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Study on the Economic Impacts of Convergence Interventions (2007-2013)

Final Report

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1 Introduction

The main objective of this study is to quantify the economic impacts of the convergence interventions in a number of selected countries for the period 2007-2013.

A sound evaluation of these impacts can only be done within a consistent quantitative modelling framework capable of taking into account the multisectoral issues, the linkages between the economic agents. In this project we use EcoMod's dynamic multi-sector general equilibrium model.

The main tasks of the project are:

1. to update the database of the model using the latest harmonised input-output tables for the 15 current and future Member States (Spain, Greece, Portugal, Poland, Hungary, Czech Republic, Slovakia, Slovenia, Estonia, Latvia, Lithuania, Italy, Germany, Bulgaria, and Romania);

2. to run country-level simulations/projections for different scenarios;

3. to provide the Commission potential impact estimates for a number of economic variables.

After updating the database of the EcoMod model using the latest input-output, supply and use tables, and other economic data, we have run the following five scenarios:

1. Past profile scenario
2. Worst case scenario
3. Programming prices scenario
4. Lisbon scenario
5. Co-financing scenario

The "past profile scenario" assumes that structural and cohesion funds are spent following the average profile of six countries[1] that received funds during 2000-2006 (see Tables 2 and 3).

The "worst case scenario" (n+3/n+2) is based on the programming prices expenditures but assumes that the structural and cohesion funds are spent with a delay during 2010-2015. Therefore, the annual expenditures profile is more 'bunched' than in the past profile of six countries scenario, reaching a peak in 2013.

The "programming prices scenario" assumes that the structural and cohesion funds are spent as planned, during 2007-2013.

The "Lisbon scenario" assumes that the annual use of the funds follow the same pattern as the past profile scenario. However, the allocation of the structural funds between fields of intervention is different (see Table 6). A part of the expenditures on infrastructure is shifted to the productive environment and human resources.

[1] We only consider the payments to Spain, Ireland, Portugal, Eastern Germany, Italy, and Greece.

The "co-financing scenario" assumes the same annual expenditure profile as the past profile scenario. The co-financing rate is assumed to be 25 per cent. The co-financing of structural and cohesion funds is financed through an increase in the personal income taxes. The budget deficit to the GDP ratio is kept at the same level as in the past profile scenario. The allocation between the fields of intervention is the same as in the past profile scenario.

These five scenarios have been simulated under the assumption of an identical elasticity of TFP growth to investment of 0.1 for all the countries. However, as we have shown in the interim reports, the results are sensitive to this assumption. The interim reports provide the simulation results under different elasticity assumptions for different countries for the "past profile" and "worst case" scenarios.

In addition to the differentiated TFP elasticities, as an illustration of the sensitivity of the results not only to the TFP elasticity but also to the model closure assumption, we have run the same five scenarios described above for Poland under a non-classical closure and a smaller elasticity (0.03 instead of 0.1) of TFP and labour productivity growth to investment.

2 Modelling framework

This study uses the general equilibrium framework for impact assessment.

General equilibrium models are powerful tools for the analysis of structural issues and are flexible enough to incorporate micro and macro elements and highly disaggregated features of the economy at the regional, country, sectoral, household, and government levels. These models take into account the complex and dynamic social, economic, and financial framework in which factor and product markets, as well as domestic and foreign markets interact, and how governments intervene.

General equilibrium models are based on microeconomic theories. They are designed to measure the direct, indirect and induced economic and environmental impacts of policy changes on an economy in the short, medium and long run. The input-output core enables the model to trace the extent and the channels of changes in policy and international environment. The resulting price changes affect the demand for the sectoral outputs and alter the resource allocation of factors. The simulations explore the effects of external shocks (such as changes in the international prices, the fluctuations in the real exchange rate, foreign demand, etc) and domestic policy changes. Model simulations provide results regarding the impacts on the:

- GDP
- sectoral production,
- sectoral value added
- sectoral trade flows,
- employment,

- investment,
- prices,
- wages
- income,
- public finance outcomes,
- energy use,
- etc.

While CGE models comprise a large number[1] of simultaneous non-linear equations, their structure is relatively straightforward. They have a strong micro-economic theoretical background. The main premise of the CGE models is that "structure" matters and they explicitly consider the workings of a multi-sectoral, multi-market, general equilibrium system undergoing structural adjustment, i.e. CGE models simulate the transactions in a market economy. They capture the interaction of various actors in the economy including: households, (as consumers, workers and savers); firms, (as producers, consumers of intermediate goods, and investors); government, (as consumer and transfer agent); and the rest of the world, (as consumers of exports, producers of imports and providers or recipients of international capital flows). Consistent with microeconomic theory, all agents are assumed to optimize within budget constraints as well as the constraints imposed by regulatory frameworks. CGEs are unique in their ability to present the trade-offs of a given policy decision, especially when the policy has economy-wide repercussions as in the case of corporate, sales and individual income taxes. Even the sign of an affected variable may change when an analysis is extended from partial to general equilibrium.

One of the most desirable properties of CGE models is their ability to trace economy-wide implications of several policy changes simultaneously, taking into account both the interactions between these policy changes as well as the policy changes and existing distortions. Hence, they are well suited to simulate the effects of various tax regimes. In particular, CGE models capture the interactions between indirect taxes, income taxes, payroll taxes, subsidies and import duties, as well as the trade and transportation margins.

The use of detailed inter-industry flow information allows the modelling of the interaction between industries that can result from the change in relative prices of specific commodities or the level of demand.

For the purposes of this project, the EcoMod modelling platform has been customized for each one of the fifteen countries under consideration: Bulgaria, Czech Republic, Estonia, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Poland, Portugal, Romania, Slovakia, Slovenia, and Spain. The customised models differ depending on the data availability and the specific features of each economy. The technical details

[1] The number of equations can go from several hundred to several hundred of thousands of equations depending on the disaggregation level.

of the model are provided in appendix 1. The database of the model has been updated using the latest data available at the Eurostat and national statistical offices. The social accounting matrices used by the models incorporate the latest input-output tables which are currently available (see Table 1) for the fifteen countries.

The full database of the EcoMod model covers 60 activities. However, for the purpose of this study, they are aggregated in the following six branches of activity:

1. Agriculture
2. Manufacturing
3. High-tech manufacturing
4. Services
5. Construction
6. Public administration

Table 1: Most recent available input-output data

		Czech Rep.	Estonia	Germany	Greece	Hungary	Italy	Latvia	Lithuania	Poland	Portugal	Slovakia	Slovenia	Spain	Romania	Bulgaria
Available tables	Supply table at basic prices, including a transformation into purchasers' prices	2003	1997	2002	1999	2001	2001	1998	2002	2000	1999	2000	2004	2000	2003	2004
	Use table at purchasers' prices	2003	1997	2002	1999	2001	2001	1998	2002	-	1999	2000	2004	2000	2003	2004
	Input-output table at basic prices	2003	1997	2003	1998	2000	2000	1998	2000	2000	1999	-	2001	1995	2003	2004
	Input-output table for domestic output at basic prices	-	1997	2003	-	2000	2000	1998	2000	2000	1999	-	2001	1995	2003	2004
	Input-output table for imports at basic prices	-	1997	2003	-	2000	2000	1998	2000	2000	1999	-	2001	1995	2003	2004
Source		National Statistical Office	Eurostat	Eurostat & National Statistical Office	Eurostat	Eurostat	Eurostat	National Statistical Office	Eurostat	Eurostat	Eurostat	Eurostat	Eurostat & National Statistical Office	Eurostat	National Institute of Statistics	National Institute of Statistics
Currency		Mill.NAC	Mill.NAC	Mill.EUR	Mill.EUR	Mill.NAC	Mill.EUR	Thsd.NAC	Mill.NAC	Mill.NAC	Mill.EUR	Mill.NAC	Mill.NAC	Mill.EUR	Mill.ROL	Mill.BGN
N° of sectors		60	60	60	60	60	60	60	60	60	60	60	60	60	34	60

3 Scenario setup

The following main five scenarios have been simulated:

1. Past profile scenario
2. Worst case scenario
3. Programming prices scenario
4. Lisbon scenario
5. Co-financing scenario

All these scenarios have been simulated under the assumption of a uniform elasticity of 0.1 of TFP growth with respect to investment for all the member states.

Given the uncertainty regarding the TFP elasticity, the "past profile" and the "worst case" scenarios have also been simulated under the assumption of different elasticities for different member states for the interim report. We reproduce here the results to show their sensitivity of the assumption of uniform elasticity of 0.1.

Given that general equilibrium models focus on long term, potential allocative impacts, the current account balance is kept constant (in real terms or as a share of GDP) in the simulations. As a variant, we also ran an additional simulation with a different model closure where the current adjusts to the policy measures. This simulation was run as an illustration for Poland only.

3.1 Past profile scenario

The "past profile scenario" assumes that structural and cohesion funds are spent following the average payment profile of six countries[3] that received funds during 2000-2006 (see Tables 2 and 3).

Table 2: Payments profile of the six countries that received structural and cohesion funds (2000-2008)

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
Spain	0.29%	8.84%	13.77%	13.75%	13.70%	12.40%	8.36%	14.44%	14.44%	100.0%
Ireland	5.50%	12.76%	16.98%	15.19%	13.92%	10.77%	9.92%	7.48%	7.48%	100.0%
Portugal	5.52%	7.40%	11.90%	13.02%	13.02%	11.23%	9.81%	14.05%	14.05%	100.0%
Eastern Germany	2.87%	10.75%	11.51%	10.69%	12.84%	14.14%	13.08%	12.06%	12.06%	100.0%
Italy	5.35%	1.05%	5.63%	11.46%	10.75%	12.17%	13.79%	19.90%	19.90%	100.0%
Greece	0.00%	8.48%	5.93%	5.37%	9.81%	9.13%	13.19%	24.04%	24.04%	100.0%
Average	**3.26%**	**8.21%**	**10.95%**	**11.58%**	**12.34%**	**11.64%**	**11.36%**	**15.33%**	**15.33%**	**100.0%**

[3] We only consider the payments to Spain, Ireland, Portugal, Eastern Germany, Italy, and Greece.

Table 3: Payments profile in the past profile scenario

Payments profile 2007-2015	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**Total**
Payments profile at current prices	3.26%	8.21%	10.95%	11.58%	12.34%	11.64%	11.36%	15.33%	15.33%	100.0%
Payments profile at constant prices 2004	3.57%	8.83%	11.54%	11.96%	12.50%	11.56%	11.06%	14.63%	14.35%	100.0%

The assumptions regarding the fields of intervention corresponding to the structural funds are provided in Table 4. The allocation of the structural funds between different fields of intervention is assumed to be the same each year.

The positive effects of the funds on the TFP and labour productivity are assumed to take place with a delay of one year.

Table 4: Assumptions regarding the fields of intervention for the structural funds

Fields of intervention	Poland		Czech R		Estonia		Greece		Spain		Italy	
	Share in %	Volume	Share in %	Volume	Share in %	Volume	Share in %	Volume	Share in %	Volume	Share in %	Volume
Productive environment	**12.9**	**5,178**	**24.0**	**3,808**	**25.2**	**514**	**12.3**	**1,836**	**18.7**	**5,289**	**33.2**	**6,397**
Business support	10.7	4,295	15.0	2,380	10.5	214	7.2	1,075	10.1	2,857	20.0	3,854
Tourism	1.2	482	7.6	1,206	7.5	153	2.9	433	1.4	396	8.0	1,541
RTDI	1.0	401	1.4	222	7.2	147	2.2	328	7.2	2,037	5.2	1,002
Human resources	**28.3**	**11,359**	**29.9**	**4,745**	**26.6**	**542**	**23.1**	**3,449**	**30.3**	**8,571**	**20.5**	**3,950**
Labour market	7.4	2,970	6.8	1,079	6.9	141	4.7	702	13.1	3,705	6.0	1,156
Social inclusion	2.5	1,003	5.3	841	2.3	47	4.2	627	2.6	735	1.1	212
Education	11.3	4,535	12.0	1,904	11.4	232	7.6	1,135	3.6	1,018	7.9	1,522
Entrepreneurship	6.1	2,448	4.8	762	5.6	114	4.3	642	9.7	2,744	3.9	751
Actions for women	1.0	401	1.0	159	0.4	8	2.3	343	1.3	368	1.6	308
Infrastructure	**52.5**	**21,072**	**41.7**	**6,617**	**43.7**	**891**	**59.7**	**8,913**	**50.2**	**14,200**	**39.3**	**7,572**
Transport	30.9	12,402	18.8	2,983	13.4	273	33.4	4,986	25.4	7,185	16.7	3,218
Telecom	7.5	3,010	2.9	460	2.3	47	7.1	1,060	2.3	651	5.5	1,060
Energy	1.5	602	1.6	254	2.9	59	1.0	149	0.6	170	1.4	270
Environment	5.6	2,248	6.9	1,095	1.3	27	4.7	702	10.9	3,083	8.3	1,599
Urban rehabilitation	3.9	1,565	8.4	1,333	5.2	106	7.2	1,075	6.2	1,754	6.0	1,156
Social infrastructure and health	3.1	1,244	3.1	492	18.6	379	6.3	941	4.8	1,358	1.4	270
Subtotal	**93.7**	**37,608**	**95.6**	**15,170**	**95.5**	**1,947**	**95.1**	**14,197**	**99.2**	**28,060**	**93.0**	**17,919**
Rest	6.3	2,529	4.4	698	4.5	92	4.9	732	0.8	226	7.0	1,349
Total SF 2007-2013	**100.0**	**40,137**	**100.0**	**15,868**	**100.0**	**2,039**	**100.0**	**14,929**	**100.0**	**28,286**	**100.0**	**19,268**

Table 4: Assumptions regarding the fields of intervention for the structural funds (continued)

Fields of intervention	Latvia		Lithuania		Hungary		Portugal		Slovenia		Slovakia	
	Share in %	Volume	Share in %	Volume	Share in %	Volume	Share in %	Volume	Share in %	Volume	Share in %	Volume
Productive environment	**32.1**	**876**	**27.8**	**1,130**	**23.3**	**3,463**	**22.2**	**3,646**	**41.3**	**1,033**	**8.4**	**574**
Business support	26.6	726	11.0	447	12.8	1,902	12.8	2,102	19.0	475	3.0	205
Tourism	1.9	52	10.5	427	4.7	699	4.3	706	15.0	375	4.2	287
RTDI	3.6	98	6.3	256	5.8	862	5.1	838	7.3	183	1.2	82
Human resources	**27.1**	**739**	**18.6**	**756**	**25.7**	**3,820**	**28.6**	**4,698**	**29.2**	**730**	**34.7**	**2,371**
Labour market	10.7	292	4.5	183	7.3	1,085	2.6	427	11.0	275	16.2	1,107
Social inclusion	2.3	63	1.7	69	5.0	743	4.4	723	4.1	103	2.1	143
Education	9.7	265	6.0	244	8.9	1,323	15.1	2,480	10.3	258	14.3	977
Entrepreneurship	3.9	106	6.0	244	4.0	594	6.1	1,002	3.4	85	1.2	82
Actions for women	0.5	14	0.4	16	0.5	74	0.4	66	0.4	10	0.9	61
Infrastructure	**34.9**	**952**	**47.9**	**1,946**	**45.5**	**6,762**	**46.5**	**7,638**	**23.6**	**590**	**44.0**	**3,006**
Transport	18.2	496	18.4	748	16.1	2,393	18.7	3,071	3.7	93	25.1	1,715
Telecom	3.9	106	6.7	272	5.5	817	3.4	558	8.7	218	1.1	75
Energy	3.9	106	7.8	317	0.9	134	0.0	0	3.7	93	0.5	34
Environment	5.8	158	0.9	37	3.7	550	4.5	739	3.7	93	9.5	649
Urban rehabilitation	0.0	0	1.6	65	6.3	936	9.8	1,610	3.8	95	1.8	123
Social infrastructure and health	3.1	85	12.5	508	13.0	1,932	10.1	1,659	0.0	0	6.0	410
Subtotal	**94.1**	**2,567**	**94.3**	**3,831**	**94.5**	**14,045**	**97.3**	**15,982**	**94.1**	**2,353**	**87.1**	**5,951**
Rest	5.9	161	5.7	232	5.5	817	2.7	443	5.9	148	12.9	881
Total SF 2007-2013	**100.0**	**2,728**	**100.0**	**4,063**	**100.0**	**14,862**	**100.0**	**16,425**	**100.0**	**2,500**	**100.0**	**6,832**

Table 4: Assumptions regarding the fields of intervention for the structural funds (continued)

Fields of intervention	Eastern Germany		Bulgaria		Romania	
	Share in %	Volume	Share in %	Volume	Share in %	Volume
Productive environment	**31.3**	**4,807**	**20.1**	**809**	**20.1**	**2,317**
Business support	19.6	3,010	12.8	518	12.8	1,482
Tourism	1.7	261	4.5	181	4.5	520
RTDI	10.0	1,536	2.7	110	2.7	316
Human resources	**32.2**	**4,945**	**28.0**	**1,128**	**28.0**	**3,229**
Labour market	12.7	1,950	7.2	289	7.2	828
Social inclusion	6.6	1,014	4.3	172	4.3	493
Education	3.5	538	10.7	433	10.7	1,239
Entrepreneurship	5.7	875	5.0	200	5.0	574
Actions for women	3.7	568	0.8	34	0.8	96
Infrastructure	**36.3**	**5,575**	**46.6**	**1,878**	**46.6**	**5,377**
Transport	18.7	2,872	21.9	885	21.9	2,533
Telecom	0.9	138	5.3	214	5.3	612
Energy	0.1	15	1.3	54	1.3	154
Environment	7.8	1,198	5.4	218	5.4	624
Urban rehabilitation	5.7	875	6.2	250	6.2	716
Social infrastructure and health	3.1	476	6.4	258	6.4	739
Subtotal	**99.8**	**15,327**	**94.6**	**3,815**	**94.6**	**10,923**
Rest	0.2	31	5.4	218	5.4	624
Total SF 2007-2013	**100.0**	**15,358**	**100.0**	**4,033**	**100.0**	**11,547**

3.2 Worst case scenario

The "worst case scenario" (n+3/n+2) is based on the programming prices expenditures but assumes that the structural and cohesion funds are spent with a delay, during 2010-2015. Therefore, the annual expenditures profile is more 'bunched' than in the past profile of six countries scenario, reaching a peak in 2013. An example for Poland is provided in Tables 5 and 6.

In fact, in this scenario the annual expenditures for 2010-2012 are assumed to be the same as the planned expenditures for 2007-2009. In 2013, the planned expenditures for 2010-2011 are regrouped, while during 2014-2015 the expenditures follow the planned ones for 2012-2013.

The allocation between the fields of intervention is the same as in the past profile of 6 countries scenario (see Table 4).

Table 5: Payments profile, worst case payment scenario (n+3/n+2) – Poland (EUR mil., current prices)

Poland (mil. euro, current prices)	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Structural and cohesion funds	**0**	**0**	**0**	**8,150**	**8,686**	**9,237**	**19,514**	**10,631**	**11,235**	**67,454**
Structural funds	***0***	***0***	***0***	***6,147***	***6,290***	***6,433***	***12,861***	***6,664***	***6,827***	***45,221***
Productive environment	*0*	*0*	*0*	*793*	*811*	*830*	*1,659*	*860*	*881*	*5,834*
Manufacturing	0	0	0	491	503	514	1,028	532	545	3,613
Services	0	0	0	302	309	316	631	327	335	2,220
Human resources	*0*	*0*	*0*	*1,739*	*1,780*	*1,821*	*3,640*	*1,886*	*1,932*	*12,798*
Infrastructure	*0*	*0*	*0*	*3,227*	*3,302*	*3,378*	*6,752*	*3,499*	*3,584*	*23,741*
Rest (services)	*0*	*0*	*0*	*387*	*396*	*405*	*810*	*420*	*430*	*2,849*
Cohesion funds	***0***	***0***	***0***	***2,004***	***2,397***	***2,803***	***6,653***	***3,967***	***4,409***	***22,232***

Table 6: Payments profile, programming prices scenario – Poland (EUR mil., current prices)

Poland (mil. euro, current prices)	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Structural and cohesion funds	**8,150**	**8,686**	**9,237**	**9,465**	**10,049**	**10,631**	**11,235**	**0**	**0**	**67,454**
Structural funds	***6,147***	***6,290***	***6,433***	***6,354***	***6,507***	***6,664***	***6,827***	***0***	***0***	***45,221***
Productive environment	*793*	*811*	*830*	*820*	*839*	*860*	*881*	*0*	*0*	*5,834*
Manufacturing	491	503	514	508	520	532	545	0	0	3,613
Services	302	309	316	312	320	327	335	0	0	2,220
Human resources	*1,739*	*1,780*	*1,821*	*1,798*	*1,842*	*1,886*	*1,932*	*0*	*0*	*12,798*
Infrastructure	*3,227*	*3,302*	*3,378*	*3,336*	*3,416*	*3,499*	*3,584*	*0*	*0*	*23,741*
Rest (services)	*387*	*396*	*405*	*400*	*410*	*420*	*430*	*0*	*0*	*2,849*
Cohesion funds	***2,004***	***2,397***	***2,803***	***3,112***	***3,541***	***3,967***	***4,409***	***0***	***0***	***22,232***

3.3 Programming prices scenario

The "programming prices scenario" assumes that structural and cohesion funds are spent as planned, during 2007-2013.

The allocation between the fields of intervention is the same as in the past profile scenario (see Table 4).

3.4 Lisbon scenario

The "Lisbon scenario" assumes that the annual allocation of the structural and cohesion funds follows the past profile scenario.

However, the allocation of the structural funds between the fields of intervention is different (see Table 7). A part of the expenditures in infrastructure is shifted to the productive environment and human resources.

In the Lisbon scenario, the share of the infrastructure expenditures in the total structural funds is 5 percentage points lower than in the past profile scenario, while the expenditures related to the productive environment and the human resources are each 2.5 percentage points higher than in the past profile scenario.

Table 7: Assumptions regarding the fields of intervention for the structural funds – Lisbon scenario

Fields of intervention	Poland		Czech R		Estonia		Greece		Spain		Italy	
	share in %	Volume	share in %	Volume	share in %	Volume	share in %	Volume	share in %	Volume	share in %	Volume
Productive environment	**15.4**	**6,181**	**26.5**	**4,205**	**27.7**	**565**	**14.8**	**2,209**	**21.2**	**5,997**	**35.7**	**6,879**
Business support	12.8	5,127	16.6	2,628	11.5	235	8.7	1,293	11.5	3,239	21.5	4,144
Tourism	1.4	575	8.4	1,332	8.2	168	3.5	521	1.6	449	8.6	1,658
RTDI	1.2	479	1.5	245	7.9	161	2.6	395	8.2	2,309	5.6	1,077
Human resources	**30.8**	**12,362**	**32.4**	**5,141**	**29.1**	**593**	**25.6**	**3,822**	**32.8**	**9,278**	**23.0**	**4,432**
Labour market	8.1	3,233	7.4	1,169	7.5	154	5.2	778	14.2	4,011	6.7	1,297
Social inclusion	2.7	1,092	5.7	911	2.5	51	4.7	695	2.8	796	1.2	238
Education	12.3	4,936	13.0	2,063	12.5	254	8.4	1,257	3.9	1,102	8.9	1,708
Entrepreneurship	6.6	2,665	5.2	825	6.1	125	4.8	711	10.5	2,970	4.4	843
Actions for women	1.1	437	1.1	172	0.4	9	2.5	381	1.4	398	1.8	346
Infrastructure	**47.5**	**19,065**	**36.7**	**5,824**	**38.7**	**789**	**54.7**	**8,166**	**45.2**	**12,785**	**34.3**	**6,609**
Transport	28.0	11,221	16.5	2,625	11.9	242	30.6	4,569	22.9	6,469	14.6	2,808
Telecom	6.8	2,724	2.6	405	2.0	42	6.5	971	2.1	586	4.8	925
Energy	1.4	545	1.4	223	2.6	52	0.9	137	0.5	153	1.2	235
Environment	5.1	2,034	6.1	964	1.2	23	4.3	643	9.8	2,776	7.2	1,396
Urban rehabilitation	3.5	1,416	7.4	1,173	4.6	94	6.6	985	5.6	1,579	5.2	1,009
Social infrastructure and health	2.8	1,126	2.7	433	16.5	336	5.8	862	4.3	1,222	1.2	235
Subtotal	**93.7**	**37,608**	**95.6**	**15,170**	**95.5**	**1,947**	**95.1**	**14,197**	**99.2**	**28,060**	**93.0**	**17,919**
Rest	6.3	2,529	4.4	698	4.5	92	4.9	732	0.8	226	7.0	1,349
Total SF 2007-2013	**100.0**	**40,137**	**100.0**	**15,868**	**100.0**	**2,039**	**100.0**	**14,929**	**100.0**	**28,286**	**100.0**	**19,268**

Table 7: Assumptions regarding the fields of intervention for the structural funds – Lisbon scenario (continued)

Fields of intervention	Latvia		Lithuania		Hungary		Portugal		Slovenia		Slovakia	
	share in %	Volume	share in %	Volume	share in %	Volume	share in %	Volume	share in %	Volume	share in %	Volume
Productive environment	**34.6**	**944**	**30.3**	**1,231**	**25.8**	**3,834**	**24.7**	**4,057**	**43.8**	**1,095**	**10.9**	**745**
Business support	28.7	782	12.0	487	14.2	2,106	14.2	2,339	20.2	504	3.9	266
Tourism	2.0	56	11.4	465	5.2	773	4.8	786	15.9	398	5.5	372
RTDI	3.9	106	6.9	279	6.4	954	5.7	932	7.7	194	1.6	106
Human resources	**29.6**	**807**	**21.1**	**857**	**28.2**	**4,191**	**31.1**	**5,108**	**31.7**	**793**	**37.2**	**2,542**
Labour market	11.7	319	5.1	207	8.0	1,190	2.8	464	11.9	299	17.4	1,187
Social inclusion	2.5	69	1.9	78	5.5	815	4.8	786	4.5	111	2.3	154
Education	10.6	289	6.8	277	9.8	1,451	16.4	2,697	11.2	280	15.3	1,047
Entrepreneurship	4.3	116	6.8	277	4.4	652	6.6	1,090	3.7	92	1.3	88
Actions for women	0.5	15	0.5	18	0.5	82	0.4	71	0.4	11	1.0	66
Infrastructure	**29.9**	**816**	**42.9**	**1,743**	**40.5**	**6,019**	**41.5**	**6,816**	**18.6**	**465**	**39.0**	**2,664**
Transport	15.6	425	16.5	670	14.3	2,130	16.7	2,741	2.9	73	22.2	1,520
Telecom	3.3	91	6.0	244	4.9	728	3.0	498	6.9	171	1.0	67
Energy	3.3	91	7.0	284	0.8	119	0.0	0	2.9	73	0.4	30
Environment	5.0	136	0.8	33	3.3	489	4.0	660	2.9	73	8.4	575
Urban rehabilitation	0.0	0	1.4	58	5.6	833	8.7	1,437	3.0	75	1.6	109
Social infrastructure and health	2.7	72	11.2	455	11.6	1,720	9.0	1,481	0.0	0	5.3	363
Subtotal	**94.1**	**2,567**	**94.3**	**3,831**	**94.5**	**14,045**	**97.3**	**15,982**	**94.1**	**2,353**	**87.1**	**5,951**
Rest	5.9	161	5.7	232	5.5	817	2.7	443	5.9	148	12.9	881
Total SF 2007-2013	**100.0**	**2,728**	**100.0**	**4,063**	**100.0**	**14,862**	**100.0**	**16,425**	**100.0**	**2,500**	**100.0**	**6,832**

Table 7: Assumptions regarding the fields of intervention for the structural funds – Lisbon scenario (continued)

Fields of intervention	Eastern Germny		Bulgaria		Romania	
	share in %	Volume	share in %	Volume	share in %	Volume
Productive environment	**33.8**	**5,191**	**22.6**	**910**	**22.6**	**2,606**
Business support	21.2	3,251	14.4	582	14.4	1,666
Tourism	1.8	282	5.1	204	5.1	584
RTDI	10.8	1,658	3.1	124	3.1	355
Human resources	**34.7**	**5,329**	**30.5**	**1,229**	**30.5**	**3,518**
Labour market	13.7	2,102	7.8	315	7.8	902
Social inclusion	7.1	1,092	4.6	187	4.6	537
Education	3.8	579	11.7	472	11.7	1,350
Entrepreneurship	6.1	943	5.4	218	5.4	625
Actions for women	4.0	612	0.9	37	0.9	105
Infrastructure	**31.3**	**4,807**	**41.6**	**1,676**	**41.6**	**4,800**
Transport	16.1	2,476	19.6	790	19.6	2,261
Telecom	0.8	119	4.7	191	4.7	546
Energy	0.1	13	1.2	48	1.2	137
Environment	6.7	1,033	4.8	194	4.8	557
Urban rehabilitation	4.9	755	5.5	223	5.5	639
Social infrastructure and health	2.7	411	5.7	230	5.7	660
Subtotal	**99.8**	**15,327**	**94.6**	**3,815**	**94.6**	**10,923**
Rest	0.2	31	5.4	218	5.4	624
Total SF 2007-2013	**100.0**	**15,358**	**100.0**	**4,033**	**100.0**	**11,547**

3.5 Co-financing scenario

The "co-financing scenario" assumes the same annual expenditures profile as the past profile scenario. The co-financing rate is assumed to be 25 per cent.

The co-financing of structural and cohesion funds is financed through an increase in the personal income taxes.

The budget deficit to the GDP ratio is kept at the same level as in the past profile scenario.

The allocation between the fields of intervention is the same as in the past profile scenario (see Table 4).

3.6 Simulations with different elasticities

The five scenarios explained above have been simulated under the assumption of an identical elasticity of 0.1 for the TFP and labour productivity growth with respect to investment for all the countries.

However, as we have shown in the interim reports, the results are sensitive to this uniform elasticity assumption. Given the uncertainty regarding the TFP elasticity, the "past profile" and the "worst case" scenarios have also been simulated under the assumption of different elasticities for different member states for the interim report. We reproduce here the results to show their sensitivity of the assumption of uniform elasticity of 0.1.

Table 8: Elasticity of TFP growth

Country	*Different*	*Uniform*
Bulgaria	0.02	0.1
Czech Republic	0.07	0.1
Estonia	0.13	0.1
Germany	0.02	0.1
Greece	0.10	0.1
Hungary	0.02	0.1
Italy	0.06	0.1
Latvia	0.12	0.1
Lithuania	0.03	0.1
Poland	0.04	0.1
Portugal	0.11	0.1
Romania	0.02	0.1
Slovakia	0.09	0.1
Slovenia	0.04	0.1
Spain	0.11	0.1

3.7 Simulation with a different closure and different elasticities

Given that general equilibrium models focus on long term, potential allocative impacts, the current account balance is kept constant (in real terms or as a share of GDP) in the simulations. This is also the classical closure[1] which has been used in the simulations explained above. However, as a variant, we also ran additional simulations for each of the five scenarios described earlier with a different model closure where the current account a balance adjusts to the policy measures. These simulations were run as an illustration for Poland only and with an elasticity of 0.03 (instead of 0.1) for the TFP growth with respect to investments.

4 Overview of the simulation results

In this section we summarise the main findings of the simulation results.

The simulations take into account the different impact channels of the different components of the structural and cohesions funds. In this respect, we use DG REGIO's classification of the structural and cohesion funds into the three following fields of intervention:

- Productive environment
- Human resources
- Infrastructure

4.1 Modelling the EU funds

In the model, an institution called 'The Fund' receives the EU structural and cohesion funds and the domestic public co-financing funds and allocates them according to the stated uses.

The effects of the EU funds are captured in the model in several ways:

- First, the structural and cohesion funds are distributed by the Fund to different branches of activity as investments, which add to the capital stock and lead to an increase in the productive capacity of the sector;
- Secondly, the investments by the Fund lead to an increase in the total factor productivity (TFP) or labour productivity depending on the field of intervention

Three types of investments are distinguished in the model:

[1] For details, please see the model closure section in the annexed technical overview of the model.

- Investments to improve the productive environment $(INVSF_s)$, which are provided to the manufacturing and services sectors and originate from the structural funds.
- Investments in human resources $(INVSFH_s)$, which also originate from the structural funds and are destined to the services sector.
- Investments in infrastructure $(INVCF_s)$, which are meant for the services sector and rely on both structural and cohesion funds.

The EU funds are expressed in national currency by multiplying them with the exchange rate (ER). Furthermore, they are translated into real terms using the price index corresponding to investments (PI):

$$INVSFR_s = INVSF_s \cdot ER/PI$$

$$INVSFHR_s = INVSFH_s \cdot ER/PI$$

$$INVCFR_s = INVCF_s \cdot ER/PI$$

where $INVSFR_s$ stands for the investments to improve the productive environment in branch *s*, expressed in real terms and in the domestic currency, $INVSFHR_s$ represents the investments in human resources expressed in real terms and domestic currency and $INVCFR_s$ gives the investments in infrastructure in real terms and domestic currency.

The domestic public co-financing corresponding to each type of investment is derived by applying the co-financing rate $(tcof)$:

$$INVSFRCOF_s = tcof/(100\text{-}tcof) \cdot INVSF_s \cdot ER/PI$$

$$INVSFHRCOF_s = tcof/(100\text{-}tcof) \cdot INVSFH_s \cdot ER/PI$$

$$INVCFRCOF_s = tcof/(100\text{-}tcof) \cdot INVCF_s \cdot ER/PI$$

where $INVSFRCOF_s$ is the domestic public co-financing for the investments to improve the productive environment, $INVSFHRCOF_s$ represents the domestic public co-financing for the investments in human resources and $INVCFRCOF_s$ stands for the domestic public co-financing for the investments in infrastructure.

Total domestic public co-financing for the EU funds, expressed in nominal terms $(COFIN)$, is thus given by:

$$COFIN = PI \cdot \sum_s (INVSFRCOF_s + INVSFHRCOF_s + INVCFRCOF_s)$$

and adds to the government expenditures.

Total investments (including domestic public co-financing) to productive environment $(INVSFRTOT_s)$, total investments in human resources $(INVSFHRTOT_s)$ and total investments in infrastructure $(INVCFRTOT_s)$, expressed in real terms, can be expressed as:

$$INVSFRTOT_s = INVSFR_s + INVSFRCOF_s$$

$$INVSFHRTOT_s = INVSFHR_s + INVSFHRCOF_s$$

$$INVCFRTOT_s = INVCFR_s + INVCFRCOF_s$$

The Fund's total resources $(SFUND)$, in nominal terms, should be equal to the total investments by the Fund:

$$SFUND = PI \cdot \sum_s (INVSFRTOT_s + INVSFHRTOT_s + INVCFRTOT_s)$$

whereas the investments by the Fund excluding domestic public co-financing should be equal to the total transfers from the EU $(TREUF)$, expressed in domestic currency:

$$PI \cdot \sum_s (INVSFR_s + INVSFHR_s + INVCFR_s) = TREUF \cdot ER$$

In addition to increasing the productive capacity, the investments for improving the productive environment are assumed to increase the TFP in the manufacturing and services sectors:

$$TFPSF_{s,t+1} = TFPSF_{s,t} \cdot [(KSKBA_{s,t} + INVSFRTOT_{s,t})/KSKBA_{s,t}]^{elasTFPSF}$$

where $TFPSF_{s,t+1}$ represents the TFP improvement in branch s in year $t+1$ thanks to investments in productive environment, $TFPSF_{s,t}$ stands for the TFP improvement in branch s in year t, $KSKBA_{s,t}$ provides the capital stock of sector s in year t in the non-cohesion policy baseline scenario and $elasTFPSF$ is the TFP elasticity of investments provided to the productive environment. The effects of the EU funds on the TFP arise with one year lag.

Investments in human resources are assumed to lead to an improvement in the labour productivity in all the activities. In order to derive the increase in the labour productivity, we first calculate the number of trainees that could be supported by the structural funds (Bradley, Morgenroth, Gács and Untiedt, 2004):

$$\sum_{ctm} INVSFHRTOT_{ctm,t} \cdot PI_t = OVERHD \cdot \sum_{ctm} INVSFHRTOT_{ctm,t} \cdot PI_t + TRAIN_t \cdot PLMA_t + (TRAIN_t / TRATIO) \cdot PLSV_t$$

by assuming that a part of the total funds for human resources in year t $(\sum_{ctm} INVSFHRTOT_{ctm,t} \cdot PI_t)$, expressed in nominal terms, represent the current operation costs related to the buildings, materials, etc. $(OVERHD \cdot \sum_{ctm} INVSFHRTOT_{ctm,t} \cdot PI_t)$, a part

of the funds reflects payments to the trainees $(TRAIN_t \cdot PLMA_t)$ and the rest are expenditures related to the compensation of instructors $[(TRAIN_t / TRATIO) \cdot PLSV_t]$. Current operation costs are derived as a share $(OVERHD)$ of the total structural funds for human resources, where $OVERHD$, given the lack of detailed information, is assumed to be equal to the average share of other current expenditures in the total current expenditures in tertiary education (OECD, 2006). The payments to the trainees are calculated by assuming that each trainee receives a share of the average wage in the manufacturing sectors, services and construction $(PLMA_t)$, where $TRAIN_t$ is the number of policy-funded trainees (expressed in trainee-years). Finally, the compensation of the instructors is derived by applying the average wage in the services sector $(PLSV_t)$ to the number of instructors $(TRAIN_t / TRATIO)$, where $TRATIO$ is the trainee-instructor ratio assumed to be equal to the student-teacher ratio in the tertiary education for each country under study (OECD, 2006).

Thus, the number of trainees (expressed in trainee-years) that could be supported through the structural funds is given by:

$$TRAIN_t = \sum_{ctm} INVSFHRTOT_{ctm,t} \cdot PI_t \cdot (1 - OVERHD) / [PLMA_t + PLSV_t / TRATIO]$$

while the stock of trainees (expressed in trainee-years) is provided by:

$$KSKTRAIN_{t+1} = (1 - dhc) \cdot KSKTRAIN_t + TRAIN_t$$

where $KSKTRAIN_{t+1}$ is the stock of trainee in year $t+1$, $KSKTRAIN_t$ represents the stock of trainees in year t and dhc is the depreciation rate equal to 5 per cent (Bradley, Morgenroth, Gács and Untiedt, 2004).

The labour productivity improvements due to the structural funds on human resources are derived as:

$$TFPSFH_{s,t+1} = TFPSFH_{s,t} \cdot [(KSKTRAIN_t + KSKHBA_t) / KSKHBA_t]^{elasTFPSFH}$$

where $TFPSFH_{s,t+1}$ represents the labour productivity improvement in branch s in year $t+1$, $TFPSFH_{s,t}$ provides the labour productivity improvement in branch s in year t, $KSKHBA_t$ is the stock of human capital in the non-cohesion policy baseline scenario in year t and $elasTFPSFH$ is the labour productivity elasticity of investments in human resources.

The spillover effects related to the investments in infrastructure are captured through a TFP increase in all the branches of activity:

$$TFPCF_{s,t+1} = TFPCF_{s,t} \cdot [(KSKPbBA_t + \sum_{ctm} INVCFRTOT_{ctm,t}) / KSKPbBA_t]^{elasTFPCF}$$

where $TFPCF_{s,t+1}$ is the TFP increase in branch s in year $t+1$ due to investments in infrastructure, $TFPCF_{s,t}$ is the TFP increase in branch s in year t, $\sum_{ctm} INVCFRTOT_{ctm,t}$ stand for the total investments in infrastructure, $KSKPbBA_t$ gives the stock of

infrastructure in the non-cohesion policy baseline scenario in year *t* and *elasTFPCF* represents the TFP elasticity of investments in infrastructure.

Both improvements in the labour productivity due to the investments in human resources and TFP increases related to investments in infrastructure occur with a lag of one year after the investments take place.

Value-added is a CES aggregation of capital (KSK_s) and labour (LSK_s):

$$KL_s = (aF_s \cdot TFPSF_s \cdot TFPCF_s) \cdot [\gamma FK_s \cdot KSK_s^{-\rho F_s} + \gamma FL_s \cdot (TFPSFH_s \cdot LSK_s)^{-\rho F_s}]^{-1/\rho F_s} \quad (1)$$

where $TFPSF_s$ reflects the total factor productivity (TFP) increase due to the structural funds provided as direct aid to the productive environment, $TFPCF_s$ gives the TFP increase due to the structural and cohesion funds on infrastructure and $TFPSFH_s$ provides the labour productivity increase due to the structural funds targeted to human resources.

Minimizing the costs function:

$$Cost_s(KSK_s, LSK_s) = [PK_s \cdot (1+tk_s) + d_s \cdot PI] \cdot KSK_s + [PL \cdot (1+premLSK_s) \cdot (1+tl_s)] \cdot LSK_s \quad (2)$$

subject to (9) yields the demand equations for capital and labour:

$$KSK_s = KL_s \cdot \{PKL_s / [PK_s \cdot (1+tk_s) + d_s \cdot PI]\}^{\sigma F_s} \cdot \gamma FK_s^{\sigma F_s} \cdot (aF_s \cdot TFPSF_s \cdot TFPCF_s)^{(\sigma F_s - 1)} \quad (3)$$

$$LSK_s = KL_s \cdot \{PKL_s / [PL \cdot (1+premLSK_s) \cdot (1+tl_s)]\}^{\sigma F_s} \cdot \gamma FL_s^{\sigma F_s} \cdot TFPSFH_s^{(\sigma F_s - 1)} \cdot (aF_s \cdot TFPSF_s \cdot TFPCF_s)^{(\sigma F_s - 1)} \quad (4)$$

and the associated zero profit condition:

$$PKL_s \cdot KL_s = PK_s \cdot (1+tk_s) \cdot KSK_s + PL \cdot (1+premLSK_s) \cdot (1+tl_s) \cdot LSK_s + DEP_s \cdot PI \quad (5)$$

where PL is the national average wage and $premLSK_s$ is the wage differential of branch *s* with respect to the average wage PL, tl_s is the social security contributions rate for industry *s*, PK_s is the return to capital in branch *s*, tk_s is the corporate income tax rate for branch *s*, and d_s is the depreciation rate in industry *s*. The depreciation (DEP_s) related to the private and public capital stock is valued at the investment price index (PI). The elasticity of substitution between capital and labour is given by σF_s, where $\sigma F_s = 1/(1+\rho F_s)$, and γFK_s and γFL_s represent the distribution parameters corresponding to capital and labour.

4.2 Overview of the simulation results

The detailed year-by-year macro and sectoral results of the policy simulations are provided in the annexed country documents for each one of the simulations. Below we provide only the summary tables which present the macroeconomic impacts and the effects on the labour market for 2015 and 2020.

Before we summarise the most salient outcomes of the simulations, it is important to underline that the simulation results should not be interpreted as economic forecasts or projections. Using the general equilibrium framework, in this study, we try to isolate and capture the impacts the EU funds. In order to isolate the impacts du to the EU funds, we need to make an abstraction of any other probable changes which may influence the development of the economies in the coming years. This is done through the model closure.

The most widely used macro closure rule for CGE models is based on the investment and savings balance. In the model, the investment is assumed to adjust to the available domestic and foreign savings. This reflects an economy in which savings form a binding constraint. An alternative closure is possible where the investments determine the total level of savings. In this case the foreign savings adjusts to meet the total savings requirement.

Additional assumptions are needed with regard to the government behaviour in the EcoMod model. First, the total current consumption by the government is fixed as a share of GDP, while the allocation between the consumption of different goods and services is provided by a Cobb-Douglas function. Secondly, the government net transfers to the foreign sector are assumed to be fixed in real terms, while the government net transfers to the household (except the unemployment benefits) are fixed as a share of GDP. Thus, the government savings are endogenously determined in the current version of EcoMod model. Alternative assumptions are possible, where total government expenditures can be fixed in real terms or as a share of GDP, while the total current consumption adjusts.

In the co-financing scenario an alternative closure is used for the government balance, where, besides the current consumption, the government savings are fixed as a share of GDP. The personal income tax rate adjusts to meet this constraint. In order to allow the comparability between the past profile of 6 countries scenario and the co-financing scenario, government savings to GDP ratio in the co-financing scenario has been fixed to its levels in the past profile of 6 countries scenario.

With respect to the external balance, the current account balance to GDP ratio is kept unchanged in the simulations, while the real exchange rate adjusts. In an illustrative scenario for Poland, we let current account (and thus the capital account) adjust which leads to capital flows other than the EU funds. This means that the results from this simulation do not only represent the potential impacts of the EU funds, but also other stem from other changes such as additional capital inflows or capital outflows. If there are any additional capital inflows for example, then the impacts shown by the model simulations are not only those of the EU funds but also of other foreign resources (increased or decreased).

The setup of the closure rules is important in determining the mechanisms governing the model. Therefore, the closure rules should be established also taking into account the policy scenario in question.

Below is an overview of the main findings from the simulation results:

- Structural and cohesion funds will have positive impacts in all the recipient countries.

- The positive impacts in all the new member states are substantial and long-lasting.

- The impacts, though positive and substantial, in the "worst case" scenario are smaller than those of all the other scenarios given the delays in the use of the funds in the MS.

- The changes go in the same direction in all the scenarios. However, the magnitude of the annual impacts is different given that the pattern of the flows of funds is naturally different in each one of the scenarios. However, the mechanisms are the same, only the magnitudes change.

- Given that in most cases the impact channels are the same in all the scenarios, the differences in the magnitude and in the year-by-year pattern of the changes are simply due to the differences in the annual pattern of the funds available to the member states in the different scenarios.

- Even if, in all the scenarios the macroeconomic impacts and the effects on the labour market are highly positive, the magnitude of the changes is sensitive to the assumption on the elasticity of the productivity growth with respect to investment. The variants with different and usually lower elasticities we ran for the "past profile" and "worst case" scenarios show that the effects would be smaller though still positive and strong. In the case of Bulgaria, for example, real GDP would increase by 8.8% (instead of 12.3% under the assumption of 0.1 for the productivity elasticity) in 2015 and by 10.6% (instead of 16.2%) in the "past profile" scenario. In the case of Poland, real GDP would increase by 6.1% (instead of 8.6% under the assumption of 0.1 for the productivity elasticity) in 2015 and by 7.2% (instead of 10.7%). The positive impacts in the labour market would also be smaller (see Tables 9 and 10, and the details in Tables 17-20 for the "past profile" scenario, and Tables 25-28 for the "worst case" scenario).

- As explained above (and in the technical appendix), the simulation results are sensitive not only to the assumption of the elasticity of productivity to the model closure. In order to investment, but also to the model closure. In order to isolate and capture the impacts of the EU funds, we need to make a set of theoretical abstractions and hypothesis on the government expenditures, deficit, current and capital account balances. If we change these closure rules, the results would of course change as they would not only capture the impacts of the EU funds, but of other elements as well. For example, in the illustrative simulation for Poland with a modified foreign account closure (flexible current and capital account balances), the potential impact on real GDP and employment effects become smaller: real GDP would increase by 5.07% in 2007 instead of 7.15%, and total employment would increase by 2.96% in 2020 instead of 4.08% in the "past profile" scenario (for details see the appendix on this specific simulation for Poland)..

- In some countries, such as Slovakia, Lithuania, Latvia, and Bulgaria the real GDP would be more than 15% higher than the business-as-usual level by the year 2020 (in the uniform elasticity simulations).

- The positive impacts of the structural and cohesion funds would continue even after the end of the financial period 2007-2013, thanks to increased TFP growth, higher labour productivity, and higher human, capital, and better infrastructure.

- The main engine of growth would be investment, both public and private.

- Private consumption would also be major component in the growth dynamics thanks to increasing real income and decreasing unemployment.

- The positive impacts on Germany, Italy, Spain, and to some extend on Greece and Slovenia are smaller (at the national level, though they may be important at the regional level in these countries) given that the amount of funds they receive are much smaller compared to their baseline GDP.

- The highest impacts are observed in the co-financing scenario (Tables 37-40). This is understandable given that in this scenario we assume that the total amount of funds available for the structural and cohesion policies will increase thanks to national co-financing. However, since we assume a constant deficit-to-GDP ratio, co-financing needs to be funded by an increase in taxes. We assume that the increase in the government expenditures is compensated by an increase in personal income taxes. The simulation results show that this compensation is not large enough to dampen the positive impacts of the additional investments carried out thanks to the national co-financing sources. In the long-run, the government would even be able to reduce the tax rates thanks to the additional revenue generated by higher economic growth in this scenario (see Table 41). The decline in the personal income tax rates strengthens the positive demand effect through an increase in private consumption and savings given the increase in the disposable real income.

- Following the co-financing scenario, the second best one would be the "programming prices" scenario (Tables 33-36) which, optimistically, assumes that the fund will be spent as planned.

- All the industries and services benefit from growth, however, construction and high-tech industries are the two branches which benefit the most. This is understandable given the considerable increase in investment and productivity.

- Improvement in the labour markets is substantial: employment increases in all the member states and the number of unemployed decreases tremendously (by more than 30% in some countries by 2020).

- As a result of considerably improved labour market conditions and high growth, the unemployment rate decreases by more than 5 percentage points in some countries.

- The increase in the labour productivity generated by the new investments does not lead to a decline in the total employment. On the contrary, the strong economic growth generated by the structural and cohesion funds leads to a long-lasting increase in employment. Given the sustainable long-term impact of the cohesion

policy on the potential economic capacity of the member countries, the increase in employment endures even after the end of the funds.

- Imports increase considerably in the first years given the required import content by the high growth rates, and exports may even decline given rapidly growing domestic demand. During the 2007-2013 programming period, the increase in the imports is especially strong in the sectors providing goods and services to investment. However, after a couple of years, exports catch up and increase to a large extent thanks to increased capacity and the changes in the terms of trade. In the long run, both imports and exports are much higher with respect to the baseline for all industries. Even if higher exports are an important element in the higher growth path (going well beyond the programming period), growth is not export drive. The main engines of growth beyond the programming period are domestic: much improved capital and labour productivity, better human resources, higher physical capital stock in the industries and services, improved infrastructure, and higher productive capacity.

- The version of the model used in this study does not distinguish bilateral trade flows, however, given the importance of the bilateral trade among all the member states, we can confidently assume that the initial surge in import demand in the new member states will benefit to the other member states.

- In all the scenarios, thanks to the flow of funds, there is a build-up of the productive capacity and increased productivity (even if the timings are different in the scenarios) with cumulative and long-term positive effects on the potential output and employment.

- In all the scenarios, the supply side effects dominate the demand side effects. This explains why even after the end of the flow of EU funds there is no sharp decline in output or employment. However, beyond the programming period, the annual growth rates slow down, but the effect of the EU funds on the increased potential output is long-lasting in the sense that the real GDP growth path is higher than the baseline. This may of course be partially due to the general equilibrium modelling framework which focuses on the long-run impacts of policy changes on the potential GDP and productive capacity of the economy. The short-run Keynesian effects are not properly captured by this modelling framework.

The impacts of the cohesion funds come through both demand and supply sides of the economy. The question of demand-side effects is a trivial one. These are well understood in the literature and usually well captured in the macroeconometric models. The direct and indirect demand side effects play a major role in the short run. However, the most important rationale of the cohesion policy is related to the long term effects of the flow of funds to the recipient countries. If there were no positive long-term structural and sustainable impacts remaining after the end of the flow of funds, the cohesion policy would only produce a temporary relief to the recipient countries and the termination of the EU funds would have a negative effect on output and employment. The EcoMod model and many other studies show that the supply-side effects would fortunately play a major role in the positive long run impacts of the cohesion funds.

The EcoMod model captures well these long-term supply side effects on investment, infrastructure, physical capital, human capital, labour supply, productivity growth, and the decline in the production costs.

The dynamic supply effects of the cohesion funds are captured through several channels in the model:

First, the structural and cohesion funds are distributed by the Fund to different branches of activity as investments, which add to the capital stock and lead to an increase in the productive capacity of the sector. Three types of investments are distinguished in the model:

- Investments to improve the productive environment, which are provided to the manufacturing and services sectors and originate from the structural funds.
- Investments in human resources, which also originate from the structural funds and are destined to the services sector.
- Investments in infrastructure, which are meant for the services sector and rely on both structural and cohesion funds.

Secondly, the investments by the Fund lead to an increase in the total factor productivity (TFP) or labour productivity depending on the field of intervention.

During the funding period, the flow of structural and cohesion funds increase the stock of productive capital in the economy, generates higher TFP growth, and develop skills and productivity in human resources. All these mechanisms not only increase the productive capacity of the economy over the years, but they also have a favourable impact on the unit cost of production, an increase in household income and total savings in the economy. These virtuous circle effects help the expansion of the production, employment, investment, and capital stock over the years. Even when the funds end, the increased productive capacity, improved productivity, better human resources remain as long term development engines within the country and continue to sustain a higher growth path of the economy with respect to the baseline. Beyond the funding period, even if the annual growth rates decline due to the end of the flow of EU funds, the growth path of the economy remains much above the baseline thanks to increased and improved productive *domestic* capacity of the economies.

Table 9: Growth effects (% change in real GDP with respect to the BAU) - 2015

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
Past profile	12.27	8.39	7.15	0.31	2.85	4.94	0.43	12.71	16.05	8.55	3.35	6.23	14.80	3.07	1.05
Worst case	10.19	7.72	6.41	0.28	2.63	4.47	0.39	11.30	13.17	7.45	3.10	5.27	12.29	2.86	1.00
Programming prices	14.76	9.75	8.07	0.38	3.08	5.53	0.51	14.57	18.81	10.10	3.73	7.02	18.00	3.37	1.18
Lisbon	12.14	8.27	7.00	0.30	2.78	4.83	0.41	12.52	15.89	8.42	3.27	6.13	14.67	3.01	1.02
Co-financing	15.65	10.49	8.90	0.38	3.62	5.97	0.53	15.81	19.92	10.65	4.14	7.96	18.22	3.75	1.31
Past profile different elasticities	8.80	7.34	8.39	0.22	2.85	2.51	0.36	13.99	11.99	6.14	3.49	3.95	14.41	2.22	1.09
Worst case different elasticities	7.58	6.79	7.44	0.21	2.63	2.34	0.33	12.35	10.06	5.47	3.22	3.49	11.98	2.12	1.04

Table 10: Growth effects (% change in real GDP with respect to the BAU) - 2020

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
Past profile	16.20	9.57	8.22	0.41	3.11	5.53	0.53	14.90	22.54	10.70	3.73	6.95	20.58	3.22	1.17
Worst case	14.12	8.95	7.48	0.38	2.92	5.09	0.49	13.56	19.24	9.59	3.46	6.10	18.05	3.04	1.11
Programming prices	17.70	10.11	8.84	0.45	3.41	5.90	0.59	16.04	25.05	11.90	4.05	7.44	22.64	3.40	1.30
Lisbon	16.00	9.41	8.01	0.40	3.03	5.38	0.52	14.64	22.26	10.51	3.61	6.81	20.36	3.14	1.13
Co-financing	20.42	12.27	10.69	0.50	4.06	7.08	0.67	18.96	27.82	13.46	4.86	9.08	24.52	4.15	1.49
Past profile different elasticities	10.58	8.10	9.90	0.27	3.11	2.40	0.44	16.76	15.60	7.15	3.91	3.89	19.93	2.09	1.23
Worst case different elasticities	9.50	7.62	8.97	0.25	2.92	2.24	0.41	15.18	13.40	6.49	3.63	3.51	17.51	2.01	1.17

Table 11: Employment effects (% change to the BAU) - 2015

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
Past profile	6.57	3.27	2.92	0.15	1.56	1.95	0.22	5.91	7.11	4.79	1.39	2.38	6.18	1.21	0.61
Worst case	5.48	3.07	2.76	0.14	1.36	1.87	0.20	5.46	6.11	4.29	1.29	2.06	5.36	1.14	0.56
Programming prices	7.54	3.01	2.70	0.17	1.26	1.41	0.23	6.08	7.19	5.50	1.23	2.40	6.59	1.10	0.56
Lisbon	6.51	3.24	2.87	0.14	1.53	1.92	0.22	5.84	7.06	4.73	1.37	2.35	6.13	1.19	0.59
Co-financing	8.14	3.75	3.33	0.18	1.90	2.12	0.27	6.90	8.29	5.77	1.61	2.79	7.20	1.36	0.73
Past profile different elasticities	5.02	3.00	3.28	0.11	1.56	1.34	0.19	6.34	5.78	3.62	1.43	1.67	6.05	0.96	0.63
Worst case different elasticities	4.31	2.83	3.07	0.11	1.36	1.33	0.18	5.82	5.06	3.31	1.33	1.51	5.25	0.93	0.58

Table 12: Employment effects (% change to the BAU) - 2020

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
Past profile	8.89	3.41	3.11	0.19	1.43	1.62	0.25	6.71	9.45	5.82	1.29	2.65	8.66	1.13	0.58
Worst case	7.83	3.18	2.84	0.17	1.32	1.48	0.23	6.18	8.26	5.27	1.20	2.32	7.71	1.07	0.55
Programming prices	9.65	3.65	3.35	0.21	1.61	1.74	0.27	7.18	10.33	6.40	1.41	2.85	9.41	1.20	0.65
Lisbon	8.79	3.36	3.04	0.18	1.39	1.58	0.24	6.61	9.36	5.73	1.26	2.60	8.57	1.11	0.56
Co-financing	10.88	4.23	3.96	0.23	1.85	2.06	0.31	8.31	11.14	7.21	1.66	3.38	10.14	1.45	0.73
Past profile different elasticities	6.20	2.96	3.68	0.13	1.43	0.71	0.20	7.40	7.07	4.08	1.35	1.61	8.42	0.77	0.61
Worst case different elasticities	5.59	2.77	3.34	0.12	1.32	0.64	0.19	6.79	6.15	3.73	1.25	1.43	7.50	0.74	0.58

Past profile scenario (TFP elasticity of 0.1 for all countries)

Table 13: Macroeconomic effects in real terms (% change to the BAU) - 2015

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
GDP	12.27	8.39	7.15	0.31	2.85	4.94	0.43	12.71	16.05	8.55	3.35	6.23	14.80	3.07	1.05
Private consumption	7.33	5.39	4.07	0.19	2.90	4.23	0.33	6.98	7.09	6.05	2.85	5.18	6.19	2.22	0.83
Government consumption	10.64	7.87	6.51	0.28	3.19	4.84	0.40	11.13	15.09	8.44	3.22	6.04	16.61	2.89	1.04
Gross fixed investment	29.36	20.05	18.42	1.06	8.43	16.92	1.43	30.88	42.40	21.88	10.02	15.55	31.94	8.88	3.33
Exports	10.42	4.74	4.68	0.15	0.10	1.72	0.08	10.78	11.84	4.99	0.49	3.84	11.73	1.60	0.14
Imports	10.44	6.95	7.18	0.32	5.43	5.73	0.69	12.78	12.15	10.39	4.83	7.35	10.01	3.38	1.60

Table 14: Macroeconomic effects in real terms (% change to the BAU) - 2020

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
GDP	16.20	9.57	8.22	0.41	3.11	5.53	0.53	14.90	22.54	10.70	3.73	6.95	20.58	3.22	1.17
Private consumption	10.05	5.88	4.23	0.25	2.55	3.83	0.37	7.79	9.36	7.15	2.58	5.43	8.96	2.07	0.82
Government consumption	13.62	7.79	7.14	0.37	2.98	4.82	0.50	12.65	19.61	10.04	3.39	6.35	20.41	2.89	1.09
Gross fixed investment	23.33	11.29	9.39	0.82	3.37	5.86	0.88	19.28	41.56	15.18	5.12	6.71	30.49	3.36	1.61
Exports	15.73	8.38	7.75	0.35	3.09	4.80	0.46	16.62	22.49	10.42	3.43	7.06	19.82	3.19	1.05
Imports	10.22	5.89	5.15	0.25	1.78	3.33	0.33	9.97	14.33	6.68	2.28	4.27	12.26	2.02	0.73

Table 15: Labour market effects - 2015

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
National employment	6.57	3.27	2.92	0.15	1.56	1.95	0.22	5.91	7.11	4.79	1.39	2.38	6.18	1.21	0.61
Number of unemployed	-23.45	-26.32	-19.74	-1.24	-9.26	-20.87	-1.82	-28.98	-39.40	-21.04	-16.71	-21.31	-23.11	-12.38	-3.90
Active population	0.72	0.82	0.59	0.03	0.26	0.63	0.05	0.92	1.35	0.63	0.49	0.64	0.70	0.35	0.11
Unemployment rate (in %)	14.82	6.07	8.22	8.10	10.86	4.56	8.24	10.06	7.41	12.63	4.14	5.75	14.28	5.50	10.66
Unemployment rate (% points difference with BAU)	-4.68	-2.23	-2.08	-0.10	-1.14	-1.24	-0.16	-4.24	-4.99	-3.47	-0.86	-1.60	-4.42	-0.80	-0.44

Table 16: Labour market effects - 2020

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
National employment	8.89	3.41	3.11	0.19	1.43	1.62	0.25	6.71	9.45	5.82	1.29	2.65	8.66	1.13	0.58
Number of unemployed	-31.48	-27.33	-20.98	-1.56	-8.52	-17.45	-2.03	-32.79	-51.18	-25.45	-15.55	-23.58	-32.08	-11.63	-3.72
Active population	1.01	0.86	0.63	0.04	0.24	0.51	0.05	1.07	1.93	0.79	0.45	0.72	1.04	0.33	0.10
Unemployment rate (in %)	13.23	5.98	8.09	8.07	10.95	4.76	8.23	9.51	5.94	11.91	4.20	5.58	12.57	5.55	10.68
Unemployment rate (% points difference with BAU)	-6.27	-2.32	-2.21	-0.13	-1.05	-1.04	-0.17	-4.79	-6.46	-4.19	-0.80	-1.77	-6.13	-0.75	-0.42

Past profile scenario (different TFP elasticities for different countries)

Table 17: Macroeconomic effects in real terms (% change to the BAU) - 2015

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
GDP	8.80	7.34	8.39	0.22	2.85	2.51	0.36	13.99	11.99	6.14	3.49	3.95	14.41	2.22	1.09
Private consumption	5.38	4.68	4.62	0.15	2.90	2.79	0.29	7.65	5.58	4.36	2.95	3.51	5.97	1.69	0.86
Government consumption	7.50	6.96	7.59	0.20	3.19	2.65	0.34	12.21	11.31	6.07	3.36	3.90	16.23	2.13	1.08
Gross fixed investment	24.76	19.23	19.64	0.90	8.43	14.50	1.34	32.20	35.81	18.97	10.17	13.41	31.55	8.15	3.38
Exports	7.12	3.81	5.85	0.08	0.10	-0.45	0.03	12.18	7.71	2.82	0.61	1.58	11.36	0.74	0.18
Imports	8.63	6.41	7.83	0.27	5.43	4.46	0.66	13.48	9.95	9.17	4.90	6.18	9.82	2.91	1.62

Table 18: Macroeconomic effects in real terms (% change to the BAU) - 2020

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
GDP	10.58	8.10	9.90	0.27	3.11	2.40	0.44	16.76	15.60	7.15	3.91	3.89	19.93	2.09	1.23
Private consumption	6.61	4.83	5.12	0.17	2.55	1.75	0.30	8.87	6.30	4.60	2.72	3.04	8.60	1.31	0.87
Government consumption	8.60	6.51	8.66	0.24	2.98	1.94	0.41	14.26	13.31	6.61	3.57	3.49	19.77	1.85	1.15
Gross fixed investment	15.51	9.94	11.22	0.54	3.37	2.55	0.73	21.37	29.81	10.65	5.34	3.79	29.75	2.31	1.68
Exports	10.26	7.09	9.36	0.22	3.09	1.99	0.38	18.68	15.50	7.05	3.59	4.00	19.21	2.05	1.10
Imports	6.71	4.98	6.21	0.16	1.78	1.37	0.27	11.19	9.97	4.50	2.39	2.40	11.89	1.29	0.77

Table 19: Labour market effects - 2015

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
National employment	5.02	3.00	3.28	0.11	1.56	1.34	0.19	6.34	5.78	3.62	1.43	1.67	6.05	0.96	0.63
Number of unemployed	-17.99	-24.20	-22.10	-0.96	-9.26	-14.50	-1.60	-31.04	-32.34	-15.99	-17.17	-15.09	-22.62	-9.90	-4.03
Active population	0.53	0.74	0.67	0.03	0.26	0.42	0.04	1.00	1.05	0.47	0.50	0.44	0.69	0.28	0.11
Unemployment rate (in %)	15.91	6.25	7.97	8.12	10.86	4.94	8.26	9.76	8.30	13.46	4.12	6.21	14.37	5.66	10.64
Unemployment rate (% points difference with BAU)	-3.59	-2.05	-2.33	-0.08	-1.14	-0.86	-0.14	-4.54	-4.10	-2.64	-0.88	-1.14	-4.33	-0.64	-0.46

Table 20: Labour market effects - 2020

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
National employment	6.20	2.96	3.68	0.13	1.43	0.71	0.20	7.40	7.07	4.08	1.35	1.61	8.42	0.77	0.61
Number of unemployed	-22.15	-23.88	-24.66	-1.06	-8.52	-7.74	-1.68	-35.99	-39.19	-17.96	-16.23	-14.53	-31.23	-7.95	-3.90
Active population	0.67	0.73	0.76	0.03	0.24	0.22	0.05	1.20	1.34	0.53	0.47	0.42	1.00	0.22	0.11
Unemployment rate (in %)	15.08	6.27	7.70	8.11	10.95	5.34	8.25	9.05	7.44	13.14	4.17	6.26	12.73	5.79	10.66
Unemployment rate (% points difference with BAU)	-4.42	-2.03	-2.60	-0.09	-1.05	-0.46	-0.15	-5.25	-4.96	-2.96	-0.83	-1.09	-5.97	-0.51	-0.44

Worst case scenario (TFP elasticity of 0.1 for all countries)

Table 21: Macroeconomic effects in real terms (% change to the BAU) - 2015

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
GDP	10.19	7.72	6.41	0.28	2.63	4.47	0.39	11.30	13.17	7.45	3.10	5.27	12.29	2.86	1.00
Private consumption	6.14	5.04	3.91	0.18	2.58	3.99	0.30	6.51	6.32	5.36	2.64	4.59	5.48	2.10	0.77
Government consumption	9.16	7.41	5.99	0.25	2.88	4.47	0.36	10.16	13.19	7.51	2.99	5.35	14.92	2.72	0.98
Gross fixed investment	29.00	19.95	19.67	0.99	7.86	17.55	1.36	31.65	39.17	21.21	9.48	17.32	29.64	8.72	2.90
Exports	8.28	3.98	3.61	0.14	0.22	1.12	0.06	8.68	8.22	3.74	0.38	2.26	8.85	1.38	0.24
Imports	10.19	6.72	7.44	0.30	4.88	5.77	0.66	12.94	11.10	10.34	4.58	8.00	9.01	3.27	1.38

Table 22: Macroeconomic effects in real terms (% change to the BAU) - 2020

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
GDP	14.12	8.95	7.48	0.38	2.92	5.09	0.49	13.56	19.24	9.59	3.46	6.10	18.05	3.04	1.11
Private consumption	8.74	5.46	3.83	0.23	2.36	3.49	0.34	7.06	7.92	6.39	2.38	4.72	7.93	1.95	0.78
Government consumption	11.92	7.45	6.49	0.34	2.78	4.42	0.46	11.50	16.92	9.03	3.14	5.59	18.03	2.73	1.03
Gross fixed investment	20.40	10.53	8.58	0.75	3.24	5.47	0.81	17.63	35.63	13.59	4.75	5.96	26.73	3.17	1.53
Exports	13.74	7.80	7.05	0.32	2.92	4.42	0.43	15.13	19.23	9.34	3.19	6.26	17.33	3.00	1.00
Imports	8.94	5.48	4.69	0.23	1.67	3.06	0.30	9.08	12.31	5.98	2.11	3.76	10.76	1.90	0.69

Table 23: Labour market effects - 2015

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
National employment	5.48	3.07	2.76	0.14	1.36	1.87	0.20	5.46	6.11	4.29	1.29	2.06	5.36	1.14	0.56
Number of unemployed	-19.61	-24.71	-18.69	-1.14	-8.12	-20.00	-1.66	-26.87	-34.11	-18.86	-15.54	-18.54	-20.08	-11.69	-3.61
Active population	0.58	0.76	0.55	0.03	0.23	0.60	0.04	0.84	1.12	0.56	0.45	0.55	0.60	0.33	0.10
Unemployment rate (in %)	15.58	6.20	8.33	8.10	11.00	4.61	8.26	10.37	8.08	12.99	4.20	5.95	14.86	5.54	10.69
Unemployment rate (% points difference with BAU)	-3.92	-2.10	-1.97	-0.10	-1.00	-1.19	-0.14	-3.93	-4.32	-3.11	-0.80	-1.39	-3.84	-0.76	-0.41

Table 24: Labour market effects - 2020

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
National employment	7.83	3.18	2.84	0.17	1.32	1.48	0.23	6.18	8.26	5.27	1.20	2.32	7.71	1.07	0.55
Number of unemployed	-27.84	-25.61	-19.17	-1.45	-7.88	-15.96	-1.87	-30.25	-45.27	-23.08	-14.45	-20.79	-28.68	-10.98	-3.54
Active population	0.87	0.79	0.57	0.04	0.22	0.47	0.05	0.97	1.62	0.70	0.42	0.62	0.91	0.31	0.10
Unemployment rate (in %)	13.95	6.13	8.28	8.08	11.03	4.85	8.24	9.88	6.68	12.30	4.26	5.79	13.22	5.59	10.70
Unemployment rate (% points difference with BAU)	-5.55	-2.17	-2.02	-0.12	-0.97	-0.95	-0.16	-4.42	-5.72	-3.80	-0.74	-1.56	-5.48	-0.71	-0.40

Worst case scenario (different TFP elasticities for different countries)

Table 25: Macroeconomic effects in real terms (% change to the BAU) - 2015

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
GDP	7.58	6.79	7.44	0.21	2.63	2.34	0.33	12.35	10.06	5.47	3.22	3.49	11.98	2.12	1.04
Private consumption	4.69	4.42	4.36	0.14	2.58	2.75	0.26	7.06	5.16	3.95	2.73	3.30	5.30	1.63	0.80
Government consumption	6.77	6.62	6.90	0.19	2.88	2.56	0.31	11.05	10.22	5.54	3.11	3.66	14.62	2.05	1.02
Gross fixed investment	25.54	19.25	20.71	0.85	7.86	15.41	1.28	32.73	34.15	18.85	9.62	15.61	29.36	8.10	2.95
Exports	5.81	3.17	4.60	0.07	0.22	-0.79	0.02	9.83	5.04	1.95	0.49	0.49	8.57	0.63	0.28
Imports	8.83	6.24	7.99	0.26	4.88	4.65	0.64	13.52	9.38	9.33	4.65	7.08	8.87	2.87	1.40

Table 26: Macroeconomic effects in real terms (% change to the BAU) - 2020

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
GDP	9.50	7.62	8.97	0.25	2.92	2.24	0.41	15.18	13.40	6.49	3.63	3.51	17.51	2.01	1.17
Private consumption	5.92	4.50	4.62	0.16	2.36	1.61	0.28	8.00	5.35	4.16	2.51	2.70	7.61	1.25	0.82
Government consumption	7.74	6.27	7.85	0.23	2.78	1.79	0.38	12.91	11.54	6.02	3.31	3.16	17.49	1.79	1.09
Gross fixed investment	13.93	9.32	10.20	0.51	3.24	2.44	0.68	19.46	25.67	9.66	4.96	3.48	26.12	2.22	1.60
Exports	9.22	6.63	8.48	0.21	2.92	1.85	0.35	16.94	13.34	6.41	3.35	3.66	16.81	1.95	1.05
Imports	6.04	4.66	5.63	0.15	1.67	1.26	0.25	10.16	8.60	4.08	2.22	2.17	10.45	1.24	0.73

Table 27: Labour market effects - 2015

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
National employment	4.31	2.83	3.07	0.11	1.36	1.33	0.18	5.82	5.06	3.31	1.33	1.51	5.25	0.93	0.58
Number of unemployed	-15.49	-22.87	-20.68	-0.90	-8.12	-14.43	-1.46	-28.58	-28.49	-14.64	-15.95	-13.66	-19.69	-9.55	-3.73
Active population	0.45	0.70	0.62	0.02	0.23	0.42	0.04	0.90	0.90	0.42	0.47	0.39	0.59	0.27	0.10
Unemployment rate (in %)	16.41	6.36	8.12	8.12	11.00	4.94	8.27	10.12	8.79	13.69	4.18	6.32	14.93	5.68	10.67
Unemployment rate (% points difference with BAU)	-3.09	-1.94	-2.18	-0.08	-1.00	-0.86	-0.13	-4.18	-3.61	-2.41	-0.82	-1.03	-3.77	-0.62	-0.43

Table 28: Labour market effects - 2020

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
National employment	5.59	2.77	3.34	0.12	1.32	0.64	0.19	6.79	6.15	3.73	1.25	1.43	7.50	0.74	0.58
Number of unemployed	-20.00	-22.44	-22.49	-1.00	-7.88	-7.03	-1.56	-33.14	-34.33	-16.45	-15.08	-12.99	-27.93	-7.63	-3.71
Active population	0.60	0.68	0.68	0.03	0.22	0.19	0.04	1.08	1.13	0.48	0.44	0.37	0.88	0.21	0.10
Unemployment rate (in %)	15.51	6.39	7.93	8.12	11.03	5.38	8.27	9.46	8.05	13.39	4.23	6.37	13.36	5.81	10.68
Unemployment rate (% points difference with BAU)	-3.99	-1.91	-2.37	-0.08	-0.97	-0.42	-0.13	-4.84	-4.35	-2.71	-0.77	-0.98	-5.34	-0.49	-0.42

Programming prices scenario (TFP elasticity of 0.1 for all countries)

Table 29: Macroeconomic effects in real terms (% change to the BAU) - 2015

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
GDP	14.76	9.75	8.07	0.38	3.08	5.53	0.51	14.57	18.81	10.10	3.73	7.02	18.00	3.37	1.18
Private consumption	8.41	5.06	3.48	0.22	2.32	3.42	0.34	6.51	6.07	6.34	2.40	4.91	6.02	1.97	0.80
Government consumption	12.10	8.37	6.74	0.33	2.88	4.62	0.46	11.82	16.23	9.59	3.39	6.44	18.83	2.98	1.09
Gross fixed investment	20.13	10.50	8.46	0.74	3.63	5.48	0.84	17.82	33.82	13.90	5.02	6.80	27.10	3.28	1.57
Exports	14.19	8.26	7.59	0.32	3.07	4.76	0.42	16.45	19.21	9.63	3.42	7.33	16.85	3.28	1.03
Imports	7.78	4.81	4.18	0.19	1.46	2.73	0.26	8.08	10.08	5.15	1.89	3.60	8.68	1.75	0.61

Table 30: Macroeconomic effects in real terms (% change to the BAU) - 2020

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
GDP	17.70	10.11	8.84	0.45	3.41	5.90	0.59	16.04	25.05	11.90	4.05	7.44	22.64	3.40	1.30
Private consumption	11.01	6.32	4.58	0.28	2.83	4.11	0.41	8.44	10.50	7.96	2.82	5.87	9.80	2.19	0.91
Government consumption	14.80	7.81	7.66	0.41	3.27	5.15	0.56	13.62	21.65	11.10	3.67	6.79	22.27	3.04	1.21
Gross fixed investment	25.42	12.05	10.08	0.91	3.58	6.21	0.97	20.65	45.94	16.90	5.57	7.11	33.53	3.55	1.80
Exports	17.16	8.94	8.33	0.39	3.34	5.14	0.51	17.86	24.94	11.56	3.70	7.51	21.87	3.38	1.16
Imports	11.12	6.29	5.55	0.27	1.95	3.56	0.36	10.71	15.85	7.43	2.48	4.55	13.49	2.14	0.81

Table 31: Labour market effects - 2015

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
National employment	7.54	3.01	2.70	0.17	1.26	1.41	0.23	6.08	7.19	5.50	1.23	2.40	6.59	1.10	0.56
Number of unemployed	-26.84	-24.27	-18.30	-1.41	-7.51	-15.26	-1.86	-29.80	-39.77	-24.06	-14.75	-21.49	-24.61	-11.25	-3.62
Active population	0.84	0.74	0.54	0.04	0.21	0.44	0.05	0.95	1.36	0.74	0.43	0.65	0.76	0.32	0.10
Unemployment rate (in %)	14.15	6.24	8.37	8.08	11.08	4.89	8.24	9.94	7.37	12.14	4.24	5.73	13.99	5.57	10.69
Unemployment rate (% points difference with BAU)	-5.35	-2.06	-1.93	-0.12	-0.92	-0.91	-0.16	-4.36	-5.03	-3.96	-0.76	-1.62	-4.71	-0.73	-0.41

Table 32: Labour market effects - 2020

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
National employment	9.65	3.65	3.35	0.21	1.61	1.74	0.27	7.18	10.33	6.40	1.41	2.85	9.41	1.20	0.65
Number of unemployed	-34.11	-29.15	-22.55	-1.75	-9.59	-18.69	-2.26	-34.94	-55.40	-27.92	-16.94	-25.31	-34.78	-12.29	-4.16
Active population	1.12	0.92	0.68	0.05	0.27	0.55	0.06	1.15	2.18	0.88	0.50	0.78	1.15	0.35	0.11
Unemployment rate (in %)	12.71	5.83	7.92	8.05	10.82	4.69	8.21	9.20	5.41	11.50	4.13	5.45	12.06	5.51	10.63
Unemployment rate (% points difference with BAU)	-6.79	-2.47	-2.38	-0.15	-1.18	-1.11	-0.19	-5.10	-6.99	-4.60	-0.87	-1.90	-6.64	-0.79	-0.47

Lisbon scenario (TFP elasticity of 0.1 for all countries)

Table 33: Macroeconomic effects in real terms (% change to the BAU) - 2015

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
GDP	12.14	8.27	7.00	0.30	2.78	4.83	0.41	12.52	15.89	8.42	3.27	6.13	14.67	3.01	1.02
Private consumption	7.25	5.30	4.00	0.19	2.84	4.16	0.32	6.88	7.03	5.97	2.79	5.10	6.12	2.19	0.80
Government consumption	10.51	7.75	6.36	0.27	3.12	4.72	0.39	10.93	14.91	8.29	3.13	5.93	16.46	2.83	1.00
Gross fixed investment	29.22	19.96	18.27	1.05	8.36	16.81	1.42	30.72	42.13	21.74	9.92	15.47	31.79	8.83	3.29
Exports	10.31	4.65	4.55	0.15	0.03	1.63	0.08	10.60	11.69	4.88	0.42	3.74	11.63	1.55	0.11
Imports	10.38	6.90	7.11	0.32	5.40	5.68	0.69	12.70	12.08	10.34	4.79	7.31	9.96	3.35	1.58

Table 34: Macroeconomic effects in real terms (% change to the BAU) - 2020

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
GDP	16.00	9.41	8.01	0.40	3.03	5.38	0.52	14.64	22.26	10.51	3.61	6.81	20.36	3.14	1.13
Private consumption	9.93	5.77	4.12	0.24	2.47	3.73	0.36	7.64	9.24	7.02	2.49	5.32	8.84	2.02	0.79
Government consumption	13.44	7.64	6.95	0.36	2.90	4.68	0.48	12.38	19.35	9.85	3.27	6.21	20.19	2.81	1.05
Gross fixed investment	23.07	11.14	9.18	0.80	3.29	5.71	0.85	19.01	41.09	14.96	4.98	6.58	30.22	3.29	1.56
Exports	15.55	8.26	7.57	0.34	3.00	4.68	0.45	16.36	22.22	10.24	3.33	6.93	19.62	3.12	1.01
Imports	10.10	5.80	5.03	0.24	1.73	3.24	0.32	9.82	14.16	6.57	2.21	4.18	12.14	1.97	0.70

Table 35: Labour market effects - 2015

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
National employment	6.51	3.24	2.87	0.14	1.53	1.92	0.22	5.84	7.06	4.73	1.37	2.35	6.13	1.19	0.59
Number of unemployed	-23.24	-26.07	-19.42	-1.22	-9.07	-20.57	-1.78	-28.67	-39.14	-20.79	-16.40	-21.03	-22.94	-12.20	-3.81
Active population	0.71	0.81	0.58	0.03	0.25	0.62	0.05	0.91	1.33	0.62	0.48	0.63	0.70	0.35	0.10
Unemployment rate (in %)	14.86	6.09	8.25	8.10	10.88	4.58	8.25	10.11	7.45	12.67	4.16	5.77	14.31	5.51	10.67
Unemployment rate (% points difference with BAU)	-4.64	-2.21	-2.05	-0.10	-1.12	-1.22	-0.15	-4.19	-4.95	-3.43	-0.84	-1.58	-4.39	-0.79	-0.43

Table 36: Labour market effects - 2020

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
National employment	8.79	3.36	3.04	0.18	1.39	1.58	0.24	6.61	9.36	5.73	1.26	2.60	8.57	1.11	0.56
Number of unemployed	-31.15	-26.95	-20.51	-1.53	-8.27	-17.01	-1.97	-32.30	-50.74	-25.08	-15.11	-23.18	-31.78	-11.38	-3.59
Active population	1.00	0.84	0.61	0.04	0.23	0.50	0.05	1.05	1.91	0.77	0.44	0.71	1.03	0.32	0.10
Unemployment rate (in %)	13.29	6.01	8.14	8.07	10.98	4.79	8.23	9.58	5.99	11.97	4.23	5.61	12.63	5.57	10.69
Unemployment rate (% points difference with BAU)	-6.21	-2.29	-2.16	-0.13	-1.02	-1.01	-0.17	-4.72	-6.41	-4.13	-0.77	-1.74	-6.07	-0.73	-0.41

Co-financing scenario (TFP elasticity of 0.1 fro all countries)

Table 37: Macroeconomic effects in real terms (% change to the BAU) - 2015

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
GDP	15.65	10.49	8.90	0.38	3.62	5.97	0.53	15.81	19.92	10.65	4.14	7.96	18.22	3.75	1.31
Private consumption	8.18	4.84	2.86	0.21	3.05	3.82	0.34	6.42	7.25	6.52	2.81	5.36	6.74	1.89	0.83
Government consumption	13.45	9.76	8.01	0.34	4.01	5.79	0.49	13.71	18.61	10.49	3.95	7.66	20.66	3.49	1.28
Gross fixed investment	37.03	25.09	23.30	1.28	10.70	19.97	1.77	38.56	52.34	26.82	12.45	20.14	38.32	11.00	4.04
Exports	13.93	6.64	6.59	0.22	0.90	2.74	0.18	14.84	15.75	7.21	1.21	5.90	15.07	2.40	0.38
Imports	12.29	8.04	8.19	0.36	5.82	6.31	0.75	14.67	14.19	11.54	5.24	8.35	11.68	3.80	1.74

Table 38: Macroeconomic effects in real terms (% change to the BAU) - 2015

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
GDP	20.42	12.27	10.69	0.50	4.06	7.08	0.67	18.96	27.82	13.46	4.86	9.08	24.52	4.15	1.49
Private consumption	13.25	7.83	5.63	0.32	3.37	5.01	0.48	10.55	12.05	9.41	3.48	7.14	11.52	2.76	1.12
Government consumption	17.14	10.27	9.26	0.45	3.90	6.18	0.63	16.05	24.07	12.62	4.43	8.28	24.31	3.70	1.39
Gross fixed investment	27.44	13.69	11.96	0.95	4.22	7.22	1.07	23.06	49.51	18.05	6.36	8.64	34.06	4.12	1.88
Exports	19.68	10.71	10.09	0.43	4.01	6.16	0.58	21.01	27.86	12.98	4.47	9.24	23.44	4.11	1.33
Imports	12.72	7.49	6.69	0.30	2.31	4.26	0.41	12.56	17.61	8.33	2.97	5.57	14.44	2.60	0.93

Table 39: Labour market effects - 2015

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
National employment	8.14	3.75	3.33	0.18	1.90	2.12	0.27	6.90	8.29	5.77	1.61	2.79	7.20	1.36	0.73
Number of unemployed	-29.88	-32.66	-25.40	-1.54	-12.02	-25.45	-2.31	-35.79	-46.96	-26.15	-20.72	-26.96	-27.31	-15.52	-4.93
Active population	0.73	0.73	0.37	0.04	0.23	0.53	0.05	0.79	1.44	0.64	0.50	0.60	0.75	0.30	0.10
Unemployment rate (in %)	13.58	5.55	7.66	8.07	10.53	4.30	8.20	9.11	6.48	11.82	3.94	5.34	13.49	5.31	10.54
Unemployment rate (% points difference with BAU)	-5.92	-2.75	-2.64	-0.13	-1.47	-1.50	-0.20	-5.19	-5.92	-4.28	-1.06	-2.01	-5.21	-0.99	-0.56

Table 40: Labour market effects - 2020

	BG	CZ	EE	DE	EL	HU	IT	LV	LT	PL	PT	RO	SK	SI	ES
National employment	10.88	4.23	3.96	0.23	1.85	2.06	0.31	8.31	11.14	7.21	1.66	3.38	10.14	1.45	0.73
Number of unemployed	-37.83	-33.12	-26.31	-1.89	-10.93	-21.67	-2.53	-39.62	-58.76	-30.96	-19.51	-29.64	-36.86	-14.56	-4.62
Active population	1.38	1.13	0.84	0.05	0.32	0.68	0.07	1.46	2.47	1.06	0.60	0.95	1.35	0.44	0.14
Unemployment rate (in %)	11.96	5.49	7.53	8.04	10.65	4.51	8.18	8.51	4.99	11.00	4.00	5.12	11.65	5.36	10.57
Unemployment rate (% points difference with BAU)	-7.54	-2.81	-2.77	-0.16	-1.35	-1.29	-0.22	-5.79	-7.41	-5.10	-1.00	-2.23	-7.05	-0.94	-0.53

Table 41: Percentage change in the personal income tax rates in the co-financing scenario

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
BG	8.55	19.81	24.10	22.95	21.81	17.84	14.90	18.90	16.26	-7.28	-7.63	-7.81	-7.89	-7.91
CZ	5.71	13.50	16.97	16.92	16.94	14.89	13.48	17.35	16.11	-2.43	-2.49	-2.50	-2.54	-2.57
EE	5.80	13.66	17.13	17.10	17.15	15.21	13.90	17.63	16.50	-0.81	-0.85	-0.89	-0.92	-0.95
DE	0.07	0.17	0.21	0.20	0.20	0.17	0.14	0.19	0.17	-0.08	-0.09	-0.09	-0.09	-0.09
EL	1.98	4.72	5.96	5.97	6.04	5.38	4.97	6.45	6.11	-0.56	-0.56	-0.56	-0.56	-0.55
HU	3.81	9.00	11.34	11.38	11.48	10.22	9.37	11.97	11.23	-1.05	-1.10	-1.16	-1.21	-1.25
IT	0.14	0.33	0.42	0.42	0.42	0.37	0.34	0.44	0.41	-0.07	-0.07	-0.07	-0.08	-0.08
LV	7.10	16.41	20.21	19.73	19.30	16.48	14.46	18.38	16.56	-4.08	-4.17	-4.23	-4.28	-4.31
LT	5.01	11.56	14.30	14.02	13.74	11.71	10.22	13.06	11.77	-3.49	-3.49	-3.45	-3.40	-3.34
PL	5.51	12.71	15.51	14.94	14.46	12.15	10.49	13.51	12.00	-4.36	-4.43	-4.49	-4.53	-4.57
PT	2.36	5.61	7.05	7.03	7.05	6.22	5.66	7.33	6.85	-1.01	-1.09	-1.11	-1.13	-1.14
RO	4.31	9.94	12.23	11.99	11.82	10.30	9.26	11.54	10.63	-0.47	-0.47	-0.46	-0.46	-0.45
SK	7.79	17.63	20.76	18.86	17.15	12.79	9.62	13.50	10.53	-13.61	-12.75	-12.08	-11.52	-11.02
SI	2.55	6.08	7.67	7.66	7.71	6.83	6.24	8.04	7.53	-0.74	-0.76	-0.77	-0.79	-0.80
ES	0.57	1.36	1.71	1.68	1.67	1.43	1.26	1.66	1.51	-0.52	-0.54	-0.55	-0.56	-0.57

5 Appendix: Technical overview of the EcoMod model

This section provides a technical overview of the EcoMod model. For the purposes of this study, the model has been customized for each one of the 15 countries: Bulgaria, Czech Republic, Estonia, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Poland, Portugal, Romania, Slovakia, Slovenia, and Spain. The customised models differ depending on the data availability and the specific features of each economy. However, only the common, general framework is presented in this section.

EcoMod model incorporates the economic behaviour of five economic agents: firms, household, government, the Fund and the external sector. The behaviour of each agent in the model is described in detail below.

The model has been solved by using the general algebraic modelling system GAMS (Rosenthal, 2006).

The following conventions are adopted for the presentation of the model. Variable names are given in capital letters, small letters denote parameters calibrated from the database (SAM) and elasticity parameters. The subscript *s* stands for one of the production activities (6 branches of activity). The subscript *c* stands for one of the commodities (6 types of commodities). The subscript *ctm* stands for services, while *nctm* stands for all the other commodities except services (5 types of commodities). Finally, subscript *sm* stands for the manufacturing sectors, services and construction (4 branches of activity).

5.1 Firms

CGE models do not take into account the behaviour of individual firms, but of groups of similar ones aggregated into branches. The full database of the EcoMod model covers 60 activities. However, for the purpose of this study, they are aggregated in 6 branches of activity, summarized in Table A1.

Table A1: Activity and commodity aggregation in EcoMod

1	Agriculture
2	Manufacturing
3	High-tech manufacturing
4	Services
5	Construction
6	Public administration

The usual assumption for such a model is that producers operate in perfectly competitive markets and maximize profits (or minimize costs for each level of output) to determine the optimal levels of inputs and output. Furthermore, production prices equal average and marginal costs, a condition that implied by profit maximization for a constant returns to scale technology.

The level of production for each branch of activity is determined from a nested production structure (see Figure A1). In the first stage, producers are assumed to choose between intermediate inputs and value-added according to a Leontief production function. In the second stage, the optimal mix between capital and labour is given by another optimization process, where substitution possibilities between capital and labour are represented by a constant elasticity of substitution (CES) function. Firms' costs related to corporate income tax and social security contributions are also taken into account in the optimization process.

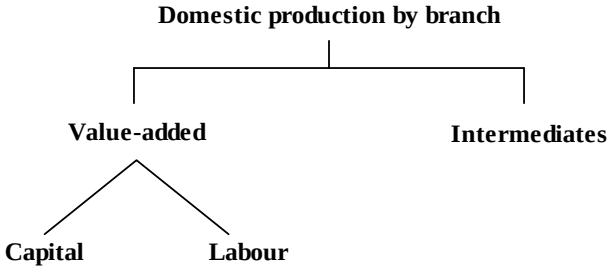

Figure A1. The nested Leontief and CES production technology for the domestic production by branch of activity

Value-added (KL_s) is related to domestic production by branch *s* (XD_s) through a Leontief production function, which assumes an optimal allocation of inputs:

$$KL_s = aKL_s \cdot XD_s \tag{6}$$

where aKL_s is the well-known fixed coefficient relating value-added to domestic production. Similarly, total intermediate inputs used by industry *s* (IO_s) are derived as:

$$IO_s = \sum_c io_{c,s} \cdot XD_s \tag{7}$$

where $io_{c,s}$ are the technical coefficients. Thus, domestic production valued at basic prices net of taxes (tp_s) but including direct subsidies (tsp_s) on production, $\left[PD_s \cdot (1 - tp_s + tsp_s)\right]$, is given by the sum of value-added (KL_s) for branch *s* valued at basic prices (PKL_s) and intermediate commodities used by sector *s* valued at the price of the commodities (P_c), less subsidies on intermediate consumption $(tsic_c)$ but including the trade and transport margins $(\sum_{ctm} tcictm_{ctm,c} \cdot P_{ctm})$ and other taxes (tic_c) on intermediate consumption:

$$PD_s \cdot (1 - tp_s + tsp_s) \cdot XD_s = \sum_c \{io_{c,s} \cdot XD_s \cdot [(1 - tsic_c) \cdot P_c + \sum_{ctm} tcictm_{ctm,c} \cdot P_{ctm}] \cdot (1 + tic_c)\} + PKL_s \cdot KL_s \tag{8}$$

The trade and transport margins are valued at the price (P_{ctm}) of the corresponding service (trade services or transport services), while $tcictm_{ctm,c}$ represents the trade and transport services *ctm* per unit of intermediate consumption of commodity *c*.

Value-added is a CES aggregation of capital (KSK_s) and labour (LSK_s):

$$KL_s = (aF_s \cdot TFPSF_s \cdot TFPCF_s) \cdot [\gamma FK_s \cdot KSK_s^{-\rho Fs} + \gamma FL_s \cdot (TFPSFH_s \cdot LSK_s)^{-\rho Fs}]^{-1/\rho Fs} \quad (9)$$

where $TFPSF_s$ reflects the total factor productivity (TFP) increase due to the structural funds provided as direct aid to the productive environment, $TFPCF_s$ gives the TFP increase due to the structural and cohesion funds on infrastructure and $TFPSFH_s$ provides the labour productivity increase due to the structural funds targeted to human resources.

Minimizing the costs function:

$$Cost_s(KSK_s, LSK_s) = [PK_s \cdot (1+tk_s) + d_s \cdot PI] \cdot KSK_s + [PL \cdot (1+premLSK_s) \cdot (1+tl_s)] \cdot LSK_s \quad (10)$$

subject to (9) yields the demand equations for capital and labour:

$$KSK_s = KL_s \cdot \{PKL_s / [PK_s \cdot (1+tk_s) + d_s \cdot PI]\}^{\sigma F_s} \cdot \gamma FK_s^{\sigma F_s} \cdot (aF_s \cdot TFPSF_s \cdot TFPCF_s)^{(\sigma F_s - 1)} \quad (11)$$

$$LSK_s = KL_s \cdot \{PKL_s / [PL \cdot (1+premLSK_s) \cdot (1+tl_s)]\}^{\sigma F_s} \cdot \gamma FL_s^{\sigma F_s} \cdot TFPSFH_s^{(\sigma F_s - 1)} \cdot (aF_s \cdot TFPSF_s \cdot TFPCF_s)^{(\sigma F_s - 1)} \quad (12)$$

and the associated zero profit condition:

$$PKL_s \cdot KL_s = PK_s \cdot (1+tk_s) \cdot KSK_s + PL \cdot (1+premLSK_s) \cdot (1+tl_s) \cdot LSK_s + DEP_s \cdot PI \quad (13)$$

where PL is the national average wage and $premLSK_s$ is the wage differential of branch s with respect to the average wage PL, tl_s is the social security contributions rate for industry s, PK_s is the return to capital in branch s, tk_s is the corporate income tax rate for branch s, and d_s is the depreciation rate in industry s. The depreciation (DEP_s) related to the private and public capital stock is valued at the investment price index (PI). The elasticity of substitution between capital and labour is given by σF_s, where $\sigma F_s = 1/(1+\rho F_s)$, and γFK_s and γFL_s represent the distribution parameters corresponding to capital and labour.

Capital is industry specific, introducing rigidities in the capital market. The inter-sectoral wage differential is a parameter derived as the ratio between the wage by branch and the national average wage (Dervis, De Melo and Robinson, 1982). Holding the inter-sectoral wage differentials constant in counterfactual policy simulations introduce rigidities in the labour market.

Each branch of activity in the EcoMod model produces several types of goods and services. The optimal allocation of domestic production between the different types of commodities is given by a Leontief function:

$$XDDE_c = \sum_s ioC_{s,c} \cdot XD_s \quad (14)$$

where $XDDE_c$ represents the domestic production of commodity c by different branches, supplied on the home and foreign markets, XD_s is the domestic production of branch s, and $ioC_{s,c}$ is a fixed coefficient expressing the volume of production of commodity c by the industry s per unit of production of industry s.

The corresponding zero profit condition is given by:

$$PD_s = \sum_c ioC_{s,c} \cdot PDDE_c \quad (15)$$

where $PDDE_c$ is the domestic price of commodity *c* supplied on the home and foreign markets and PD_s is the price index corresponding to domestic production by branch *s*.

Treated at an aggregate level, firms' savings are given by a share of the net operating surplus less net transfers by the firms to the household, to the government and to the external sector.

5.2 Household

The representative household receives a part of the capital income (net operating surplus), all labour income and net transfers from the government, from the firms and from the external sector. Government transfers comprise the unemployment benefits and other transfers such as pensions. The household pays income taxes and saves a share of the net income. Household savings (SH) are given by:

$$SH = MPS \cdot (1 - ty \cdot MUty) \cdot YH \quad (16)$$

where YH is the household income, ty is the personal income tax rate, $MUty$ represents the change in the personal income tax rate[1] and MPS the household propensity to save. Household propensity to save reacts to changes in the after-tax average return to capital, according to:

$$MPS = MPSZ \cdot \{[(1 - ty \cdot MUty) \cdot PKavr]/[(1 - tyz) \cdot PKavrZ]\}^{elasS} \quad (17)$$

where $MPSZ$ is the benchmark level of the propensity to save, $PKavr$ is the real average return to capital received by the household, $PKavrZ$ is the benchmark level of $PKavr$, tyz is the benchmark level of the personal income tax rate and $elasS$ is the elasticity of savings with respect to after-tax rate of return. Subsequently, household budget disposable for consumption $(CBUD)$ is derived as:

$$CBUD = (1 - ty \cdot MUty) \cdot YH - SH \quad (18)$$

The disposable budget for consumption is allocated between different goods and services according to a Stone-Geary utility function. Maximizing the utility function:

$$U(C_c) = \prod_c (C_c - \mu H_c)^{\alpha H_c} \quad (19)$$

subject to the budget constraint:

$$CBUD = \sum_c \{[(1 - tsc_c) \cdot P_c + \sum_{ctm} tchtm_{ctm,c} \cdot P_{ctm}] \cdot (1 + tc_c) \cdot C_c\} \quad (20)$$

[1] $MUty$ is used to derive the change in the personal income tax rate in the co-financing scenario.

with: $\sum_c \alpha H_c = 1$, yields the demand equations for commodities:

$$[(1-tsc_c)\cdot P_c+\sum_{ctm} tchtm_{ctm,c}\cdot P_{ctm}]\cdot(1+tc_c)\cdot C_c = [(1-tsc_c)\cdot P_c+\sum_{ctm} tchtm_{ctm,c}\cdot P_{ctm}]\cdot(1+tc_c)\cdot \mu H_c+\alpha H_c\cdot\{CBUD-\sum_{cc}[(1-tsc_{cc})\cdot P_{cc}+\sum_{ctm} tchtm_{ctm,cc}\cdot P_{ctm}]\cdot(1+tc_{cc})\cdot \mu H_{cc}\} \quad (21)$$

Consumption of commodity *c* (C_c) is valued at purchaser's prices, which include trade and transport margins $(\sum_{ctm} tchtm_{ctm,c}\cdot P_{ctm})$ and other taxes on consumption (tc_c) less subsidies (tsc_c), where P_c is the price of commodity *c* net of taxes but including subsidies. The trade and transport margins on private consumption are valued at the prices corresponding to the trade and transport services (P_{ctm}), where $tchtm_{ctm,c}$ represents the quantity of trade and transport services *ctm* per unit of commodity *c*.

In the allocation process, the consumer first decides on the minimum (subsistence) level of consumption of commodity *c* (μH_c). Then, the marginal income is allocated between different types of commodities according to the marginal budget shares (αH_c). A schematic representation of the household decisions is given in Figure A2.

Household welfare gains/losses are valued using the equivalent variation in income (EV), which is based on the concept of a money metric indirect utility function (Varian, 1992).

$$EV = (VU-VUI)\cdot\prod_c\{\{[(1-tscz_c)\cdot PZ_c+\sum_{ctm} tchtmz_{ctm,c}\cdot PZ_{ctm}]\cdot(1+tcz_c)\}/\alpha H_c\}^{\alpha H_c} \quad (22)$$

The indirect utility function (VU) corresponding to the Linear Expenditures System (LES) in the counter-factual (policy scenario) equilibrium is defined as:

$$VU = \{CBUD-\sum_c[(1-tsc_c)\cdot P_c+\sum_{ctm} tchtm_{ctm,c}\cdot P_{ctm}]\cdot(1+tc_c)\cdot \mu H_c\}\cdot \prod_c\{\alpha H_c/\{[(1-tsc_c)\cdot P_c+\sum_{ctm} tchtm_{ctm,c}\cdot P_{ctm}]\cdot(1+tc_c)\}\}^{\alpha H_c} \quad (23)$$

and the indirect utility function (VUI) in the benchmark equilibrium is given by:

$$VUI = \{CBUDZ-\sum_c[(1-tscz_c)\cdot PZ_c+\sum_{ctm} tchtmz_{ctm,c}\cdot PZ_{ctm}]\cdot(1+tcz_c)\cdot \mu H_c\}\cdot \prod_c\{\alpha H_c/\{[(1-tscz_c)\cdot PZ_c+\sum_{ctm} tchtmz_{ctm,c}\cdot PZ_{ctm}]\cdot(1+tcz_c)\}\}^{\alpha H_c} \quad (24)$$

where *CBUDZ* is the benchmark level of the disposable budget for consumption, PZ_c is the benchmark level of the price of commodity *c* net of taxes but including subsidies, $tchtmz_{ctm,c}$ is the benchmark level of the trade and transport margin rate, and $tscz_c$ and tcz_c are the benchmark rates corresponding to subsidies and taxes on consumption, respectively.

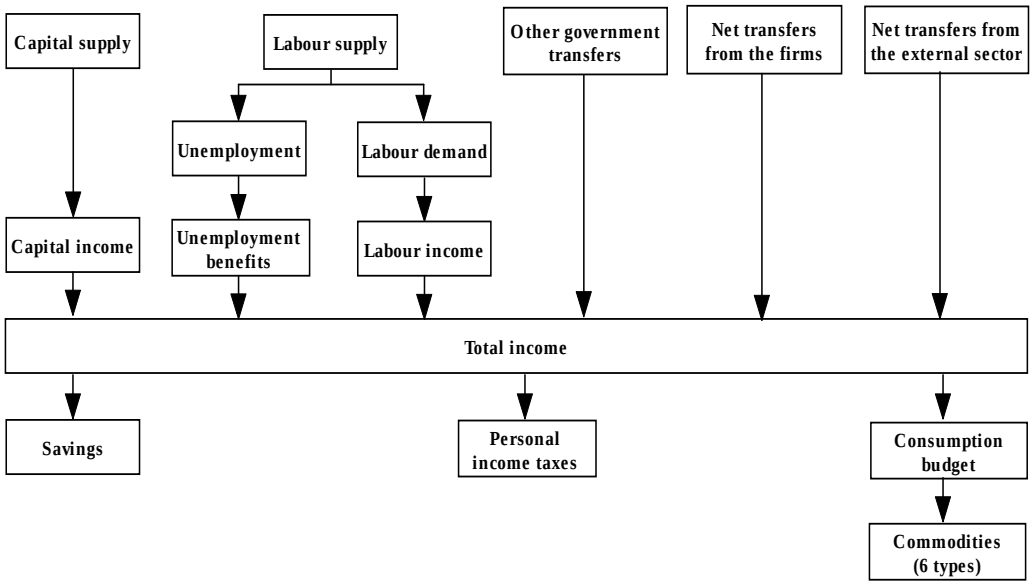

Figure A2. Decision structure of the household

Equivalent variation measures the income needed to make the household as well off as she is in the new counter-factual equilibrium (policy scenario) evaluated at benchmark prices. Thus, the equivalent variation is positive for welfare gains from the policy scenario and negative for losses.

5.3 Government

Government collects all the taxes, such as: taxes on income and wealth *(TRPROP)*, taxes on products and on production *(TRPROD)*, social security contributions *(TRSOC)* and receives transfers from the firms and the external sector *(TRANSR)* (see Figure A3):

$$GREV = TRPROP+TRPROD+TRSOC+TRANSR \tag{25}$$

where $GREV$ stands for the total government revenues.

The taxes on income and wealth are given by:

$$TRPROP = ty \cdot MUty \cdot YH + \sum_s tk_s \cdot KSK_s \cdot PK_s \tag{26}$$

In the derivation of each category of tax revenue the tax rate is applied to the corresponding tax base.

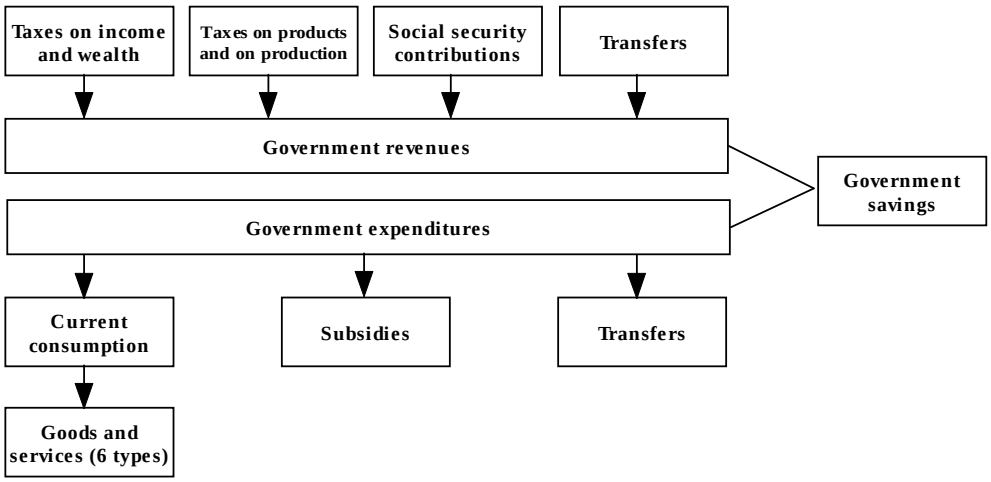

Figure A3. Structure of the government budget

Taxes on products are differentiated in the model according to the category of consumption on which they apply: intermediate consumption, private consumption, and gross capital formation. Taxes on products and on production are provided by:

$$TRPROD = \sum_{s} tp_s \cdot XD_s \cdot PD_s + \sum_{c} [(1 - tsc_c) \cdot P_c + \sum_{ctm} tchtm_{ctm,c} \cdot P_{ctm}] \cdot tc_c \cdot C_c +$$
$$\sum_{c} [(1 - tsi_c) \cdot P_c + \sum_{ctm} tcitm_{ctm,c} \cdot P_{ctm}] \cdot ti_c \cdot I_c +$$
$$\sum_{c,s} [(1 - tsic_c) \cdot P_c + \sum_{ctm} tcictm_{ctm,c} \cdot P_{ctm}] \cdot tic_c \cdot io_{c,s} \cdot XD_s + \sum_{c} tm_c \cdot PWM_c \cdot M_c \cdot ER \quad (27)$$

where I_c represents the investment demand for commodity c, $tcitm_{ctm,c}$ gives the trade and transport margin rate on investment good c, tsi_c is the subsidy rate on investment good c, ti_c gives the tax rate on investment good c, tm_c represents the tariff rate on commodity c, M_c give the imports of commodity c, PWM_c stands for the world import price of commodity c and ER is the exchange rate.

Social security contributions are derived by applying the social security contribution rate (tl_s) to the tax base:

$$TRSOC = \sum_{s} tl_s \cdot LSK_s \cdot PL \cdot (1 + premLSK_s) \quad (28)$$

The total transfers received by the government $(TRANSR)$ are given by transfers from the firms $(TRGF)$ and transfers from the external sector $(TRGW)$:

$$TRANSR = TRGW \cdot ER + TRGF \cdot GDPDEF \quad (29)$$

where the transfers from the firms are expressed in nominal terms using the GDP deflator $(GDPDEF)$.

Government expenditures *(GEXP)* comprise the public current consumption *(CGBUD)*, total transfers by the government *(TRANS)* and subsidies on products and on production *(SUBSID)*:

$$GEXP = CGBUD + TRANS + SUBSID \tag{30}$$

The optimal allocation of the public current consumption between different types of goods and services is given by the maximization of a Cobb-Douglas function:

$$U(CG_c) = \prod_c CG_c^{\alpha CG_c} \tag{31}$$

subject to the budget constraint:

$$CGBUD = \sum_c P_c \cdot CG_c \tag{32}$$

with: $\sum_c \alpha CG_c = 1$. The maximization $U(CG_c)$ of yields the demand equations for public current consumption by type of commodity:

$$P_c \cdot CG_c = \alpha CG_c \cdot CGBUD \tag{33}$$

where CG_c represents the public demand for commodity *c*, P_c is the price of commodity *c* and αCG_c gives the Cobb-Douglas preference parameter corresponding to commodity *c*.

Total transfers by the government include the transfers to the household *(TRHG)*, the transfers to the external sector *(TRWG)* and the domestic public co-financing for the EU funds *(COFIN)*:

$$TRANS = TRHG + TRWG \cdot ER + COFIN \tag{34}$$

Government net transfers to the household:

$$TRHG = PL \cdot trep \cdot UNEMP \cdot shUNEMPB + TRHGOTH \cdot PCINDEX \tag{35}$$

consist of the unemployment benefits, determined by the combination of the replacement rate *(trep)*, the national average wage *(PL)*, the number of unemployed *(UNEMP)* and the share of unemployed subject to unemployment benefits *(shUNEMPB)*, and the other transfers *(TRHGOTH)* such as pensions, translated into nominal terms by using the Laspeyres consumer price index *(PCINDEX)*.

The total subsidies on products and on production are further derived as:

$$SUBSID = \sum_c (tsc_c \cdot C_c \cdot P_c + tsi_c \cdot I_c \cdot P_c) + \sum_{c,s} tsic_c \cdot P_c \cdot io_{c,s} \cdot XD_s + \sum_s tsp_s \cdot XD_s \cdot PD_s \tag{36}$$

The difference between the government revenues and the government expenditures yields the government savings *(SG)*.

$$SG = GREV - GEXP \quad (37)$$

5.4 The Fund

In the model, an institution called 'The Fund' receives the EU structural and cohesion funds and the domestic public co-financing funds and allocates them according to the stated uses.

Structural funds, following the DG REGIO classification, are regrouped into three fields of intervention:

- Productive environment;
- Human resources;
- Infrastructure.

The effects of the EU funds are captured in the model in several ways:

- First, the structural and cohesion funds are distributed by the Fund to different branches of activity as investments, which add to the capital stock and lead to an increase in the productive capacity of the sector;
- Secondly, the investments by the Fund lead to an increase in the total factor productivity (TFP) or labour productivity depending on the field of intervention

Three types of investments are distinguished in the model:

- Investments to improve the productive environment $(INVSF_s)$, which are provided to the manufacturing and services sectors and originate from the structural funds.
- Investments in human resources $(INVSFH_s)$, which also originate from the structural funds and are destined to the services sector.
- Investments in infrastructure $(INVCF_s)$, which are meant for the services sector and rely on both structural and cohesion funds.

The EU funds are expressed in national currency by multiplying them with the exchange rate (ER). Furthermore, they are translated into real terms using the price index corresponding to investments (PI):

$$INVSFR_s = INVSF_s \cdot ER/PI \quad (38)$$

$$INVSFHR_s = INVSFH_s \cdot ER/PI \quad (39)$$

$$INVCFR_s = INVCF_s \cdot ER/PI \quad (40)$$

where $INVSFR_s$ stands for the investments to improve the productive environment in branch *s*, expressed in real terms and in the domestic currency, $INVSFHR_s$ represents the investments in human resources expressed in real terms and domestic currency and $INVCFR_s$ gives the investments in infrastructure in real terms and domestic currency.

The domestic public co-financing corresponding to each type of investment is derived by applying the co-financing rate $(tcof)$:

$$INVSFRCOF_s = tcof/(100\text{-}tcof) \cdot INVSF_s \cdot ER/PI \quad (41)$$

$$INVSFHRCOF_s = tcof/(100\text{-}tcof) \cdot INVSFH_s \cdot ER/PI \quad (42)$$

$$INVCFRCOF_s = tcof/(100\text{-}tcof) \cdot INVCF_s \cdot ER/PI \quad (43)$$

where $INVSFRCOF_s$ is the domestic public co-financing for the investments to improve the productive environment, $INVSFHRCOF_s$ represents the domestic public co-financing for the investments in human resources and $INVCFRCOF_s$ stands for the domestic public co-financing for the investments in infrastructure.

Total domestic public co-financing for the EU funds, expressed in nominal terms $(COFIN)$, is thus given by:

$$COFIN = PI \cdot \sum_s (INVSFRCOF_s + INVSFHRCOF_s + INVCFRCOF_s) \quad (44)$$

and adds to the government expenditures.

Total investments (including domestic public co-financing) to productive environment $(INVSFRTOT_s)$, total investments in human resources $(INVSFHRTOT_s)$ and total investments in infrastructure $(INVCFRTOT_s)$, expressed in real terms, can be expressed as:

$$INVSFRTOT_s = INVSFR_s + INVSFRCOF_s \quad (45)$$

$$INVSFHRTOT_s = INVSFHR_s + INVSFHRCOF_s \quad (46)$$

$$INVCFRTOT_s = INVCFR_s + INVCFRCOF_s \quad (47)$$

The Fund's total resources $(SFUND)$, in nominal terms, should be equal to the total investments by the Fund:

$$SFUND = PI \cdot \sum_s (INVSFRTOT_s + INVSFHRTOT_s + INVCFRTOT_s) \quad (48)$$

whereas the investments by the Fund excluding domestic public co-financing should be equal to the total transfers from the EU $(TREUF)$, expressed in domestic currency:

$$PI \cdot \sum_{s} (INVSFR_s + INVSFHR_s + INVCFR_s) = TREUF \cdot ER \tag{49}$$

In addition to increasing the productive capacity, the investments for improving the productive environment are assumed to increase the TFP in the manufacturing and services sectors:

$$TFPSF_{s,t+1} = TFPSF_{s,t} \cdot [(KSKBA_{s,t} + INVSFRTOT_{s,t})/KSKBA_{s,t}]^{elasTFPSF} \tag{50}$$

where $TFPSF_{s,t+1}$ represents the TFP improvement in branch *s* in year *t+1* thanks to investments in productive environment, $TFPSF_{s,t}$ stands for the TFP improvement in branch *s* in year *t*, $KSKBA_{s,t}$ provides the capital stock of sector *s* in year *t* in the non-cohesion policy baseline scenario and $elasTFPSF$ is the TFP elasticity of investments provided to the productive environment. The effects of the EU funds on the TFP arise with one year lag.

Investments in human resources are assumed to lead to an improvement in the labour productivity in all the activities. In order to derive the increase in the labour productivity, we first calculate the number of trainees that could be supported by the structural funds (Bradley, Morgenroth, Gács and Untiedt, 2004):

$$\sum_{ctm} INVSFHRTOT_{ctm,t} \cdot PI_t = OVERHD \cdot \sum_{ctm} INVSFHRTOT_{ctm,t} \cdot PI_t + TRAIN_t \cdot PLMA_t + (TRAIN_t / TRATIO) \cdot PLSV_t \tag{51}$$

by assuming that a part of the total funds for human resources in year *t* ($\sum_{ctm} INVSFHRTOT_{ctm,t} \cdot PI_t$), expressed in nominal terms, represent the current operation costs related to the buildings, materials, etc. ($OVERHD \cdot \sum_{ctm} INVSFHRTOT_{ctm,t} \cdot PI_t$), a part of the funds reflects payments to the trainees ($TRAIN_t \cdot PLMA_t$) and the rest are expenditures related to the compensation of instructors $[(TRAIN_t / TRATIO) \cdot PLSV_t]$. Current operation costs are derived as a share ($OVERHD$) of the total structural funds for human resources, where $OVERHD$, given the lack of detailed information, is assumed to be equal to the average share of other current expenditures in the total current expenditures in tertiary education (OECD, 2006). The payments to the trainees are calculated by assuming that each trainee receives a share of the average wage in the manufacturing sectors, services and construction ($PLMA_t$), where $TRAIN_t$ is the number of policy-funded trainees (expressed in trainee-years). Finally, the compensation of the instructors is derived by applying the average wage in the services sector ($PLSV_t$) to the number of instructors ($TRAIN_t / TRATIO$), where $TRATIO$ is the trainee-instructor ratio assumed to be equal to the student-teacher ratio in the tertiary education for each country under study (OECD, 2006).

Thus, the number of trainees (expressed in trainee-years) that could be supported through the structural funds is given by:

$$TRAIN_t = \sum_{ctm} INVSFHRTOT_{ctm,t} \cdot PI_t \cdot (1 - OVERHD)/[PLMA_t + PLSV_t/TRATIO] \tag{52}$$

while the stock of trainees (expressed in trainee-years) is provided by:

$$KSKTRAIN_{t+1} = (1 - dhc) \cdot KSKTRAIN_t + TRAIN_t \quad (53)$$

where $KSKTRAIN_{t+1}$ is the stock of trainee in year $t+1$, $KSKTRAIN_t$ represents the stock of trainees in year t and dhc is the depreciation rate equal to 5 per cent (Bradley, Morgenroth, Gács and Untiedt, 2004).

The labour productivity improvements due to the structural funds on human resources are derived as:

$$TFPSFH_{s,t+1} = TFPSFH_{s,t} \cdot [(KSKTRAIN_t + KSKHBA_t)/KSKHBA_t]^{elasTFPSFH} \quad (54)$$

where $TFPSFH_{s,t+1}$ represents the labour productivity improvement in branch s in year $t+1$, $TFPSFH_{s,t}$ provides the labour productivity improvement in branch s in year t, $KSKHBA_t$ is the stock of human capital in the non-cohesion policy baseline scenario in year t and $elasTFPSFH$ is the labour productivity elasticity of investments in human resources.

The spillover effects related to the investments in infrastructure are captured through a TFP increase in all the branches of activity:

$$TFPCF_{s,t+1} = TFPCF_{s,t} \cdot [(KSKPbBA_t + \sum_{ctm} INVCFRTOT_{ctm,t})/KSKPbBA_t]^{elasTFPCF} \quad (55)$$

where $TFPCF_{s,t+1}$ is the TFP increase in branch s in year $t+1$ due to investments in infrastructure, $TFPCF_{s,t}$ is the TFP increase in branch s in year t, $\sum_{ctm} INVCFRTOT_{ctm,t}$ stand for the total investments in infrastructure, $KSKPbBA_t$ gives the stock of infrastructure in the non-cohesion policy baseline scenario in year t and $elasTFPCF$ represents the TFP elasticity of investments in infrastructure.

Both improvements in the labour productivity due to the investments in human resources and TFP increases related to investments in infrastructure occur with a lag of one year after the investments take place.

5.5 Foreign trade

The specification of the foreign trade is based on the small-country assumption, which means that the country is a price taker in both its import and its export markets.

On the import side, imperfect substitution is assumed between domestically produced and imported goods, according to the Armington function (see Figure A4). Thus, domestic consumers use composite goods (X_c) of imported and domestically produced goods, according to a CES function:

$$X_c = aA_c \cdot (\gamma A1_c \cdot XDD_c^{-\rho A_c} + \gamma A2_c \cdot M_c^{-\rho A_c})^{-1/\rho A_c} \quad (56)$$

Minimizing the cost function:

$$Cost_c(XDD_c, M_c) = PDD_c \cdot XDD_c + PM_c \cdot M_c \quad (57)$$

subject to (56) provides the demand for imports (M_c) and demand for domestically produced goods (XDD_c):

$$M_c = X_c \cdot (P_c/PM_c)^{\sigma A_c} \cdot \gamma A2_c^{\sigma A_c} \cdot aA_c^{(\sigma A_c - 1)} \quad (58)$$

$$XDD_c = X_c \cdot (P_c/PDD_c)^{\sigma A_c} \cdot \gamma A1_c^{\sigma A_c} \cdot aA_c^{(\sigma A_c - 1)} \quad (59)$$

and the corresponding zero profit condition:

$$P_c \cdot X_c = PM_c \cdot M_c + PDD_c \cdot XDD_c \quad (60)$$

where P_c is the price index of the composite good *c* incorporating the imported and domestically produced goods supplied on the domestic market, PM_c represents the domestic price of imports (including tariffs) and PDD_c is the price of good *c* from the domestic producers. aA_c represents the efficiency parameter while $\gamma A1_c$ and $\gamma A2_c$ are the distribution parameters corresponding to domestic demand for the domestically produced goods and the demand for imports, respectively. The elasticity of substitution between imports and domestically produced goods (σA_c) is given by $1/(1+\rho A_c)$.

In a similar fashion, the differentiation between the exported goods by the domestic producers (E_c) and the domestic goods supplied on the domestic market (XDD_c) is captured through a constant elasticity of transformation (CET) function:

$$XDDE_c = aT_c \cdot (\gamma T1_c \cdot XDD_c^{-\rho T_c} + \gamma T2_c \cdot E_c^{-\rho T_c})^{-1/\rho T_c} \quad (61)$$

where $XDDE_c$ is the domestic production of commodity *c* by different branches, supplied on the home and foreign markets, aT_c is the efficiency parameter, $\gamma T1_c$ and $\gamma T2_c$ are the distribution parameters corresponding to XDD_c and E_c, respectively, and the elasticity of transformation (σT_c) between domestically produced goods supplied on the domestic market and the exports by the domestic producers is given by $1/(1+\rho T_c)$.

By maximizing the revenue:

$$Revenue_c(XDD_c, E_c) = PDD_c \cdot XDD_c + PE_c \cdot E_c \quad (62)$$

subject to (61) we derive the supply of exports by the domestic producers and the supply by the domestic producers to the domestic market:

$$E_c = XDDE_c \cdot (PDDE_c/PE_c)^{\sigma T_c} \cdot \gamma T2_c^{\sigma T_c} \cdot aT_c^{(\sigma T_c - 1)} \quad (63)$$

$$XDD_c = XDDE_c \cdot (PDDE_c/PDD_c)^{\sigma T_c} \cdot \gamma T1_c^{\sigma T_c} \cdot aT_c^{(\sigma T_c - 1)} \quad (64)$$

and the corresponding zero profit condition:

$$PDDE_c \cdot XDDE_c = PDD_c \cdot XDD_c + PE_c \cdot E_c \tag{65}$$

where $PDDE_c$ is the price index corresponding to $XDDE_c$, and PE_c represents the domestic price of exports received by the domestic producers.

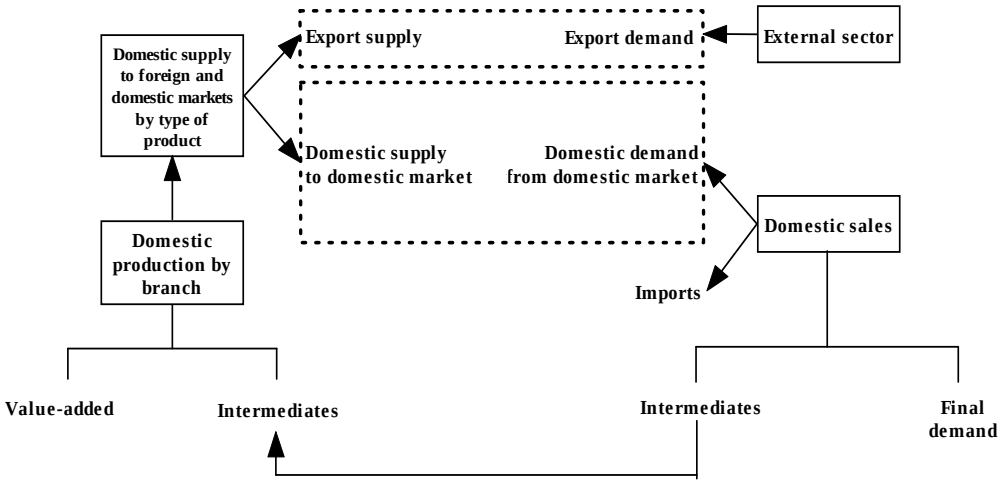

Figure A4. Foreign trade specification

In addition, an export demand function is introduced in the model (see Figure A4):

$$ED_c = EDI_c \cdot (PWE_c \cdot ER/PEFOB_c)^{elasE_c} \tag{66}$$

such that the export demand for domestically produced goods by the foreign sector (ED_c), depends on the benchmark level of the export demand by the foreign sector (EDI_c), the relative price change and the price elasticity of export demand $(elasE_c)$. PWE_c represents the world price of exports of commodity *c*, ER is the exchange rate, and $PEFOB_c$ gives the domestic price of exports of commodity *c* f.o.b. The market clearing equation for exports:

$$E_c = ED_c \tag{67}$$

determines the domestic price of exports f.o.b.

The balance of payments takes into account all the trade and capital flows:

$$\sum_c M_c \cdot PWM_c + TRWH + TRWF + TRWG = \sum_c (E_c \cdot PEFOB_c/ER) + TRHW + TRGW + PLLSW \cdot LSW + TREUF + SW \tag{68}$$

where PWM_c is the world price of imports of commodity *c*, $TRWH$ gives the household transfers to the foreign sector, $TRWF$ represents the firms transfers to the external sector and $TRWG$ stands for the government transfers to the foreign sector, $TRHW$ are the transfers received by the household from the external sector, $TRGW$ gives the transfers

received by the government from the foreign sector, $(PLLSW \cdot LSW)$ represents the net factor (labour) income from the foreign sector (payments for the employees in non-resident firms), $TREUF$ stands for the EU funds received by each country and SW reflects the surplus/deficit of the current account. The net labour income for the employees in non-resident firms is derived by taking into account: the number of employees in non-resident firms (LSW) and the average wage $PLLSW$ corresponding to employment in non-resident firms (net of social security contributions).

5.6 Investment demand

Total savings (S) used to buy investment goods are given by:

$$S = SH+SF+SG+SW \cdot ER+\sum_s DEP_s \cdot PI+SFUND \tag{69}$$

where SH represents the household savings, SF stands for firms savings, SG gives the government savings, SW is the current account balance expressed in domestic currency using the exchange rate (ER), $\sum_s DEP_s \cdot PI$ is the depreciation related to the private and public capital stock and $SFUND$ represents the total resources of the Fund used for investments.

The depreciation related to the private and public capital stock is valued at the price index of investments (PI) and is derived as:

$$DEP_s = d_s \cdot KSK_s \tag{70}$$

where d_s is the depreciation rate and KSK_s gives the capital stock of industry *s*.

Total investments in real terms (ITT) are given by:

$$PI \cdot ITT = (S - \sum_c SV_c \cdot P_c) \tag{71}$$

where SV_c stands for the inventories of commodity *c*.

The optimal allocation of total investments (ITT) between different types of investment commodities (I_c) is given by the Leontief function:

$$I_c = ioI_c \cdot ITT \tag{72}$$

where ioI_c is a parameter that provides the composition of total investments in terms of investment goods.

The composite price (unit cost) of investments (PI) is defined as the weighted average of the price of investment goods:

$$PI = \sum_{c}\{(1+ti_c)\cdot[(1-tsi_c)\cdot P_c+\sum_{ctm} tcitm_{ctm,c}\cdot P_{ctm}]\cdot ioI_c\} \tag{73}$$

where P_c stands for the price of (investment) commodity c, tsi_c is the subsidy rate on investment good c, ti_c is the tax rate on investment goods c and $tcitm_{ctm,c}$ is the trade and transport margin rate on investment good c.

5.7 Price equations

A common assumption for CGE models, which has also been adopted here, is that the economy is initially in equilibrium with the quantities normalized in such a way that prices of commodities equal unity. Due to the homogeneity of degree zero in prices, the model only determines the relative prices. Therefore, a particular price is selected to provide the numeraire against which all relative prices in the model will be measured. We choose the GDP deflator $(GDPDEF)$ as the numeraire.

Different prices are defined for all the branches, exports and imports. The domestic price of exports (PE_c) reflects the price received by the domestic producers for selling their production on the foreign market. The relationship between the domestic price of exports received by the domestic producers and the domestic price of exports free on board is provided by:

$$PE_c = PEFOB_c - \sum_{ctm} tcetm_{ctm,c}\cdot P_{ctm} \tag{74}$$

The cost of trade and transport services reduces the domestic price received by the producers, where $tcetm_{ctm,c}$ is the quantity of trade and transport services ctm per unit of commodity c exported, and P_{ctm} represents the price of the trade and transport services ctm.

As already explained, trade and transport margins are paid on all categories of demand in the EcoMod model except the government consumption (on intermediate consumption, on private consumption and on investment goods).

The domestic price of imports (PM_c) is determined by the world price of imports, the exchange rate and the tariff rate (tm_c), according to:

$$PM_c = PWM_c\cdot ER\cdot(1+tm_c) \tag{75}$$

The consumer price index $(PCINDEX)$ used in the model is defined as:

$$PCINDEX = \sum_{c}\{[(1-tsc_c)\cdot P_c+\sum_{ctm} tchtm_{ctm,c}\cdot P_{ctm}]\cdot(1+tc_c)\cdot CZ_c\}/ \sum_{c}\{[(1-tscz_c)\cdot PZ_c+\sum_{ctm} tchtmz_{ctm,c}\cdot PZ_{ctm}]\cdot(1+tcz_c)\cdot CZ_c\} \tag{76}$$

where tsc_c is the subsidy rate on commodity c and $tscz_c$ its benchmark level, P_c is the price index of commodity c net of taxes but including subsidies and PZ_c gives its benchmark level, $tchtm_{ctm,c}$ represents the trade and transport margin rate on private consumption and

$tchtmz_{ctm,c}$ is its benchmark level, and tc_c gives the tax rate on private consumption, while tcz_c is its benchmark level. Finally, CZ_c accounts for the benchmark level of private consumption of commodity *c*.

Consumer prices (PCT_c) are further defined as:

$$PCT_c = [(1-tsc_c)\cdot P_c + \sum_{ctm} tchtm_{ctm,c}\cdot P_{ctm}]\cdot(1+tc_c) \quad (77)$$

The average wage paid to the trainees $(PLMA)$, supported by the structural funds on human resources, is given by a share $(shPLMA)$ of the average wage in the manufacturing sectors, services and construction:

$$PLMA = shPLMA\cdot\{\sum_{sm}[(1+premLSK_{sm})\cdot PL\cdot LSK_{sm}]/\sum_{sm} LSK_{sm}\} \quad (78)$$

whereas the average wage in the services sector $(PLSV)$ is given by:

$$PLSV = [\sum_{ctm} PL\cdot(1+premLSK_{ctm})\cdot LSK_{ctm}]/\sum_{ctm} LSK_{ctm} \quad (79)$$

5.8 Labour market

The following identity defines the relation between the labour supply, the labour demand, and unemployment:

$$\sum_s LSK_s = LSR - UNEMP \quad (80)$$

where LSK_s stands for the number of employees in industry *s*, $UNEMP$ represents the number of unemployed and LSR reflects the active population.

The responsiveness of real wage to the labour market conditions is surprised by a wage curve (Blanchflower, 2001; Sanz-de-Galdeano & Turunen, 2006):

$$log(PL/PCINDEX) = elasU\cdot log(UNRATE) + err \quad (81)$$

where PL is the nominal wage corresponding to national employment (net of social security contributions), $PCINDEX$ is the consumer price index, $UNRATE$ provides the unemployment rate, err is the error term and $elasU$ is the unemployment elasticity.

The labour supply is provided by the following equation:

$$LSR = LSRI\cdot\{[PL\cdot(1-ty\cdot MUty)\cdot PCINDEXZ]/[PLZ\cdot(1-tyz)\cdot PCINDEX]\}^{elasLS} \quad (82)$$

where $LSRI$ is the benchmark level corresponding to the active population, ty is the personal income tax rate and tyz its benchmark level, and PLZ and $PCINDEXZ$ are the benchmark levels corresponding to the nominal wage and CPI, respectively. $elasLS$ further provides the elasticity of labour supply.

The national employment $(EMPN)$ is defined as:

$$EMPN = LSR - UNEMP \tag{83}$$

5.9 Market clearing equations

The equilibrium in the product, capital and labour markets requires that demand equals supply at prevailing prices (taking into account unemployment for the labour market). Labour market clearing equation has already been presented above. Capital stock is sector specific, such that the equality between capital demand and supply determines the return to capital by branch of activity.

Separate market clearing equations are distinguished in the model for each commodity *c*. For the trade and transport services *ctm*, the sum of demand for intermediate consumption of commodity *ctm* $(\sum_s io_{ctm,s} \cdot XD_s)$, the private demand for commodity *ctm* (C_{ctm}), the public demand for commodity *ctm* (CG_{ctm}), the demand for inventories (SV_{ctm}) and the demand for trade and transport services $(MARGTT_{ctm})$ which are invoiced separately (trade and transport margins) should be equal with the total supply of commodity *ctm* (X_{ctm}) from imports and domestic production:

$$C_{ctm} + CG_{ctm} + I_{ctm} + SV_{ctm} + \sum_s io_{ctm,s} \cdot XD_s + MARGTT_{ctm} = X_{ctm} \tag{84}$$

The demand for trade and transport services *ctm* $(MARGTT_{ctm})$ invoiced separately (Löfgren, Harris and Robinson, 2002), is further derived as the sum of demand for trade and transport services on private consumption $(\sum_c tchtm_{ctm,c} \cdot C_c)$, of demand for trade and transport services on investment goods $(\sum_c tcitm_{ctm,c} \cdot I_c)$, of demand for trade and transport services on exports $(\sum_c tcetm_{ctm,c} \cdot E_c)$, and of demand for trade and transport services on intermediate consumption $(\sum_{s,c} tcictm_{ctm,c} \cdot io_{c,s} \cdot XD_s)$:

$$MARGTT_{ctm} = \sum_c (tchtm_{ctm,c} \cdot C_c + tcitm_{ctm,c} \cdot I_c + tcetm_{ctm,c} \cdot E_c) + \sum_{s,c} tcictm_{ctm,c} \cdot io_{c,s} \cdot XD_s \tag{85}$$

The market clearing equations corresponding to all commodities *nctm*, except the trade and transport services are given by:

$$C_{nctm} + CG_{nctm} + I_{nctm} + SV_{nctm} + \sum_s io_{nctm,s} \cdot XD_s = X_{nctm} \tag{86}$$

The demand for inventories for each commodity *c* is defined as a fixed share of domestic sales:

$$SV_c = svr_c \cdot X_c \tag{87}$$

5.10 Other macroeconomic indicators

Gross domestic product is provided at both constant prices (GDP) and at current market prices $(GDPC)$:

$$GDP = \sum_c \{C_c \cdot [(1-tscz_c) \cdot PZ_c + \sum_{ctm} tchtmz_{ctm,c} \cdot PZ_{ctm}] \cdot (1+tcz_c)\} + \sum_c CG_c \cdot PZ_c + \sum_c \{I_c \cdot (1+tiz_c) \cdot [(1-tsiz_c) \cdot PZ_c + \sum_{ctm} tcitmz_{ctm,c} \cdot PZ_{ctm}]\} + \sum_c SV_c \cdot PZ_c + \sum_c E_c \cdot PEFOBZ_c - \sum_c M_c \cdot PWMZ_c \cdot ERZ \quad (88)$$

$$GDPC = \sum_c \{C_c \cdot [(1-tsc_c) \cdot P_c + \sum_{ctm} tchtm_{ctm,c} \cdot P_{ctm}] \cdot (1+tc_c)\} + \sum_c CG_c \cdot P_c + \sum_c \{I_c \cdot (1+ti_c) \cdot [(1-tsi_c) \cdot P_c + \sum_{ctm} tcitm_{ctm,c} \cdot P_{ctm}]\} + \sum_c SV_c \cdot P_c + \sum_c E_c \cdot PEFOB_c - \sum_c M_c \cdot PWM_c \cdot ER \quad (89)$$

where $PWMZ_c$, $PEFOBZ_c$ and ERZ represent the benchmark levels corresponding to the world price of imports, domestic price of exports f.o.b. and the exchange rate, respectively.

Derivation of some other macroeconomic indicators like the components of GDP at constant prices is provided in section 1.13 of this technical overview.

5.11 Incorporation of dynamics

EcoMod model has a recursive dynamic structure composed of a sequence of several temporary equilibria. The first equilibrium in the sequence is given by the benchmark year. In each time period, the model is solved for an equilibrium given the exogenous conditions assumed for that particular period. The equilibria are connected to each other through capital accumulation. Thus, the endogenous determination of investment behaviour is essential for the dynamic part of the model. Investment and capital accumulation in year *t* depend on expected rates of return for year *t+1*, which are determined by actual returns on capital in year *t*.

The normal rate of return to capital in branch *s* (ROR_s) is specified as an inverse logistic function (see Figure A5) of the proportionate growth in sector's *s* capital stock (Dixon and Rimmer, 2002):

$$ROR_{s,t} = RORH_s + (1/B_s) \cdot [ln(KSKg_{s,t} - KSKg\,min_s) - ln(KSKg\,max_s - KSKg_{s,t}) - ln(KSKtrend_s - KSKg\,min_s) + ln(KSKg\,max_s - KSKtrend_s)] \quad (90)$$

where $RORH_s$ is the historically normal rate of return in branch *s*, $KSKg_{s,t}$ is the capital growth rate in industry *s* in year *t*, $KSKg\,min_s$ and $KSKg\,max_s$ are the minimum and the maximum possible growth rates of capital stock in branch *s*, $KSKtrend_s$ is the industry's historically normal growth rate and B_s is a positive parameter. The minimum possible growth rate is set at the negative of the rate of depreciation in branch *s*. This condition implies that investments in each branch of activity have positive values, such that once

installed, capital cannot be shifted from one sector to another except for the gradual process of depreciation. The maximum possible growth rate of capital stock in industry *s* is set at $KSKtrend_s$ plus $\lim INV_s$ in order to avoid unrealistically large simulated growth rates (Dixon and Rimmer, 2002). In the current version $\lim INV_s$ is taken equal to 6 per cent for all the branches. For example, if the historically normal growth rate in an industry is 4 per cent, the upper limit in any year *t* would not exceed 10 per cent.

Parameter (B_s) reflects the sensitivity of capital growth in branch *s* to variations in its expected rate of return. It is derived by differentiating equation (90) with respect to $KSKg_{s,t}$:

$$B_s = SEA \cdot \left[\frac{KSKg\,max_s - KSKg\,min_s}{(KSKg\,max_s - KSKtrend_s) \cdot (KSKtrend_s - KSKg\,min_s)} \right] \tag{91}$$

where:

$$SEA = \left(\frac{\partial ROR_{s,t}}{\partial KSKg_{s,t}} \right)^{-1} \tag{92}$$

Evaluating (92) in the neighbourhood of $KSKg_{s,t} = KSKtrend_s$ provides:

$$SEA = \left(\frac{\partial ROR_{s,t}}{\partial KSKg_{s,t}} \middle| KSKg_{s,t} = KSKtrend_s \right)^{-1} \tag{93}$$

where SEA is the reciprocal of the slope of the RR' in Figure A5, which is considered to be the same for all industries due to the lack of detailed estimates by branch.

The present value $(PVK_{s,t})$ of investing a unit of capital in industry *s* in year *t* is defined as:

$$PVK_{s,t} = -PI_t + [PK_{s,t+1} + PI_{t+1} \cdot d_s + PI_{t+1} \cdot (1 - d_s)] / [1 + NINT_t] \tag{94}$$

where PI_t is the cost of buying a unit of capital (the price of composite investment good) in year *t*, $PK_{s,t} + PI_{t+1} \cdot d_s$ is the rental rate on industry's *s* capital stock, d_s is the depreciation rate in branch *s* and $NINT_t$ is the nominal interest rate in year *t* (Dixon and Rimmer, 2002). The purchase of one unit of capital in year *t* by industry *s* involves an immediate expenditure (PI_t), followed by two benefits in year *t+1* which are discounted by $(1 + NINT_t)$: the rental value of an extra unit of capital in year *t+1* $(PK_{s,t+1} + PI_{t+1} \cdot d_s)$, including the depreciation, and the value at which the depreciated unit of capital can be sold in year *t+1* $[PI_{t+1} \cdot (1 - d_s)]$.

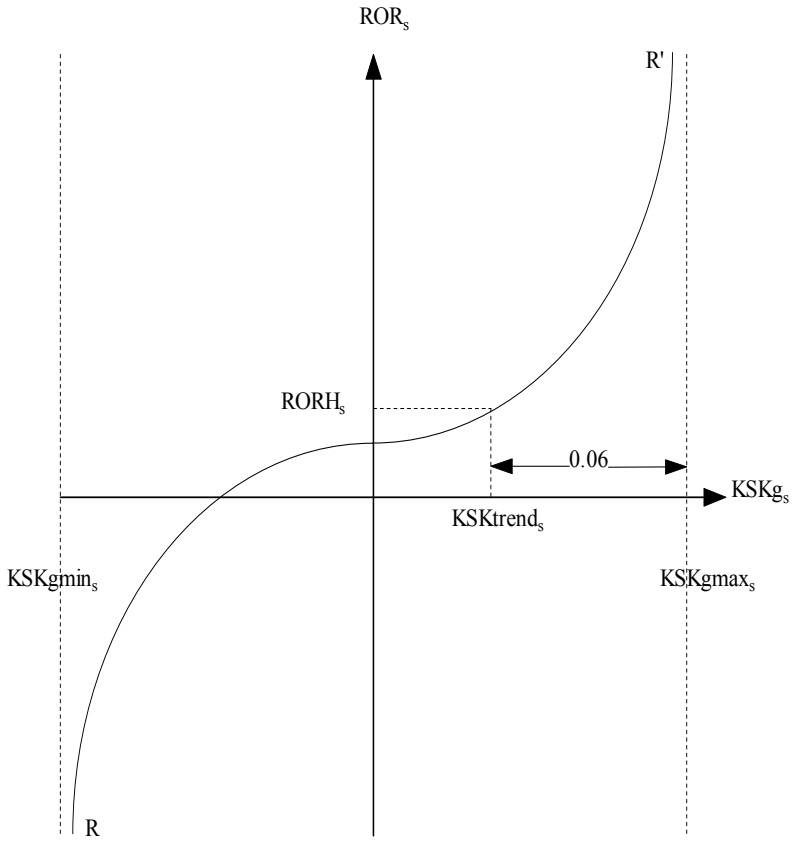

Figure A5. The expected rate of return for industry s

The expected rate of return on investment in industry *s* in year *t* is given by dividing both sides of (94) by PI_t:

$$ROR_{s,t} = -1 + [\,PK_{s,t+1} / PI_t + PI_{t+1} / PI_t\,] / [\,1 + NINT_t\,] \tag{95}$$

Under static expectations, investors are assumed to anticipate that the asset prices (the cost of buying a unit of capital) and the net rental rates will increase by the current rate of inflation $(RINF_t)$. Thus, the expected rate of return $(ROR_{s,t})$ under static expectations is given by:

$$ROR_{s,t} = -1 + [\,PK_{s,t} \cdot (1 + RINF_t) / PI_t + PI_t \cdot (1 + RINF_t) / PI_t\,] / [\,1 + NINT_t\,] \tag{96}$$

Simplifying further, we get:

$$ROR_{s,t} = -1 + [\,PK_{s,t} / PI_t + 1\,] / (1 + RINT_t) \tag{97}$$

where the real interest rate $(RINT_t)$ is defined as:

$$1 + RINT_t = (1 + NINT_t) / (1 + RINF_t) \tag{98}$$

The weighted average real return to capital has been taken as a proxy for the real interest rate in EcoMod model. The return to capital is expressed in real terms using the production price index:

$$RINT_t = \sum_s [(PK_{s,t} / PD_{s,t}) \cdot KSK_{s,t}] / \sum_s KSK_{s,t} \quad (99)$$

The capital stock in industry *s* in the next period (year *t+1*) is given by:

$$KSK_{s,t+1} = (1 - d_s) \cdot KSK_{s,t} + INV_{s,t} + INVSFRTOT_{s,t} + INVSFHRTOT_{s,t} + INVCFRTOT_{s,t} \quad (100)$$

where $KSK_{s,t}$ is the current capital stock (in year *t*), $INV_{s,t}$ stand for the investments by the branch *s* in year *t* (before the investments supported by the EU funds), $INVSFRTOT_s$ represents the investments to productive environment supported by the structural funds (including co-financing), $INVSFHRTOT_s$ represents the investments in human resources supported by structural funds (including co-financing) and $INVCFRTOT_s$ stands for the investments in infrastructure supported by structural and cohesion funds (including co-financing).

The capital growth rate in terms of capital stock in year *t+1* and the capital stock in year *t* is given by:

$$KSKg_{s,t} = KSK_{s,t+1} / KSK_{s,t} - 1 \quad (101)$$

whereas the actual growth rate of capital in industry *s* can be derived from equation. (90) as:

$$\begin{aligned} KSKg_{s,t} = & \left[\alpha ROR_{s,t} \cdot KSKg\,max_s \cdot (KSKtrend_s - KSKg\,min_s) + \right. \\ & KSKg\,min_s \cdot (KSKg\,max_s - KSKtrend_s) \left. \right] / \left[\alpha ROR_{s,t} \cdot (KSKtrend_s - \right. \\ & \left. KSKg\,min_s) + (KSKg\,max_s - KSKtrend_s) \right] \end{aligned} \quad (102)$$

The parameter $\alpha ROR_{s,t}$ is given by:

$$\alpha ROR_{s,t} = e^{\{[(ROR_{s,t} - RORH_s)(KSKgmax_s - KSKgmin_s)]/[(KSKgmax_s - KSKtrend_s)(KSKtrend_s - KSKgmin_s)]\}} \quad (103)$$

A first estimate of investments in the branch *s* in year *t* $(INVS_{s,t})$ excluding investments supported by the structural and cohesion funds is derived from equations (100)-(102) as:

$$\begin{aligned} INVS_{s,t} = & KSK_{s,t} \cdot [\alpha ROR_{s,t} \cdot KSKgmax_s \cdot (KSKtrend_s - KSKgmin_s) + KSKgmin_s \cdot \\ & (KSKgmax_s - KSKtrend_s)] / [\alpha ROR_{s,t} \cdot (KSKtrend_s - KSKgmin_s) + \\ & (KSKgmax_s - KSKtrend_s)] + d_s \cdot KSK_{s,t} \end{aligned} \quad (104)$$

while the actual level of investments in branch *s* in year *t*, excluding investments supported by the structural and cohesion funds, is provided by:

$$INV_{s,t} = INVS_{s,t} / \sum_{ss} INVS_{ss,t} \cdot (S_t - \sum_c SV_{c,t} \cdot P_{c,t} - SFUND_t) / PI_t \quad (105)$$

which also insures the consistency between total investments and savings.

The model is solved dynamically with annual steps. The simulation horizon of the model has been set at 20 years but it can easily be extended.

5.12 Closure rules

The closure rules refer to the manner in which demand and supply of commodities, the macroeconomic identities and the factor markets are equilibrated ex-post. Due to the complexity of the model, a combination of closure rules is needed. The particular set of closure rules should also be consistent, to the largest extent possible, with the institutional structure of the economy and with the purpose of the model.

In mathematical terms, the model should consist of an equal number of independent equations and endogenous variables. The closure rules reflect the choice of the model builder of which variables are exogenous and which variables are endogenous, so as to achieve ex-post equality.

Three macro balances are usually identified in CGE models that can be a potential source of ex-ante disequilibria and must be reconciled ex-post (Adelman and Robinson, 1989):

- The savings-investment balance;
- The government balance;
- The external balance.

The most widely used macro closure rule for CGE models is based on the investment and savings balance. In the model, the investment is assumed to adjust to the available domestic and foreign savings. This reflects an economy in which savings form a binding constraint. An alternative closure is possible where the investments determine the total level of savings. In this case the foreign savings adjusts to meet the total savings requirement.

Additional assumptions are needed with regard to government behaviour in the EcoMod model. First, the total current consumption by the government is fixed as a share of GDP, while the allocation between the consumption of different goods and services is provided by a Cobb-Douglas function. Secondly, the government net transfers to the foreign sector are assumed to be fixed in real terms, while the government net transfers to the household (except the unemployment benefits) are fixed as a share of GDP. Thus, the government savings are endogenously determined in the current version of EcoMod model. Alternative assumptions are possible, where total government expenditures can be fixed in real terms or as a share of GDP, while the total current consumption adjusts.

In the co-financing scenario an alternative closure is used for the government balance, where, besides the current consumption, the government savings are fixed as a share of GDP. The personal income tax rate adjusts to meet this constraint. In order to allow the comparability between the past profile of 6 countries scenario and the co-financing scenario, government savings to GDP ratio in the co-financing scenario has been fixed to its levels in the past profile of 6 countries scenario.

With respect to the external balance, the current account balance to GDP ratio is kept unchanged in the simulations, while the real exchange rate adjusts. In an alternative scenario, we let current account adjust.

The setup of the closure rules is important in determining the mechanisms governing the model. Therefore, the closure rules should be established also taking into account the policy scenario in question.

According to the Walras law if *(n-1)* markets are cleared the *n*th one is cleared as well. Therefore, in order to avoid over-determination of the model, the current account balance has been dropped (see equation (68), section 1.5 of this technical overview). However, the system of equations guarantees, through the Walras law, that the total imports plus transfers by different agents to the external sector equals total exports plus transfers received by different agents from the external sector plus the current account balance.

5.13 Model equations

5.13.1 Household

$$[(1-tsc_c)\cdot P_c+\sum_{ctm} tchtm_{ctm,c}\cdot P_{ctm}]\cdot(1+tc_c)\cdot C_c = [(1-tsc_c)\cdot P_c+\sum_{ctm} tchtm_{ctm,c}\cdot P_{ctm}]\cdot(1+tc_c)\cdot \mu H_c+\alpha H_c\cdot\{CBUD-\sum_{cc}[(1-tsc_{cc})\cdot P_{cc}+\sum_{ctm} tchtm_{ctm,cc}\cdot P_{ctm}]\cdot(1+tc_{cc})\cdot\mu H_{cc}\} \quad (A.1)$$

$$YH = shYKH\cdot\sum_s PK_s\cdot KSK_s+\sum_s PL\cdot LSK_s\cdot(1+premLSK_s)+PLLSW\cdot LSW\cdot ER+ TRHF\cdot GDPDEF+TRHG+TRHW\cdot ER-TRWH\cdot ER \quad (A.2)$$

$$CBUD = (1-ty\cdot MUty)\cdot YH - SH \quad (A.3)$$

$$SH = MPS\cdot(1-ty\cdot MUty)\cdot YH \quad (A.4)$$

$$MPS = MPSZ\cdot\{[(1-ty\cdot MUty)\cdot PKavr]/[(1-tyz)\cdot PKavrZ]\}^{elasS} \quad (A.5)$$

5.13.2 Firms

$$SF = shYKF\cdot\sum_s PK_s\cdot KSK_s - TRHF\cdot GDPDEF - TRGF\cdot GDPDEF - TRWF\cdot ER \quad (A.6)$$

$$KL_s = aKL_s\cdot XD_s \quad (A.7)$$

$$KSK_s = KL_s\cdot\{PKL_s/[PK_s\cdot(1+tk_s)+d_s\cdot PI]\}^{\sigma F_s}\cdot\gamma FK_s^{\sigma F_s}\cdot(aF_s\cdot TFPSF_s\cdot TFPCF_s)^{(\sigma F_s-1)} \quad (A.8)$$

$$LSK_s = KL_s\cdot\{PKL_s/[PL\cdot(1+premLSK_s)\cdot(1+tl_s)]\}^{\sigma F_s}\cdot\gamma FL_s^{\sigma F_s}\cdot TFPSFH_s^{(\sigma F_s-1)}\cdot (aF_s\cdot TFPSF_s\cdot TFPCF_s)^{(\sigma F_s-1)} \quad (A.9)$$

$$PKL_s \cdot KL_s = PK_s \cdot (1+tk_s) \cdot KSK_s + PL \cdot (1+premLSK_s) \cdot (1+tl_s) \cdot LSK_s + DEP_s \cdot PI \quad \text{(A.10)}$$

$$PD_s \cdot (1-tp_s+tsp_s) \cdot XD_s = \sum_c \{io_{c,s} \cdot XD_s \cdot [(1-tsic_c) \cdot P_c + \sum_{ctm} tcictm_{ctm,c} \cdot P_{ctm}] \cdot (1+tic_c)\} + PKL_s \cdot KL_s \quad \text{(A.11)}$$

5.13.3 Government

$$GREV = TRPROP+TRPROD+TRSOC+TRANSR \quad \text{(A.12)}$$

$$TRPROP = ty \cdot MUty \cdot YH + \sum_s tk_s \cdot KSK_s \cdot PK_s \quad \text{(A.13)}$$

$$TRPROD = \sum_s tp_s \cdot XD_s \cdot PD_s + \sum_c [(1-tsc_c) \cdot P_c + \sum_{ctm} tchtm_{ctm,c} \cdot P_{ctm}] \cdot tc_c \cdot C_c + \sum_c [(1-tsi_c) \cdot P_c + \sum_{ctm} tcitm_{ctm,c} \cdot P_{ctm}] \cdot ti_c \cdot I_c + \sum_{c,s} [(1-tsic_c) \cdot P_c + \sum_{ctm} tcictm_{ctm,c} \cdot P_{ctm}] \cdot tic_c \cdot io_{c,s} \cdot XD_s + \sum_c tm_c \cdot PWM_c \cdot M_c \cdot ER \quad \text{(A.14)}$$

$$TRSOC = \sum_s tl_s \cdot LSK_s \cdot PL \cdot (1+premLSK_s) \quad \text{(A.15)}$$

$$TRANSR = TRGW \cdot ER + TRGF \cdot GDPDEF \quad \text{(A.16)}$$

$$GEXP = CGBUD+TRANS+SUBSID \quad \text{(A.17)}$$

$$P_c \cdot CG_c = \alpha CG_c \cdot CGBUD \quad \text{(A.18)}$$

$$TRANS = TRHG+TRWG \cdot ER+COFIN \quad \text{(A.19)}$$

$$TRHG = PL \cdot trep \cdot UNEMP \cdot shUNEMPB + TRHGOTH \cdot PCINDEX \quad \text{(A.20)}$$

$$SUBSID = \sum_c (tsc_c \cdot C_c \cdot P_c + tsi_c \cdot I_c \cdot P_c) + \sum_{c,s} tsic_c \cdot P_c \cdot io_{c,s} \cdot XD_s + \sum_s tsp_s \cdot XD_s \cdot PD_s \quad \text{(A.21)}$$

$$SG = GREV - GEXP \quad \text{(A.22)}$$

$$rTRPROPGDP = TRPROP/GDPC \cdot 100 \quad \text{(A.23)}$$

$$rTRPRODGDP = TRPROD/GDPC \cdot 100 \quad \text{(A.24)}$$

$$rTRSOCGDP = TRSOC/GDPC \cdot 100 \quad \text{(A.25)}$$

$$rTRANSRGDP = TRANSR/GDPC \cdot 100 \quad \text{(A.26)}$$

$$rCGBUDGDP = CGBUD/GDPC \cdot 100 \quad \text{(A.27)}$$

$$rTRANSGDP = TRANS/GDPC \cdot 100 \quad \text{(A.28)}$$

$$rTRHGOTHGDP = (TRHGOTH \cdot PCINDEX)/GDPC \cdot 100 \quad \text{(A.29)}$$

$$rSUBSIDGDP = SUBSID/GDPC \cdot 100 \quad \text{(A.30)}$$

$$rSGGDP = SG/GDPC \cdot 100 \quad \text{(A.31)}$$

5.13.4 Domestic supply to domestic and foreign markets

$$XDDE_c = \sum_s ioC_{s,c} \cdot XD_s \quad \text{(A.32)}$$

$$PD_s = \sum_c ioC_{s,c} \cdot PDDE_c \quad \text{(A.33)}$$

5.13.5 Foreign sector

$$E_c = XDDE_c \cdot (PDDE_c/PE_c)^{\sigma T_c} \cdot \gamma T2_c^{\sigma T_c} \cdot aT_c^{(\sigma T_c - 1)} \quad \text{(A.34)}$$

$$ED_c = EDI_c \cdot (PWE_c \cdot ER/PEFOB_c)^{elasE_c} \quad \text{(A.35)}$$

$$XDD_c = XDDE_c \cdot (PDDE_c/PDD_c)^{\sigma T_c} \cdot \gamma T1_c^{\sigma T_c} \cdot aT_c^{(\sigma T_c - 1)} \quad \text{(A.36)}$$

$$PDDE_c \cdot XDDE_c = PDD_c \cdot XDD_c + PE_c \cdot E_c \quad \text{(A.37)}$$

$$M_c = X_c \cdot (P_c/PM_c)^{\sigma A_c} \cdot \gamma A2_c^{\sigma A_c} \cdot aA_c^{(\sigma A_c - 1)} \quad \text{(A.38)}$$

$$XDD_c = X_c \cdot (P_c/PDD_c)^{\sigma A_c} \cdot \gamma A1_c^{\sigma A_c} \cdot aA_c^{(\sigma A_c - 1)} \quad \text{(A.39)}$$

$$P_c \cdot X_c = PM_c \cdot M_c + PDD_c \cdot XDD_c \quad \text{(A.40)}$$

$$\sum_c M_c \cdot PWM_c + TRWH + TRWF + TRWG = \sum_c (E_c \cdot PEFOB_c/ER) + TRHW + TRGW + PLLSW \cdot LSW + TREUF + SW \quad \text{(A.41)}$$

$$rSWGDP = (SW \cdot ER)/GDPC \cdot 100 \quad \text{(A.42)}$$

5.13.6 The Fund

$$INVSFR_s = INVSF_s \cdot ER/PI \quad \text{(A.43)}$$

$$INVSFHR_s = INVSFH_s \cdot ER/PI \quad \text{(A.44)}$$

$$INVCFR_s = INVCF_s \cdot ER/PI \quad \text{(A.45)}$$

$$INVSFRCOF_s = tcof/(100\text{-}tcof) \cdot INVSF_s \cdot ER/PI \quad \text{(A.46)}$$

$$INVSFHRCOF_s = tcof/(100\text{-}tcof) \cdot INVSFH_s \cdot ER/PI \quad \text{(A.47)}$$

$$INVCFRCOF_s = tcof/(100\text{-}tcof) \cdot INVCF_s \cdot ER/PI \quad \text{(A.48)}$$

$$INVSFRTOT_s = INVSFR_s + INVSFRCOF_s \quad \text{(A.49)}$$

$$INVSFHRTOT_s = INVSFHR_s + INVSFHRCOF_s \quad \text{(A.50)}$$

$$INVCFRTOT_s = INVCFR_s + INVCFRCOF_s \quad \text{(A.51)}$$

$$COFIN = PI \cdot \sum_s (INVSFRCOF_s + INVSFHRCOF_s + INVCFRCOF_s) \quad \text{(A.52)}$$

$$SFUND = PI \cdot \sum_s (INVSFRTOT_s + INVSFHRTOT_s + INVCFRTOT_s) \quad \text{(A.53)}$$

$$PI \cdot \sum_s (INVSFR_s + INVSFHR_s + INVCFR_s) = TREUF \cdot ER \quad \text{(A.54)}$$

$$rTREUFGDP = TREUF \cdot ER/GDPC \cdot 100 \quad \text{(A.55)}$$

$$TRAIN = \sum_{ctm} INVSFHRTOT_{ctm} \cdot PI \cdot (1 - OVERHD)/[PLMA + PLSV/TRATIO] \quad \text{(A.56)}$$

5.13.7 Investment

$$S = SH + SF + SG + SW \cdot ER + \sum_s DEP_s \cdot PI + SFUND \quad \text{(A.57)}$$

$$I_c = ioI_c \cdot ITT \quad \text{(A.58)}$$

$$PI = \sum_c \{(1+ti_c) \cdot [(1 - tsi_c) \cdot P_c + \sum_{ctm} tcitm_{ctm,c} \cdot P_{ctm}] \cdot ioI_c \} \quad \text{(A.59)}$$

$$PI \cdot ITT = (S - \sum_c SV_c \cdot P_c) \quad \text{(A.60)}$$

$$SV_c = svr_c \cdot X_c \quad \text{(A.61)}$$

$$DEP_s = d_s \cdot KSK_s \quad \text{(A.62)}$$

5.13.8 Labour market

$$LSR = LSRI \cdot \{ [PL \cdot (1 - ty \cdot MUty) \cdot PCINDEXZ]/[PLZ \cdot (1 - tyz) \cdot PCINDEX] \}^{elasLS} \quad \text{(A.63)}$$

$$log(PL/PCINDEX) = elasU \cdot log(UNRATE) + err \quad \text{(A.64)}$$

$$EMPN = LSR - UNEMP \quad \text{(A.65)}$$

$$UNRATE = UNEMP/LSR \tag{A.66}$$

5.13.9 Trade and transport margins

$$MARGTT_{ctm} = \sum_{c}(tchtm_{ctm,c} \cdot C_c + tcitm_{ctm,c} \cdot I_c + tcetm_{ctm,c} \cdot E_c) + \sum_{s,c} tcictm_{ctm,c} \cdot io_{c,s} \cdot XD_s \tag{A.67}$$

5.13.10 Market clearing

$$\sum_{s} LSK_s = LSR - UNEMP \tag{A.68}$$

$$C_{nctm} + CG_{nctm} + I_{nctm} + SV_{nctm} + \sum_{s} io_{nctm,s} \cdot XD_s = X_{nctm} \tag{A.69}$$

$$C_{ctm} + CG_{ctm} + I_{ctm} + SV_{ctm} + \sum_{s} io_{ctm,s} \cdot XD_s + MARGTT_{ctm} = X_{ctm} \tag{A.70}$$

$$E_c = ED_c \tag{A.71}$$

5.13.11 Price definitions

$$PCINDEX = \sum_{c}\{[(1\text{-}tsc_c) \cdot P_c + \sum_{ctm} tchtm_{ctm,c} \cdot P_{ctm}] \cdot (1+tc_c) \cdot CZ_c\} / \{[(1\text{-}tscz_c) \cdot PZ_c + \sum_{ctm} tchtmz_{ctm,c} \cdot PZ_{ctm}] \cdot (1+tcz_c) \cdot CZ_c\} \tag{A.72}$$

$$PE_c = PEFOB_c - \sum_{ctm} tcetm_{ctm,c} \cdot P_{ctm} \tag{A.73}$$

$$PM_c = PWM_c \cdot ER \cdot (1+tm_c) \tag{A.74}$$

$$RINT = \sum_{s}[(PK_s/PD_s) \cdot KSK_s] / \sum_{s} KSK_s \tag{A.75}$$

$$PKavr = \sum_{s}[(PK_s/PCINDEX) \cdot KSK_s] / \sum_{s} KSK_s \tag{A.76}$$

$$PCT_c = [(1\text{-}tsc_c) \cdot P_c + \sum_{ctm} tchtm_{ctm,c} \cdot P_{ctm}] \cdot (1+tc_c) \tag{A.77}$$

$$PLAVRT \cdot (LSR - UNEMP) = \sum_{s}[PL \cdot (1+tl_s) \cdot (1+premLSK_s) \cdot LSK_s] \tag{A.78}$$

$$PLMA = shPLMA \cdot \{\sum_{sm}[(1+premLSK_{sm}) \cdot PL \cdot LSK_{sm}] / \sum_{sm} LSK_{sm}\} \tag{A.79}$$

$$PLSV = [\sum_{ctm} PL \cdot (1+premLSK_{ctm}) \cdot LSK_{ctm}] / \sum_{ctm} LSK_{ctm} \tag{A.80}$$

5.13.12 Gross domestic product at current and constant market prices

$$GDPC = \sum_c \{C_c \cdot [(1-tsc_c)\cdot P_c + \sum_{ctm} tchtm_{ctm,c} \cdot P_{ctm}] \cdot (1+tc_c)\} + \sum_c CG_c \cdot P_c + \sum_c \{I_c \cdot (1+ti_c)\cdot [(1-tsi_c)\cdot P_c + \sum_{ctm} tcitm_{ctm,c} \cdot P_{ctm}]\} + \sum_c SV_c \cdot P_c + \sum_c E_c \cdot PEFOB_c - \sum_c M_c \cdot PWM_c \cdot ER \quad (A.81)$$

$$GDP = \sum_c \{C_c \cdot [(1-tscz_c)\cdot PZ_c + \sum_{ctm} tchtmz_{ctm,c} \cdot PZ_{ctm}] \cdot (1+tcz_c)\} + \sum_c CG_c \cdot PZ_c + \sum_c \{I_c \cdot (1+tiz_c)\cdot [(1-tsiz_c)\cdot PZ_c + \sum_{ctm} tcitmz_{ctm,c} \cdot PZ_{ctm}]\} + \sum_c SV_c \cdot PZ_c + \sum_c E_c \cdot PEFOBZ_c - \sum_c M_c \cdot PWMZ_c \cdot ERZ \quad (A.82)$$

$$GDPDEF = GDPC/GDP \quad (A.83)$$

5.13.13 Components of GDP at constant prices

$$CT = \sum_c \{C_c \cdot [(1-tscz_c)\cdot PZ_c + \sum_{ctm} tchtmz_{ctm,c} \cdot PZ_{ctm}] \cdot (1+tcz_c)\} \quad (A.84)$$

$$CGT = \sum_c CG_c \cdot PZ_c \quad (A.85)$$

$$IT = \sum_c \{I_c \cdot (1+tiz_c)\cdot [(1-tsiz_c)\cdot PZ_c + \sum_{ctm} tcitmz_{ctm,c} \cdot PZ_{ctm}]\} + \sum_c SV_c \cdot PZ_c \quad (A.86)$$

$$ET = \sum_c E_c \cdot PEFOBZ_c \quad (A.87)$$

$$MT = \sum_c M_c \cdot PWMZ_c \cdot ERZ \quad (A.88)$$

5.13.14 Equivalent variation in income

$$VU = \{CBUD - \sum_c [(1-tsc_c)\cdot P_c + \sum_{ctm} tchtm_{ctm,c} \cdot P_{ctm}] \cdot (1+tc_c)\cdot \mu H_c\} \cdot \prod_c \{\alpha H_c / \{[(1\text{-}tsc_c)\cdot P_c + \sum_{ctm} tchtm_{ctm,c} \cdot P_{ctm}] \cdot (1+tc_c)\}\}^{\alpha H_c} \quad (A.89)$$

$$EV = (VU - VUI)\cdot \prod_c \{\{[(1-tscz_c)\cdot PZ_c + \sum_{ctm} tchtmz_{ctm,c} \cdot PZ_{ctm}] \cdot (1+tcz_c)\}/\alpha H_c\}^{\alpha H_c} \quad (A.90)$$

5.13.15 Capital accumulation

$$ROR_{s,t} = -1 + (PK_{s,t}/PI_t + 1)/(1+RINT_t) \quad (A.91)$$

$$\alpha ROR_{s,t} = e^{\{[(ROR_{s,t} - RORH_s)\cdot(KSKgmax_s - KSKgmin_s)]/[(KSKgmax_s - KSKtrend_s)\cdot(KSKtrend_s - KSKgmin_s)]\}} \quad (A.92)$$

$$INVS_{s,t} = KSK_{s,t} \cdot [\alpha ROR_{s,t} \cdot KSKgmax_s \cdot (KSKtrend_s - KSKgmin_s) + KSKgmin_s \cdot (KSKgmax_s - KSKtrend_s)]/[\alpha ROR_{s,t} \cdot (KSKtrend_s - KSKgmin_s) + (KSKgmax_s - KSKtrend_s)] + d_s \cdot KSK_{s,t} \quad (A.93)$$

$$INV_{s,t} = INVS_{s,t} / \sum_{ss} INVS_{ss,t} \cdot (S_t - \sum_c SV_{c,t} \cdot P_{c,t} - SFUND_t)/PI_t \quad (A.94)$$

$$KSK_{s,t+1} = (1 - d_s) \cdot KSK_{s,t} + INV_{s,t} + INVSFRTOT_{s,t} + INVSFHRTOT_{s,t} + INVCFRTOT_{s,t} \quad (A.95)$$

$$KSKTRAIN_{t+1} = (1 - dhc) \cdot KSKTRAIN_t + TRAIN_t \quad (A.96)$$

$$TFPSFH_{s,t+1} = TFPSFH_{s,t} \cdot [(KSKTRAIN_t + KSKHBA_t)/KSKHBA_t]^{elasTFPSFH} \quad (A.97)$$

$$TFPSF_{s,t+1} = TFPSF_{s,t} \cdot [(KSKBA_{s,t} + INVSFRTOT_{s,t})/KSKBA_{s,t}]^{elasTFPSF} \quad (A.98)$$

$$TFPCF_{s,t+1} = TFPCF_{s,t} \cdot [(KSKPbBA_t + \sum_{ctm} INVCFRTOT_{ctm,t})/KSKPbBA_t]^{elasTFPCF} \quad (A.99)$$

5.14 Endogenous variables

$\alpha ROR_{s,t}$	parameter in the supply of capital function
CBUD	household budget disposable for consumption
C_c	consumer demand for commodity *c*
CGBUD	government current expenditures
CG_c	public current consumption of commodity *c*
CGT	total public consumption at constant prices
COFIN	total domestic public co-financing for structural and cohesion funds
CT	total private consumption at constant prices
DEP_s	depreciation related to public and private capital stock
E_c	export supply of commodity *c* by the domestic producers
ED_c	export demand of commodity *c* from the external sector
EMPN	national employment
ER	exchange rate
ET	total exports at constant prices
EV	equivalent variation in income
GDP	gross domestic product at constant prices
GDPC	gross domestic product at current market prices
GEXP	total government expenditures
GREV	total government revenues
I_c	demand for investment good *c*
INV_s	investments carried out in branch *s* excluding investments supported by the structural and cohesion funds (actual level)
$INVS_s$	investments carried out in branch *s* excluding investments supported by the structural and cohesion funds (first estimate)
$INVCFR_s$	investments in infrastructure carried out in branch *s*, supported by the structural and cohesion funds, excluding domestic public co-financing (expressed in real terms, in domestic currency)

$INVCFRCOF_s$	domestic public co-financing for investments in infrastructure carried out in branch *s*, supported by the structural and cohesion funds (expressed in real terms, in domestic currency)
$INVCFRTOT_s$	total investments in infrastructure carried out in branch *s*, supported by the structural and cohesion funds, including domestic public co-financing (expressed in real terms, in domestic currency)
$INVSFR_s$	investments to productive environment carried out in branch *s*, supported by the structural funds, excluding domestic public co-financing (expressed in real terms, in domestic currency)
$INVSFRCOF_s$	domestic public co-financing for investments to productive environment carried out in branch *s*, supported by the structural funds (expressed in real terms, in domestic currency)
$INVSFRTOT_s$	total investments to productive environment carried out in branch *s*, supported by the structural funds, including domestic public co-financing (expressed in real terms, in domestic currency)
$INVSFHR_s$	investments in human resources carried out in branch *s*, supported by the structural funds, excluding domestic public co-financing (expressed in real terms, in domestic currency)
$INVSFHRCOF_s$	domestic public co-financing for investments in human resources carried out in branch *s*, supported by the structural funds (expressed in real terms, in domestic currency)
$INVSFHRTOT_s$	total investments in human resources carried out in branch *s*, supported by the structural funds, including domestic public co-financing (expressed in real terms, in domestic currency)
IT	total gross capital formation at constant prices (including inventories)
ITT	total investments in real terms
KL_s	value-added by branch
$KSKTRAIN_t$	stock of trainees funded by structural funds on human resources
$KSKBA_{s,t}$	capital stock of branch *s* and year *t* in the non-cohesion policy baseline scenario
$KSKHBA_t$	human capital in the non-cohesion policy baseline scenario
$KSKPbBA_t$	stock of infrastructure in the non-cohesion policy baseline scenario
LSK_s	number of employees in branch *s*
LSR	active population
$MARGTT_c$	trade and transport margins
M_c	imports of commodity *c*
MPS	household propensity to save
MT	total imports at constant prices
MUty	change in the personal income tax rate (co-financing scenario)
P_c	price level of domestic sales (composite commodities coming from imports and domestic production)
PCINDEX	consumer price index
PCT_c	consumer prices (including taxes)
PD_s	price index of domestic production by branch of activity
PDD_c	price index of domestic production delivered to home market by type of good *c*

$PDDE_c$	price index of domestic production delivered to home and foreign markets by type of good *c*
PE_c	domestic price of exports received by the domestic producers
$PEFOB_c$	domestic price of exports free on board
PI	price index corresponding to composite investment good
PKavr	real average return to capital received by the household
PKL_s	price index corresponding to value-added by branch of activity
PK_s	return to capital by branch of activity
PL	national average wage (excluding social security contributions)
PLAVRT	national average wage (including social security contributions)
PLMA	average wage in the manufacturing sectors, services and construction (net of social security contributions)
PLSV	average wage in the services sector (net of social security contributions)
PM_c	domestic price of imports (including tariffs)
RINT	average return to capital corresponding to firms
$ROR_{s,t}$	normal rate of return to capital
rSGGDP	government savings to the GDP ratio
rSUBSIDGDP	total subsidies by the government to the GDP ratio
rTRANSGDP	total transfers by the government to the GDP ratio
rTRANSRGDP	total transfers received by the government to the GDP ratio
rTREUFGDP	total EU funds, expressed in domestic currency, to the GDP ratio
rTRPRODGDP	government revenues from taxes on products and on production to the GDP ratio
rTRPROPGDP	government revenues from taxes on income and wealth to the GDP ratio
rTRSOCGDP	government revenues from social security contributions to the GDP ratio
S	total savings
SF	firms' savings
SFUND	total resources available for investments by the Fund (Fund savings)
SG	government savings
SH	household savings
SUBSID	total subsidies by the government
SV_c	inventories
SW	balance of the current account
$TFPCF_{s,t}$	TFP improvements due to investments in infrastructure, supported by structural and cohesion funds
$TFPSF_{s,t}$	TFP improvements due to investments to productive environment supported by the structural funds
$TFPSFH_{s,t}$	labour productivity improvements due to investments in human resources supported by the structural funds
TRAIN	trainees that can be funded by structural funds on human resources (expressed in number of trainee-years)
TRANS	total transfers by the government
TRANSR	total transfers received by the government
TREUF	total EU funds expressed in euros
TRHG	total transfers by the government to the household

TRHGOTH	transfers by the government to the household (excluding unemployment benefits)
TRPROD	government revenues from taxes on products and on production
TRPROP	government revenues from taxes on income and wealth
TRSOC	government revenues from social security contributions
UNEMP	number of unemployed
UNRATE	unemployment rate
VU	level of indirect utility corresponding to the household
X_c	domestic sales of composite commodities coming from imports and domestic production
XD_s	domestic production by branch of activity
XDD_c	domestic production delivered to home market
$XDDE_c$	domestic production delivered to home and foreign markets (by type of commodity)
YH	household income

5.15 Exogenous variables

CZ_c	consumer demand for commodity *c* (benchmark value)
EDI_c	export demand from the external sector (benchmark value)
ERZ	exchange rate (benchmark value)
GDPDEF	GDP deflator
$INVCF_s$	investments in infrastructure carried out in branch *s,* supported by the structural and cohesion funds, excluding domestic public co-financing (expressed in nominal terms, in euros)
$INVSF_s$	investments to productive environment carried out in branch *s,* supported by the structural funds, excluding domestic public co-financing (expressed in nominal terms, in euros)
$INVSFH_s$	investments in human resources carried out in branch *s,* supported by the structural funds, excluding domestic public co-financing (expressed in nominal terms, in euros)
KSK_s	capital demand by branch (capital stock)
LSRI	active population (benchmark value)
LSW	number of employed in non-resident firms
MPSZ	household propensity to save (benchmark value)
PCINDEXZ	consumer price index (benchmark value)
$PEFOBZ_c$	domestic price of exports free on board (benchmark value)
PLLSW	average wage in the non-resident firms (excluding social security contributions)
PLZ	national average wage (excluding social security contributions) – benchmark value
PKavrZ	real average return to capital received by the household (benchmark value)
PWE_c	world price of exports
PWM_c	world price of imports
$PWMZ_c$	world price of imports (benchmark value)
PZ_c	price level of domestic sales (composite commodities coming from imports and domestic production) – benchmark value
$RORH_s$	historically normal rate of return to capital

rCGBUDGDP	government current expenditures to the GDP ratio
rTRHGOTHGDP	transfers by the government to the household (excluding unemployment benefits)
rSWGDP	current account balance to GDP ratio
TRGF	transfers received by the government from the firms
TRGW	transfers received by the government from the external sector
TRHF	transfers received by the household from the firms
TRHW	transfers received by the household from the external sector
TRWF	transfers by the firms to the external sector
TRWG	transfers by the government to the external sector
TRWH	transfers by the household to the external sector
VUI	level of indirect utility corresponding to the household (benchmark level)

5.16 Other parameters

aA_c	efficiency parameter in the Armington function for imports
aF_s	efficiency parameter in the CES production function of the firm
aKL_s	Leontief parameter - share of value added in domestic production
aT_c	efficiency parameter in the CET function for exports
dhc	depreciation rate corresponding to the stock of trainees funded by the structural funds on human resources
d_s	depreciation rate by branch of activity
$elasE_c$	price elasticity of export demand
elasS	elasticity of private savings with respect to after-tax rate of return
elasLS	elasticity of labour supply
elasU	unemployment elasticity
elasTFPSFH	labour productivity elasticity of investments in human resources (structural funds)
elasTFPCF	TFP elasticity of investments in infrastructure (structural and cohesion funds)
elasTFPSF	TFP elasticity of investments provided to productive environment (structural funds)
err	error term in the wage curve equation
$io_{c,s}$	technical coefficients corresponding to intermediate consumption
$ioC_{s,c}$	shares of domestic production delivered to home and foreign markets by branch of activity and commodity
ioI_c	Leontief parameter for the investment demand by type of investment good
$KSKgmax_s$	maximum possible growth rate of capital stock in branch *s*
$KSKgmin_s$	minimum possible growth rate of capital stock in branch *s* (equal to the negative of the rate of depreciation in branch *s*)
$KSKtrend_s$	industry's historically normal growth rate
OVERHD	share of current operation costs in total expenditures on human resources supported by the structural funds
$premLSK_s$	wage premium by branch
shUNEMPB	share of unemployed subject to unemployment benefits
shPLMA	share of average wage in the manufacturing sectors, services and construction paid to the trainees funded through structural funds

shYKH	share of the net operating surplus received by the household
shYKF	share of the net operating surplus retained by the firms
svr_c	share of inventories in domestic sales
tc_c	tax rate on private consumption of commodity *c*
$tcetm_{ctm,c}$	quantity of commodity *ctm* as trade and transport services per unit of exports
$tchtm_{ctm,c}$	quantity of commodity *ctm* as trade and transport services per unit of private consumption
$tchtmz_{ctm,c}$	quantity of commodity *ctm* as trade and transport services per unit of private consumption (benchmark value)
$tcictm_{ctm,c}$	quantity of commodity *ctm* as trade and transport services per unit of intermediate consumption
$tcitm_{ctm,c}$	quantity of commodity *ctm* as trade and transport services per unit of investment goods
$tcitmz_{ctm,c}$	quantity of commodity *ctm* as trade and transport services per unit of investment goods (benchmark value)
tcz_c	tax rate on private consumption (benchmark level)
tcof	co-financing rate for the structural and cohesion funds (in per cent)
ti_c	tax rate on investment good *c*
tic_c	tax rate on intermediate consumption of commodity *c*
tiz_c	tax rate on investment goods (benchmark level)
tk_s	corporate tax rate in branch *s*
tl_s	social security contributions rate in branch *s*
tm_c	tariff rate applied on commodity *c*
tp_s	tax rate on production in branch *s*
trep	replacement rate out of national average wage (net of social security contributions)
TRATIO	trainee-instructor ratio
tsc_c	subsidy rate on private consumption
tsi_c	subsidy rate on investment good *c*
$tsiz_c$	subsidy rate on investment good *c* (benchmark level)
$tsic_c$	subsidy rate on intermediate consumption
$tscz_c$	subsidy rate on private consumption (benchmark level)
tsp_s	subsidy rate on production in branch *s*
ty	personal income tax rate
tyz	personal income tax rate (benchmark level)
αCG_c	Cobb-Douglas preference parameter in government utility function
αH_c	marginal budget shares in the Stone-Geary utility function
$\gamma A1_c$	CES distribution parameter for the domestic demand from the domestic producers in the Armington function
$\gamma A2_c$	CES distribution parameter for imports in the Armington function
γFK_s	CES distribution parameter for capital in the production function of the firm
γFL_s	CES distribution parameter for labour in the production function of the firm

$\gamma T1_c$	CET distribution parameter for domestic production delivered to home markets
$\gamma T2_c$	CET distribution parameter for exports
μH_c	subsistence level out of consumer demand for commodities
σA_c	substitution elasticities for the Armington function
σF_s	CES capital-labour substitution elasticities by branch
σT_c	elasticities of transformation in the CET function

5.17 List of indices used in the model

c	a subscript for one of the commodities (6 types of commodities)
cc	the same as *c* (used for exposition purposes)
ctm	a subscript for services
nctm	a subscript for all the other commodities except services (5 types of commodities)
s	a subscript for one of the production activities (6 branches of activity)
sm	a subscript for the manufacturing sectors, services and construction (4 branches of activity)
ss	the same as *s* (used for exposition purposes)
t	a subscript for year *t*

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