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Do economic models tell us anything useful about Cohesion Policy impacts?

A comparison of HERMIN, QUEST and ECOMOD

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ABSTRACT

An ex-ante impact analysis of EC Cohesion Policy investment programmes for the period 2007-2013 was recently carried out on behalf of the European Commission (DG Regional Policy) using three different economic models: the *QUEST II* model of DG-ECFIN, the *ECOMOD* model of EcoMod Network/Free University of Brussels and the COHESION system of *HERMIN* models of GEFRA/EMDS. The main results were published in the most recent Fourth Cohesion Report (EC, 2007), and it turned out that different models gave different results. In some cases the differences were very big and pointed to quite different conclusions about the impact of the European Cohesion Policy on growth and employment impacts. In order to progress the debate on the usefulness of model-based policy impact analysis, we first set out the wider context within which EC Cohesion Policy is designed, implemented and evaluated. We then present a brief summary of the main findings of the model-based analysis in terms of impacts on aggregate GDP and total employment. We conclude with a discussion of possible reasons why two of the models – QUEST and HERMIN - may be producing different results.

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1

INTRODUCTORY REMARKS

Since 1989, the European Commission has implemented cohesion policies that now absorb over one third of its available annual budgetary resources.[1] These policies are embedded in a sophisticated system of public investment planning that represents a creative partnership between the national governments of the recipient states and the Commission authorities. The magnitude of the financial resources devoted to implementing EU Cohesion Policy demands that detailed and searching evaluations of the likely policy outcomes be carried out.

The challenge of evaluating the impacts of Cohesion Policy programmes lies in the extreme complexity of the public policy instruments being used, in terms of individual projects, wider measures, operational programmes and the entire investment package taken as a whole. The goal of Cohesion Policy – to promote accelerated growth and development in lagging EU member states and regions – is ambitious, and draws on economic and other research that is still at an early stage of its evolution. The context within which Cohesion Policy is designed, implemented and evaluated is also complex, and this should serve as a warning against simplistic evaluations and premature judgements. Economic models are used to deal with these complex evaluation challenges and are the subject of this paper.

The task of this paper is three-fold. First, we attempt to stand back from the technical aspects of the analysis of Cohesion Policy impacts and identify and describe the logical stages of the whole process starting with the challenge of the European Cohesion Policy, the different steps to be taken to make to implement the programmes, and finally to discuss evaluation steps in order to isolate specific areas where evaluators may legitimately differ from each other. Second, we examine three recent model-based evaluations of Cohesion Policy impacts that were produced using different models: the (European Commission internal) *QUEST II* model of DG-ECFIN, the *ECOMOD* model of EcoMod Network/Free University of Brussels and the COHESION system of *HERMIN* models of GEFRA/EMDS.[2] These results were recently published as part of the Commission's Fourth Cohesion Report, and have been widely discussed (European Commission, 2007). Third, in light of the radically different policy impact results obtained from these three models, we initiate a discussion of possible explanations for these differences. [3]

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1   Cohesion policy programmes have been variously called Structural Funds (SF), Cohesion Funds (CF), Community Support Frameworks (CSF), Single Programming Documents (SPD) and National Strategic Reference Frameworks (NSRF). In this paper we use the term "Cohesion Policy" (or CP) to refer to all of the above.

2   The documentation of large-scale macro-models sometimes lags behind improvements made to the operational software versions. Basic descriptions of each of the three model systems can be obtained from Roeger and in't Veld (1997), for QUEST II; Bayar (2007) for ECOMOD; and Bradley and Untiedt (2007) for the COHESION System of HERMIN models.

3   The authors carried out analysis based on the COHESION system of HERMIN models. Although they attempt to be dispassionately scientific in their judgements, it would be reasonable to assume that they have certain preferences! However, they try to make any such judgement calls very explicit.

2

THE LOGIC OF COHESION POLICY ANALYSIS

Rather than plunging immediately into a detailed technical examination of the policy analysis results of the three models, and the properties of the models that may be influencing the different impact conclusions, we suggest that it is first necessary to widen the examination into the context within which Cohesion Policy is formulated, implemented and evaluated. Only then can the use of models be properly interpreted. In section 3 we will present the actual model impact results, followed by a technical examination of the reasons why models (and modellers) differ from each other in their approaches to capturing how economies function and respond to these policy shocks.

In an effort to identify the wider taxonomy of Cohesion Policy formation and analysis, we can identify a series of fourteen separate logical steps. These can then be collected into the four main stages involved in the analysis of the impacts of Cohesion Policy, which are the following:

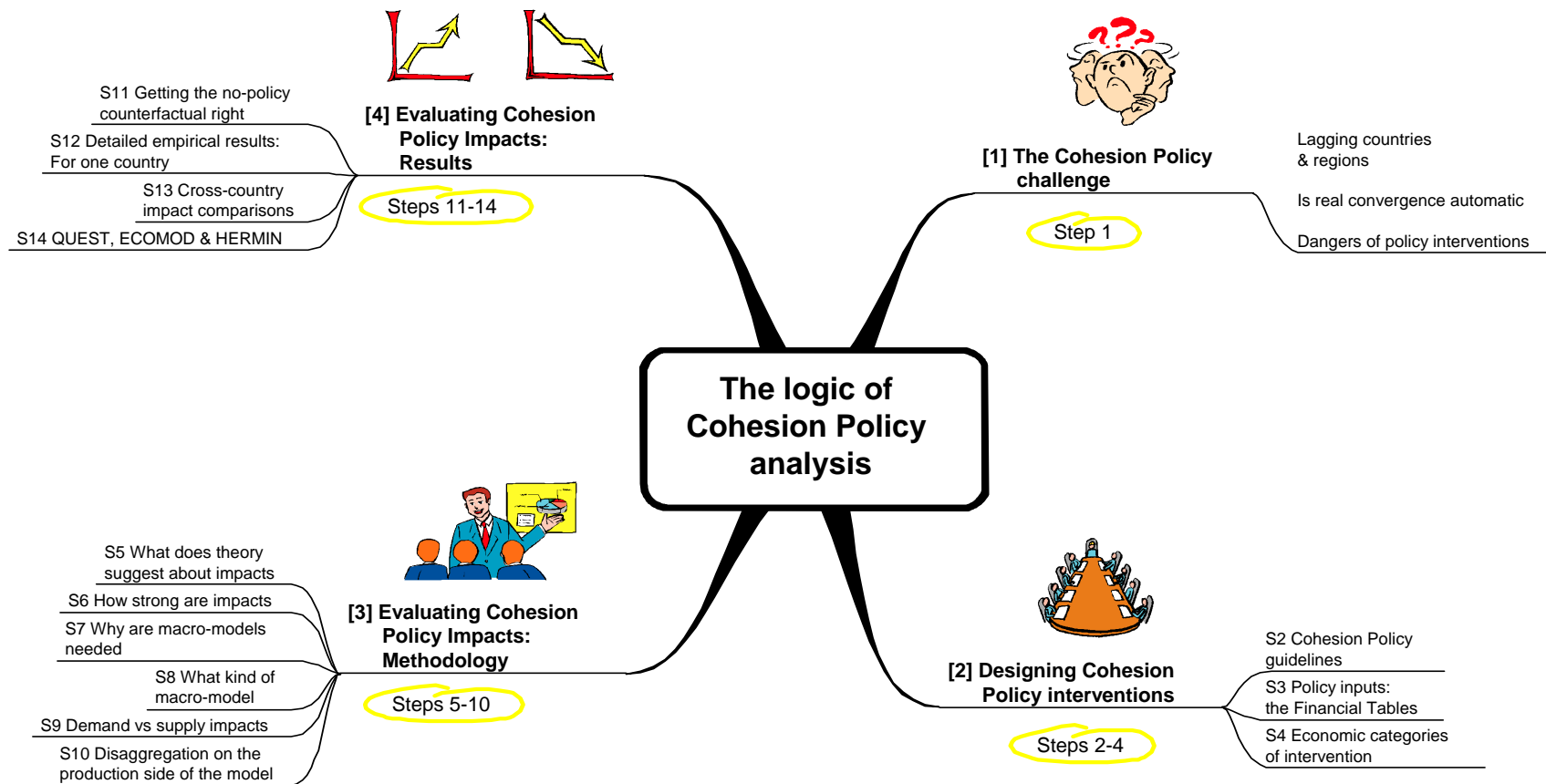*Stage 1*: The Cohesion Policy challenge (step 1)

Stage 2: Designing Cohesion Policy interventions (steps 2-4)

Stage 3: The methodology of Cohesion Policy impact evaluation (steps 5- 10)

Stage 4: The presentation and interpretation of results (steps 11-14)

The structure and interrelationships of these fourteen steps and four stages are illustrated in Figure 1, and we briefly describe each below.

Figure 1:
The logic of Cohesion Policy analysis

The logic of Cohesion Policy analysis

[1] The Cohesion Policy challenge

Step 1

Lagging countries & regions

Is real convergence automatic

Dangers of policy interventions

[2] Designing Cohesion Policy interventions

Steps 2-4

S2 Cohesion Policy guidelines

S3 Policy inputs: the Financial Tables

S4 Economic categories of intervention

[3] Evaluating Cohesion Policy Impacts: Methodology

Steps 5-10

S5 What does theory suggest about impacts

S6 How strong are impacts

S7 Why are macro-models needed

S8 What kind of macro-model

S9 Demand vs supply impacts

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[4] Evaluating Cohesion Policy Impacts: Results

Steps 11-14

S11 Getting the no-policy counterfactual right

S12 Detailed empirical results: For one country

S13 Cross-country impact comparisons

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2.1 STAGES AND STEPS IN COHESION POLICY DESIGN AND ANALYSIS

Stage 1: The Cohesion Policy challenge

<u>Step 1</u>: *The cohesion challenge*: Before embarking on model-based analysis, we need to explore and understand the main characteristics of the Objective 1-type lagging economies, compared with the "advanced" or "mature" EU economies. Prior to the 2004 enlargement that brought in eight new member states that had previously been within the Communist centrally planned system, the lagging states had been the economies of the EU's southern (Greece, Portugal and Spain) and western (Ireland) periphery.[4] Why were they lagging? Could they catch up simply through participating in the integrated Single Market and Monetary Union? What are (if any) the specific barriers to convergence that need an EU policy initiative like Cohesion Policy? How much need we learn before we commit to specific macro-modelling frameworks?

Stage 2: Designing Cohesion Policy interventions

<u>Step 2</u>: *Cohesion Policy guidelines*: This step deals with the role of the development planning process in each recipient state as it prepares to receive and use EU aid. It is a combination of the identification of national priorities and heavily influenced by guidelines issued by the Commission. In each case, one has to examine carefully how each country or region has carried out this task. What techniques (if any) were used to select measures within the investment programmes within the overall policy package? Were formal micro-evaluation techniques applied (e.g., cost-benefit analysis, micro-scoring, etc.)?[5] How good is the local institutional capacity likely to be? How did the authorities proceed with implementation?

<u>Step 3</u>: *Cohesion Policy financial inputs*: This step deals with the formal financial plan, where the ex-ante funding allocations are set out in terms of different administrative categories of public investment. It also reviews how the administrative investment categories are mapped into "economic" categories of investment, such as physical infrastructure, human resources and direct aid to firms. One needs to identify carefully the main economic categories of investment that are likely to be drivers of faster convergence, since different types of investment will influence an economy in different ways and through different mechanisms. This step tends to be somewhat neglected in past evaluations and evaluation designs.

<u>Step 4</u>: *Economic classification of policy instruments*: This step examines how the investment flows are transformed into stocks of physical infrastructure, human capital and R&D.

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4   The re-unification of Germany brought in the eastern Länder from the early 1990s, but this region was also the recipient of massive internal transfers within Germany. It is difficult to single out the separate role of EU Cohesion Policy.

5   For a review of commonly used micro-evaluation techniques, see Bradley, Mitze, Morgenroth, and Untiedt (2006).

Although the flow of investment expenditures impact on the demand side of the economy during implementation, it is the improved stocks that actually produce the improved economic performance of the economy, even after the investment flows cease.[6]

Stage 3: Evaluating Cohesion Policy interventions: methodology

Step 5: *Economic theory and public investment*: Recent theoretical advances in trade theory, growth theory and economic geography provide insights that can be drawn on for the planning and analysis of Cohesion Policy.[7] These theoretical advances tell us something about the role of investment in physical infrastructure, human resources and R&D. In particular, they suggest ways in which these policies could promote growth.

Step 6: *Empirics of investment impacts*: Given the theoretical insights that are provided in the trade, growth and spatial literatures, we can then seek to establish what the international empirical literature tells us about the strength of these drivers. This literature is still at an early stage, and it is easy to become agnostic![8] What is important is to draw lessons from empirical studies that provide guidance as to how these driving forces can be related to model mechanisms and equations that trace through the consequences for changes in sectoral output and productivity.

Step 7: *Why are models needed*: The complexity of Cohesion Policies means that models must be used to evaluate their impacts. Without models, one is unable to isolate the influences of Cohesion Policy from all the other factors that drive a small open economy.[9] In addition, the financial injections are usually so large that there will be macroeconomic consequences that will affect all aspects of the economy, and not just the areas that are directly influenced by the investments (e.g., output and productivity).

Step 8: *What kind of macro model*: One then has to ask the important question of what kind of model is appropriate for the evaluation of Cohesion Policy impacts. This will be influenced by insights into what are the key characteristics of the recipient countries (step 1 above). What kind of paradigm best captures these characteristics and gives an appropriate description of the supported country? What level of sectoral disaggregation is required? We return to this vital step in the next section. But it is important to stress a methodological point here. Economic models are very imperfect representations of the real world. Modern modelling practice has tended to assign high status to frameworks that incorporate complete rational

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[6]   It should be recalled that EC Cohesion Policy aid is not open-ended. The aid programmes tend to run for periods of from five to seven years, and are renegotiated when the programming period ends.

[7]   Krugman and Helpman (1985), Lucas (1988), Grossman and Helpman (1991), Romer (1994), Krugman (1995), Fujita, Krugman and Venables (1999), Aghion and Howitt (2005).

[8]   Aschauer (1989), Munnell (1993), Bajo-Rubio and Sosvilla-Rivero (1993), Schalk and Untiedt (2000), Acemoglu and Angrist (2000), Sianesi and van Reenen (2003), Congressional Budget Office (2005), Romp and de Haan (2007)

[9]   *Monitoring* should be clearly distinguished from *impact evaluation*. Monitoring indicators can be used to show (for example) how much motorway has been constructed, but cannot identify the role of roadway improvements in boosting output and/or productivity.

optimising behaviour and perfect foresight.[10] Such models are elegant but may trap policy analysts into interpreting policy impacts on the basis of models that do not represent the realistic behaviour of agents in the real world (Akerlof, 2005 and 2007). The price of realism may be a lack of complete optimising elegance!

Step 9: *Demand versus supply impacts*: It is well known that Cohesion Policy investments have demand impacts during implementation, and supply impacts both during and long after the programmes have terminated. One must be careful to ensure that this distinction is captured in the models. A wide range of other questions also become important. In particular, how are we to handle demand and supply impacts that arise during implementation and after termination? The recipient states sometimes have rather specific characteristics. Given the known characteristics of the recipient states, what could be expected? Total crowding out of private sector activity by the rise in public sector activity? Partial crowding out? Crowding in? Ricardian equivalence? The answers to these questions surely must be heavily influenced by the known facts about the economies being aided.

Step 10: *Sectoral issues in modelling*: A final specific and very important issue arises with the models, and concerns the level of disaggregation of sectoral production. One needs to be aware of how each different model addresses questions of sectoral disaggregation on the production side of the economy (e.g., QUEST, ECOMOD, HERMIN, etc.). Can these differences be subjected to empirical testing? Which approach is more plausible?

Stage 4: Evaluating Cohesion Policy interventions: results

Step 11: *The "no Cohesion Policy" counterfactual*: The notion of a "no-Cohesion Policy" baseline in not trivial. In using a macro-model to quantify the impacts of Cohesion Policy shocks, all models must go through the following stages:[11]

   (a) Project all non-Cohesion Policy (CP) exogenous variables out to the terminal year of the simulation (i.e., world, domestic policy instruments, etc.). For the 2007-2013 Cohesion Policy analysis, this year was taken to be 2020 for all three models.

   (b) Set all CP instruments to the appropriate counterfactual values (see below)

   (c) Simulate the model out to 2020

   (d) Re-set the Cohesion Policy instruments to the appropriate values

   (e) Re-simulate the model to 2020

   (f) Compare results obtained from stage (e) to results from stage (c), to evaluate CP impacts

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[10] Bayoumi (2004) describes the IMF DSGE model, GEM; Ratto et al. (2005) describe DG-ECFIN's new DSGE implementation of QUEST III..

[11] Hanging over step 11 is the spectre of the so-called Lucas critique. However, all three models are based carefully on micro-foundations, albeit in different ways and to different degrees. But we have come a long way from the reduced form, time-series models that Lucas convincingly destroyed in the 1970s!

However, a range of different "no-Cohesion Policy" counterfactuals are possible. We distinguish three main cases: the "zero" substitution case; the "full" substitution case; and the "partial" substitution case. We explain each below.

(a) The "zero substitution" case:

Domestic authorities do not substitute with domestic finance, and cancel the entire investment programme (usually selected as the default case). In some cases, the fiscal imbalances in a recipient economy would preclude any expansions of public investment. However, in other cases the national authorities could step in and fund the Cohesion Policy investment programme purely out of local resources.[12] Of course, in the latter situation, there would be more severe fiscal consequences for the public sector budget balance compared to the case of EU-funded Cohesion Policy.

(b) The "full substitution" case:

Domestic authorities fully implement original CP investments, but financed entirely out of own resources (see discussion above). This could be a mixture of public funding re-allocation to the kinds of public investments involved in Cohesion Policy, borrowing and tax increases.

(c) The "partial substitution" case:

Domestic authorities implement only part of the original CP investments, but financed out of their own resources.

Very different implications arise from these counterfactuals. For example, in the "zero" substitution case, impact analysis would attribute to Cohesion Policy the entire economic benefits of the CP investments, treating the funding as a grant. In the "full" substitution case, impact analysis in this case would be identical to the "zero substitution" case, except for the negative impacts (such as higher tax rates, offsetting cuts in expenditure, higher interest rates, exchange rate effects, etc.) of the need to finance domestically. Finally, the "partial" substitution case is difficult to evaluate. If the cancelled Cohesion Policy investments were genuine barriers to growth, the outcome might fall well below "full" substitution. If the cancelled investments were poorly designed (high deadweight/crowding out), then this case might be actually better than the case of "full" substitution.

Step 12: *Policy Impacts for a single country:* It is useful to present the empirical results, initially for a single country so that the presentation can refer to country specifics. The analysis should then provide a wide range of information aimed at interpreting the analysis.

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12 Countries are expected to grow out of the need for EU development aid. For example, the Irish Cohesion Policy funding effectively ended in 2006, having run from 1989 to 2006. But the Irish authorities have continued with a seven-year national programme that is funded purely out of local sources (National Development Plan, 2007)).

(a) Present stylised facts about the country model.

(b) Present the no-Cohesion Policy baseline under different assumptions, e.g., zero substitution and full substitution.

(c) Present sensitivity analysis with respect to important model parameters, e.g., the so-called externality parameters that link changes in stocks of infrastructure, human capital and R&D to changes in sectoral output and productivity. Discuss the consequences in terms of what micro-scoring might indicate about the "quality" of the CP planning and implementation.

(d) Design the presentation of the results for a given country in a way that facilitates comparisons with other countries. The concept of a cumulative Cohesion Policy multiplier is particularly useful here (and is explained in the next section).

Step 13: *Policy Impacts for many countries:* In a multi-country evaluation, present summary results for all the countries, and explore international differences (within a given model system) as well as national differences (between the three models).

Step 14: *Drawing conclusions.* Discuss what the evaluations tell about the initial structure and characteristics of the economies. Why do the models produce different results? What can be done about it? This is, of course, the most important question of all. But it comes at the end of a list of other issues that also influence the answers. Only when the question of model-based impact comparisons is placed in the above wider context can we isolate and rationally explore these differences.

It is useful to enquire informally into whether there are likely to be strong differences of approach to these steps as between the various modelling groups. To that end, we suggest that the fourteen points can be further subdivided into two distinct groups. In the first, we suggest that there ought to be no strong differences of approach between the three modelling groups. In the second, unfortunately, strong differences of approach can and do legitimately arise.

2.2 AREAS OF POSSIBLE BROAD AGREEMENT

Within the range of different impact evaluation studies, there are likely to be areas within the above 14 steps where there is broad agreement. The most obvious cases for agreement might be the following:

Step 2: *Cohesion Policy guidelines*: Although there may be differences between the modelling groups with respect to the underlying characterisation of the cohesion challenge (step 1, to which we will revert below), the Cohesion Policy guidelines – as set out by the Commission - have to be accepted. The bottom line is that the modellers are usually asked to evaluate the Commission's policy, and not any alternative or hypothetical policy package.

Step 3: *Cohesion Policy financial inputs*: These public investment policy instrument settings must also be accepted by all modelling groups.

Step 4: *Economic classification of policy instruments*: Only very minor differences of opinion can exist between the three groups concerning how the administrative categories of invest-

ment are to be reclassified into economic categories. Most modelling groups adopt a three-way classification into physical infrastructure, human resources and direct aid to firms (of which R&D is a sub-component), although a higher level of disaggregation might be more desirable.

Step 5: *Economic theory and public investment*: Faced with the challenge of analysing Cohesion Policy impacts, all modelling groups dip into new growth theory and economic geography in order to articulate the theoretical roles of physical infrastructure, human capital and R&D in promoting faster growth and catch-up. There is likely to be a lot of common ground here.

Step 7: *Why are models needed*: All modelling groups tend to accept that the role of models is to place the Cohesion Policy interventions in a wider macro context, where macro and other spillover impacts can be examined.

Step 11: *The "no Cohesion Policy" counterfactual*: There should be little or no differences between modelling groups on the taxonomies of the counterfactuals. However, the counterfactuals are seldom discussed explicitly (see previous material on Step 11 above), and there may be differences of opinion as to the most appropriate counterfactual to adopt as a standard.

2.3 AREAS OF POSSIBLE DISAGREEMENT

Step 1: *The cohesion challenge*: The nature of the cohesion challenge could be regarded as having certain ambiguities. For example, Greece, Portugal and Spain experienced dramatic convergence in the 1960-1980 period, without any trans-European policy interventions. The Baltic States have recently experienced double-digit growth, before any credible role for Cohesion Policy could be asserted. Some authors display an almost ideological distaste for Cohesion Policy, and the book by Herve & Holtzman (1998) is a long catalogue of the potential evils of policy intervention, untroubled by any actual empirical analysis of the situation in individual countries or the conduct of Cohesion Policy. More recent research by the Dutch CPB that failed to find any significant Cohesion Policy impacts was largely based on data that preceded the 1989 expansion of Cohesion Funding and its narrower focus on Objective 1 countries.[13] Although they are largely subliminal, there are probably major differences of interpretation between modelling groups, and these interpretations of the actual situation in the recipient countries and regions may influence the choices of scientific modelling strategies adopted.

Step 6: *Empirics of investment impacts*: It is possible that all modelling groups have a common interpretation of the role of theory in exploring the drivers of growth and catch-up. However, there may be differences between the groups as to the strength of these relationships. Here we are focusing on the immediate relationship between (say) improved physical infrastructure and (say) manufacturing output or manufacturing productivity. We are not referring to the wider macro-economic outcome that is obtained when the immediate relationships are embedded in large-scale models. The literature presents a wide range of op-

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[13] Ederveen, Gorter, de Mooij and Nahuis (2002). See Bradley (2007) for a critique of the Ederveen et al work and Rodrik (2005) for a more general critique of using growth regressions to investigate policy interventions.

tions from empirical studies, and is fraught with methodological and conceptual difficulties. However, even if there was agreement on what to take from the rather confused empirical literature, there would still be problems. The structures of the different models often impose differences in the underlying cohesion mechanisms.

Step 8: *What kind of macro model*: The most important difference between the three groups QUEST, ECOMOD and HERMIN probably lies in their choice of the modelling framework. This is not to say that there are any deep, fundamental *paradigmatic* differences between the models. All three draw in varying degrees from recent advances in modelling within the neo-Keynesian and CGE traditions. All three have a significant degree of micro underpinnings and are probably reasonably robust to the so-called Lucas critique.

The origins of QUEST II in the analysis of the economies of the "old" EU member states may have led to a stance on crowding out that may be appropriate for fiscal policy interventions in developed economies that are attempting to stabilize about given concept of capacity output. However, the carryover of these mechanisms to the relatively less developed new member state economies, many of which are operating at low rates of utilization of already low rates of capacity, may be problematic or inappropriate. We return to this important point in the next section.

Step 9: *Demand versus supply impacts*: Although the need to distinguish demand (implementation) effects from long-lasting supply (post-implementation) effects is accepted by all groups, the empirical analysis can lead to dramatically different outcomes, mainly due to the issues mentioned in Step 8 above.

Step 10: *Sectoral issues in modelling*: Under this heading we draw attention to the fact that any detailed examination of Cohesion Policy impacts needs to be performed at a level of sectoral disaggregation that permits – at the very least - the separate analysis of manufacturing, market services, agriculture and government. With few exceptions, the main sectoral driver of growth has been manufacturing, or sub-sectors of manufacturing. The rise of market services from a very low base has been a common characteristic of the post-Communist transition of the new EU member states of the CEE area. Also, the agricultural sector has very specific characteristics that may serve to distort Cohesion Policy analysis unless the sector is isolated. For example, it is conceivable that the one sector approach used by QUEST, compared to the modestly disaggregated approach of HERMIN and the highly disaggregated approach of ECOMOD, may distort the comparisons of their results.

Steps 12-14: *Policy impacts*: The dramatically different analyses of Cohesion Policy impacts derived from the three models (QUEST, ECOMOD and HERMIN) are simply the results of all the divergences in modelling that are outlined above.

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THREE MODEL-BASED EVALUATIONS OF COHESION POLICY: 2007-2013

Three model-based ex-ante evaluations of EU Cohesion Policy were commissioned by DG Regional Policy in early 2007, and formed an input to the Fourth Cohesion Report published in May.[14] These evaluations explored the likely impact of the investments funded during the 2007-2013 expenditure programme. A common set of Cohesion Policy financial data was used by all three modelling groups: the *QUEST II* model of DG ECFIN; the *ECOMOD* model of EcoMOD Network/Free University of Brussels and the HERMIN models of the COHE-SION-System developed for the Commission by GEFRA/EMDS.[15]

Although the different models have the potential to examine the impacts of Cohesion Policy on many different aspects of economic performance, the impacts on aggregate GDP and on aggregate employment serve to characterise the key features of the three different evaluations. Such analysis is usually presented in terms of the comparison of a "with Cohesion Policy" scenario relative to a "without Cohesion Policy" scenario. This distinction is not without its complications, and there are a range of alternative counterfactuals. Using the terminology set out above, all three models implemented the "zero" substitution counterfactual.

In Figure 2 we present a comparison of the impacts of the 2007-2013 Cohesion Policy programmes on the level of GDP, taking the case of Poland as an example.[16] The graphs show the percentage increase in the level of GDP in the "with-CP" case when compared to the baseline "without-CP" case.

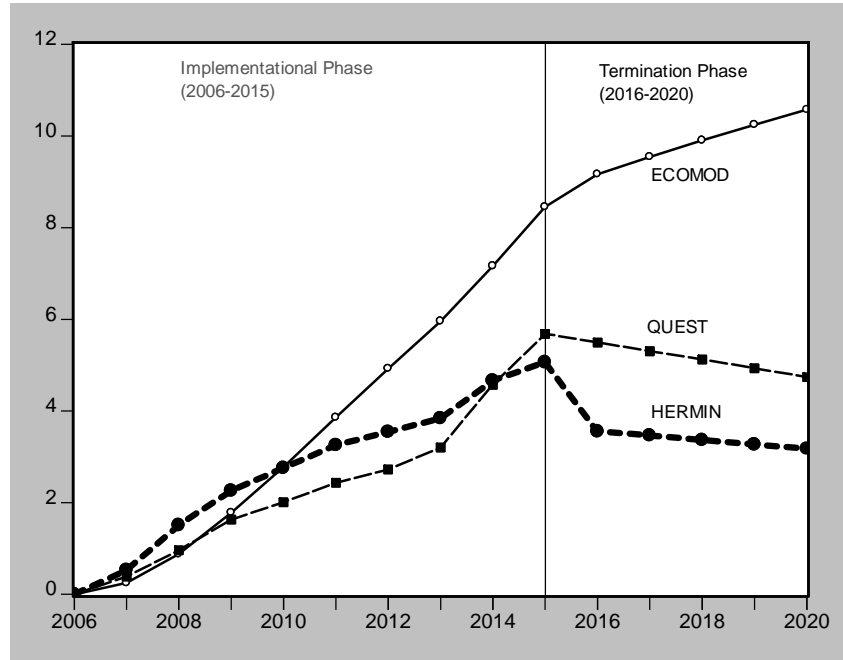---

14 See European Commission (2007), Chapter 2 for the model results.
15 http://ec.europa.eu/regional_policy/sources/docgener/evaluation/rado_en.htm.
16 Poland is a useful example, since it absorbs a very significant proportion of total Cohesion Policy funding.

Figure 2:
QUEST, ECOMOD & HERMIN - GDP impacts
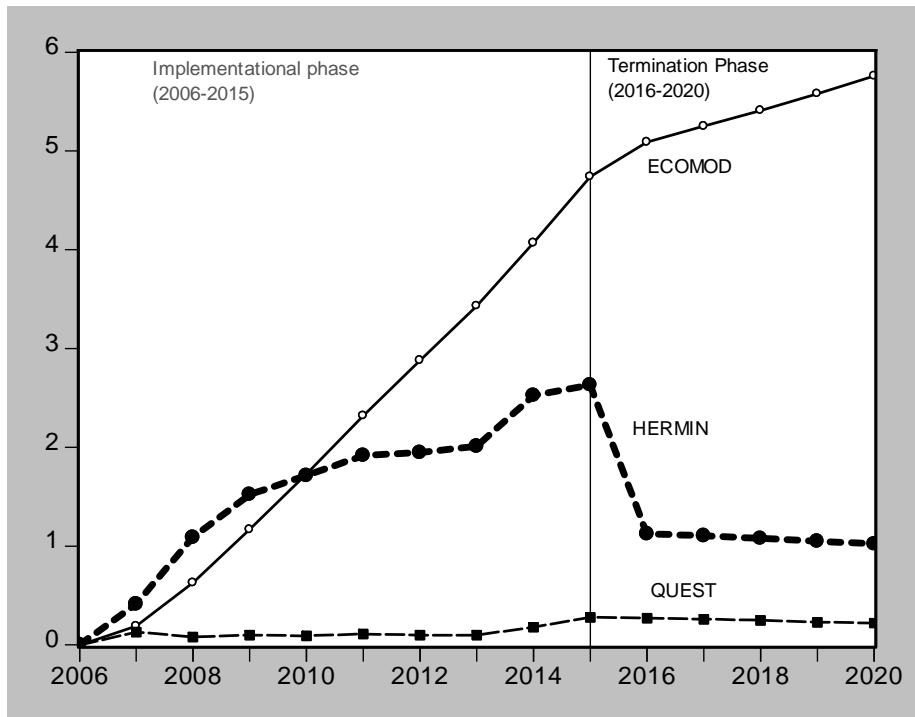(percentage deviation from baseline)

Source: ECOMOD (2007) DG ECFIN (2007), GEFRA/EMDS (2007)

Remark: QUEST figures for 2016 to 2019 follow from a linear interpolation.

In Figure 3 we present a comparison of the impacts on the level of total employment. Once again, the graphs show the percentage increase in the level of total employment in the "with-CP" case when compared to the baseline "without-CP" case.

Figure 3:
QUEST, ECOMOD & HERMIN - Employment impacts
(percentage deviation from baseline)

Source: ECOMOD (2007) DG ECFIN (2007), GEFRA/EMDS (2007)

Remark: QUEST figures for 2016 to 2019 follow from a linear interpolation.

The patterns of the impacts on GDP and on employment derived from the three models show significant differences. The *ECOMOD* analysis shows a rapid build-up of the impact on GDP, to about 8% higher than the baseline in the termination year 2015.[17] After termination, the impact on GDP continues to rise, reaching about 10% above the baseline by the year 2020. In the cases of *QUEST* and *HERMIN*, the GDP impacts indicated by both models during the implementation period 2007-2015 resemble each other, reaching a peak impact of 5.7% (*QUEST*) and 5.1% (*HERMIN*). Thereafter, the *HERMIN* impacts fall off more than the *QUEST* impacts, to end at 4.7% (*QUEST*) and 3.2% (*HERMIN*).

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[17] Although the Cohesion Policy programme for the seven year period 2007-2013 is being analysed, the so-called "n+2" rule is invoked by all three models, so that financial aid terminates at the end of the year 2015. The assumption is also made post-2015 that there is no subsequent Cohesion Policy aid, nor any domestically funded alternative. This is an extreme assumption, but one that was mandated by the Commission in their instructions to the model users.

The differences between the models in the impacts on total employment are much more dramatic. The *ECOMOD* impacts follow the same pattern as the impacts on GDP, rising to an increase of 4.7% by end 2015, and increasing further to almost 6% by 2020 (relative to the "no-CP baseline level of total employment). The *QUEST* analysis suggests that there will be almost no impact on employment, either during implementation (peaking at 0.3% above the baseline) or after termination (reaching 0.2% above the baseline by 2020). The *HERMIN* analysis suggests that there will be fairly strong impacts during implementation, rising to 2.6% by 2015, but falling off rapidly after termination and stabilizing at a long-term increase of just over 1% (relative to the no-CP baseline).

Clearly these three model-based impact studies are pointing in very different directions. *ECOMOD* suggests that there are likely to be very strong, and ever increasing impacts on GDP and employment associated with the Cohesion Policy investment programmes for the period 2007-2015. These GDP impacts are dramatically larger than those found using either *QUEST* or *HERMIN*.

Turning to employment impacts, serious differences now emerge between *QUEST* and *HERMIN*, even though both of these models broadly agree on the GDP impacts. The almost insignificant employment impact shown by *QUEST* (even during the implementation period 2007-2015) is in contrast to the stronger implementation impact shown by *HERMIN*. But in the case of *HERMIN*, the termination of the Cohesion Policy funding after 2015 induces a demand contraction that reduces the longer term employment increase. In summary, by the year 2020, the increase in employment suggested by *ECOMOD* is six times bigger than that found using *HERMIN* and almost thirty times bigger than the *QUEST* results.

We conclude our presentation of the modelling impact results by showing two figures that are based on the HERMIN analysis.[18] In Figure 4 we show the results of impact analysis in a situation where there are no spillover effects from the improved stocks of physical infrastructure, human capital and R&D.[19] This is an unrealistic and extreme counterfactual, and represents a case of Cohesion Policy investment programmes that was so badly designed and poorly implemented that no enduring benefits arose from the investments.[20] Figure 4(a) shows the Cohesion Policy funding injection (as a percentage of GDP), and the GDP impact (expressed as a percentage increase relative to the no-CP baseline). Although there is a modest "Keynesian" demand-side boost during implementation (2007-2015), there are no enduring benefits. Figure 4(b) shows the case of "standard" spillover effects, that were used in the earlier analysis reported in Figures 2 and 3 above. These spillovers are phased in linearly from the year 2004, and have full effect after five years. As the stocks of physical infrastructure, human capital and R&D build up after 2007, the supply-side benefits take effect, and even after termination, the economy is more productive.In summary, the CP shock is the same in Figures 4(a) and (b), but the difference in the impacts on GDP is accounted for by the supply-side spillover effects that are assumed to be absent in 4(a) but are present in (in "standardised" form) in 4(b).

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18 The analysis in Figures 4 and 5 could easily be replicated for *QUEST* and *ECOMOD*, but the authors only have access to the *HERMIN* software.

19 The spillover (or externality) effects of improved physical infrastructure, human capital and R&D are described in Steps 5 and 6 of Section 2 above. All three models incorporate such mechanisms, but differ in the empirical values assumed.

20 In his *General Theory of Employment, Interest and Money*, John Maynard Keynes described how an economy in recession could be stimulated if the government paid for holes to be dug in the ground, and filled in again. An NSRF/NDP with zero spillover impacts would be a bit like this!

Figure 4:
HERMIN: Demand- vs. supply-side effects of Cohesion Policy interventions
Cohesion Policy (GDP) as a percentage of GDP and GDP (Impact)
as percentage deviation from baseline

a) Zero spillover elasticities - Poland
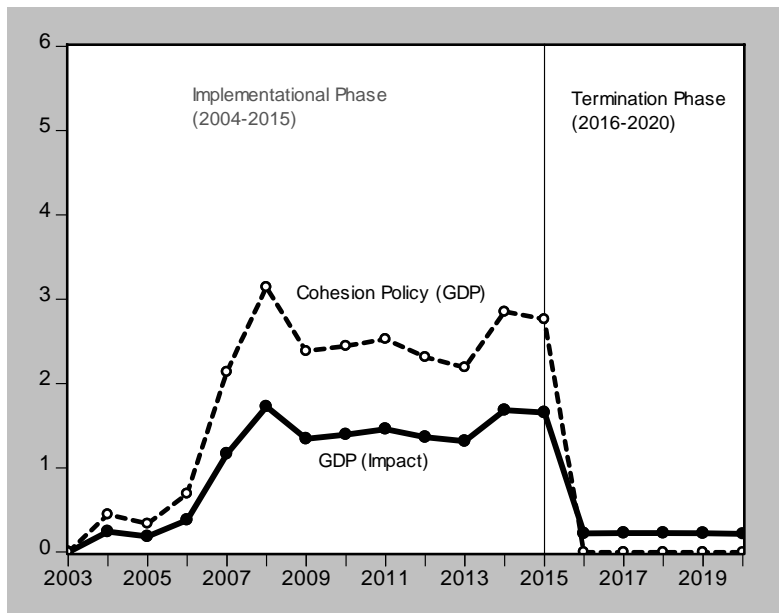
b) Standard spillover elasticities - Poland
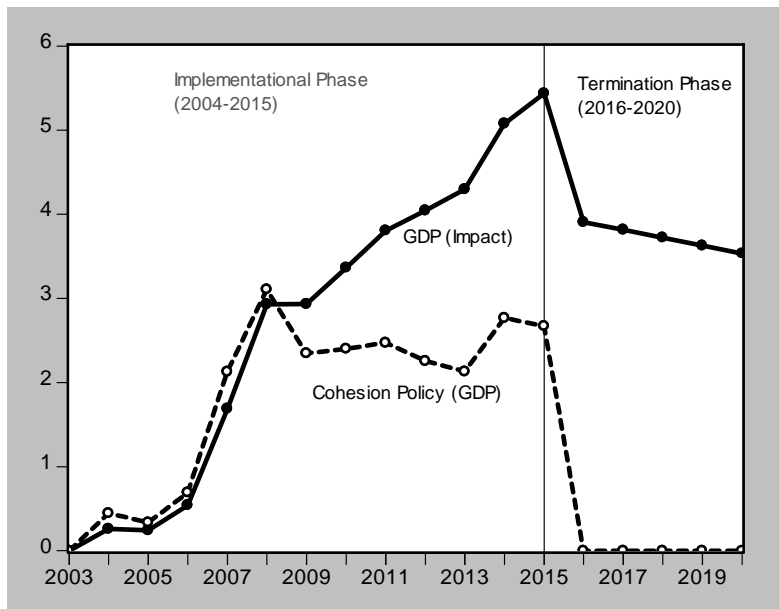
Finally, in Figure 5 we show the so-called cumulative Cohesion Policy multiplier for the *HERMIN* analysis, in the cases of zero and standard spillover effects. The normal policy multiplier (at time t) is defined as follows:

$$\text{Normal policy multiplier} = \frac{\text{Change in GDP}}{\text{Change in public investment}}$$

However, the cumulative policy multiplier (between time t and time t+n) is defined as:

$$\text{Cumulative CP multiplier} = \frac{\text{Cumulative percentage change in GDP}}{\text{Cumulative percentage share of CP in GDP}}$$

Figure 5 illustrates how the spillover effects from the Cohesion Policy investments generate a return in terms of increased output. When these spillovers are positive (as in a well-designed Cohesion Policy intervention) the cumulative multiplier increases. When the spillover effects are assumed to be zero (as in a very poorly designed investment programme), the cumulative multiplier is flat, and merely captures the Keynesian multiplier effects.

Figure 5:
HERMIN: Cumulative Multiplier of Cohesion Policy interventions – Poland
Cumulative Impact defined as: Cumulative GDP (Impact) /
Cumulative Cohesion Policy (GDP)

4
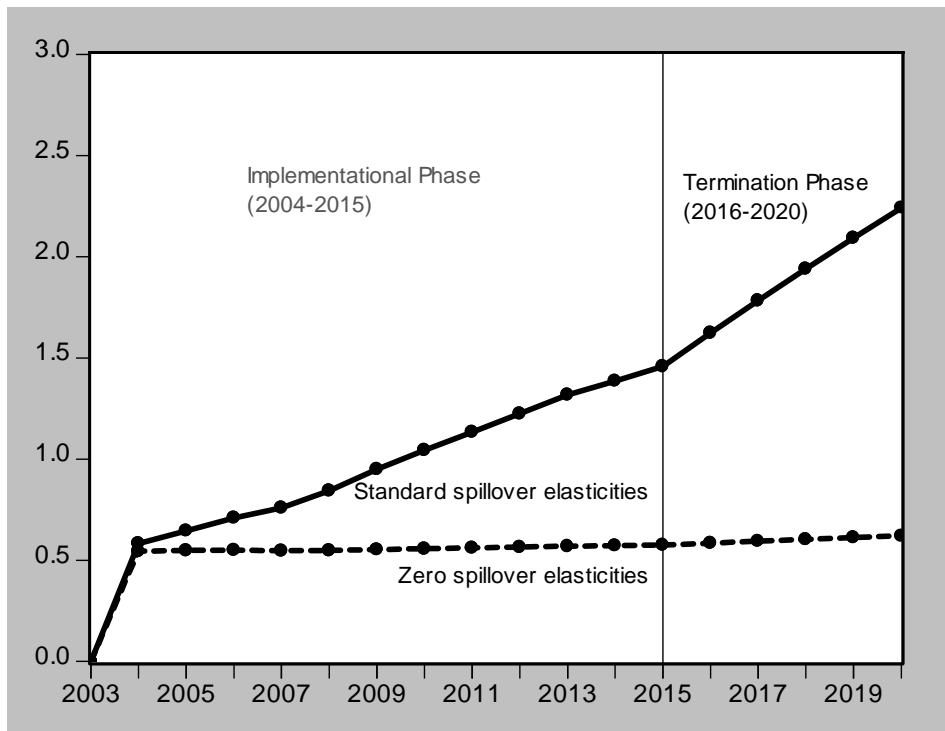
INTERPRETING THE DIFFERENT MODEL-BASED
IMPACT ANALYSES

Unfortunately it is only possible to compare and contrast the structure of QUEST and the HERMIN models, since full information on the ECOMOD model was not available at the time of writing. Drawing on comparisons of analysis carried out using QUEST and HERMIN, one is driven to the conclusion that these are based on rather different views of how the economies of the recipient countries behave. These different views have been incorporated into QUEST and HERMIN, both of which operate according to broadly neo-Keynesian rules.

Our diagnosis is that the first key difference between QUEST and HERMIN-based CP analysis concerns the manner in which spillover, or externality effects from the Structural Funds are incorporated into the two models. These were briefly discussed in Steps 5 and 6 above. We now examine this issue in more detail.

4.1 MODELLING COHESION POLICY SUPPLY-SIDE SPILLOVER EFFECTS

Both QUEST and HERMIN used similar financial data for the Cohesion Policy shock. The demand-side impact mechanisms are handled in a similar way, with elements of expenditure being affected during the programmes implementation phase (i.e., 2007-2015). Of course, both models differ in the modelling of expenditure (private consumption and investment, in particular), but we return to this point later. There are some differences in the manner in which the financial data were transformed into changed stocks of physical infrastructure, human capital and R&D, but these are likely to be minor. The biggest difference is in the manner in which the improved stocks influence sectoral output and productivity in the models.

QUEST is a one-sector model, with modelling only at the level of aggregate private sector output. Improved stocks of infrastructure and human capital feed into capacity output in QUEST, through a Cobb-Douglas (CD) production function that has constant returns to private factor inputs (labour and private capital) and increasing returns to public capital. Consequently, it is mainly through the consequences of capacity utilization that QUEST reacts on the supply-side. During the implementation phase, capacity utilization is driven up, as demand impacts outstrip the gradual build-up of new capacity. This generates large crowding-out mechanisms. This may be further increased by assumptions made on the expenditure side of QUEST, and we return to this below.

Production modelling in the HERMIN models of the COHESION System is on the basis of five sectors: manufacturing, market services, building and construction, agriculture and non-market services (Bradley and Untiedt, 2007). Factor demands in the first three are determined on the basis of cost minimization (using a CES production function constraint). A

simpler approach is used in agriculture, and output in non-market services is policy driven through employment and wages.

For the important manufacturing sector (and also for the service and building and construction sector), HERMIN drew on the SOE modelling research of Bradley and FitzGerald (1988), and where country (capacity) output is not determined directly by a national production function constraint (as in QUEST). Rather, the national production function appears in the determination of the national technology (via national factor demand equations), and the national output equation originated from a higher level "global" production function. This approach attempts to capture the essential notion that integrating within the EU Single Market, and particularly the integration of its peripheral and weakest economies, is best handled directly through the internationalisation of production than indirectly, through trade flows.

Consequently, output determination in manufacturing can be directly influenced by improved infrastructure, human capital and R&D, through making the recipient economies more attractive as hosts to inward investment, and strengthening the internal attractiveness of the competitive environment for locally owned firms. The international empirical literature is used to provide plausible values for the externality parameters.

National productivity can also be influenced directly by improved stocks of infrastructure, human capital and R&D, and these effects are incorporated into the national CES production functions. In other words, while the output effects are mainly international in their consequences (affecting the international allocation of production), the productivity effects are local and serve to modify the local production technology.[21]

4.2 OTHER DIFFERENCES BETWEEN QUEST AND HERMIN

Another important difference between the QUEST and HERMIN-based analysis probably lie in the different nature and strength of crowding out mechanisms, through the labour market (Philips curve), through fiscal tightening and through monetary tightening. The analysis presented in the reports made available to the authors does not permit a thorough analysis of these issues, but they need to be examined. For example, the assumption is made in QUEST that *all increases* in productivity are passed on to labour. Consequently, none of the productivity increases caused by Cohesion Policy will have any effect in increasing cost competitiveness in the recipient countries. In HERMIN, on the other hand, empirical analysis suggests that there is a less than full pass-through of productivity changes to wages. This is quite striking in some countries, such as Poland. Where there is significant foreign ownership of firms, this affects the role of productivity pass-through. Our judgement is that the strong crowding-out features of QUEST may not be appropriate to the lagging economies of many of the new member states. In particular, the "grant" nature of Cohesion Policy funding, with a "weakened" concept of additionality, may not be reflected in the QUEST analysis.

Another big difference between QUEST and HERMIN is that the former imposes model-consistent expectations, while the latter uses static (or auto-regressive) expectations. What

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21 See Bradley, Petrakos and Traistaru (2004) for further details.

this means is that in QUEST, agents have perfect (model consistent) information about the exact future consequences of cohesion policy impacts and consequences, and can react today in light of tomorrow's impacts. HERMIN makes no such assertion. Rather, it takes a pragmatic view that for the analysis of extremely long-tailed investment policies in rapidly transforming economies, the incorporation of model consistent expectations (MCEs) is probably not justifiable in terms of the context of these economies. Furthermore, if the basic model set-up is inappropriate, the incorporation of MCEs simply compounds the error and increases the possibility of misinterpretation of the policy analysis. MCEs are perhaps more appropriate for the analysis of short-term demand and monetary shocks, where the underlying economic structure is fairly stable and well understood. There is less justification for their use for long-term supply-side shocks administered mainly through public investment in productive infrastructure and human capital, in a situation where the underlying structure is not well understood, and is rapidly changing.

On a more technical issue, in QUEST the degree of liquidity constrained consumption behaviour assumed for the new member state models is 40% compared with 30% in the OMS.[22] Is there strong empirical evidence that the liquidity constraint in the new member states of the CEE area is so low? With such a low degree of liquidity constraint, and the assumption of MCEs, it is not surprising that there is so much crowding out of employment in the QUEST-based analysis.

Another technical issue concerns the nature of the production technology used in QUEST. It should also be noted that a property of the Cobb-Douglas production function is that all factor inputs are substitutes.[23] In a more generalised production function (e.g., nested CES, Generalised Leontief, etc.), the possibility arises that public and private capital might actually be complements. This CD-based restriction may be a factor in the high crowding out mechanisms that appear to operate within QUEST.

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[22] In other words, 40 per cent of households are assumed to be liquidity constrained, and the remaining 60% can be modelled in terms of (forward-looking) permanent income.

[23] The assumption is also made in QUEST that the marginal product of public capital stock (K_{pub}) is the same as the marginal product of private capital stock (K_{priv}).

5

CONCLUDING REMARKS

It is possible to attempt to pinpoint more accurately those aspects of the QUEST and HER-MIN model frameworks that may be at the basis of the dramatic differences in their implications for the analysis of the impacts of Cohesion Policy. We stress that we offer merely initial insights for the purposes of stimulating further discussion. Macro-models are very complex tools, and are intrinsically difficult to compare. And the most active area of design and analysis of Cohesion Policy are currently the former centrally planned states of Eastern Europe, where one has access to time series data only from the mid-1990s.

We conclude with the observation that the impact analysis of Cohesion Policy interventions is very complex and the final results shown to the audience are determined by a series of hidden decisions taken by the modellers which are seldom obvious but determine the outcome. To be able to use and judge the results it is absolutely necessary to be fully transparent concerning the exact set-up of the models. Otherwise, macro-economic Cohesion Policy impact analysis will continue to be an impenetrable "black-box". The obvious theoretical advantage claimed for macro-models, i.e., to be able to look at Cohesion Policy impacts in a way that takes into account the specific and realistic economic relations within the recipient countries and their linkage to the rest of the world, will not be realised in practice.

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