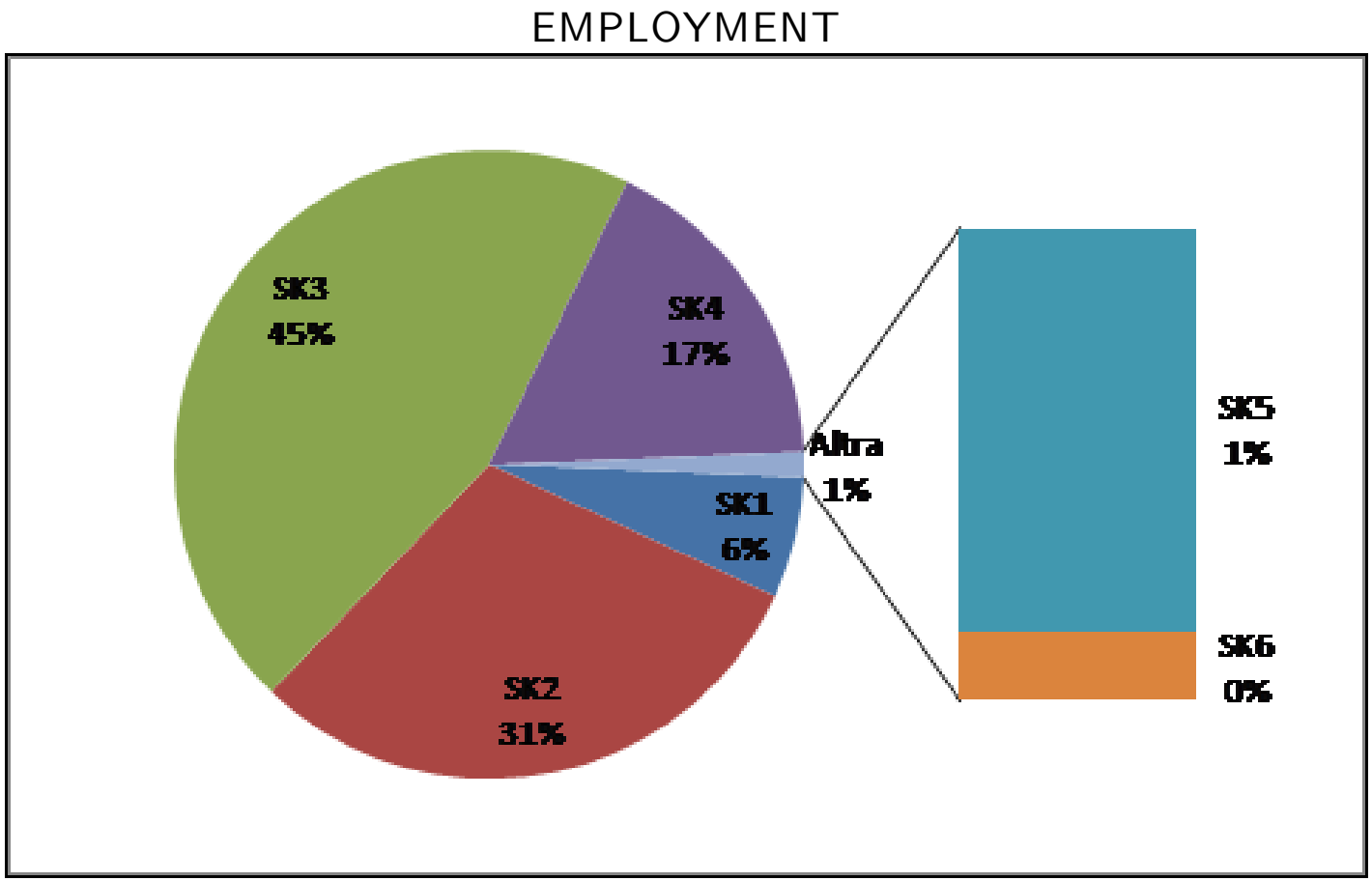
Italy: Hiring by skill level (thousands) - forecast 2010-2014

	Hiring					
Time	SK1	SK2	SK3	SK4	SK5	SK6
2010	27	189	323	138	18	2000
2011	28	197	337	145	19	2115
2012	29	201	345	149	20	2198
2013	30	214	368	161	21	2385
2014	31	217	373	165	22	2474
$\Delta\%$	3.6	3.5	3.7	4.6	4.8	5.5

Notes: $\Delta\%$ is avg hiring changes 2010-14

SK1: no education and primary; SK2: secondary school; SK3: high school; SK4: university grad; SK5: post-graduate master or specialization; SK6: Ph.D

Italy: Employment by skill level - composition



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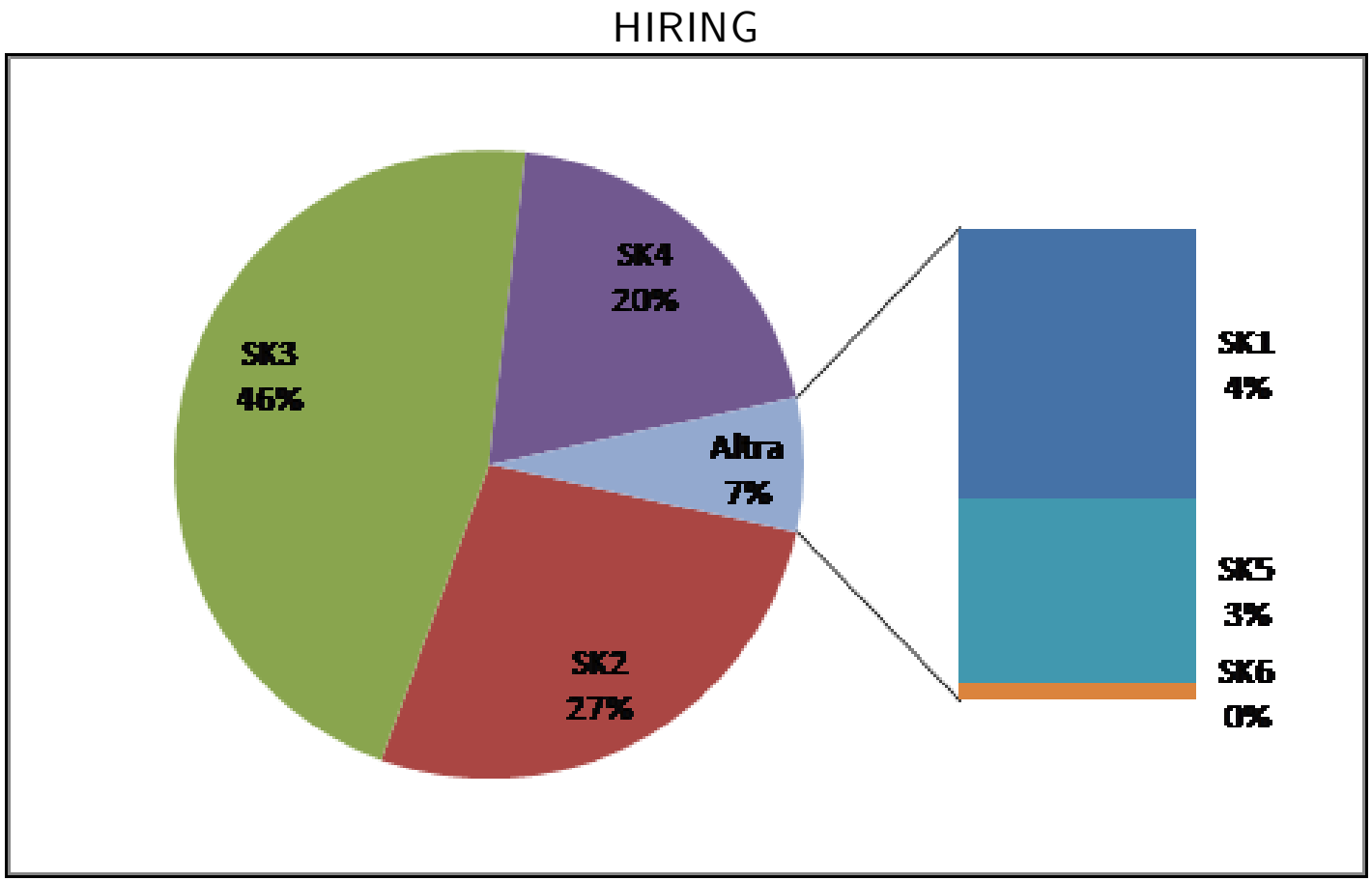

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Italy: Employment by professional profile (thousands) - forecast 2010-2014

	Employment						
Time	P1	P2	P3	P4	P5	P6	P7
2010	991	2504	4935	2398	7442	1977	2348
2011	991	2547	4982	2416	7410	1945	2363
2012	992	2597	5039	2437	7377	1909	2383
2013	996	2662	5119	2468	7362	1873	2416
2014	999	2734	5204	2500	7338	1832	2451
$\Delta\%$	0.8	9.2	5.4	4.3	-1.4	-7.3	4.4

Notes: $\Delta\%$ is employment: total change 2010-14

P1: Managers and entrepeneurs; P2: Math, health, social and life sciences specialists; P3: Tech. prof.; P4: White collars; P5: Spec. workers; P6: Machine oper.; P7: Not qualif

Italy: Hiring by professional profile (thousands) - forecast 2010-2014

	Hirings						
Time	P1	P2	P3	P4	P5	P6	P7
2010	31	77	153	74	230	61	73
2011	32	82	161	78	239	63	76
2012	33	85	166	80	243	63	78
2013	35	93	179	86	257	65	84
2014	35	96	183	88	258	64	86
$\Delta\%$	3.5	5.6	4.7	4.4	3.0	1.4	4.4

Notes: $\Delta\%$ is avg hiring changes 2010-14

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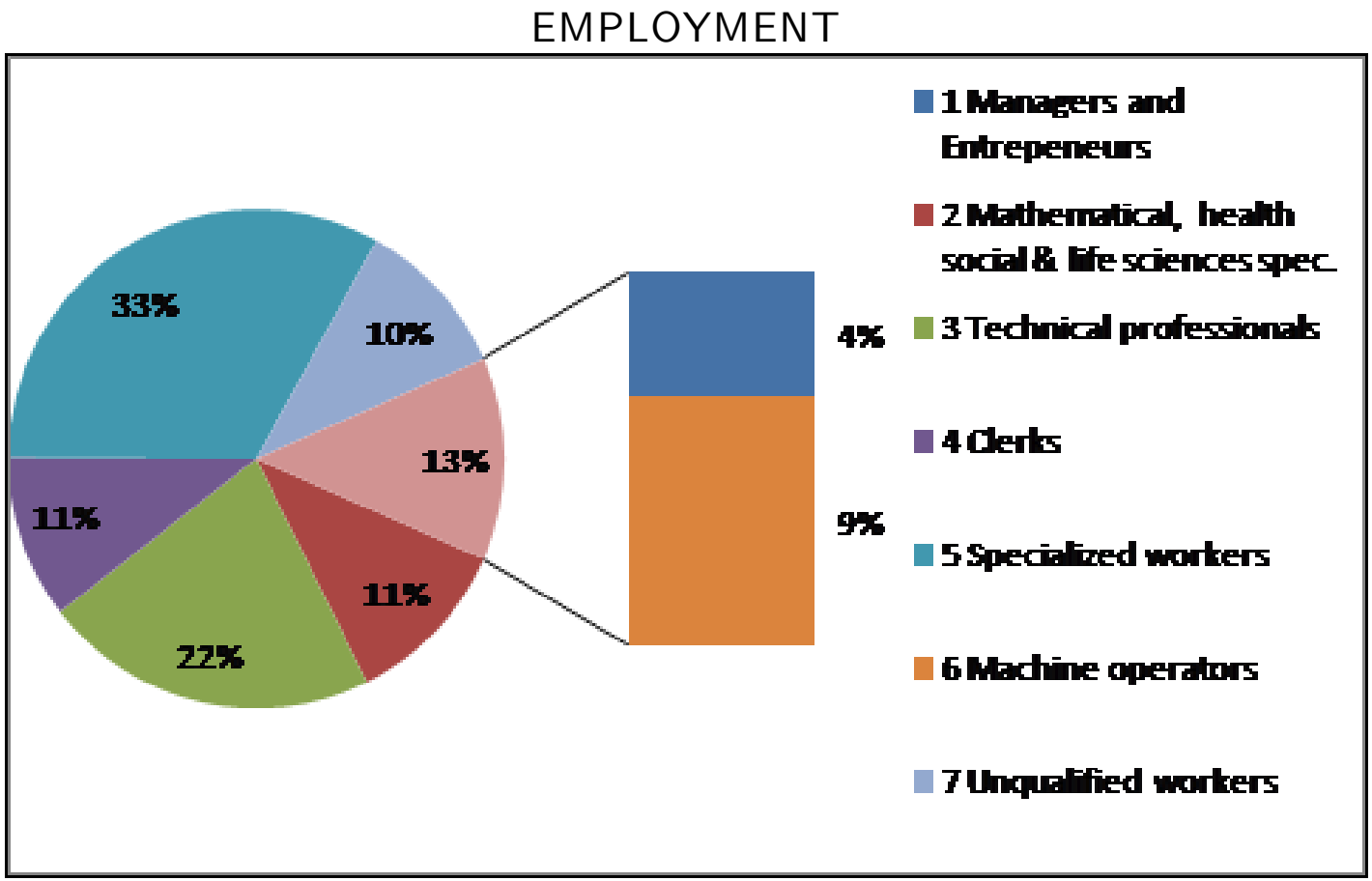
Italy: Employment by professional profile - composition



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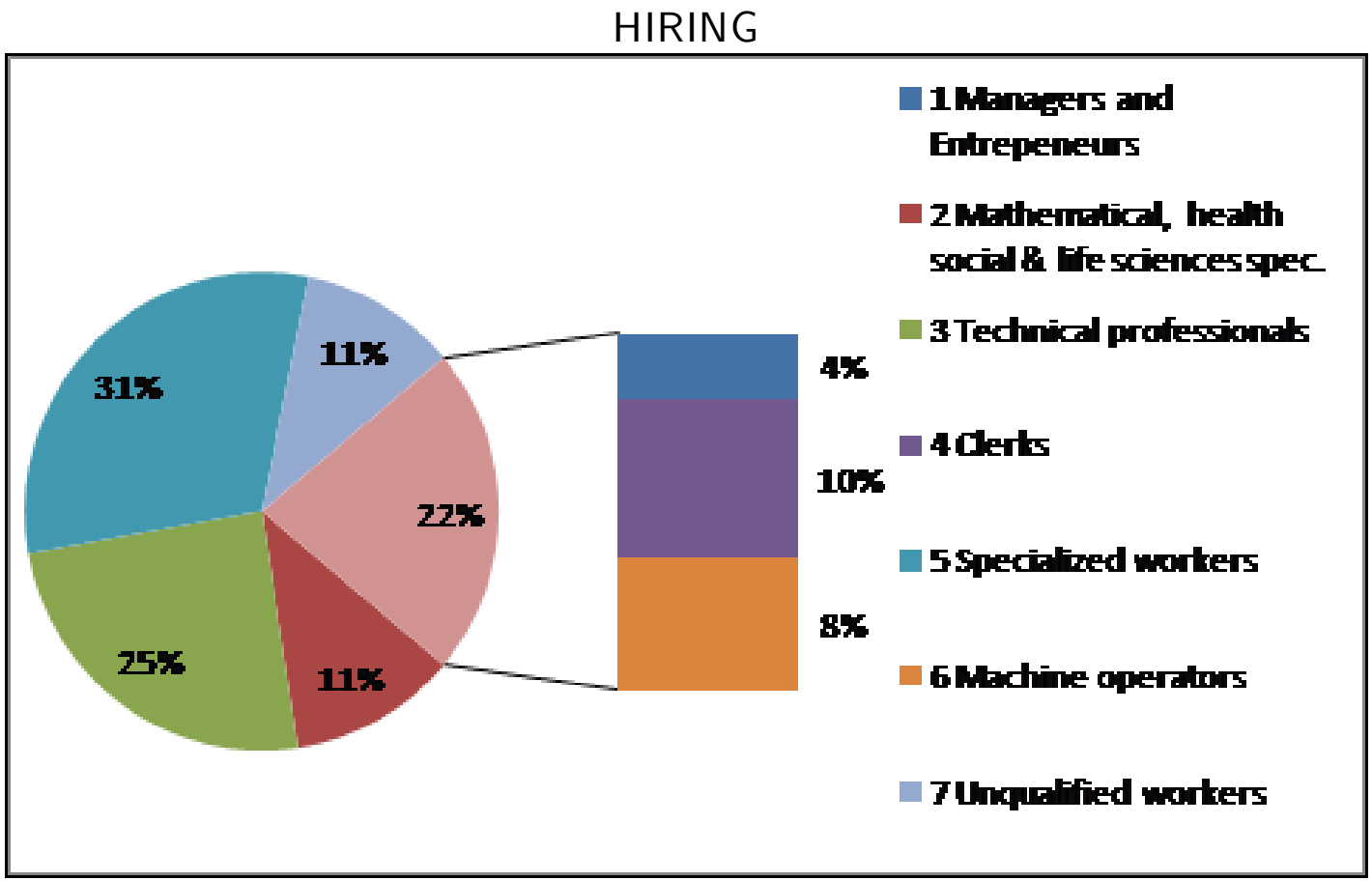

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Further developments

- Improve the simulation approach for the demographic evolution (migrations)
- Nest a pension expenditure simulation module
- Use administrative data on inflows and outflows, now available from the Italian Ministery of Labour

- Thank you for attention