From foresight to welfare practices. Report on econometric modelling

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1. Introduction

European societies are changing in a number of interlinked areas including demography, family structure, employment, poverty and social inclusion. The implications arising from these changes are profound and compel EU Member States to adapt their social policies in response:

> *Demographic changes, an ageing population and decreased fertility mean fewer people of working age and increasing dependency ratios. ...[A] smaller population of working age relative to the elderly will not only impact the design of Member States' health systems, but will also threaten the solidity of financing for social protection budgets, which are generally financed through labour taxation. Meanwhile, changes in family sizes and structures have led to weaker support systems, as social protection models have failed to adapt. The workforce will become increasingly diverse as the population of working age shrinks. Member States are introducing measures to enable more women, older people and non-EU nationals to join the labour market. ... [W]orkers are increasingly mobile, but this sometimes creates problems as children and older people are left without family support. (European Commission 2013 p.2)*

There is growing consensus in Europe that an active set of approaches to welfare is required to meet these changes. In particular, an evolving approach known as Social Investment will, it is suggested, improve human capital, enable more people to participate in society, and reduce intergenerational deprivation. However, while the term 'Social Investment' is increasingly popular among policy makers, its meaning varies and implementation has been uneven across EU member states. Much remains to be learned, especially with regard to regional and local realities of Social Investment.

The emerging social investment paradigm focuses on active labour market policies, education and the 'new social risks' that people face in the course of their lives because of the challenges of post-industrial societies.

The emphasis, is on investments in people to enhance their productive capacities and foster longer-term economic development. At the heart of the social investment approach to welfare lies the idea that welfare states must invest in human capital rather in passive cash transfers The European Commission argues that: '[S]ocial investment policies reinforce social policies that protect and stabilise by addressing some of the causes of disadvantage and giving people tools with which to improve their social situations.' (European Commission 2013 p.3). They do this by strengthening people's skills and capacities, to prepare them for confronting or preventing risks over the life course and improving their future prospects. It is the idea of having a lasting impact that gives such policies the characteristics of an investment by offering some returns over time (*ibid*.).

In the INNOSI project we investigate the 'state of the art' in social investment in the EU. INNOSI asks how we can design robust social investment strategies which can deal with emerging socio-economic challenges and the aftershocks of the 2008 economic crisis. Our overall approach is based on our distinct understanding of social investment which recognises:

- the importance of regional context in social investment policy;
- the role for social innovation in social investment;
- the need to recognise and measure social as well as economic value when evaluating policies; and
- how beneficiaries' experiences of social investment policies help shape civic identities in

Europe.

The project aims to:

1. The identification and evaluation existing innovative and strategic approaches to social welfare reform which utilise social innovation at a regional and local level.
2. For those socially innovative and strategic approaches to welfare reform identified during Aim 1, we will explore the social and psychological impact of welfare reform on individuals and communities.
3. For those interventions considered in Aim 2 to be successful, we seek to identify ways of implementing effective innovative and strategic approaches to welfare reform (including social financing) and establish pathways to impact for knowledge created during the project.

This current report relates to Work Package 6 of the InnoSI project 'WP6: From foresight to welfare practices', the general aims of which are to:

1. Model the distribution of costs & benefits, including those that are non-financial
2. Identify effective means of public investment, including in public administration & public services
3. Identify effective means of complementing public investments through third & private sector contributions
4. Provide insight on how future thinking techniques can be applied in forecasting the need and implementing innovative social investments in the 21st century

In particular, this report relates the second of these aims and describes the assessment of public 'social' investment insofar as it relates to the facilitation of achieving social outcomes.

Outline of the remainder of the report

The remainder of the report is comprised two main sections – each taking a different, but complementary approach to assessing public social investment expenditure.

In section 2 we consider small area techniques and utilise EU-SILC data to construct new indicators of compensatory and investment policies at regional level. We then explore whether these indicators either converge or diverge across EU Member States.

We go on to include these indicators in a Structural Vector AutoRegression, (SVAR) analysis in section 3. The aim of this section is to investigate the casual relationships between labour market outcomes of the young and different types of spending. Because of degrees of freedom issues, this analysis is carried out using NUTS1 data[2] cumulated to an EU wide level.

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[2] The NUTS1 Classification system divides the 28 EU member states into 98 major socio-economic regions. See http://ec.europa.eu/eurostat/web/nuts/overview

In section 4 we present our analysis of the efficacy of public social investment expenditure in regions of the EU. Not only do we consider the impact of public spending allowing for regional difference, we also consider other outcomes, for example, Real GDP per capita. The calculation of impulse response functions allows us to determine the impact of small changes in public social investment expenditure, and tax, in key areas.

Our general findings are summarised in section 5.

2. Social Investment and Young People's Labour Market Participations: An EU regional analysis

2.1 Introduction

Since its inception, the EU has experienced robust convergence in terms of GDP per capita. However, this process has largely been driven by convergence at the country level. Convergence at the regional level has been weaker, with some countries exhibiting regional divergence or sustained North-South (or West-East) divides (Monfort, 2008, Wunsch, 2013). For example, the correlation between low GDP per capita and unemployment rates tends to be much higher within countries than across countries.

Among the many possible drivers, this obviously raises the important question about the role of different types of policies that have been adopted, both at European and country level (Wunsch, 2013). Traditionally, we can differentiate between investment-related and compensatory policies (Nikolai, 2012). Compensatory policies are mainly based on a contribution-financed social security with the goal of protecting individuals from the risks of unemployment and old-age. Investment-related social policies tend to focus more on investment in human capital and the provisions for the needs and the future of the younger generations.

However, without data disaggregated expenditure at regional level, it is quite impossible to tackle this question. As it has also highlighted by the DG Regional Policy of the European Commission been, in order to better target policy measures, there is an increasing need of social policy indicators developed at regional level (Verma *et al*., 2013).

Therefore, in the following analysis, our objective main objective will be to develop new indicators of spending at regional level and to investigate their impact on economic outcomes. In particular, our focus will be on indicators of labour market participation of young people. While the low level of market participation of young people is not a new problem, what is new is the scale that has reached in the current economic crises. For example, in some countries the youth unemployment rate has doubled or tripled since the onset of the recession (Mascherini *et al*., 2012). With young people having paid the highest price during the global economic crises, there is a renewed sense of urgency to integrate them into the labour market and the education system. Youth employment remains thus the crucial node to sustainable economic and social development.

However, traditional indicators of labour market participation, such as unemployment and employment rate of the young do not adequately capture new “grey” area that represent market attachment in contemporary societies. Both researchers and policy makers has started using alternative concepts and indicators for young people who are disengaged from both work and education, usually referring to this group of people with the term NEET (not in employment, education and training). In particular, at European level, the term NEET has caught the attention of policy makers as a useful indicators for monitoring the labour market participation and social situation of the young.

The needs to focus more on NEET is now central in the European policy debate, and the term is explicitly mentioned in the Europe 2020 agenda as well as in the 2012 Employment Package "Towards a job-rich recovery".

In the following, we therefore briefly review in section 3.2 the main statistics about labour market participation of the young currently available at Eurostat, while in section 3.3 we rely on cumulation methodology to develop indicators of compensatory and investment spending at regional level. In section 3.4 we rely on recently developed econometric methodology to investigate the effects of these types of policies on labour market outcome.

2.2 Young people's labour market participation

While NEET and youth (un)employment are related concepts, there are important differences. In particular, unemployment rate measure the share of the labour population who are not able to find a job. More precisely, it is a measure of those who are out of work, but have actively looked for work in the recent past and available for work in the near future. However, this measure does not take into account those who become discouraged and decide to stop looking for a job. This implies that the unemployment rate may stop falling even when a relevant number of individuals are at high risk of labour market and social exclusion. A similar remark can be made for the employment rate of the young, which measure the share of the working age population (*i.e*. people aged 15 to 24) which is currently employed. In contrast, the NEET captures the share of the young population currently disengaged from the labour market and education, namely unemployed and inactive young people not in education or training. More precisely, we have:

$$Youth\ unemployment\ rate = \frac{Total\ young\ unemployed}{Young\ labour\ force}$$

$$NEET\ rate = \frac{Total\ NEET}{Young\ population}$$

For this reason, to have an additional indicator for monitoring the situation of young people in the framework of the Europe 2020 strategy the European Commission (DG EMPL) agreed on a definition and methodology for a standardized indicator for measuring the size of the NEET population among Member States. This indicator has been built by Eurostat using the standardized definition of the numerator and denominator, and is available for download at Eurostat[3]. We report it in Table 2.1 at NUTS1 level, along with the measures for unemployment and employment of the young for the 15-24 age group.

In particular, this table reports for each variable, in addition to the mean (μ) and the standard deviation (σ) computed at country-level, the coefficient of variation (CV). This latter indicator is a normalized measure of dispersion defined as the ratio between the standard deviation and the mean (*i.e*. $\sigma/_{|\mu|}$). For a given standard deviation value, it thus indicates a high or low degree of variability only in relation to the mean value.

[3] More precisely, the numerator of the indicator refers to persons who meet the following two definitions: a) they are not employed and b) they have not received any training or education in the four weeks preceding the survey.

Since the coefficient of variation is a measure of relative variability which is unit-free (*i.e*. does not depend on the unit of measurement), it is often preferred to the standard deviation which has no interpretable meaning on its own. In particular, the CV indicators is among those indicators of σ-convergence, which is a term used to refer to a reduction of disparities among regions over time (see Monfort, 2008).[4]

For example, from Table (2.1) we can observe that high average youth employment rates can be observed in Austria (AT), Denmark (DK), Finland (FI), the Netherlands (NL), and United Kingdom (UK). Conversely, young people seem particularly disengaged from the labour market in Slovakia (SK), Bulgaria (BG), Lithuania (LT), Italy (IT), Hungary (HU) and Greece (EL). Moreover, although there is not high variation in the employment rate of the young across European countries, there is a large variation in the unemployment rate of the young (with the CV being between 13-15%) and in the level of NEETS.

However, as Figure 2.1 suggests, the EU-28 CV computed at NUTS1 level is increasing over time for all these measures. Even if this a rough measure (*i.e*. we did not use weight to account for the different country size population), it suggests a divergence among EU countries in the level of unemployment, employment and NEETS.

Finally, it is important to notice, that the increase in regional disparities within the EU as a whole does not prevent disparities from decreasing within each member state (Monfort, 2008). For this reason, we also compute CV regional indicators for each member state. However, even when we look at the regional variation with countries of the same variable, we can notice that for some countries, the regional variation can be very large: for example, in Italy and Portugal the CV is about 40%.

The aim of the next sections will be to investigate the impact of different type of policies (compensatory or investment) on these variables.

4 The concept of σ-convergence is strictly related to the concept of β-convergence, which implies a catching up process. Formally, β-convergence is necessary but not sufficient for σ-convergence.

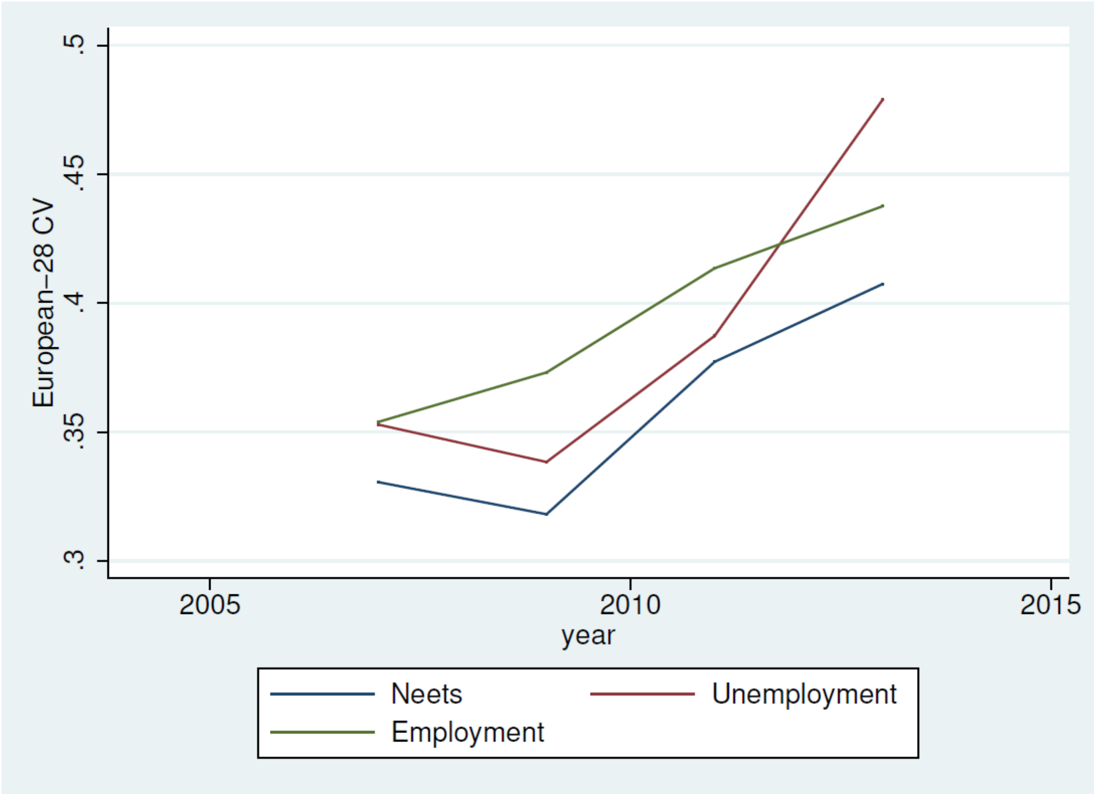
Table 2.1: (Un)employment rate young (15-24)

	Employment rate young				*Unemployment rate young*				*NEETs*			
Country	**Mean**	**Std**	**CV**	**Reg. CV**	**Mean**	**Std**	**CV**	**Reg. CV**	**Mean**	**Std**	**CV**	**Reg. CV**
AT	53.003	4.956	0.094	0.105	9.828	2.954	0.301	0.342	9.247	1.694	0.183	0.195
BE	23.406	5.251	0.224	0.258	26.072	9.712	0.372	0.432	17.672	5.181	0.293	0.344
BG	23.005	2.503	0.109	0.103	21.688	6.374	0.294	0.269	26.475	7.291	0.275	0.343
CY	32.991	5.237	0.159	.	20.000	11.176	0.559	.	18.742	5.002	0.267	.
CZ	26.691	1.363	0.051	.	16.433	3.485	0.212	.	11.733	2.603	0.222	.
DE	45.011	4.797	0.107	0.093	12.113	4.408	0.364	0.286	12.656	3.217	0.254	0.195
DK	60.036	4.665	0.078	.	10.850	2.769	0.255	.	7.556	1.218	0.161	.
EE	31.309	2.890	0.092	.	18.783	7.168	0.382	.	14.575	2.683	0.184	.
EL	19.994	6.648	0.332	0.145	38.517	15.420	0.400	0.107	22.858	6.267	0.274	0.214
ES	27.819	9.013	0.324	0.113	36.169	15.010	0.415	0.160	18.506	5.365	0.290	0.212
EU15	39.115	13.790	0.353		20.483	11.937	0.583	.	15.098	6.317	0.418	
EU27	35.829	13.343	0.372		20.901	10.852	0.506	.	15.611	6.053	0.416	
EU28	**35.725**	13.351	0.374		21.009	10.912	0.520	.	15.650	6.058	0.389	
FI	41.673	1.918	0.046	.	20.367	2.926	0.144	.	11.875	1.502	0.126	.
FR	29.078	4.821	0.166	0.155	24.206	8.759	0.362	0.307	16.146	4.216	0.261	0.234
HR	23.282	4.646	0.200	.	34.817	8.676	0.249	.	21.144	4.140	0.196	.
HU	20.718	2.898	0.140	0.119	20.872	6.614	0.317	0.288	16.300	4.133	0.254	0.282
IE	38.591	9.640	0.250	.	19.217	8.945	0.465	.	18.417	4.876	0.265	.
IT	21.956	7.577	0.345	0.312	30.587	13.024	0.426	0.401	23.767	9.285	0.391	0.409
LT	22.536	2.986	0.133	.	20.825	8.786	0.422	.	13.967	2.407	0.172	.
LU	22.764	1.896	0.083	.	16.858	2.340	0.139	.	7.583	0.713	0.094	.
LV	31.055	4.354	0.140	.	21.900	8.586	0.392	.	16.725	3.186	0.191	.
MT	45.245	1.027	0.023	.	13.892	1.979	0.142	.	10.933	1.558	0.143	.
NL	64.211	4.219	0.066	0.035	9.185	2.790	0.304	0.113	6.117	1.008	0.165	0.084
PL	24.842	2.800	0.113	0.089	26.369	7.403	0.281	0.136	16.079	2.894	0.180	0.134
PT	29.682	7.492	0.252	0.120	31.995	12.542	0.392	0.183	19.981	6.192	0.310	0.234
RO	24.114	2.375	0.098	0.088	21.933	3.579	0.163	0.150	19.779	3.484	0.176	0.091
SE	40.285	1.957	0.049	0.032	22.342	2.350	0.105	0.052	11.031	1.647	0.149	0.099
SI	32.764	4.213	0.129	.	15.583	3.696	0.237	.	10.075	1.600	0.159	.
SK	23.391	2.953	0.126	.	28.917	5.172	0.179	.	18.083	2.423	0.134	.
UK	49.699	5.931	0.119	0.098	16.813	4.563	0.271	0.179	15.314	3.890	0.254	0.147

Table 2.2: (Un)employment rate

	Employment rate female				*Employment rate total*				*Unemployment rate total*			
Country	**Mean**	**Std**	**CV**	**Reg. CV**	**Mean**	**Std**	**CV**	**Reg. CV**	**Mean**	**Std**	**CV**	**Reg. CV**
AT	64.514	3.045	0.047	0.030	69.919	2.803	0.040	0.035	4.955	1.398	0.282	0.316
BE	53.172	5.411	0.102	0.119	58.922	5.072	0.086	0.103	10.830	5.116	0.472	0.561
BG	56.379	4.588	0.081	0.092	59.896	4.092	0.068	0.071	9.895	3.083	0.312	0.277
CY	60.408	2.062	0.034	.	67.142	3.474	0.052	.	7.736	4.689	0.606	.
CZ	57.933	1.977	0.034	.	66.367	1.797	0.027	.	6.700	1.095	0.163	.
DE	65.198	4.844	0.074	0.043	69.549	4.581	0.066	0.043	9.177	4.489	0.489	0.378
DK	71.583	1.507	0.021	.	74.775	2.024	0.027	.	5.755	1.608	0.279	.
EE	64.583	2.315	0.036	.	66.975	3.282	0.049	.	9.336	3.695	0.396	.
EL	44.919	3.972	0.088	0.048	55.717	5.429	0.097	0.025	16.328	7.922	0.485	0.077
ES	52.131	6.340	0.122	0.125	59.821	6.223	0.104	0.092	16.561	8.142	0.492	0.287
EU15	59.342	1.227	0.021	.	65.592	0.738	0.011	.	8.964	1.423	0.159	.
EU27	58.158	1.381	0.024	.	64.400	0.878	0.014	.	9.073	1.240	0.137	.
EU28	58.092	1.401	0.024	.	64.333	0.884	0.014	.	9.118	1.257	0.138	.
FI	72.425	5.215	0.072	0.094	74.133	5.420	0.073	0.097	8.082	1.030	0.127	.
FR	58.081	5.377	0.093	0.093	62.571	4.944	0.079	0.078	9.912	4.086	0.412	0.330
HR	50.325	1.927	0.038	.	56.075	2.373	0.042	.	12.800	3.098	0.242	.
HU	52.367	4.867	0.093	0.098	58.119	5.013	0.086	0.089	8.618	2.823	0.328	0.305
IE	57.333	1.921	0.034	.	63.592	3.917	0.062	.	9.436	4.526	0.480	.
IT	45.398	11.996	0.264	0.292	56.245	9.842	0.175	0.193	9.645	4.984	0.517	0.514
LT	61.483	2.425	0.039	.	62.833	2.705	0.043	.	10.700	4.320	0.404	.
LU	56.825	2.728	0.048	.	64.708	1.261	0.019	.	4.973	0.548	0.110	.
LV	61.708	3.087	0.050	.	63.900	3.465	0.054	.	12.127	4.436	0.366	.
MT	40.242	6.447	0.160	.	57.250	3.562	0.062	.	6.555	0.437	0.067	.
NL	68.479	1.945	0.028	0.016	74.202	1.780	0.024	0.017	4.882	1.525	0.312	0.098
PL	51.256	4.165	0.081	0.059	57.726	4.078	0.071	0.042	11.527	4.166	0.361	0.124
PT	57.206	4.771	0.083	0.092	63.253	3.662	0.058	0.035	10.355	4.459	0.431	0.187
RO	52.552	1.716	0.033	0.034	59.427	2.070	0.035	0.033	6.889	0.862	0.125	0.108
SE	71.258	1.672	0.023	0.016	73.283	1.644	0.022	0.018	7.624	0.943	0.124	0.071
SI	61.600	1.483	0.024	.	65.767	1.670	0.025	.	7.055	1.914	0.271	.
SK	52.908	1.507	0.028	.	59.867	1.718	0.029	.	13.664	2.434	0.178	.
UK	65.263	3.179	0.049	0.048	70.387	3.226	0.046	0.045	6.462	1.772	0.274	0.186

Figure 2.1: European CV - NEETs, young employment and young unemployment



2.3 Descriptive statistics at NUTS1 by country: data from EU-SILC

Social policies that are defined as social investment policies are distinguished according to three aspects (Heitzmann and Wukovitsch, 2015):

1. Policies that help maintain or restore the capacity of labour market participants (*e.g*. old age pensions, survivor pensions, social assistance, long-term unemployment insurance, long-term maternity leave, housing benefits);
2. Policies that facilitate entrance of new labour market participants (short-term unemployment insurance; short-term maternity and parental leave; active labour market policies)
3. Policies that invest in the capacity of new labour market participants (care for elderly, child care, active labour market policies);

Unfortunately, data on these dimensions are often not available at regional level and across several years. For these reasons, any attempt to examine development of social investment across regions and countries often fail. Nikolai (2012) classifies family policies and education policies as social **investment policies**, while old-age and passive labour policies are classified as social investment are classified as **compensatory policies**.

For our purposes, the analysis of Nikolai (2012) is particularly relevant. She compares across countries the CV – the indicator computed at national level. She finds evidence for σ-convergence of social investment as the CV indicator is getting smaller over time but without a ‘race to the bottom’ (*i.e*. a reduction in public expenditure). In particular, she finds:

1. An increase in old-age benefits;

2. stable pattern of active and labour market policies;
3. A decrease in spending on education. Moreover, there are different priorities: service-oriented transfer are higher in Scandinavian countries.

To sum up, she finds mixed evidence in support of a shift toward more social investment. Continental and Southern European Countries are characterized by spending more for compensatory and less for investment-related policy (especially education).

Even if alternative approaches are available (*e.g*. De Deken, 2014), because of data limitation they largely end up with two categories, one for compensatory (*i.e*. the old risk categories) and another for social investment policies (*i.e*. the new risk categories).

In this analysis, we similarly distinguish between these categories; in addition we rely on data from the EU Statistics on Income and Living Conditions (EU-SILC) to derive indicators at country regional level. The EU-SILC is a very rich survey on income and social condition collected at household (and individual) level under a standard integrated design by nearly all EU countries. As we will explained below, we rely on small area techniques (SAE) to derive – from EU-SILC – regional indicators of investment and compensatory policies. More precisely, for each category of spending (investment and compensatory), we rely on small area estimation technique (SAE) to derive a series of indicators by computing the average amount received per household at NUTS1 level. This an important contribution with previous studies, in which indicators of total spending were usually derived at country level as a share of GDP (see also Prandini *et al*., 2015 on this issue). In particular, as we describe in the next section, we rely on a cumulation technique.

2.3.1 Cumulation

In order to target policy measures better, there is an increasing need of social policy indicators developed at regional level. For example, the Directorate-General Regional Policy of the European Commission is aiming to use regional level data to correctly identify regions with the highest proportion of people being poor or socially excluded[5]. However, regional level data, which is homogeneously gathered across countries, is often lacking.

For these reasons EU-wide comparative data sets, such as EU-SILC, even though primarily developed to construct indicators at the national level can serve as a unique source for generating comparative indicators at regional levels through small area estimation (SAE) techniques. Such methodologies have already been proved to be successful to derive regional measures of poverty (Verma *et al*., 2013, 2010; Marchetti *et al*., 2015).

In particular, two types of measures can be constructed at the regional level by aggregating information on individual elementary units from national survey:

1. average measures such as totals, means, rates and proportions constructed by aggregating or averaging individual values; and

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[5] http://ec.europa.eu/dgs/regional_policy/index_en.htm

2. distributional measures, such as measures of variation or dispersion among households and persons in the region.

We will rely on the first type of measures, which are obtained by cumulating and consolidating the information over waves of national sample surveys in order to obtain measures which permit greater spatial disaggregation. However, many measures of averages can also serve as indicators of disparity and deprivation when seen in the regional context: the dispersion of regional means is of direct relevance in the identification of geographical disparity.

To be able to compute spatial statistics through cumulation, the only information required is the strata identifiers from which individuals are sampled. More specifically in our case, to cumulate over waves we need to know the NUTS1 regions from which the individuals were sampled. Unfortunately, this information is only available for a limited numbers of countries, namely: Austria, Belgium, Bulgaria, Czech Republic, France, Greece, Hungary, Italy, Poland, Spain, Sweden, and the United Kingdom. Therefore, only for this group of countries, we were able to derive a measure of variation (*i.e*. the regional CV). For the remaining group of countries, we were only able to derive from EU-SILC country-level indicators.

Specifically, we proceed as follows. Given that we have the cross-sectional dataset of the EU-SILC survey for nine consecutive years (from 2006 to 2014), the objective is to compute the cumulative average of a given measure y over three years, *i.e*. $\bar{y}_t^c$.

We first construct for each year (*i.e*. EU-SILC wave) the yearly average relying on N individual observations (*i.e*. $\bar{y}_t = \frac{1}{N}\sum_{i=1}^{N} y_i$). Then for each year *t*, we estimate the required statistic $\bar{y}_t^c$ as the one-year moving average over three consecutive years of the annual average $\bar{y}_t$, that is:

$$\bar{y}_t^c = \frac{\bar{y}_{t-1}+\bar{y}+\bar{y}_{t+1}}{3} = \frac{1}{t}\sum_{j=1}^{t}\bar{y}_j$$

However, to allow for more variability in our dataset, we only allow for one overlapping year across observations, relying therefore on four central years, *i.e*. we select $\bar{y}_{2007}^c$, $\bar{y}_{2009}^c$, $\bar{y}_{2011}^c$ and $\bar{y}_{2013}^c$.

2.3.2 Variable Selection.

As explained above we will apply the cumulation methodology to EU-SILC data, which provide us with the necessary variables to compute indicators of compensatory and investment policies as in the current literature (see for example Nikolai, 2012). In particular, we rely on the following variables from EU-SILC data available from questions related to household gross income (in parentheses we report the EU-SILC number of each variable):[6]

[6] See http://ec.europa.eu/eurostat/web/income-and-living-conditions/methodology/list-variables to access a complete list of the variables available from EU-SILC.

1. unemployment benefits (PY090G): refers to (full or partial) benefits for benefits compensating for loss of earnings. It also includes early retirement, vocational training, redundancy compensation, severance and termination payments;
2. old-age & survivors benefits (PY100G): refers to the provision of social protection against the risk linked to old age (*e.g*. old age pensions, care allowance) or to the loss of the spouse (survivor's pension, death grant);
3. sickness benefits (PY120G): refers to benefits that replace in whole or in part loss of earnings during temporary inability to work due to sickness or injury (*e.g*. paid sick leave);
4. disability benefits (PY130G): refers to benefits that provide an income to persons impaired by a physical or mental disability (*e.g*. disability pensions, care allowance);

Similarly, to measure investment policies, we similarly select the variables:

1. education-related allowances (PY140G): refers to grants, scholarships and other education help received by students;
2. family/children allowances (HY050G): refers to benefits that provide financial support to bringing up children and relatives other than children (*e.g*. Birth grant, Parental leave benefits, earning-related payments to compensate loss of earnings);
3. housing allowance (HY070G/HY070Y)): interventions that help households meet the costs of housing (*e.g*. rent benefits granted to tenants);

More generally, both groups of variables are defined as current transfers received during the reference period by the households, through collectively organized schemes, or outside such schemes by government units and Non-Profits Institutions Serving Households (NPISHs). It includes the value of any social contributions and income tax payable on the benefits by the beneficiary to social insurance scheme or tax authorities. To be included in these groups of variables, the transfer must meet two criteria:

i) the coverage is compulsory;
ii) it is based on the principle of social solidarity.

The social benefits included in EU-SILC, with the exception of housing benefits, are restricted to cash benefits.

2.3.3 Results

We apply the cumulation methodology to obtain the NUTS1 level average of each selected variable in the previous section. We then group these variables according to Nikolai (2012): the first group comprises "compensatory" variables, while the second group included "investment" variables. The average per recipient household over four years is given in Table 2.3, while in Figure 2.2 we report the CV indicators computed at European level (EU28) for total investment and total compensatory.

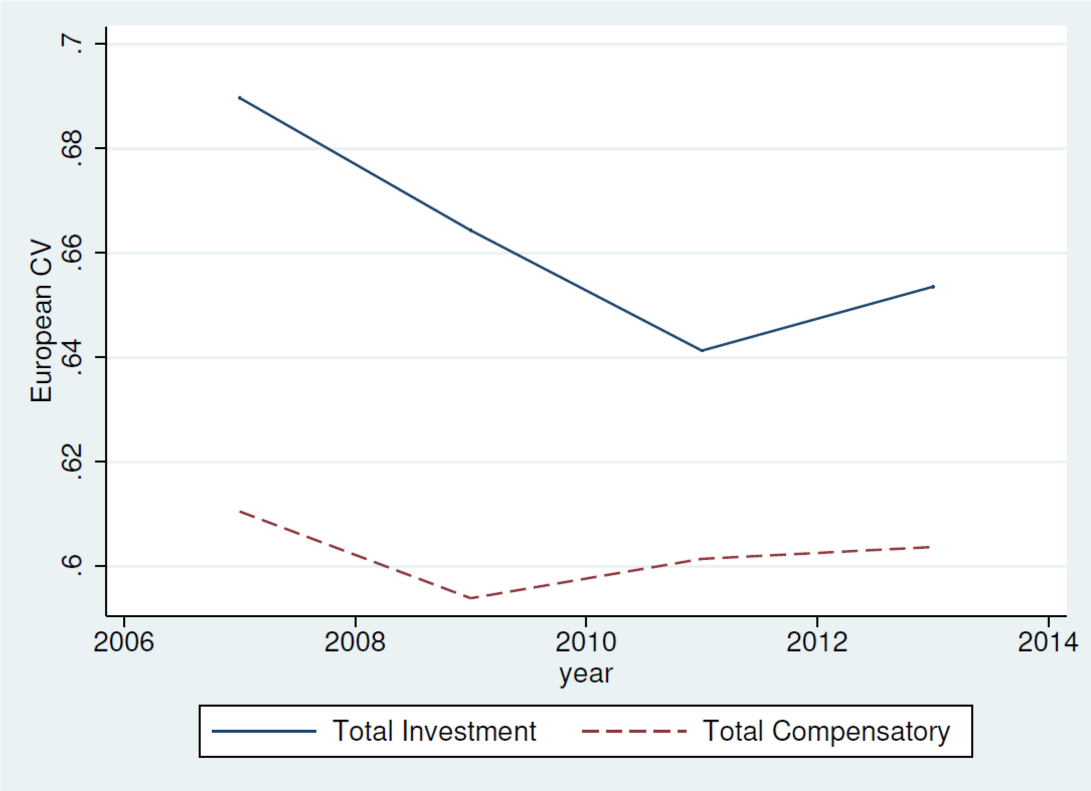
First of all, we observe that there is a remarkable difference in the CV for total investment across Europe, being the CV almost 0.70 in 2007 and much larger in comparison to the CV for total compensatory. However, we also observe that even though the difference for total investment remains higher than for total compensatory, there is a tendency for a reduction in the period 2007-2013. In line with Nikolai (2012), but relying on a very different dataset, we therefore find evidence for σ-convergence in total investment in Europe, while we observe a more stable pattern for total spending for compensatory policy.

Table 2.3: DATA EU-SILC

This table reports the average (computed over 4 years: 2007, 2009, 2011, 2013) of the amount of Euro per recipient household for each spending category. Data are derived from EU-SILC data through the cumulation methodology (explained in section 2.3.1).

	Compensatory					*Investment*		
	Old age & Survivors	*Sickness*	*Unemployment*	*Disability*		*Education*	*Family*	*Housing Allowances*
AT	28963.660	2,133.389	3,983.593	12269.675		2,395.584	5,024.067	1,540.396
BE	29985.481	6,882.746	8,393.498	9,745.557		917.002	3,834.507	1,779.114
BG	2,050.337	295.416	506.534	889.021		282.490	487.128	157.721
CY	21591.830	1,997.840	6,341.432	8,135.511		2,846.973	1,849.577	6,508.598
CZ	5,481.341	966.027	955.940	3,276.192		398.300	1,740.774	758.679
DE	21923.336	4,218.311	5,349.471	8,453.336		3,580.148	3,757.179	2,303.338
DK	30574.877	4,678.608	8,326.608	19573.360		5,292.157	3,032.879	2,398.943
EE	4,559.260	321.178	1,244.568	1,769.974		708.651	1,492.453	558.574
EL	18139.462	2,019.569	2,904.287	6,043.221		2,530.247	1,435.487	1,681.500
ES	19903.970	4,480.739	4,434.187	9,246.095		1,497.090	2,735.697	2,222.783
FR	26178.656	3,014.565	6,113.630	6,409.401		1,415.041	3,665.754	2,049.838
HU	5,480.686	385.845	958.555	2,322.598		614.371	1,536.951	207.887
IE	29213.996	2,549.636	8,027.722	7,420.527		3,712.418	6,488.660	1,626.399
IS	22798.902	8,001.309	4,240.782	14165.254		2,463.721	3,163.754	1,791.669
IT	24419.023	.	3,870.974	6,591.035		4,880.047	1,068.580	1,239.233
LT	3,186.222	412.592	845.385	1,774.985		430.034	1,422.239	142.519
LU	42241.571	13005.274	17458.672	19277.024		4,268.158	8,058.280	1,853.503
LV	3,977.220	536.278	855.717	1,574.061		507.077	802.829	215.703
NL	27844.778	4,981.020	8,273.349	14245.024		2,818.128	1,967.597	1,810.706
NO	31123.304	5,802.989	6,474.943	17951.443		2,447.223	5,948.912	2,287.293
PL	7,615.036	828.574	1,472.368	2,364.762		702.988	953.252	397.547
PT	11264.240	2,837.172	4,185.207	4,530.107		2,339.191	770.973	436.278
SE	22602.767	2,388.459	6,088.357	10902.041		2,996.206	4,810.426	2,421.003
SI	14169.719	1,454.165	2,616.632	5,681.010		1,625.774	2,203.959	699.723
SK	5,124.139	678.925	1,253.619	2,298.632		1,173.672	749.115	631.964
UK	19071.733	5,740.334	5,234.869	5,789.690		4,764.372	4,074.775	4,947.629

Figure 2.2: European CV - Total Compensatory & Total Investment



In addition, we are able to compute indicators of regional variation in total spending within a group of European countries. As highlighted above, even if regional disparities decrease (or increase) when considering the EU as whole, it does not prevent disparities from increasing (or decreasing) with each Member states.

The results for total compensatory and total investment are respectively reported in Figure 2.3 and Figure 2.4. While the regional CVs are much smaller than European CVs, we can similarly observe a similar pattern. That is, we also observe within countries a much smaller level of the CVs for compensatory policy (being always smaller than 0.15), while we observe a larger level of CVs for total investment (being in some cases around 0.40). However, even in this case, we observe a tendency for σ-convergence, with the only exception being Bulgaria and Greece for total investment.

2.3.4 Results from cluster analysis

In this section, we rely on a cluster analysis to divide our data into group of countries on the basis of compensatory and investment spending measured at regional level. The aim is to compare this grouping with the other traditionally groupings emerged in the literature (see, for example, Hemerijck, 2013); Heitzmann and Wukovitsch, 2015 and Prandini *et al.*, 2015). If a NUT1 region is not include with the other NUT1 regions of the same countries, it will be explicitly reported with its own name. Otherwise the country abbreviations will be used. When we rely on total compensatory spending, the results are the following:

- First group: AT, CY, DE, EL3,ES, FR, IE, IS, IT, SE
- Second group: EL, PT, SI
- Third group: BE, DK, NL, NO,
- Forth group: BG, CZ, EE, HU, LT, LV, PL, SK
- Fifth group: LU

Figure 2.3: Regional CV - Total Compensatory

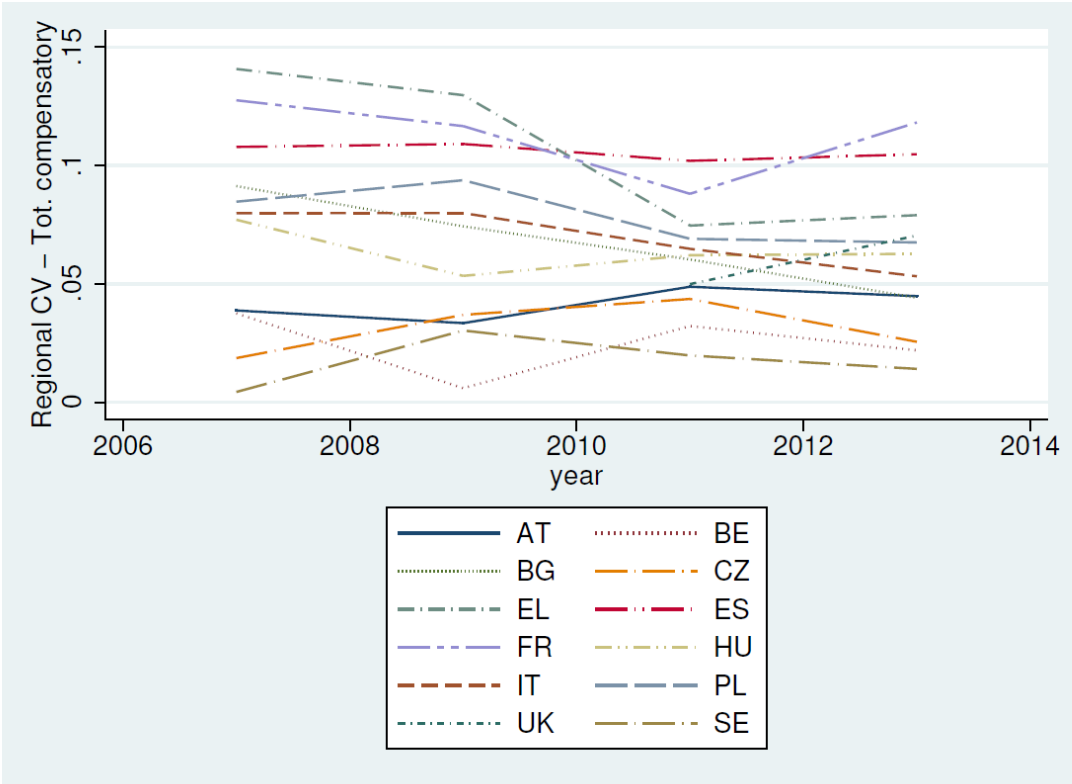
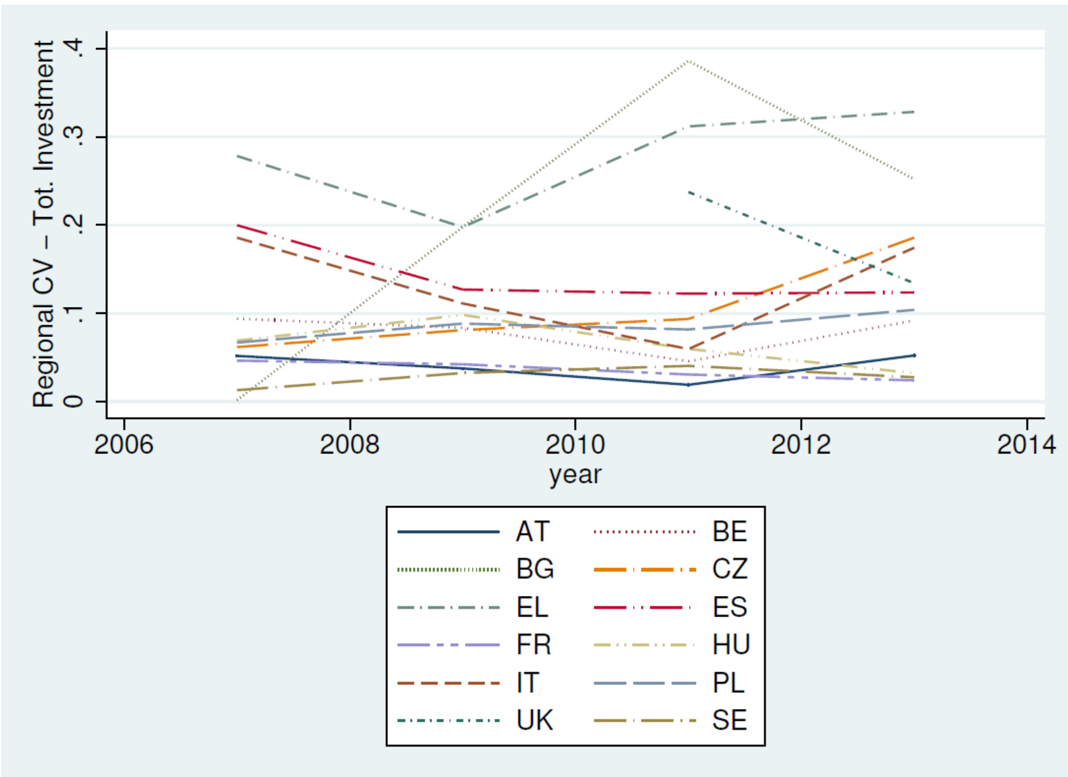


Figure 2.4: Regional CV - Total Investment



When we rely on total investment spending, the results are the following:

- First group: AT, BE, EL1, EL3,ES , FR, IS, IT, NL

- Second group: CY, DE, DK, IE, NO, SE
- Third group: BG, CZ, EE, HU, LT, LV, PL, SK
- Forth group: EL2, EL1, ES, PT, SI
- Fifth group: LU

As this simple exercise highlights, there is more variation across countries when looking at total investment spending. Moreover classic welfare regimes are not necessarily valid at regional level. For example, Italy does not belong to the group of Mediterranean Countries. Moreover, we can observe that the NUTS1 region EL3 often tends to belong to a different group of countries than the other Greek NUTS1 regions.

2.4 Discussion

As it has been already evidenced in several articles and reports, the regional dimension does matter. There are strong differences across regions in EU, but also inside individual countries. Therefore, in order to better target policy measures, there is an increasing need of social policy indicators developed at regional level.

In this report, we rely on Small Area Estimation techniques (SMA) applied to EU-SILC data to develop new indicators of spending at regional level, and to investigate their impact on economic outcomes. These methodologies have already been utilised to derive regional measures of poverty.

Interestingly, by looking at these measures, we can observe regional convergence of social investment and compensating expenditure across EU Member States. Moreover, we also notice that classic welfare regimes are not necessarily valid when using data at regional level.

3. Youth Employment Outcomes: A Structural VAR Analysis

In the following we rely on Structural Vector AutoRegressions to estimate causal relationship among some variables of interests. Structural Vector AutoRegressions (SVAR models) are among the most prevalent tools in empirical economics to analyse dynamic phenomena. Their basic model is the Vector AutoRegression (VAR model), in which a system of variables is formalized as driven by their past values and a vector of random disturbances. This reduced form representation is typically used for the sake of estimation and forecasting. The VAR form, however, is not sufficient for our purpose: it does not provide enough information to study the causal influence. Therefore the estimated parameters cannot be used to predict the effect of an intervention. This latter is instead the objective of SVAR models, which add structural information to the VAR (*i.e*. they solve the *identification problem*) so that one can recover the causal relationships existing among the variables under investigation.

The common approach is to derive this structural information from economic theory or from institutional knowledge related to the data generating mechanism (Stock and Watson, 2001). In the following, we instead rely on a more data-driven approach recently developed in the literature by Moneta *et al*. (2013). In particular, Moneta *et al*. (2013) have shown that if the VAR residuals are non-Gaussian, one can exploit higher-order statistics of the data and apply *Independent Component Analysis* (ICA) in order to fully identify the SVAR model. This method has therefore the great advantage of avoiding subjective choices and theory driven considerations to estimate SVAR model.

3. 1 Independent component analysis and SVAR identification

Starting from a multiple time series dataset composed of k variables collected for T periods we can denote by $Y_t = (Y_{1t}, \dots, Y_{kt})'$ the values of these variables at a particular time t. A simple, but useful way of representing the data generating process, is to model the value of each variable Y_{kt} as a linear combination of the previous values of all the variables as well as their contemporaneous values:

$$Y_t = \mathrm{B} Y_t + \Gamma_1 Y_{t-1} + \ldots + \Gamma_p Y_{t-p} + \varepsilon_t \tag{1}$$

where the diagonal elements of the matrix B are set equal to zero by definition and where ε_t represents a vector of error terms. This model can be equivalently written in the standard VAR form:

$$\Gamma_0 Y_t = \Gamma_1 Y_{t-1} + \ldots + \Gamma_p Y_{t-p} + \varepsilon_t \tag{2}$$

where $\Gamma_0 = \mathbf{I} - \mathrm{B}$. Since variables are endogenous in eq(1) and eq(2) this model cannot be directly estimated without biases. It is typical therefore to derive and estimate the VAR reduced form:

$$Y_t = \Gamma_0^{-1} \Gamma_1 Y_{t-1} + \ldots + \Gamma_0^{-1} \Gamma_p Y_{t-p} + \Gamma_0^{-1} \varepsilon_t$$

$$Y_t = A_1 Y_{t-1} + \ldots + A_p Y_{t-p} + u_t \tag{3}$$

The problem of *identification* is therefore the problem of finding the appropriate Γ_0. Traditionally, this problem is solved by imposing restrictions on the Γ_0 using a Cholesky factorization of the estimated covariance matrix Σ_u. But this approach should only be employed when the recursive ordering implied by the identification scheme is firmly supported by theoretical consideration.

The method by Moneta *et al*. (2013) proposed to apply the ICA analysis to identify the mixing matrix Γ_0^{-1} and the independent components ε_t by finding linear combinations of u_t whose mutual statistical dependencies is, according to some given measures, minimized. This methodology, however, requires:

1. The shocks $(\varepsilon_{1t}, \dots, \varepsilon_{kt})$ are non-normally distributed;
2. the shocks $(\varepsilon_{1t}, \dots, \varepsilon_{kt})$ are statistically independent;
3. the contemporaneous causal structure among $(Y_{1t}, \dots, Y_{kt})$ is acyclic, that is, there exists an ordering of the variables such that Γ_0 is lower triangular. The appropriate ordering of the variables, however, is not known to the researcher a priori.

3.2 Results

Relying on NUTS1 level data, we apply this method to investigate to explore relationship between the level of compensatory and investment spending on the level of NEETS, unemployment and employment of the young. The results from this method are reported in Table 3.1 and can be interpreted in a causal way. For completeness, we also report in Table 3.2 the results from the estimation of the model without considering our policy variables. To validate the use of this methodology, we looked at the empirical distributions of the VAR residuals ($\hat{u}_t$) – as well as the results of the Shapiro-Wilk and the Jarque-Bera tests for normality; for all the variables, the tests rejects the null hypothesis of normality for the residuals (results are available upon request).

Table 3.1: VAR Estimation: Variables in Levels

The column-variables are the causes, while the row-variables are the effects. The B_0 coefficients give us the contemporaneous effects The B_1 coefficients provides the effect of lagged variables (at time t–1) on current variable (at time t)

Contemporaneous Effect (t): $\mathbf{B_0}$				
	NEETs	*Employment Young*	*Unemployment Young*	*Log_GDP*
NEETs		0	0.347***	-5.392***
Employment Young	0.0138		-0.418***	0.997
Unemployment Young	0	0		-39.665***
Log_GDP	0	0	0	
Lagged Effect (t–1): $\mathbf{B_1}$				
	NEETs	*Employment Young*	*Unemployment Young*	*Log_GDP*
NEETs	0.919***	0.004	-0.326***	5.572***
Employment Young	-0.005	0.967***	0.382***	-0.713
Unemployment Young	0.036	-0.048***	0.925***	39.108***
Log_GDP	-0.001*	0.0001	-0.0002	0.955***

Table 3.2: VAR Estimation: Variables In Level (288 Observations – Four Years)

The column-variables are the causes, while the row-variables are the effects. The B_0 coefficients give us the contemporaneous effects The B_1 coefficients provides the effect of lagged variables (at time t–1) on current variable (at time t)

Contemporaneous Effect (t): $\mathbf{B_0}$						
	NEETs	*Employment Young*	*Unemployment Young*	*Log_GDP*	*Log Compens.*	*Log Inv*
NEETs		0	0	-	9.728***	-
Employment Young	0.128		-0.490***	0.987	-0.632	2.495**
Unemployment Young	1.378***	0		-	9.011**	-1.499
Log_GDP	0	0	0		0.060	0
Log Compens.	0	0	0	0		0
Log Inv	0	0	0	0	0.722	
Lagged Effect (t–1): $\mathbf{B_1}$						
	NEETs	*Employment Young*	*Unemployment Young*	*Log GDP*	*Log Compens.*	*Log Inv*
NEETs	0.959***	-0.423**	-0.083***	22.554***	-8.617***	5.279***
Employment Young	-0.135	0.933***	0.468***	-1.716	0.168	-1.322
Unemployment Young	-1.347***	0.027	1.085***	14.507***	-7.658*	-0.335
Log_GDP	-0.001	0.001	0.001	0.984***	-0.090	0.013
Log Compens.	0.004***	0.002**	-0.001	0.069***	0.890***	0.002
Log Inv	-0.002	-0.001	-0.002	0.055	-0.703***	0.822***

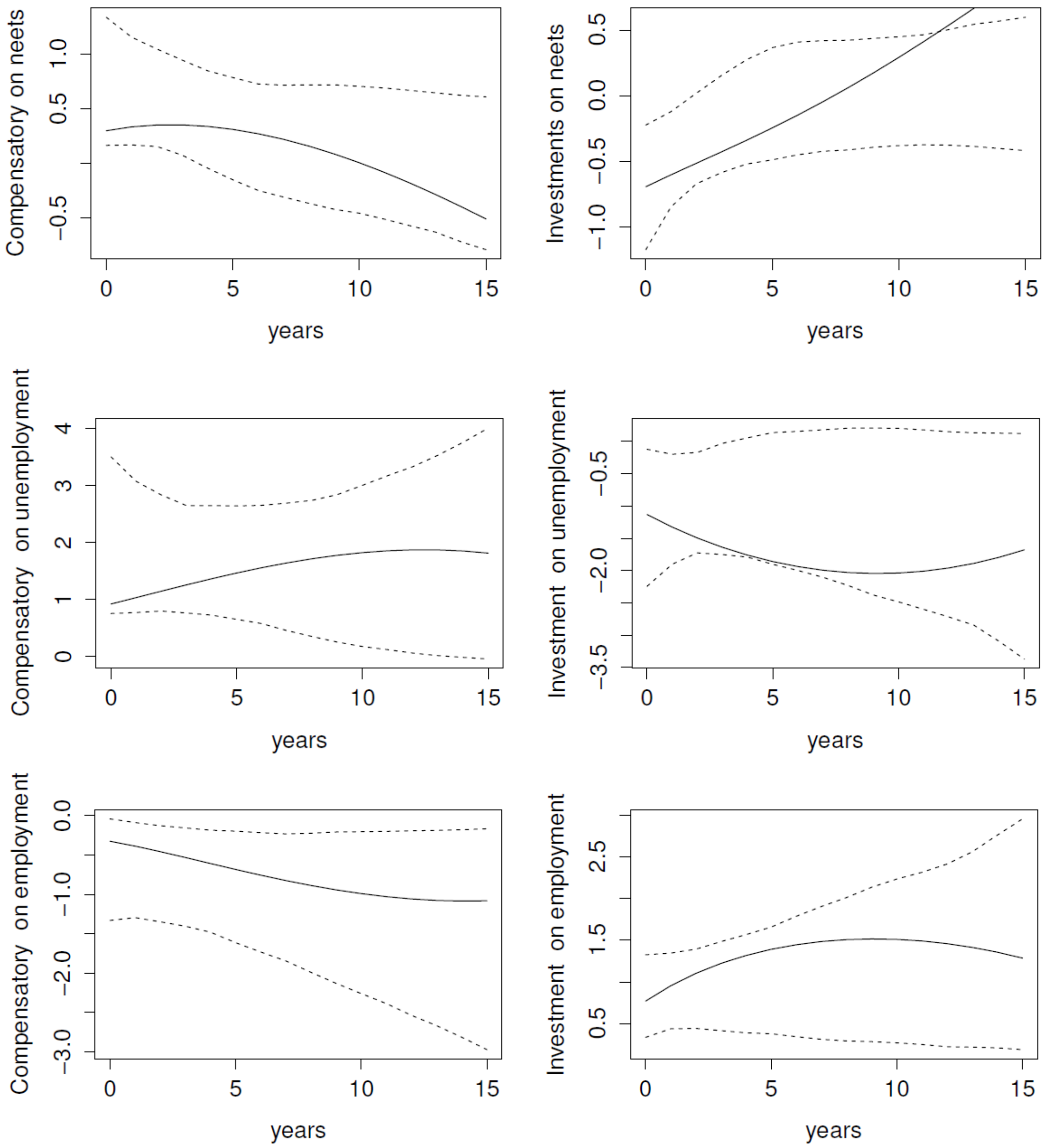
We start by observing the contemporaneous effects from Table 3.2. We notice that a one-level increase in the level of compensatory will significantly increase the level of NEETS by roughly 0.097%, while a one-level increase in the level of investment will significantly decrease the level of NEETS by roughly 0.0568%.

However, contemporaneous effects do not tell us the complete story about the interactions between the variables. It is often of interest to know the current and future response of one variable to an impulse in another variable in the system. An impulse-response function (IRF) serves this purpose as it describes the evolution of the variable of interest along a specified time horizon after a shock to another variable in a given moment.

In Figure 3.1 we report the IRFs which are related to our policy variables, *i.e*. the total amount spent in compensatory and investments policies. The first thing to notice is that a shock in the level of compensatory spending will slightly increase the level of NEETS over time, although this effect tends to become smaller and statistically insignificant. On the contrary, a shock in the level of investment spending will reduce the level of NEETS, although this effect tend to become smaller and statistically insignificant over time.

We observe that a shock in total compensatory policy has also a negative effect on employment, while a shock in total investment policy has a positive effect on it. Finally, we observe that a shock in total compensatory policy has also a positive effect on employment, while a shock in total investment policy has a positive effect on it. Overall, these results seem to suggest that shocks in the level of total investments lead to more positive economic outcomes, while the opposite is true for total compensatory.

Figure 3.1: Impulse Response Function



3.3 Discussion

We used these new regional indicators of spending in combination with a recently developed SVAR model to investigate the casual relationships between labour market outcomes and different types of spending. In particular, we focused on indicators of labour market participation of young people. While the low level of market participation of young people is not a new problem, what is new is the scale that has reached in the current economic crises. Our results suggest that social investment policies can be effective to enhance labour market outcomes of the young.

4. The Impact of Public Social Investment on Social and Economic Outcomes: A regional VAR analysis

4.1 Introduction

In this section of the report, we describe the process and results of the statistical modelling of Social Investment on both social and headline economic (Real GDP per capita) data using national data. We use econometric modelling to quantify the economic processes and transmissions mechanisms through which social innovation acts. This will allow the simulation and scenario analysis of innovations before they are implemented, and facilitate appropriate cost/benefit trade-offs and performance and impact monitoring. A foresight model will allow the estimation of expected returns. This will enable us, in turn to quantify by how much, and at what level, theory diverges from practice in application.

Dependent variables – Measures of Social Wellbeing

It is by no means straightforward to access a long-run time series of data relating to social investment and indicators of social wellbeing. Further, the more parameters our models contain, the less we can be sure they are parsimoniously estimated, and therefore delivering valid results. We include four dependent variables as follows:

Measures of social health:

Employment rate (youth/adult); and the inactivity rate – that is to say, the rate at which people are excluded from the workforce. These variables are of importance as much public social investment is aimed at improving labour market capacitation.

Measures of social sustainability:

We include the fertility rate – European societies are, in general, aging and with the recent decline in fertility across many nations indicates both a future increasing dependency rate and also serves as a proxy for the extent to which family life, the aspiration of many citizens, is supported by European economies. We also consider Real GDP per head as a (very rough) measure of prosperity. There are many drawbacks associated with the identification of per capita GDP with social sustainability as, by definition, such a measure does not indicate which segments of the population share the benefits of economic growth.

Explanatory variables

Fiscal factors:

We include various measures of social transfers to households from the public sector and public sector employment and conditions. This latter is included as it may be argued that, in circumstances of insufficient employment opportunities, the public sector might make good the shortfall in the demand for labour. Similarly, we include such possible fiscal measures as consumption by the public sector and compensation of public sector employees. Such spending might, in times of recession, be argued to “boost” the economy. Alongside such measures of spending, we include government revenue, the tax take. It is often argued that cutting taxes is one of the policy levers, which governments might use to stimulate the local economy.

4.2 Data Definitions

In general, the data are from the European Commission's Annual Macro-Economic Database, AMECO[7]. Fertility and education spending are found in the World Bank database[8].

X_1 Fertility rate, total (births per woman)
X_2 EU member (0 = "No", 1 = "Yes")
X_3 Current tax burden: total economy :- ESA 2010 (Percentage of GDP at current prices (excessive deficit procedure))
X_4 Social transfers in kind supplied to households via market producers: general government :- ESA 2010 (Percentage of GDP at current prices (excessive deficit procedure))
X_5 Social benefits other than social transfers in kind: general government :- ESA 2010 (Percentage of GDP at current prices (excessive deficit procedure))
X_6 Final consumption expenditure of general government :- ESA 2010 (Percentage of GDP at current prices (excessive deficit procedure))
X_7 Compensation of employees: general government :- ESA 2010 (Percentage of GDP at current prices (excessive deficit procedure))
X_8 Employment, persons: total economy (National accounts) 1000 persons
X_9 Real GDP per head, National Currency.
X_{10} Real compensation per employee, total economy Real compensation per employee, deflator GDP: total economy (National currency: 2010 = 100)
X_{11} Adjusted wage share: total economy: as percentage of GDP at current prices (Compensation per employee as percentage of GDP at market prices per person employed.)
X_{12} Real long-term interest rates, deflator GDP
X_{13} Inactivity rate (percentage): Youth and adults, 15-64
X_{14} Government expenditure on education, total (% of GDP)

4.3 Regional Models

Because of issues of degrees of freedom we cannot estimate the relationships between these data sets for individual EU nations. We model the impact of social investment in the EU nations by welfare regimes along the lines of Hemerijck (2013: Table 6.1)[9] though with two additional regions: The Baltic States and the Eastern European models.

In each case we adopt the approach described above, which is to say, we estimate a model for each welfare regime, determining which variables to include as potential regressors on the basis of maximising the AIC – where degrees of freedom allow, we then go on to determine an ultimate model on the basis of a general to specific approach. In each case, additive dummy variables are included to allow for national variation.

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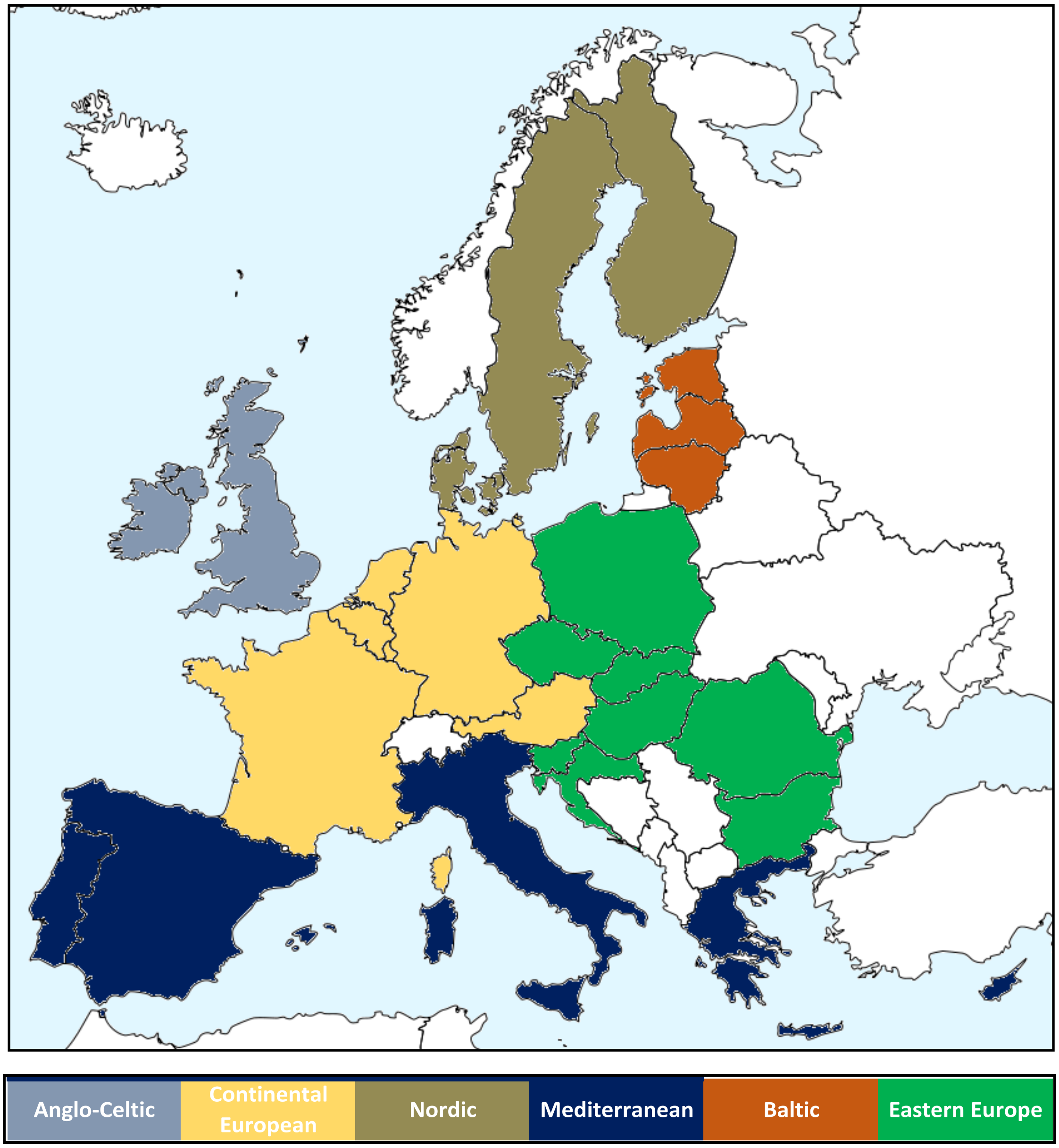
7 http://ec.europa.eu/economy_finance/db_indicators/ameco/index_en.htm

8 Fertility can be found at http://data.worldbank.org/indicator/SP.DYN.TFRT.IN
and Education is from http://data.worldbank.org/indicator/SE.XPD.TOTL.GD.ZS

9 As we have argued above, there is some evidence that slightly different groupings might be indicated if we consider clustering according to 'total investment spending' or 'total compensatory spending'. However, here we consider a further range of variables including, as we have noted, the strength of the national economy. It is appropriate, therefore, to continue with Hemerijck's classification.

The social security models are classified as follows, see Figure 4.1:

Figure 4.1 – Welfare Regions



The Anglo-Celtic model

Comprised of: the United Kingdom; and the Irish Republic, with associated dummy variables UK and IE.

The Continental European model

Comprised of: Austria; Belgium; France; Germany; Luxembourg; and the Netherlands, with associated dummy variables AT, BE, FR, DE, LU and NL.

The Nordic model

Comprised of: Denmark; Finland; and Sweden, with associated dummy variables DK, FI and SE.

The Mediterranean model

Comprised of: Cyprus; Greece; Italy; Malta; Portugal and Spain, with associated dummy variables CY, EL, IT, MT, PT and ES.

The Baltic model

Comprised of: Estonia; Latvia; and Lithuania, with associated dummy variables EE, LV and LT.

The Eastern Europe model

Comprised of: Bulgaria; Croatia; the Czech Republic; Hungary; Poland; Romania; Slovakia; and Slovenia, with associated dummy variables BG, HR, CZ, HU, PL, RO, SK and SI.

It should be borne in mind, as we have shown above, national sub-regions may bear little resemblance economically to other sub-regions of the same nation. London, for example, may experience differing rates of employment and economic growth than for example, Greater Manchester – however, the degrees of freedom at NUTS1 level are too few to allow the estimate of a VAR model. Here the use of national and regional data allows at the least regional modelling by welfare regime.

4.4 Notes on modelling

In all cases the data were modelled using a Vector AutoRegression (VAR) framework (Stock and Watson, 2001) where the endogenous variables were: X_1 (Fertility rate); X_8 (Employment, persons: total economy); X_9 (Real GDP per head); and X_{13} (Inactivity rate: Youth and adults, 15-64). There were four equations in each VAR.

The initial (theoretical) VAR in each case was a VAR(2)[10] including additive national dummy variables, $D_{j,t}$. A VAR(2) was selected as it is valid even in a situation of non-stationary and non-cointegrating data as it encompasses a model in first differences. The very limited degrees of freedom in most models precluded the possibility of testing for stationarity/cointegration as such tests general require a large sample size.

The general equation is set out in from eq(4) below. It will be noted that, as all explanatory variables enter as lags, there is no contemporaneous feedback, and therefore Ordinary Least Squares estimation of the parameter set is valid.

$$X_{i,t} = \sum \alpha D_{j,t} + \sum_{j=1}^{13} \beta_{1,j} X_{j,t-1} + \sum_{j=1}^{13} \beta_{2,j} X_{j,t-2} + \varepsilon_{i,t} \tag{4}$$

As we lack the degrees of freedom to specify an encompassing model for each nation, preliminary analysis is carried out comparing the Akaike Information Criteria (AIC) (Akaike, 1973, 1974) in the bivariate model:

[10] We used five autoregressive lags in the case of X_9, Real GDP per head, to account for the political cycle.

$$X_{i,t} = \sum \alpha D_{j,t} + \beta_{j,1} X_{j,t-1} + \beta_{j,2} X_{j,t-2} + \beta_{i,1} X_{i,t-1} + \beta_{i,2} X_{i,t-2} + \varepsilon_t \quad (5)$$

and

$$X_{i,t} = \sum \alpha D_{j,t} + \beta_{i,1} X_{i,t-1} + \beta_{i,2} X_{i,t-2} + \varepsilon_t \quad (6)$$

Where excluding X_j improved the AIC, the corresponding $\beta_{1,j}$ and $\beta_{2,j}$ is restricted to zero in eq(4) – *i.e*. X_j was dropped from eq(4).

The VAR(2) is estimated, degrees of freedom permitting, with all remaining variables X_j – *i.e*. those where consideration of the bivariate AIC indicated that they should be included in the list of regressors). Regressors are eliminated sequentially, in order of improving AIC[11], until no further improvements in the Information Criterion can be made.

The process is described in full in the first study, that of The Anglo-Celtic region. The analyses of the other regions were similarly carried out.[12] In particular, we focus on the modelling of X_8, Employment, persons: total economy (National accounts) 1000 persons.

Preliminary Analysis

Bivariate analysis was carried out to determine the strength of the relationship between X_8 and the other variables in the regressor set. In the case of X_8 and X_9 for example, the bivariate model is:

$$X_{8,t} = \alpha_1 UK_t + \alpha_2 IE_t + \beta_{8,1} X_{8,t-1} + \beta_{8,2} X_{8,t-2} + \beta_{9,1} X_{9,t-1} + \beta_{9,2} X_{9,t-2} + \varepsilon_t \quad (7)$$

where UK_t and IE_t take the value unity if observation t relates to the United Kingdom and the Irish Repubic respectively and zero otherwise and t = 1995 to 2015. The AIC from this equation is -258.4967.

The associated restricted model is:

$$X_{8,t} = \alpha_1 UK_t + \alpha_2 IE_t + \beta_{8,1} X_{8,t-1} + \beta_{8,2} X_{8,t-2} + \varepsilon_t \quad (8)$$

The AIC from this equation is -259.5411.

It will be seen the AIC decreases with X_9 excluded, therefore we conclude that X_9 may be considered in our ultimate specification for X_8 in the case of the Anglo-Celtic model.

The potential regressor variables and associated Akaike Information Criteria, AIC,[13] are shown below:

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11 The AIC is calculated as the log-likelihood of the estimated coefficient vector, less the number of coefficients estimated.

12 In the case of the Baltic Model, degrees of freedom were insufficient to estimate a model in which all potential regressors could be included. In this case, therefore, we added variables sequentially in order of improvement to AIC until no further additions were indicated.

Regressor	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}
AIC: bivariate	**-248**	NA	-261	-262	**-257**	**-255**	**-258**	**-258**	-261	-260	-262	-261	-226
AIC: restricted	-260	NA	-260	-260	-260	-260	-260	-260	-260	-260	-260	-260	-224

We see X_1, X_5, X_6, X_7, and X_9 improve the AIC when included in the bi-variate model.

VAR(2) specification

The initial specification for our general VAR(2) is:

$$X_{8,t} = \alpha_1 UK_t + \alpha_2 IE_t + \sum_{j=1,5,6,7,8,9} \left(\beta_{j,1} X_{j,t-1} + \beta_{j,2} X_{j,t-2} \right) + \varepsilon_t \tag{9}$$

where t = 1993 to 2013. The AIC is -259.8. To determine if we can reduce the regressor set, we eliminate the regressors sequentially. The associated restricted VAR(2) models and associated AICs are:

$$X_{8,t} = \alpha_1 UK_t + \alpha_2 IE_t + \sum_{j=5,6,7,8,9} \left(\beta_{j,1} X_{j,t-1} + \beta_{j,2} X_{j,t-2} \right) + \varepsilon_t \qquad \text{AIC = -260.1}$$
$$X_{8,t} = \alpha_1 UK_t + \alpha_2 IE_t + \sum_{j=1,6,7,8,9} \left(\beta_{j,1} X_{j,t-1} + \beta_{j,2} X_{j,t-2} \right) + \varepsilon_t \qquad \text{AIC = -259.3}$$
$$X_{8,t} = \alpha_1 UK_t + \alpha_2 IE_t + \sum_{j=1,5,7,8,9} \left(\beta_{j,1} X_{j,t-1} + \beta_{j,2} X_{j,t-2} \right) + \varepsilon_t \qquad \text{AIC = -261.6}$$
$$X_{8,t} = \alpha_1 UK_t + \alpha_2 IE_t + \sum_{j=1,5,6,8,9} \left(\beta_{j,1} X_{j,t-1} + \beta_{j,2} X_{j,t-2} \right) + \varepsilon_t \qquad \text{AIC = -260.7}$$
$$X_{8,t} = \alpha_1 UK_t + \alpha_2 IE_t + \sum_{j=1,5,6,7,8} \left(\beta_{j,1} X_{j,t-1} + \beta_{j,2} X_{j,t-2} \right) + \varepsilon_t \qquad \text{AIC = -257.9} \tag{10}$$

The maximum AIC is from the model in which X_9 is eliminated from the regressor set; hence this becomes our new baseline VAR(2).

To determine whether we may reduce the model still further we estimate:

$$X_{8,t} = \alpha_1 UK_t + \alpha_2 IE_t + \sum_{j=5,6,7,8} \left(\beta_{j,1} X_{j,t-1} + \beta_{j,2} X_{j,t-2} \right) + \varepsilon_t \qquad \text{AIC = -258.7}$$
$$X_{8,t} = \alpha_1 UK_t + \alpha_2 IE_t + \sum_{j=1,6,7,8} \left(\beta_{j,1} X_{j,t-1} + \beta_{j,2} X_{j,t-2} \right) + \varepsilon_t \qquad \text{AIC = -258.1}$$
$$X_{8,t} = \alpha_1 UK_t + \alpha_2 IE_t + \sum_{j=1,5,7,8} \left(\beta_{j,1} X_{j,t-1} + \beta_{j,2} X_{j,t-2} \right) + \varepsilon_t \qquad \text{AIC = -260.1}$$
$$X_{8,t} = \alpha_1 UK_t + \alpha_2 IE_t + \sum_{j=1,5,6,8} \left(\beta_{j,1} X_{j,t-1} + \beta_{j,2} X_{j,t-2} \right) + \varepsilon_t \qquad \text{AIC = -258.7}$$

The maximum AIC is given by eq(10), therefore this represents our ultimate specification for X_8.

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[13] The Information Criterion of the AIC – excluded, that is the plain AR(2) – in X_{14} differs because of the sample size. The data-range varies depending on the regressor variable and there are fewer observations available with X_{14}.

4.5 Impulse response functions

In general, the coefficient estimates in a VAR are uninterpretable. It is therefore the case, when estimating such systems to determine the impact of changes in the explanatory variables through so-called Impulse Response functions. The approach is to vary (in our case by 1%) the level of the explanatory variables and determine the impact on the dependent variables. The impact of such changes feeds through via simulation to the dependent variable – in our case modelled over a five year period – allowing us to state whether the model suggests a positive or negative long-term relationship between the variables.

4.6 Model Specifications

The Anglo-Celtic model

Fertility rate, total (births per woman)

The final equation for X_1 is:

$$\begin{aligned}\hat{X}_{1,t} = {} & 1.0051X_{1,t-1} - 0.48861X_{1,t-2} - 0.0021863X_{6,t-1} + 0.010839X_{6,t-2} \\ & - 0.000065043X_{8,t-1} + 0.000080912X_{8,t-2} + 0.26698UK_t + 0.77837IE_t\end{aligned}$$

Employment, persons: total economy (National accounts) 1000 persons

The final equation for X_8 is:

$$\begin{aligned}\hat{X}_{8,t} = {} & 1.1112X_{8,t-1} - 0.11836X_{8,t-2} - 781.49X_{1,t-1} - 422.12X_{1,t-2} \\ & + 103.37X_{5,t-1} - 55.282X_{5,t-2} - 142.85X_{6,t-1} + 227.09X_{6,t-2} \\ & - 18.899X_{7,t-1} - 191.68X_{7,t-2} + 2476UK_t + 2572.2IE_t\end{aligned}$$

Real GDP per head

The final equation for X_9 is:

$$\begin{aligned}\hat{X}_{9,t} = {} & 0.33095X_{9,t-1} - 0.44932X_{9,t-2} + 0.86575X_{9,t-3} - 0.78435X_{9,t-4} + 0.45757X_{9,t-5} \\ & - 11441X_{1,t-1} - 739.53X_{1,t-2} - 392.26X_{5,t-1} - 222.43X_{5,t-2} \\ & + 72.62X_{6,t-1} + 1288.1X_{6,t-2} - 420.39X_{7,t-1} - 397.51X_{7,t-2} \\ & - 42.072X_{10,t-1} + 119.92X_{10,t-2} - 137.24X_{11,t-1} - 218.88X_{11,t-2} \\ & - 112.55X_{13,t-1} - 362.2X_{13,t-2} - 1215X_{14,t-1} + 630.14X_{14,t-2} \\ & + 54530UK_t + 65762IE_t\end{aligned}$$

Inactivity rate (percentage): Youth and adults, 15-64

Ultimately, the final equation for X_{13} is:

$$\begin{aligned}\hat{X}_{13,t} = {} & 1.0388X_{13,t-1} - 0.24862X_{13,t-2} + 0.084715X_{11,t-1} + 0.058456X_{11,t-2} \\ & - 3.2782UK_t - 0.5761IE_t\end{aligned}$$

Discussion

It will be observed that there are feedback relationships amongst the variables which make the determination of the overall impact of policy changes unclear. X_1, for example, apparently depends directly only on its own lags, those of X_6 and X_8, however, X_8 in turn depends on its own lags, X_1, X_5, X_6 and X_7. It follows, therefore, that X_1 also depends on X_5, X_6 and X_7.

The sign of the impact of a 1% change in the explanatory variables is summarised in Table 4.1:

Table 4.1 Summary of Impact Response – Anglo-Celtic Model

	X_2	X_3	X_4	X_5	X_6	X_7	X_{10}	X_{11}	X_{12}	X_{14}
X_1				–	+	+				
X_8				+	+	–				
X_9				–	+	–	+	–		–
X_{13}								+		

According to our analysis there is little impact of education (X_{14}) on the dependent variables, however, the government may impact on social outcomes through fiscal variables, including consumption (X_6), social benefits (X_5) and compensation of public employees (X_7). It is also worth noting that there is no evidence of any impact of changes in the tax burden (X_3) on the variables we consider here. This rather undermines a common theme of neo-liberal government policy which indicates reductions in tax stimulate the economy.

The impulse response functions indicate that X_1 (Fertility) is negatively related to X_5 (Social benefits other than social transfers in kind) and positively related to X_6 (Final consumption expenditure of general government) and X_7 (Compensation of employees: general government).

In practice, however, it is not the sign (positive or negative) of the relationship which is of importance, but rather the magnitude. Further, it is reasonable to suppose that, though the government might have the means directly to influence X_3 (current tax burden), X_4 (social transfers in kind), X_5 (social benefits other than social transfers in kind), X_6 (final consumption expenditure of general government), X_7 (compensation of employees: general government and X_{14} (government expenditure on education, the other variables are rather endogenous, hence we consider the impacts only of these factors. In particular, we consider the impacts on two particular "target" variables, X_8 (employment, persons: total economy) and X_9 (Real GDP per head).

It will be noted from Table 4.1 that in some cases the effect of policy variables is mixed, in the sense that an increase will lead to an improvement in one of the target variables and a deterioration in the other. Therefore we calculate the cost and benefit only in cases where there is not a trade-off between economic growth and employment. We should note, however, that these impulse functions consider the impact of a change in the fiscal policy variables, *at the margin*. It does not follow that large increase/decreases will necessarily have the same proportionate effect.

On the basis of the analysis we estimate that, in the case of the UK, a one-off increase in X_6 (final consumption expenditure of general government) of 1% (costing, in real terms, £6,236m) will lead, over a five year period, to an increase in Real GDP of £14,381m: a benefit to cost ratio 2.31:1. There is also an impact on employment, but it is not large. We estimate only 16,000 extra jobs would be created by this change.

Conversely, if compensation of employees: general government (X_7) increases by 1% (costing £910m), we expect Real GDP to decrease by £7,727m; a ratio of -8.49:1, and paradoxically, employment to decline at the rate of one job for each additional £13,814 spent.

In the case of Ireland, the equivalent estimated five year impact of a 1% change in X_6 (costing €431m) are an increase of Real GDP is estimated to increase by €801m – a ratio of 1.86:1 – and increase employment by 13,000. According to our estimates, a 1% increase in X_7 will reduce Real GDP in the ratio 4.05:1, and reduce employment by 65,000.

In sum: our estimates indicate a marginal increase in X_6 or X_7 will have the following impacts on Real GDP and employment:

		X_6	X_7
	Cost of 1% change (local currency: real million)	6,236	910
UK	Employment created (000)	16	-66
	Real GDP benefit:cost ratio	2.31:1	-8.49:1
	Cost of 1% change (local currency: real million)	431	132
IE	Employment created (000)	13	-65
	Real GDP benefit:cost ratio	1.86:1	-4.05:1

As noted above, these are marginal effects and reflect the estimated impact only of *minor* changes in these fiscal variables. Note also, we do not allow for the distributional effects of such changes.

The Continental European model

Fertility rate, total (births per woman)

$$\begin{aligned}\hat{X}_{1,t} = {} & 0.73847X_{1,t-1} + 0.071507X_{1,t-2} - 0.00074331X_{6,t-1} - 0.014691X_{6,t-2} \\ & + 0.012348X_{7,t-1} + 0.006802X_{7,t-2} - 0.0020563X_{10,t-1} + 0.0052694X_{10,t-2} \\ & + 0.044524AT_t + 0.14718BE_t + 0.18208FR_t + 0.080289DE_t \\ & + 0.067333LU_t + 0.20876NL_t\end{aligned}$$

Employment, persons: total economy (National accounts) 1000 persons

$$\begin{aligned}\hat{X}_{8,t} = {} & 1.4731X_{8,t-1} - 0.48424X_{8,t-2} - 14.363X_{11,t-1} + 8.1979X_{11,t-2} \\ & + 399.67AT_t + 438.11BE_t + 709.52FR_t + 917.56DE_t \\ & + 324.74LU_t + 501.45NL_t\end{aligned}$$

Real GDP per head

$$\begin{aligned}\hat{X}_{9,t} = {} & 0.8682X_{9,t-1} - 0.35769X_{9,t-2} + 0.45774X_{9,t-3} - 0.27289X_{9,t-4} + 0.071347X_{9,t-5} \\ & - 40.463X_{3,t-1} + 214.33X_{3,t-2} + 139.97X_{6,t-1} - 19.457X_{6,t-2} \\ & - 218.45X_{11,t-1} + 58.693X_{11,t-2} - 165.25X_{12,t-1} - 51.249X_{12,t-2} \\ & + 7750.2AT_t + 7456BE_t + 6401.7FR_t + 8040.5DE_t \\ & + 18128LU_t + 9487.3NL_t\end{aligned}$$

Inactivity rate (percentage): Youth and adults, 15-64

$$\begin{aligned}\hat{X}_{13,t} = {} & 0.68633X_{13,t-1} + 0.22343X_{13,t-2} - 0.000082173X_{9,t-1} + 0.000039148X_{9,t-2} \\ & + 3.6814AT_t + 4.2516BE_t + 3.8284FR_t + 3.3517DE_t \\ & + 5.5599LU_t + 3.1045NL_t\end{aligned}$$

Discussion

The impulse response functions indicate that the relationship amongst the variables differs from that of the Anglo-Celtic model. As before we summarise the impulse response impacts below. In some cases, the sign of the impact cannot be determined, either because it has too low a magnitude, or because the impact differs, depending on the nation considered.

Table 4.2 Summary of Impact Response – Western Continental European

	X_2	X_3	X_4	X_5	X_6	X_7	X_{10}	X_{11}	X_{12}	X_{14}
X_1					–	+	+			
X_8								–		
X_9		+			+			–	+	
X_{13}		–			–			+	±	

In the case of the Western European continental model, there is less evidence of the impact of social security spending, though the consumption of government (X_6) apparently is related to increases in GDP and a decline in the activity rate. Counter intuitively, there is some evidence that an increase in the tax burden (X_3) can increase GDP per head and reduce the inactivity rate. There is no evidence of improvement in social outcomes related to the spending on education (X_{14}). It will be noted that an increase in the wage share in the economy (X_{11}) rather counter intuitively reduces employment (and increases the inactivity rate) while putting downwards pressure on Real GDP per capita.

Following a similar approach to that described above in the Anglo-Celtic model, we summarise the estimated impact of marginal changes in appropriate fiscal variables as follows (note that Real GDP *increases* with a 1% increase in the tax burden):

		X_3	X_6
AT	Cost/increase in tax from 1% change (local currency: real million)	2,201	816
	Real GDP benefit:cost ratio	0.68:1	0.75:1
BE	Cost/increase in tax from 1% change (local currency: real million)	2,873	1,250
	Real GDP benefit:cost ratio	0.69:1	0.76:1
DE	Cost/increase in tax from 1% change (local currency: real million)	16,854	6,918
	Real GDP benefit:cost ratio	0.73:1	0.8:1
FR	Cost/increase in tax from 1% change (local currency: real million)	16,881	6,929
	Real GDP benefit:cost ratio	0.71:1	0.8:1
LU	Cost/increase in tax from 1% change (local currency: real million)	229	90
	Real GDP benefit:cost ratio	0.39:1	0.39:1
NL	Cost/increase in tax from 1% change (local currency: real million)	3,562	2,145
	Real GDP benefit:cost ratio	0.68:1	0.7:1

As the benefit to cost ratio of an increase in X_6 with respect to Real GDP is less than unity, the increase will cost more than the economy gains from it. As noted above, these are marginal effects and reflect the estimated impact of *minor* changes in these fiscal variables. Note also, we do not allow for the distributional effects of such changes.

The Nordic model

Fertility rate, total (births per woman)

$$\hat{X}_{1,t} = 1.3685X_{1,t-1} - 0.43727X_{1,t-2} + 0.0060922X_{11,t-1} - 0.0079165X_{11,t-2} + 0.22401DK_t + 0.22941FI_t + 0.21936SE_t$$

Employment, persons: total economy (National accounts) 1000 persons

$$\begin{aligned}\hat{X}_{8,t} = {} & 1.0253X_{8,t-1} - 0.36057X_{8,t-2} + 137.15X_{4,t-1} + 12.694X_{4,t-2} \\ & - 8.5313X_{5,t-1} - 5.4447X_{5,t-2} - 46.291X_{7,t-1} + 50.549X_{7,t-2} \\ & + 0.00066442X_{9,t-1} + 0.000021912X_{9,t-2} + 4.6899X_{10,t-1} - 8.9646X_{10,t-2} \\ & + 1049.9DK_t + 1046.9FI_t + 1386.5SE_t\end{aligned}$$

Real GDP per head

$$\begin{aligned}\hat{X}_{9,t} = {} & 1.0904X_{9,t-1} - 0.37817X_{9,t-2} + 0.011433X_{9,t-3} + 0.20007X_{9,t-4} - 0.064975X_{9,t-5} \\ & + 7925.5X_{4,t-1} - 854.63X_{4,t-2} - 1365.5X_{6,t-1} - 603.6X_{6,t-2} \\ & - 48.77X_{8,t-1} + 38.889X_{8,t-2} + 114130DK_t + 58496FI_t \\ & + 130510SE_t\end{aligned}$$

Inactivity rate (percentage): Youth and adults, 15-64

$$\begin{aligned}\hat{X}_{13,t} = {} & 0.037608X_{13,t-1} + 0.31158X_{13,t-2} + 6.1018X_{1,t-1} - 8.7135X_{1,t-2} \\ & - 0.28564X_{3,t-1} - 0.121X_{3,t-2} + 0.75465X_{6,t-1} - 0.29641X_{6,t-2} \\ & - 0.33344X_{7,t-1} + 1.3212X_{7,t-2} - 0.0023441X_{8,t-1} - 0.0043892X_{8,t-2} \\ & + 0.19741X_{11,t-1} - 0.58081X_{11,t-2} + 49.625DK_t + 51.391FI_t \\ & + 60.991SE_t\end{aligned}$$

Discussion

The implied impulse response functions in the case of the Nordic model differ from those of the two previous models. As before we summarise these impacts below.

Table 4.3 Summary of Impact Response – Nordic Model

	X_2	X_3	X_4	X_5	X_6	X_7	X_{10}	X_{11}	X_{12}	X_{14}
X_1								+		
X_8			+	–	–	±	–			
X_9			±	+	–	+	+			
X_{13}		–	–	+	+	+	+	–		

In the case of the Nordic model, there is mixed evidence of the impact of social security spending (X_4 and X_5). In contrast to the preceding models, the consumption of government (X_6) is apparently related to a *decrease* in GDP per capita and employment, along with an increase in the inactivity rate. Counterintuitively, there is some evidence that an increase in the tax burden (X_3) can reduce the inactivity rate. Again, there is no evidence of improvement in social outcomes related to the spending on education (X_{14}).

Following a similar approach to that described above in the Anglo-Celtic model, we summarise the estimated impact of marginal changes in appropriate fiscal variables as follows (we do not consider the impact of changes in X_5, as we benefit in terms of increasing Real GDP, but lose employment, hence there is a trade-off):

		X_4	X_6
	Cost of 1% change (local currency: real million)	296	2,556
DK	Employment created (000)	7	-2
	Real GDP benefit:cost ratio	0.16:1	-3.71:1
	Cost of 1% change (local currency: real million)	57	-1,617[14]
FI	Employment created (000)	13	-2
	Real GDP benefit:cost ratio	1.44:1	5.22:1
	Cost of 1% change (local currency: real million)	1,502	6,370
SE	Employment created (000)	17	-2
	Real GDP benefit:cost ratio	0.13:1	-2.62:1

As noted above, these are marginal effects and reflect the estimated impact only of *minor* changes in these fiscal variables.

The Mediterranean model

Fertility rate, total (births per woman)

$$\begin{aligned}\hat{X}_{1,t} = {} & 1.0421X_{1,t-1} - 0.13723X_{1,t-2} - 0.011514X_{14,t-1} - 0.011833X_{14,t-2} \\ & + 0.28574CY_t + 0.19609EL_t + 0.22881IT_t + 0.28034MT_t \\ & + 0.22819PT_t + 0.21514ES_t\end{aligned}$$

Employment, persons: total economy (National accounts) 1000 persons

$$\begin{aligned}\hat{X}_{8,t} = {} & 1.4029X_{8,t-1} - 0.51926X_{8,t-2} - 987.03X_{1,t-1} + 743.72X_{1,t-2} \\ & - 26.499X_{11,t-1} - 2.6731X_{11,t-2} - 11.205X_{12,t-1} - 6.6033X_{12,t-2} \\ & + 2000.5CY_t + 2418.3EL_t + 4691.6IT_t + 1848MT_t \\ & + 2644.5PT_t + 4265.3ES_t\end{aligned}$$

Real GDP per head

$$\begin{aligned}\hat{X}_{9,t} = {} & 1.4895X_{9,t-1} - 0.65279X_{9,t-2} + 0.27081X_{9,t-3} - 0.25908X_{9,t-4} + 0.092606X_{9,t-5} \\ & - 386.74X_{1,t-1} + 60.53X_{1,t-2} + 28.672X_{11,t-1} - 35.089X_{11,t-2} \\ & + 2212.1CY_t + 1897.6EL_t + 2310.3IT_t + 1871MT_t \\ & + 1856.5PT_t + 2125.2ES_t\end{aligned}$$

Inactivity rate (percentage): Youth and adults, 15-64

$$\begin{aligned}\hat{X}_{13,t} = {} & 0.73268X_{13,t-1} + 0.11909X_{13,t-2} + 6.8157X_{1,t-1} - 5.6326X_{1,t-2} \\ & + 1.347X_{2,t-1} - 0.45361X_{2,t-2} - 0.00085925X_{8,t-1} + 0.00056901X_{8,t-2} \\ & - 0.30655X_{14,t-1} - 0.31254X_{14,t-2} + 5.3498CY_t + 5.6944EL_t \\ & + 12.642IT_t + 6.0639MT_t + 5.8816PT_t + 9.4753ES_t\end{aligned}$$

14 Although final consumption expenditure as a proportion of Real GDP increases, according to our estimates, the actual expenditure declines, as Real GDP itself decreases. It follows, if we increase final consumption expenditure increases, we estimate Real GDP will increase disproportionally, actually reducing X_6.

Discussion

As we have seen in the previous models, the implied impulse response functions in the case of the Mediterranean model differ from those of other social security regimes.

Table 4.4 Summary of Impact Response – Mediterranean model

	X_2	X_3	X_4	X_5	X_6	X_7	X_{10}	X_{11}	X_{12}	X_{14}
X_1										–
X_8								–	±	+
X_9								+		+
X_{13}	+							+	±	–

In the case of the Mediterranean model, there is no evidence of the impact of social security spending or the burden of taxes. Neither is there any evidence of the impact of fiscal variables, such as government spending. The most important drivers of social outcomes are the adjusted wage share (X_{11}) and spending on education (X_{14}). In particular, increases in education spending are associated with an increase in Real GDP per capita and employment, and decreases in the inactivity rate and in fertility. Following a similar approach to that described above, we estimate:

		X_{14}
	Cost of 1% change (local currency: real million)	13
CY	Employment created (000)	6
	Real GDP benefit:cost ratio	0.2:1
	Cost of 1% change (local currency: real million)	477
ES	Employment created (000)	4
	Real GDP benefit:cost ratio	0.2:1
	Cost of 1% change (local currency: real million)	79
EL	Employment created (000)	3
	Real GDP benefit:cost ratio	0.25:1
	Cost of 1% change (local currency: real million)	6541
IT	Employment created (000)	4
	Real GDP benefit:cost ratio	0.18:1
	Cost of 1% change (local currency: real million)	6
MT	Employment created (000)	6
	Real GDP benefit:cost ratio	0.24:1
	Cost of 1% change (local currency: real million)	95
PT	Employment created (000)	4
	Real GDP benefit:cost ratio	0.26:1

We see that, although it may not be worth (as the benefit to cost ratio is less than unity) increasing education expenditure as a proportion of Real GDP in terms of economic growth, it is possible to boost employment in this way. As noted above, these are marginal effects and reflect the estimated impact only of *minor* changes in these fiscal variables.

The Baltic model

Fertility rate, total (births per woman)

$$\begin{aligned}\hat{X}_{1,t} = {} & 0.33062X_{1,t-1} - 0.014227X_{1,t-2} - 0.029108X_{6,t-1} + 0.039303X_{6,t-2} \\ & + 0.05722X_{7,t-1} - 0.061131X_{7,t-2} - 0.000016749X_{9,t-1} + 0.00007083X_{9,t-2} \\ & - 0.012527X_{11,t-1} + 0.0014331X_{11,t-2} - 0.0072597X_{12,t-1} + 0.0041193X_{12,t-2} \\ & - 0.011966X_{13,t-1} + 0.015283X_{13,t-2} + 0.84308EE_t + 0.80551LV_t \\ & + 0.82877LT_t\end{aligned}$$

Employment, persons: total economy (National accounts) 1000 persons

$$\begin{aligned}\hat{X}_{8,t} = {} & 0.94931X_{8,t-1} - 0.26719X_{8,t-2} - 3.9855X_{5,t-1} + 6.191X_{5,t-2} \\ & - 5.7797X_{6,t-1} + 5.9345X_{6,t-2} + 3.3099X_{10,t-1} - 3.4381X_{10,t-2} \\ & + 5.0404X_{13,t-1} - 4.4961X_{13,t-2} + 157.9EE_t + 255.35LV_t \\ & + 386.87LT_t\end{aligned}$$

Real GDP per head

$$\begin{aligned}\hat{X}_{9,t} = {} & 0.93111X_{9,t-1} - 1.0167X_{9,t-2} + 0.52789X_{9,t-3} - 0.2485X_{9,t-4} + 0.19109X_{9,t-5} \\ & + 732.61X_{2,t-1} + 688.24X_{2,t-2} + 144.02X_{3,t-1} - 40.483X_{3,t-2} \\ & - 211.81X_{6,t-1} - 109.55X_{6,t-2} + 614.29X_{7,t-1} + 128.44X_{7,t-2} \\ & - 107.54X_{11,t-1} - 95.931X_{11,t-2} - 395.68X_{14,t-1} - 89.327X_{14,t-2} \\ & + 13511EE_t + 12191LV_t + 12100LT_t\end{aligned}$$

Inactivity rate (percentage): Youth and adults, 15-64

$$\begin{aligned}\hat{X}_{13,t} = {} & 0.48399X_{13,t-1} + 0.080674X_{13,t-2} - 1.3714X_{1,t-1} - 5.1095X_{1,t-2} \\ & - 0.0012223X_{9,t-1} + 0.00098578X_{9,t-2} - 1.3144X_{14,t-1} + 0.44869X_{14,t-2} \\ & + 29.015EE_t + 27.603LV_t + 28.623LT_t\end{aligned}$$

Discussion

As we have seen in the previous models, the implied impulse response functions in the case of the Baltic model differ from those of other social security regimes.

Table 4.5 Summary of Impact Response – Baltic model

	X_2	X_3	X_4	X_5	X_6	X_7	X_{10}	X_{11}	X_{12}	X_{14}
X_1	+	+			–	+		–	±	–
X_8	–	–		+	+	–	+	+	±	–
X_9	+	+			–	+		–		–
X_{13}	–	–			+	–		+	±	–

In the case of the Baltic social security model, there is evidence of the impact of the majority of the explanatory variables. Since joining the EU (X_2), the Baltic states have experienced improvements in Real GDP per head and a decrease in the inactivity rate – the tax burden (X_3) is also associated with these same effects. There is little evidence of the impact of social security, however the consumption of government (X_6) while boosting employment reduces Real GDP per head while the pay of public sector employees (X_7) has the opposite effect. Neither is there any evidence of the impact of fiscal variables, such as government spending.

Increases in education spending (X_{14}) are apparently associated with decreases in fertility, Real GDP per capita and employment. This is a somewhat counterintuitive result and it must be borne in mind that education expenditure in the Baltic states is growing at a lesser rate than Real GDP per capita, hence government expenditure on education as a % of GDP (X_{14}) has generally declined as a result. This may reflect the general population decline and low birth rates experienced by these states. As the youth population falls, Real GDP per head may well rise, even as educational expenditure relative to GDP declines. It does not follow, therefore, that reducing educational expenditure is a driver for increased Real GDP per capita.

It will be noted that, in the case of the relevant fiscal drivers, other than X_5, the results conflict, in the sense that we have an apparent trade-off between employment and Real GDP. In the case of X_5 we estimate:

		X_5
	Cost of 1% change (local currency: real million)	19
EE	Employment created (000)	0.5
	Cost of 1% change (local currency: real million)	19
LT	Employment created (000)	0.5
	Cost of 1% change (local currency: real million)	31
LU	Employment created (000)	0.5

We see that, although it may not be worth (as the benefit to cost ratio is less than unity) increasing education expenditure as a proportion of Real GDP in terms of economic growth, it is possible to boost employment in this way. As noted above, these are marginal effects and reflect the estimated impact only of *minor* changes in these fiscal variables.

The Eastern Europe model

Fertility rate, total (births per woman)

$$\begin{aligned}\hat{X}_{1,t} = {} & 0.96096X_{1,t-1} - 0.1485X_{1,t-2} - 0.012959X_{5,t-1} - 0.00036301X_{5,t-2} \\ & + 0.000051316X_{8,t-1} - 0.000055929X_{8,t-2} + 0.0016558X_{10,t-1} - 0.000073506X_{10,t-2} \\ & + 0.29221BG_t + 0.31231HR_t + 0.30847CZ_t + 0.29846HU_t \\ & + 0.37137PL_t + 0.32412RO_t + 0.30109SK_t + 0.34269SI_t\end{aligned}$$

Employment, persons: total economy (National accounts) 1000 persons

$$\begin{aligned}\hat{X}_{8,t} = {} & 1.1784X_{8,t-1} - 0.2551X_{8,t-2} - 23.962X_{5,t-1} + 3.3425X_{5,t-2} \\ & - 13.174X_{11,t-1} - 1.7107X_{11,t-2} + 21.425X_{13,t-1} - 25.331X_{13,t-2} \\ & + 1381.7BG_t + 1466.5HR_t + 1453.1CZ_t + 1520.5HU_t \\ & + 2424.2PL_t + 1845.9RO_t + 1227.3SK_t + 1441.1SI_t\end{aligned}$$

Real GDP per head

$$\begin{aligned}\hat{X}_{9,t} = {} & 1.2783X_{9,t-1} - 0.25064X_{9,t-2} + 0.081212X_{9,t-3} - 0.3198X_{9,t-4} + 0.17301X_{9,t-5} \\ & + 478.34BG_t + 3692.1HR_t + 17132CZ_t + 131370HU_t \\ & + 1899.9PL_t + 1272.4RO_t + 626.58SK_t + 798.02SI_t\end{aligned}$$

Inactivity rate (percentage): Youth and adults, 15-64

$$\begin{aligned}\hat{X}_{13,t} = {} & 0.794X_{13,t-1} + 0.0047675X_{13,t-2} - 0.5456X_{2,t-1} + 0.80705X_{2,t-2} \\ & + 0.073016X_{6,t-1} + 0.15931X_{6,t-2} + 0.00017052X_{8,t-1} - 0.00060593X_{8,t-2} \\ & - 0.00000415X_{9,t-1} + 0.00000325X_{9,t-2} + 0.0637X_{10,t-1} - 0.084133X_{10,t-2} \\ & - 0.036825X_{11,t-1} + 0.11249X_{11,t-2} + 1.7267BG_t + 0.53519HR_t\end{aligned}$$

$+ \quad 1.5119CZ_t \quad + \quad 4.2803HU_t \quad + \quad 6.6646PL_t \quad + \quad 5.1223RO_t$
$+ \quad 0.72093SK_t \quad - \quad 1.2423SI_t$

Discussion

The implied impulse response functions in the case of the Eastern Europe model are summarised below.

Table 4.6 Summary of Impact Response – Eastern Europe model

	X_2	X_3	X_4	X_5	X_6	X_7	X_{10}	X_{11}	X_{12}	X_{14}
X_1	±			–	±		+	–		
X_8	±			–	+		–	–		
X_9										
X_{13}	+			+	+		–	+		

In the case of the Eastern Europe model, the most interesting feature is that Real GDP per head appears unrelated to the other variables, which means that the impulse response functions generally show little or no effect of most variables. There is some evidence that social benefits other than social transfers in kind (X_5) generally increases the level of labour market inactivity, and that real compensation per employee (X_{10}) has the opposite result. As with many of the other social security regimes, there appears little or no impact of a change in education spending:

		X_5	X_6
	Cost of 1% change (local currency: real million)	100	133
BG	Employment created (000)	-11	2
	Cost of 1% change (local currency: real million)	5,696	8,919
CZ	Employment created (000)	-12	2
	Cost of 1% change (local currency: real million)	490	670
HZ	Employment created (000)	-13	2
	Cost of 1% change (local currency: real million)	41,072	62,010
HU	Employment created (000)	-12	2
	Cost of 1% change (local currency: real million)	2,512	3,174
PL	Employment created (000)	-13	2
	Cost of 1% change (local currency: real million)	652	837
RO	Employment created (000)	-10	1
	Cost of 1% change (local currency: real million)	112	159
SK	Employment created (000)	-13	2
	Cost of 1% change (local currency: real million)	64	74
SI	Employment created (000)	-15	2

As noted above, these are marginal effects and reflect the estimated impact only of *minor* changes in these fiscal variables.

5. Conclusions

In this report, D6.3 “Report on econometric modelling” which forms part of Work Package 6, “From foresight to welfare practices” of the EU funded InnoSI project, we have assessed the evidence of public sector social investment on social, labour market and economic outcomes. This analysis – or rather, these analyses – have been carried out using: regional, NUTS1, level data; NUTS1 data cumulated to the level of the EU; and national (*i.e*. NUTS0) data, cumulated to welfare regimes, though allowing for regional variation through the use of dummy variables.

The overall implication of this analysis is that the public sector can influence social outcomes through appropriate social investment. In particular, our results suggest that social investment policies can be effective to enhance labour market outcomes of the young. More generally, there is mixed evidence, depending on the region considered, that fiscal policies, such as public sector consumption and employment can influence social outcomes.

Somewhat counterintuitively, there is only limited evidence that changing educational expenditures can improve social outcomes and there is little evidence that increases in the tax burden hinder economic growth or social outcomes. This latter result in particular somewhat undermines conventional neo-liberal wisdom that tax cuts are required to boost growth. Indeed, what evidence there is suggests rather the opposite; that in the current climate, it is reductions in the tax burden hinder growth. It should be borne in mind, however, our impulse response functions consider only marginal changes in these variables.

Our results indicate clearly that the regional dimension matters in public social investment. There are not only strong differences across regions in EU, but even inside different countries. In general, there is no one-size-fits-all policy. Social investment may be most effective, these results suggest, when considered regionally. However, attempts to model these effects at a regional level are hampered by lack of data. In order to better target policy measures, there is an increasing need of social policy indicators developed at regional level.

Ultimately, the efficacy of Social Investment relies, not only on what is done, but how it is done and where it is done, both nationally and sub-nationally – and that’s what gets results.

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7. Appendix A NUTS Classifications

NUTS0	Code	NUTS1	Code
Austria	AT	East Austria	AT1
		South Austria	AT2
		West Austria	AT3
Belgium	BE	Brussels Capital Region	BE1
		Flemish Region	BE2
		Walloon Region	BE3
Bulgaria	BG	Northern and Eastern Bulgaria	BG3
		South-Western and South-Central Bulgaria	BG4
Cyprus	CY	Cyprus	CY0
Czech Republic	CZ	Czech Republic	CZ0
Germany	DE	Baden-Württemberg	DE1
		Bavaria	DE2
		Berlin	DE3
		Brandenburg	DE4
		Free Hanseatic City of Bremen	DE5
		Hamburg	DE6
		Hessen	DE7
		Mecklenburg-Vorpommern	DE8
		Lower Saxony	DE9
		North Rhine-Westphalia	DEA
		Rhineland-Palatinate	DEB
		Saarland	DEC
		Saxony	DED
		Saxony-Anhalt	DEE
		Schleswig-Holstein	DEF
		Thuringia	DEG
Denmark	DK	Denmark	DK0
Estonia	EE	Estonia	EE0
Greece	EL	Attica	EL3
		Nisia Aigaiou, Kriti	EL4
		Voreia Ellada	EL5
		Kentriki Ellada	EL6
Spain	ES	North West	ES1
		North East	ES2
		Community of Madrid	ES3
		Centre	ES4
		East	ES5
		South	ES6
		Canary Islands	ES7
Finland	FI	Mainland Finland	FI1
		Åland	FI2

Appendix A Contd.

NUTS0	Code	NUTS1	Code
France	FR	Région parisienne	FR1
		Bassin parisien	FR2
		Nord	FR3
		Est	FR4
		Ouest	FR5
		Sud-Ouest	FR6
		Centre-Est	FR7
		Méditerranée	FR8
		Départements d'Outre-Mer	FRA
Croatia	HR	Croatia	HR0
Hungary	HU	Central Hungary	HU1
		Transdanubia	HU2
		Great Plain and North	HU3
Ireland	IE	Ireland	IE0
Italy	IT	North West	ITC
		North East	ITH
		Centre	ITI
		South	ITF
		Islands	ITG
Lithuania	LT	Lithuania	LT0
Luxembourg	LU	Luxembourg	LU0
Latvia	LV	Latvia	LV0
Malta	MT	Malta	MT0
Netherlands	NL	North Netherlands	NL1
		East Netherlands	NL2
		West Netherlands	NL3
		South Netherlands	NL4
Poland	PL	Central Region	PL1
		South Region	PL2
		East Region	PL3
		Northwest Region	PL4
		Southwest Region	PL5
		North Region	PL6
Portugal	PT	Mainland Portugal	PT1
		Azores	PT2
		Madeira	PT3
Romania	RO	One	RO1
		Two	RO2
		Three	RO3
		Four	RO4
Sweden	SE	East Sweden	SE1
		South Sweden	SE2
		North Sweden	SE3
Slovenia	SI	Slovenia	SI0
Slovakia	SK	Slovakia	SK0

Appendix A Contd.

NUTS0	Code	NUTS1	Code
United Kingdom	UK	North East	UKC
		North West	UKD
		Yorkshire and the Humber	UKE
		East Midlands	UKF
		West Midlands	UKG
		East of England	UKH
		Greater London	UKI
		South East	UKJ
		South West	UKK
		Wales	UKL
		Scotland	UKM
		Northern Ireland	UKN