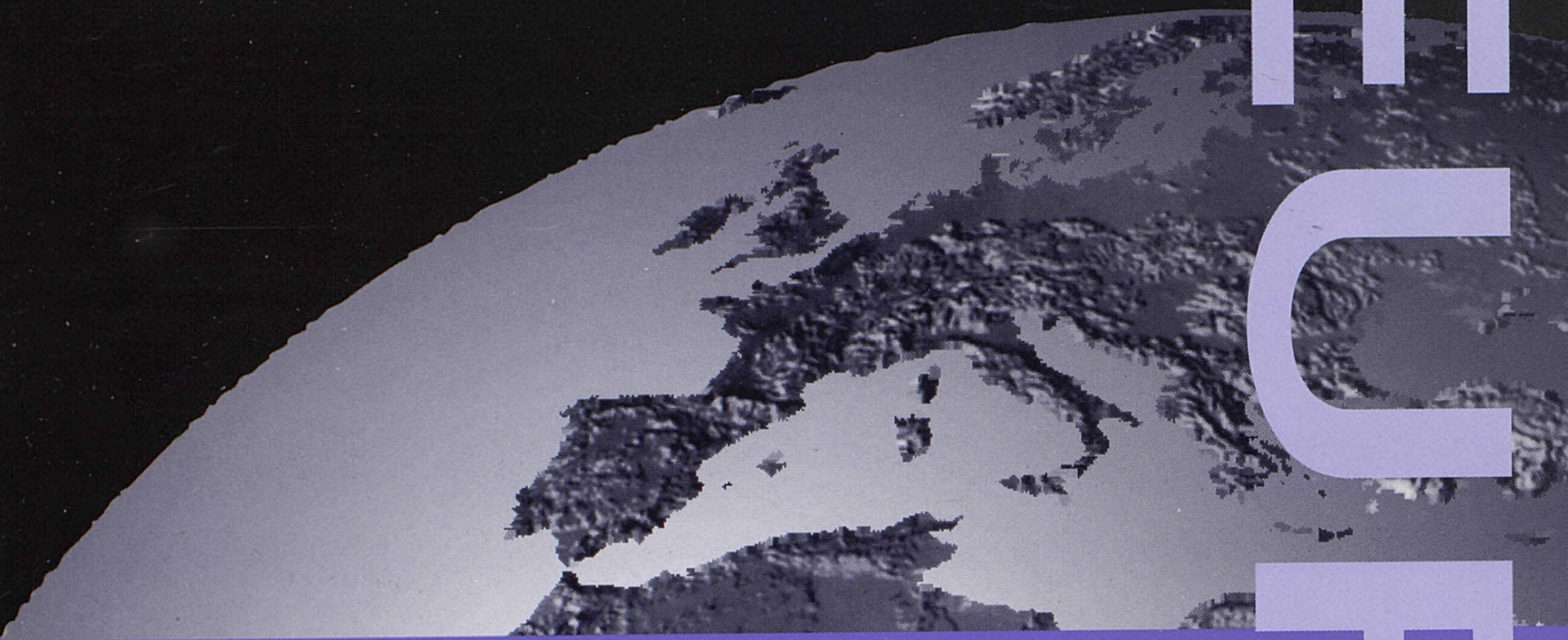
The Single Market Review



EUROPE

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Volume 1:

Regional growth and convergence

The Single Market Review

AGGREGATE AND REGIONAL IMPACT

REGIONAL GROWTH AND CONVERGENCE

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The Single Market Review

AGGREGATE AND REGIONAL IMPACT

REGIONAL GROWTH AND CONVERGENCE

The Single Market Review

SUBSERIES VI: VOLUME 1

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This report is part of a series of 39 studies commissioned from independent consultants in the context of a major review of the Single Market. The 1996 Single Market Review responds to a 1992 Council of Ministers Resolution calling on the European Commission to present an overall analysis of the effectiveness of measures taken in creating the Single Market. This review, which assesses the progress made in implementing the Single Market Programme, was coordinated by the Directorate-General 'Internal Market and Financial Services' (DG XV) and the Directorate-General 'Economic and Financial Affairs' (DG II) of the European Commission.

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Table of contents

List of tables vii

List of figures x

List of abbreviations xii

1. Summary 1

1.1. Review of the theoretical and empirical literature 1
1.2. Growth and convergence trends in Europe, 1975–87 and 1987–93 2
1.3. Econometric analysis of growth and convergence 3
1.3.1. Results at Member State level 3
1.3.2. Results at regional level 4

2. Review of the theoretical and empirical literature 7

2.1. The theoretical literature on economic growth 7
2.1.1. The basic neo-classical model 7
2.1.2. Endogenous growth models 8
2.1.3. Endogenous growth models focusing on human capital 8
2.1.4. Endogenous growth models focusing on the accumulation of knowledge 11
2.1.5. Concluding remarks on growth theories 12
2.2. Applications of neo-classical theory to economic integration 13
2.2.1. Allocation effects 13
2.2.2. Accumulation effects 14
2.2.3. Location effects 15
2.3. Empirical literature 16
2.3.1. Barro-style regressions 16
2.3.2. Empirical results using Barro-style regressions 17
2.3.3. Criticisms of the Barro-style regressions approach 19
2.4. The research strategy adopted for the present study 20

3. Growth and convergence trends in Europe, 1975–93 25

3.1. Analysis at the European Union and Member State level 25
3.1.1. Growth trends: aggregate analysis 26
3.1.2. Growth trends: broad sectoral analysis 29
3.1.3. Growth trends: more detailed sectoral analysis 30
3.2. Analysis at the regional level 32
3.2.1. Growth trends: aggregate analysis 34
3.2.2. The evolution of measures of inequality and clustering 35

4. Econometric analysis of growth and convergence 77

4.1. Analysis at Member State level 77
4.1.1. Description of the model 77

4.1.2. Results at Member State level 79
4.2. Analysis including other OECD countries 83
4.2.1. Results for OECD data set 84
4.2.2. Conclusions 85
4.3. Analysis at regional level 86
4.3.1. Description of the model 86
4.3.2. Results at regional level 87
4.3.3. The Markov chain analysis 93
4.3.4. Analysis of regional productivity and employment growth by sector 96

Appendix A. The database 123

A.1. Member State level 123
A.2. Regional level 123
A.3. Improvements to data 124
A.3.1. REGIO 124
A.3.2. CRONOS 125

Appendix B. Analytical tools 129

Appendix C. Tables 131

Bibliography 155

List of tables

Table 3.1.	GDP growth and the impact from integration, 1987–93, cumulative difference with average annual observed growth rate for 1981–90 (%)	37
Table 3.2.	GVA per capita growth rates after 1987 compared with 1975–87 trend	38
Table 3.3.	GVA growth rates after 1987 compared with 1975–87 trend	38
Table 3.4.	Average investment to output ratio	39
Table 3.5.	Average R&D spending to output ratio	40
Table 3.6.	GVA growth rates after 1987 compared with 1975–87 trend – manufacturing	41
Table 3.7.	GVA per worker growth rates after 1987 compared with 1975–87 trend – manufacturing	42
Table 3.8.	GVA growth rates after 1987 compared 1975–87 trend – market services	43
Table 3.9.	GVA per worker growth rates after 1987 compared with 1975–87 trend – market services	44
Table 3.10.	GVA growth rates after 1987 compared with 1975–87 trend – construction	45
Table 3.11.	GVA per worker growth rates after 1987 compared with 1975–87 trend – construction	46
Table 3.12.	EU-12 sectoral growth trends	47
Table 3.13.	EU-9 sectoral growth trends	48
Table 3.14.	Objective 1 sectoral growth trends	49
Table 3.15.	Japan sectoral growth trends	50
Table 3.16.	US sectoral growth trends	51
Table 3.17.	EU-12 sectoral shares	52
Table 3.18.	EU-9 sectoral shares	53
Table 3.19.	Objective 1 sectoral shares	54
Table 3.20.	Japan sectoral shares	55
Table 3.21.	US sectoral shares	56
Table 3.22.	Trend growth in GVA per capita in selected groups of regions	57
Table 3.23.	Trend growth in employment in selected groups of regions	57
Table 3.24.	Comparison of per capita GVA inequality indicators for region groups pre-1987 and post-1987	58
Table 4.1.	Unconditional beta-convergence	100
Table 4.2.	Growth regressions: OLS estimates (EU-12 countries)	100
Table 4.3.	Growth regressions: IV estimates (EU-12 countries)	101
Table 4.4.	Growth regressions: OLS estimates (EU-12 countries)	102
Table 4.5.	Growth regressions: OLS estimates (EU-12 + 2 countries)	103
Table 4.6.	Growth regressions: IV estimates (EU-12 + 2 countries)	104
Table 4.7.	Growth regressions: OLS estimates (EU-12 + 2 countries)	105
Table 4.8.	Unconditional beta-convergence over the period 1975–87 (OECD countries)	105
Table 4.9.	Unconditional beta-convergence over the period 1987–93 (OECD countries)	106
Table 4.10.	Growth regressions: OLS estimates (OECD countries)	106
Table 4.11.	Regressions based on 1987–93 growth (without country dummies)	107
Table 4.12.	Regressions based on 1975–87 growth (without country dummies)	108
Table 4.13.	Regressions based on 1987–93 growth (with country dummies)	109

Table 4.14. Regressions based on 1975–87 growth (with country dummies) 110
Table 4.15. Cross-tabulation of regions, 1975–87 110
Table 4.16. Transition probabilities 111
Table 4.17. Equilibrium probability vector using the 1975–87 observed transition probabilities 111
Table 4.18. Cross-tabulation of regions, 1987–93 111
Table 4.19. Transition probabilities 112
Table 4.20. Equilibrium probability vector using the 1987–93 observed transition probabilities 112

Table C.1. Regressions based on 1987–93 growth (without country dummies) 131
Table C.2. Regressions based on 1975–87 growth (without country dummies) 131
Table C.3. Regressions based on 1987–93 growth (with country dummies) 132
Table C.4. Regressions based on 1975–87 growth (with country dummies) 132
Table C.5. Regressions based on 1987–93 growth: maximum likelihood estimates (without country dummies) 133
Table C.6. Regressions based on 1975–87 growth: maximum likelihood estimates (without country dummies) 134
Table C.7. Regressions based on 1987–93 growth: maximum likelihood estimates (without country dummies) 135
Table C.8. Regressions based on 1975–87 growth: maximum likelihood estimates (without country dummies) 136
Table C.9. Regressions based on 1987–93 productivity growth (without country dummies) – agriculture 137
Table C.10. Regressions based on 1975–87 productivity growth (without country dummies) – agriculture 137
Table C.11. Regressions based on 1987–93 productivity growth (with country dummies) – agriculture 138
Table C.12. Regressions based on 1975–87 productivity growth (with country dummies) – agriculture 138
Table C.13. Regressions based on 1987–93 productivity growth (without country dummies) – manufacturing 139
Table C.14. Regressions based on 1975–87 productivity growth (without country dummies) – manufacturing 139
Table C.15. Regressions based on 1987–93 productivity growth (with country dummies) – manufacturing 140
Table C.16. Regressions based on 1975–87 productivity growth (with country dummies) – manufacturing 140
Table C.17. Regressions based on 1987–93 productivity growth (without country dummies) – construction 141
Table C.18. Regressions based on 1975–87 productivity growth (without country dummies) – construction 141
Table C.19. Regressions based on 1987–93 productivity growth (with country dummies) – construction 142
Table C.20. Regressions based on 1975–87 productivity growth (with country dummies) – construction 142
Table C.21. Regressions based on 1987–93 productivity growth (without country dummies) – market services 143

Table C.22. Regressions based on 1975–87 productivity growth (without country dummies) – market services 143
Table C.23. Regressions based on 1987–93 productivity growth (with country dummies) – market services 144

Table C.24. Regressions based on 1975–87 productivity growth (with country dummies) – market services 144
Table C.25. Regressions based on 1987–93 productivity growth (without country dummies) – non-market services 145
Table C.26. Regressions based on 1975–87 productivity growth (without country dummies) – non-market services 145
Table C.27. Regressions based on 1987–93 productivity growth (with country dummies) – non-market services 146
Table C.28. Regressions based on 1975–87 productivity growth (with country dummies) – non-market services 146
Table C.29. Summary of productivity transitions by sector using Markov chain analysis 147
Table C.30. Regressions based on 1987–93 employment growth: OLS estimates 148
Table C.31. Regressions based on 1975–87 employment growth: OLS estimates 149
Table C.32. Regressions based on 1987–93 employment growth: OLS estimates 150
Table C.33. Regressions based on 1975–87 employment growth: OLS estimates 150
Table C.34. Regressions based on 1987–93 growth (without country dummies) 151
Table C.35. Regressions based on 1987–93 growth (with country dummies) 151
Table C.36. List of variables used in the Member State regressions 152
Table C.37. List of variables used in the regional regressions 153

List of figures

Figure 2.1.	The Solow–Swan model	22
Figure 2.2.	Unconditional beta-convergence in Solow–Swan model	22
Figure 2.3.	Conditional beta-convergence in the Solow–Swan model	23
Figure 2.4.	Induced capital formation in the Solow–Swan model	23
Figure 3.1.	GVA per capita levels	59
Figure 3.2.	GVA per capita levels	59
Figure 3.3.	Population levels	60
Figure 3.4.	Investment to output ratio	61
Figure 3.5.	Investment to output ratio	61
Figure 3.6.	Italy – GVA shares	62
Figure 3.7.	GVA per capita ratio (Italy)	62
Figure 3.8.	Spain – GVA shares	63
Figure 3.9.	GVA per capita ratio (Spain)	63
Figure 3.10.	Standard deviation of log GVA per capita levels, 1975–93, across Member States	64
Figure 3.11.	Beta-convergence	64
Figure 3.12.	GVA levels – manufacturing	65
Figure 3.13.	GVA levels – manufacturing	65
Figure 3.14.	GVA levels – market services	66
Figure 3.15.	GVA levels – market services	66
Figure 3.16.	GVA levels – construction	67
Figure 3.17.	GVA levels – construction	67
Figure 3.18.	GVA per capita – Objective 1 regions	68
Figure 3.19.	GVA per capita – periphery regions	68
Figure 3.20.	GVA per capita – northern versus southern regions	69
Figure 3.21.	GVA per capita – regions distinguished by economic structure	69
Figure 3.22.	GVA per capita – Objective 2 regions	70
Figure 3.23.	GVA per capita – border regions	70
Figure 3.24.	Employment – Objective 1 regions	71
Figure 3.25.	Employment – periphery regions	71
Figure 3.26.	Employment – northern versus southern regions	72
Figure 3.27.	Employment – regions distinguished by economic structure	72
Figure 3.28.	Employment – Objective 2 regions	73
Figure 3.29.	Employment – border regions	73
Figure 3.30.	Standard deviation of log GVA per capita levels, 1975–93, across regions	74
Figure 3.31.	The Gini coefficient, 1975–93, for GVA per capita in the EU-12	74
Figure 3.32.	The standardized Moran's I, 1975–93, for GVA per capita in the EU-12	75
Figure 4.1.	Residuals from regression based on 1987–93 growth: unconditional convergence (without country dummies)	113
Figure 4.2.	Residuals from regression based on 1987–93 growth: conditional convergence, direct effects (without country dummies)	114
Figure 4.3.	Residuals from regression based on 1975–87 growth: unconditional convergence (without country dummies)	115

Figure 4.4.	Residuals from regression based on 1975–87 growth: conditional convergence, direct effects (without country dummies)	116
Figure 4.5.	Residuals from regression based on 1987–93 growth: unconditional convergence (with country dummies)	117
Figure 4.6.	Residuals from regression based on 1987–93 growth: conditional convergence, direct effects (with country dummies)	118
Figure 4.7.	Residuals from regression based on 1975–87 growth: unconditional convergence (with country dummies)	119
Figure 4.8.	Residuals from regression based on 1975–87 growth: conditional convergence, direct effects (with country dummies)	120
Figure 4.9.	Recursive parameter estimates: total effects without country dummies	121
Figure 4.10.	Recursive parameter estimates: total effects with country dummies	121
Figure 4.11.	Recursive parameter estimates: direct effects without country dummies	122
Figure 4.12.	Recursive parameter estimates: direct effects with country dummies	122
Figure A.1.	Data coverage at Member State level	126
Figure A.2.	Objective 1 regions	127
Figure A.3.	Objective 2 regions	127

List of abbreviations

CE	Cambridge Econometrics
ERM	exchange-rate mechanism
Eurostat	Statistical Office of the European Communities
GVA	gross value added
IV	instrumental variable
NACE	general industrial classification of economic activities within the European Communities
NACE-CLIO	Eurostat's standard sectoral classification
NAFTA	North American Free Trade Agreement
NUTS	nomenclature of territorial units for statistics (Eurostat)
OECD	Organization for Economic Co-operation and Development
OLS	ordinary least squares
p.a.	per annum
PPS	purchasing power standard
R&D	research and development
SMP	single market programme

Country codes

BE	Belgique/België (Belgium)
DK	Danmark (Denmark)
DW	BR Deutschland (FR of Germany/West Germany)
EL	Elláda (Greece)
ES	España (Spain)
FR	France
IR	Ireland
IT	Italia (Italy)
LX	Luxembourg
NL	Nederland (Netherlands)
PO	Portugal
UK	United Kingdom

1. Summary

This study examines the extent to which growth and economic convergence have been affected by the single market programme (SMP).

The study begins with a review of the theoretical and empirical literature. It then describes the historical trends in growth and convergence at the levels of the Member States and NUTS 2 regions of the EU, and then applies econometric techniques to analyse these trends, looking for evidence of a change in behaviour since 1987 (taken as the first year in which SMP effects might have begun to occur).

It is important to note the limitations of this study. Some limitations are imposed by data availability, particularly at the detailed sectoral or regional levels. We believe that we have developed the best database available for such analysis, but some estimates are particularly uncertain. Other limitations reflect the relatively short time period since the SMP measures were introduced. Many of the impacts expected, particularly those of the most dynamic (and speculative) kind, are unlikely to have had their full effect in the period for which data are available. Both kinds of limitations are reflected in the quality of the econometric estimates, which are generally suggestive rather than conclusive.

Finally, the methods used here examine whether growth and convergence performance in Europe has changed since 1987. Data are not available for some factors likely to affect growth other than the SMP, and some of the factors 'controlled for' in the econometric analysis may themselves be the vehicle through which the SMP makes an important impact. This is particularly likely to be the case for investment and R&D spending, which may have been boosted by the SMP.

1.1. Review of the theoretical and empirical literature

Conventional neo-classical theory (pp. 7–8) predicts that the reduction of barriers to trade associated with economic integration will lead to a step increase in allocative efficiency, and hence in income per capita. Growth will accelerate in the transition to a new equilibrium. The theory does not offer any explanation of sustained long-run growth, which is regarded as being given by exogenous technical progress, and so does not identify any contribution from economic integration to a higher long-run growth rate.

Conventional neo-classical theory further predicts a tendency for poorer regions to show faster growth than richer regions under certain simplifying assumptions, because both are considered to be converging toward the same level of per capita income. Under weaker assumptions, regions may be converging on different equilibrium levels of per capita income, and their growth rate is inversely related to the difference between their present per capita income and their equilibrium level.

More recent, so-called 'endogenous growth', theories (pp. 8–12) have sought to provide a theoretical framework within which per capita income does not tend to converge on a technologically-given equilibrium value. The theories emphasize various processes, including the role of human capital, innovation and knowledge capital, and spillover effects. They generally share the common feature that social returns to investment (broadly defined) are not diminishing, so that exogenous technical progress is no longer required as a *deus ex machina* to prevent per capita income growth from stagnating. This opens up the possibility that economic integration can contribute to a higher long-run growth rate, by stimulating the accumulation of those forms of capital to which returns are not diminishing. However, the same feature makes it uncertain as to whether poorer regions will tend to show faster growth than richer regions, and allows the possibility of a cumulative causation process that could widen regional disparities.

The empirical literature has been heavily influenced by a methodology popularized by Barro (see Section 2.3.1), in which the average per capita income growth of a cross-section of countries or regions is explained by their starting point (e.g. per capita income, human capital endowment); by variables intended to measure factor accumulation; and by other influences (including trade and policy variables). The result – that low starting per capita income tends to be associated with higher growth, given other factors – has been found in several studies. Recently, this methodology has been criticized on grounds of both economic and econometric theory.

In the literature, the role of investment appears too important in explaining growth (pp. 17–19), but there is evidence that this is partly because investment itself is stimulated by growth. Similarly, when investment is included as an explanatory variable, other variables including those measuring trade and integration are often rendered insignificant. This can be interpreted as meaning that the impact of integration on growth comes mainly through higher investment.

1.2. Growth and convergence trends in Europe, 1975–87 and 1987–93

Most European economies saw an improved performance relative to the US and Japan in the post-1987 period, compared with the 1975–87 experience. The largest improvements were in the Objective 1 countries (see Figure A.2 for map of regions), with the exception of Greece and southern Italy (pp. 25–29).

At the sectoral level, particularly strong growth in the post-1987 period with respect to historical trends was detected for the transport industries across the whole of Europe (p. 31).

Over the post-1987 period, industries related to infrastructure works in the Objective 1 countries greatly outperformed both their historical trends and the growth rates in other industries. This probably reflects the role of spending under the Structural Funds (p. 31).

In the post-1987 period, GVA per capita in Objective 1 and peripheral regions grew faster than over the period 1975–87. This contrasts with the growth in non-Objective 1 and non-peripheral regions, which was slower after 1987 than before (pp. 34–35). GVA per capita in Objective 2 regions (see Figure A.3 for map of regions) grew more slowly than in other regions, before and after the SMP. Border regions, which tended to grow slightly faster than interior regions prior to the SMP, increased their growth advantage after 1987; growth slowed noticeably in interior regions, in comparison (pp. 34–35). Analysis of employment growth shows a similar picture. In the post-1987 period, Objective 1, peripheral and border regions appear to have improved their pre-1987 position. Regions specializing in manufacturing appear to have outperformed the other regions in the post-1987 period with respect to both GVA per capita and employment growth.

Measures of inequality and clustering give an overall impression of a significant and enduring contrast between the richer core and poorer peripheral regions. Nonetheless, there is some indication of a trend towards lower inequality and lower clustering, but this began long before the SMP (pp. 35–37).

1.3. Econometric analysis of growth and convergence

In the discussion that follows it should be noted that the 'impact of the SMP' has been represented in the analysis simply by testing for a change in the experience after 1987, given the values taken by the explanatory variables included in the analysis.

1.3.1. Results at Member State level

Prima facie, the period of the SMP appears to have been one in which overall growth in the EU was faster, and convergence across the European economies accelerated. The poorest economies grew faster than the rest of Europe in the post-1987 period. The effect appears to be more correlated with the period of implementation of the SMP than with joining the EU (pp. 79–80).

However, estimates of the impact of the SMP are not robust to changes in the specification of the basic model (pp. 81–82). A positive (and significant) coefficient on the dummy variable used to represent the SMP was found only when controlling neither for Objective 1 countries nor for investment and R&D spending to output ratios. Once these variables are included, the SMP coefficient becomes, sometimes significantly, negative. Similarly, the tendency for poorer economies to grow faster than rich economies is not apparent once the Objective 1 countries are excluded. A possible interpretation is that the SMP has had a positive impact on growth, and that this came about through a stimulus to investment and R&D, and by stimulating growth in the Objective 1 countries (particularly Ireland). The latter effect fostered the convergence process inside the EU. The analysis did not find evidence of an impact on growth independent of these effects (due, say, to improved allocative efficiency).

In summary, therefore, a more careful analysis of the data suggests that, insofar as growth accelerated during the SMP period, this was due to higher investment and R&D spending. There is little evidence of any general acceleration in the neo-classical convergence under the SMP, but the catching-up process of the Objective 1 countries does not appear to have been hampered, and may have been helped. Ireland's particularly strong performance is not explained fully by other factors in the study, suggesting that it may have benefited particularly from the SMP (p. 81).

Results consistent with those outlined above are obtained when growth equations are estimated across the set of OECD countries, and so the effects appear to be specific to the EU Member States, rather than merely a reflection of some global trend (pp. 83–86).

At the sectoral level, there is some indication of a positive impact of the SMP on convergence in productivity (output per worker) across the European economies, but only for a group of industries that could be described as more traditional: coal and coke; gas supply; electricity; food, drink and tobacco; and textiles, clothing and footwear. In these industries there is no evidence of a positive impact of the SMP on productivity growth in the richest countries. In a number of engineering industries, including electrical goods, transport equipment, agricultural and industrial machinery and metal products, the opposite appears to be true: productivity growth appears to have strengthened after 1987 in the richest countries and to have weakened in the poorest (p. 83).

1.3.2. Results at regional level

Analysis at the regional level suggests that there was a faster rate of 'unconditional' convergence (i.e. simply comparing growth rates with starting per capita income levels) post-1987. This appears (p. 88) to be due to an improved performance by the 'problem' regions (border, Objective 1 and Objective 2) after 1987, since convergence was proceeding at a slightly faster rate and these regions were no longer performing 'below par' – where 'par' is the growth rate expected on the basis of starting per capita income (the equation suggests that, all things being equal, poorer regions would experience faster growth).

The indication of faster (unconditional) convergence after 1987 was not apparent within countries (pp. 88–89). In other words, the indication that the performance of poorer regions improved after 1987 appears to be mainly due to a better performance by poorer countries.

The apparent improved performance by poorer regions post-1987 may have been due to a greater level of spending under the Structural Funds, rather than to the effect of the SMP. Unfortunately, data on spending under the Structural Funds by regions were not available for the study. A preliminary index for spending for inhabitants in the 1989–93 period was constructed by the European Commission's Directorate-General for Economic and Financial Affairs (DG II), but when this was included in the growth equation it did not attract explanatory power from the other variables (p. 93). In other words, differences in Structural Funds spending in the 1989–93 period did not help to explain differences in growth performances. That being so, there was no evidence that making explicit allowance for Structural Funds spending would explain the change in performance of poorer regions post-1987, although, in the absence of pre-1987 data, one cannot be sure. This does not mean that the Structural Funds spending had no impact, but it does suggest (subject to the data limitations) that the demand-side effects of Structural Funds spending do not dominate other reasons for differences in regional growth. The supply-side effects would probably not be apparent after such a short period.

Markov chain analysis indicates that the equilibrium implied by regional growth rates in the post-1987 period is characterized by greater economic convergence than that implied by growth rates in the pre-1987 period (see Section 4.3.3). Also, the rate at which equilibrium is being approached appears to have accelerated. However, this rate is slow.

Barro-style equations, using growth in the employment rate (employment divided by total population) as the dependent variable, were also estimated. In the pre-SMP period there was some indication that regions with lower employment rates should see a faster rate of increase. This tendency was not evident in the post-SMP period. However, in the pre-SMP period the convergence effect (in employment rates) seems to have been led by convergence within the rich core of Europe, while in the post-SMP period convergence seems to reflect the fact that 'problem' regions no longer tend to have a weaker employment performance. A major role is played by GVA per capita growth and changes in the participation rate: regions with lower employment rates experienced higher per capita GVA growth and larger increases in participation rates, and therefore a larger increase in their employment rates (pp. 97–99).

The estimation of Barro-style growth equations at the five-sector level gives an indication of a slower progress towards convergence in productivity levels over the post-SMP period than over the pre-SMP period. Markov chain analysis of productivity growth rates by sector also supports the overall picture of slower productivity convergence after the SMP, compared with the earlier period. This result can be interpreted, in the light of the results reported earlier for GVA per capita and employment rates, as follows. 'Problem' regions saw an improved performance in the post-SMP period with respect to the pre-SMP period in terms of an increase in employment rates, even after having controlled for their stronger growth in GVA per capita. It is perhaps explained by the finding that GVA growth in the poorest countries was particularly strong in (low-productivity) infrastructure-related industries (pp. 96–97).

2. Review of the theoretical and empirical literature

This chapter surveys briefly the main contributions to economic growth theory, and identifies the predicted effects of the implementation of an integration programme on overall growth and the distribution of activity among richer and poorer regions. This chapter begins with a review of the theoretical literature on economic growth, and then discusses how this has been applied to the issue of economic integration. The literature of relevant empirical studies is then discussed, and the implications for the present study are set out.

2.1. The theoretical literature on economic growth

2.1.1. The basic neo-classical model

The basic neo-classical model, developed following Solow [1956], describes a one-sector closed economy with a composite, single 'Robinson Crusoe' agent (household/producer) who owns the inputs and manages the production process.

The model assumes a standard neo-classical production function with two factors, capital and labour, both subject to diminishing returns and constant returns to scale. The output is a homogeneous good that can be consumed or invested to add to the stock of physical capital. The saving ratio is exogenously given, and the consequences of endogenizing saving behaviour are examined later. In such a closed economy, saving determines investment and hence the rate of capital accumulation. Capital depreciation is assumed to be a constant fraction of the stock of capital. Population growth is exogenous (and, for simplicity, constant) and this determines the rate of increase of labour inputs. There is no involuntary unemployment.

The dynamics of such an economy are straightforward. Figure 2.1 depicts the per capita production function, $f(k)$, and the gross per capita saving function, $s^*f(k)$, a constant fraction of the former. The straight line, $(n+\delta)k$, represents the depreciation function, showing the investment required to maintain a constant per capita capital stock, given the population growth, n, and the depreciation rate, δ, constant. Saving and investment are measured in the same units as output per capita, y. In this economy, point A represents a steady-state position in which the per capita capital stock is such that the output produced generates sufficient saving and investment to match exactly the amount of new capital needed to maintain the per capita capital stock. At this point output, consumption and capital stock all grow at the same rate as population and the labour supply. Moreover, this is a stable steady-state, ensured by diminishing returns on the per capita capital ratio. Starting from a value of this ratio below k^*, the returns are higher, so that saving (and therefore investment) will tend to increase the amount of capital available to each worker, and conversely for a starting value greater than k^*.

Two main conclusions follow from this model:

(a) Poorer economies (defined in terms of per capita capital stock and output) grow faster (see Figure 2.2), given the same parameters determining the steady-state equilibrium of the economy. If differences in these parameters are allowed across economies, only a relative assertion can be made, that is, an economy grows faster the further it is from its steady state. Under these conditions a richer economy could experience a higher per capita output growth rate if it is further from its steady-state equilibrium (see

Figure 2.3). In the literature, these two properties have been labelled respectively as unconditional beta-convergence and conditional beta-convergence.

(b) Sustained per capita income growth (a 'stylized fact' about actual economies) can only be explained by exogenous shifts through time of the production function. This exogenous technological progress becomes the determinant of the long-run rate of growth.

The above analysis relies on the assumption of a constant saving rate. When saving is endogenized, as in any intertemporal optimization problem, the individual chooses the saving ratio to equate the (marginal) cost and benefit of saving. The benefit is the real return on saving, that is, the marginal productivity of capital less the depreciation rate. The cost reflects pure time preferences: individuals prefer consumption today to consumption tomorrow. This cost is represented by the discount rate that individuals apply to consumption tomorrow. The main conclusions of the Solow model are not changed by the fact that the steady-state value of per capita income, per capita capital and per capita consumption now depend on the intertemporal time preferences of individuals, rather than directly on the saving ratio (see Ramsey [1928], Cass [1965], Koopmans [1965]).

2.1.2. Endogenous growth models

The failure of the basic neo-classical model to provide a satisfactory model of long-term per capita output growth has been addressed by the 'new' endogenous growth theories which seek to endogenize the sustained accumulation of factors, among which they include human capital and knowledge capital. In particular, they focus attention on the micro-foundations of the accumulation process, that is, on the private and social costs and benefits of investing in physical capital, skill (human capital) or technological progress (knowledge capital).

Although the details differ among models, the key requirement is that if the investment rate is to remain constant in the long run, then the return to investment faced by self-interested investors has to be non-diminishing in the capital stock.

The requirement of a constant private return on investment (independent of the capital stock), however, implies that the investment function is not 'well-behaved'. Depending on whether the intertemporal benefit of investing is negative, positive, or equal to zero, investors will invest an infinite amount, nothing or an indefinite amount. For the investment function to be well-behaved, there must be a wedge between the private and public returns to investment. The return to investment faced by private investors is perceived as diminishing with respect to the capital stock, but the social or economy-wide return does not decline.

The different strands of endogenous growth theory are described in more detail below in two groups: the first stressing the importance of the accumulation of human capital, the second the importance of sustained innovation.

2.1.3. Endogenous growth models focusing on human capital

Lucas [1988] proposed a model in which the engine of growth is the accumulation of human capital, defined as the quality of labour an individual is able to supply, i.e. their general skill level. Hence a worker with human capital $h(t)$ is the productive equivalent of two workers with human capital $1/2\ h(t)$. The theory hypothesizes that the way an individual allocates his time over various activities in the current period affects their productivity, or $h(t)$ level, in the future. Introducing human capital into the production function implies the need to investigate both how current human capital affects the same period production, and how the current allocation of time by the individual affects the accumulation of human capital.

In this closed economy with an exogenous growth rate of population, there are two kinds of capital, or 'state variable': physical capital, which is accumulated and utilized in production of goods according to a standard neo-classical production function, and human capital, which enhances the productivity of both human and physical capital, and is accumulated according to a technology having the particular feature of constant returns to the level of human capital.

The individual allocates time between current production (let $u(h)$ be the proportion of time spent on current production) and education (that is the accumulation of human capital, with proportion $(1-u(h))$).

The production function for the production sector is then:

$$Y(t) = A\ K(t)^{\beta}\ He(t)^{(1-\beta)}\ Ha(t) \tag{2.1}$$

where:
A = technological constant factor;
K = physical capital;
He = effective labour;
Ha = average human capital level in the population;
t = time;

and:

$$He_t = u(t)\ h(t)\ N(t) \tag{2.2}$$

represents the effective workforce, given by the sum of time devoted to production by each agent multiplied by their individual skill level. Each agent's earnings is assumed to depend positively on their skill level $h(t)$ (this is the internal effect of human capital).

The term:

$$Ha = \frac{\int_0^{\infty} h\,N(h)\,dh}{\int_0^{\infty} N(h)\,dh} \tag{2.3}$$

in Equation 2.1 captures the external effect of human capital: the average level of skill (or human capital) contributing to the productivity of all factors of production. It is described as 'external' because no individual human capital accumulation decision can have an appreciable effect on Ha, so no one will take it into account in deciding how to allocate their time. It represents an externality driving a wedge between individual and social returns.

The problem for the representative agent is to maximize the function described in Equation 2.1, subject to the following constraints:

$$dK(t)\big/_{dt} = Y(t) - N(t)\,c(t) \tag{2.4}$$

(2.5) $$\frac{dh(t)}{dt}=h(t)^{\xi}\,G(1-u(t)),G'>0$$

where:
$c(t)$ = individual's optimal consumption at time t;
$N(t)$ = population (= raw labour).

The latter equation, representing the 'law' of accumulation of human capital, plays a fundamental role in the analysis. If it is assumed that $\xi<1$, i.e. diminishing returns to the accumulation of human capital, human capital cannot serve as an alternative engine of growth to the exogenous technological progress of the Solow model. Lucas assumed that returns to the stock $h(t)$ are not diminishing: a given percentage increase in $h(t)$ will require the same effort, no matter what level of $h(t)$ is already attained. The assumption of constant returns to scale to some accumulative factor is central in the theory.

This assumption seems at first to be counter-intuitive: individuals accumulate human capital rapidly in the early stages of their life, then less rapidly, then not at all, as if diminishing returns were experienced. An alternative explanation, however, is that because individuals have a finite lifetime, the returns to any skill level increment falls with age. Rosen [1976] showed that $\xi=1$ is consistent with empirical evidence on individual earnings. However, even if Equation 2.5 is accepted for the finite-life individual, further assumptions are required in order to derive this form of human capital technology for the infinite-life representative household from the finite-life individual. It needs to be assumed that each individual's capital accumulation follows Equation 2.5, and that the initial level with which each new member begins is proportional to the levels already attained by the old members of the family. As emphasized by Lucas [1988] himself:

> *this is simply one instance of a general fact: that human capital accumulation is a social activity, involving groups of people, in a way that has no counterparts in the accumulation of physical capital.*[1]

The dynamics of this model are different from those of the Solow model and have different implications for convergence and long-run growth.

Asymptotically, the marginal product of physical capital tends to a constant, determined essentially by the time preferences rate. This is no longer associated with a given long-run stock of physical capital per capita, as it was in the Solow model, but rather with a curve in the physical capital–human capital space. The system will converge to this curve from any initial configuration of capital stocks. Having once converged on this curve, human capital and physical capital grow together at the same rate, sustaining perpetual growth in the economy. This steady state is characterized by a constant value of the physical to human capital ratio and by a positive growth rate of (per capita) human capital, (per capita) physical capital, (per capita) income and (per capita) consumption. This long-run growth rate depends on the parameters of the model, including the depreciation rate of human and physical capital and intertemporal time preferences. The point to which the system converges depends on the initial conditions. In particular, economies that are initially poorer will remain poorer, though their

1 Lucas [1988], p. 19.

long-run rate of per capita income growth will be the same as that of initially (and permanently) richer economies.

In the transitional dynamics toward the steady state, the growth rate of consumption and broad output (output from both goods and education sectors) tend to be inversely related to the *(K/H)* ratio. Hence, these growth rates tend to be higher if human capital is abundant relative to physical capital, and lower if human capital is relatively scarce. The model therefore predicts that an economy will recover faster in response to a war that destroys mainly physical capital, than to an epidemic that destroys mainly human capital.

While Lucas discusses extensively the 'spillover' effect, that is, the effect of each individual's human capital on the productivity of others and of physical capital, his model's results actually rely crucially on the assumption of constant returns in the human capital production function: the same effort expended in obtaining education must always produce the same percentage increase in the amount of human capital, whatever the initial level of the state variable. This assumption can be relaxed if one assumes that physical capital is also included in the education sector production function. In this case, the spillover effect can ensure constant returns to the accumulation factors in the goods sector. Hence, diminishing returns need not arise when physical and human capital grow at the same rate. Thus, in the steady state, rates of return remain constant, and the economy can grow at a constant rate. The qualitative results of the simpler model, with respect to the transitional dynamics to the steady state, are shown by Barro and Sala-i-Martin [1995] not to change in these generalized models. However, in the case where spillover effects are large, multiple equilibria can arise, as shown by Krugman [1991] among others.

2.1.4. Endogenous growth models focusing on the accumulation of knowledge

Solow [1957] estimated that about 80% of US GDP growth between 1880 and 1950 came from technological progress. In the basic neo-classical model, the sustained growth observed in actual economies can be explained only by introducing an exogenous growth rate of technological progress. A second strand of 'new' endogenous growth theories tries to endogenize technological progress, that is, the process by which the same inputs of labour and capital can produce more output. Technological progress is nothing other than 'knowledge creation', and sustained technical knowledge creation leads to a continually rising stock of 'knowledge'. This sort of accumulative production factor is usually labelled in the growth literature as 'knowledge capital'. Some have argued that technology is driven by science, which may proceed at a pace and in a direction that is largely independent from the economic incentives, but the commercial exploitation of scientific ideas almost always requires a substantial investment of resources, as observed by Grossman and Helpman [1994].

This strand of the literature is generally regarded as having been initiated by Romer [1986], and subsequently a variety of different models have been developed, all focusing on the microfoundations of the firm's decision to invest in productivity-boosting innovations. In his early papers, Romer developed a model very similar to that of Lucas, in which technology that raises the productivity of all factors is endogenously provided as a side-effect of private investment decisions. From the point of view of users, technology is still treated as a pure public good, just as in the basic neo-classical model. As a result, firms are price takers and an equilibrium with many firms exists. In fact, Romer assumes the following aggregate production function:

(2.6) $$Yj = A(R)\ F(Rj, Kj, Lj)$$

where:
Y, K, L, A are as before; and
Rj stands for the stocks of results from expenditure on R&D by firm *j*.

He further assumes that improvements in the public stock of knowledge, *A*, arise through spillovers from private research effort. This is appealing because it implies that firms invest in R&D for private gain, and that spillovers or incomplete property rights are associated with the results of research and development. However, if it is assumed that the function *F(*)* is homogenous of degree one in all factors (as Romer [1986] did, to be consistent with a price-taker equilibrium framework, with no monopoly power), knowledge is treated as a 'rival' good, grouped together with physical capital and labour as costly factors amongst which the producer must choose, whereas the aim is to treat knowledge as 'non-rival', i.e. essentially a public good once created. But if *Rj* is treated as non-rival, this would not be consistent with the perfectly competitive framework in which Romer was seeking to develop his analysis.

The fundamental lesson coming from the discussion above is that some form of monopolistic competition appears to be needed to establish an equilibrium with knowledge treated as a non-rival input (see Romer [1990], Grossman and Helpman [1989]). Firms must be able to sell their products at prices in excess of unit production costs if they are to recover their up-front outlays in R&D. These models which, like Romer's [1990], often combine both monopoly power and spillover effects coming from incomplete intellectual property rights, have the characteristic that monopoly profits motivate the generation of new knowledge. Firms devoting resources to R&D buy themselves a chance to develop the next generation of some targeted product. Newcomers can enter freely into research activity, and firms will invest in R&D up to the point where the marginal cost of additional input into R&D equals the expected gains (increased probability of success times the market value of the new product) that those inputs provide. This sort of model predicts sustained growth in per capita output because of the continuing introduction of new innovations.

The growth process therefore assumes a Schumpeterian flavour. At the micro level, the growth process is in fact uneven and stochastic. Firms continually race to bring out the next generation of products, but there may be long periods without success in some industries. Meanwhile, other industries may experience a rapid succession of research breakthroughs. Aggregation masks this micro-level turbulence, and the macroeconomy grows at a steady pace. The costs and benefits of industrial research determine the pace of long-term growth.

2.1.5. Concluding remarks on growth theories

All the endogenous growth theories are characterized by some form of spillover. In the Lucas type models, based on human capital, the individual's private effort to improve his or her own skills will also improve productivity of other workers and of physical capital. In the same way, a firm's private effort to innovate, to exploit temporary monopolistic rent, will also increase the public stock of knowledge. The existence of these externalities imply that the market allocation of resources may not be optimal, opening up the possibility of a justification for policy intervention.

In this view,

> *both markets and free trade are good, but the traditional answer to explain why they are good, based on perfect competition and Pareto optimality, is becoming untenable. Something more interesting and more complicated is going on here.*[2]

2.2. Applications of neo-classical theory to economic integration

The discussion in Section 2.1 has focused on explanations of per capita income growth. The role of trade, and in particular a reduction in barriers to trade, has not been considered explicitly, although implications can be drawn out. This section reviews the discussion in the literature relating to the impact of integration on the overall level of activity, and on its distribution across the different economies involved in the programme.

The SMP represents a number of measures to remove, in standard international-trade terminology, non-domestic rent-creating barriers, such as border formalities; public procurement regulations; and non-uniform technical standards in production, packaging and marketing. Analysis of the effects can be classified into three categories: allocation, accumulation and location effects.

2.2.1. Allocation effects

The allocation effects of economic integration are usually understood to refer to the possible welfare gains following a more efficient allocation of the same quantity of factors of production. It should be noted that in conventional theory, a more efficient allocation of resources will raise the level of output per capita, not its long-run growth rate (i.e. after the transition to the new equilibrium has been completed). In what follows, these predicted static effects of the SMP are sketched out, to indicate the possible consequences for the focus of the present study, namely the impact of the SMP on the dynamic process of factor accumulation.

Under conditions of perfect competition and non-increasing returns to scale, the welfare gain from reducing non-domestic rent-creating barriers will come in the form of lower consumer prices, as imports are substituted for products which it is not efficient to produce domestically. In the case of a new customs union, the possibility of welfare losses due to the imposition of restrictions on trade with countries outside the union has to be considered, but this is not relevant for the SMP.

Allowing for the existence of imperfect competition and economies of scale creates additional possible welfare changes:

(a) Pure profit effect: imperfect competition allows the price to exceed marginal cost, so that induced shifts in production may shift rents to or away from the home country.
(b) Scale effect: greater specialization of production associated with the enlargement of the potential market may allow economies of scale to be exploited.
(c) Variety effect: integration is likely to increase the variety of goods available to consumers. Under certain assumptions concerning the individuals' utility function, a welfare gain will result.

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2 Romer [1994], p. 19.

Another effect mentioned in the literature is the reduction of so-called X-inefficiencies: increased competition could push firms closer to best practice organization.

2.2.2. Accumulation effects

The review of economic growth theory in Section 2.1 highlighted three possible sources of sustained growth. According to the standard neo-classical model with endogenized saving, an economy will grow until the marginal productivity of capital reaches the intertemporal preference rate of individuals. In the endogenous growth theories, the efforts of individuals to obtain a better education and of firms to introduce innovations (in products and production processes), motivated by higher wages and the possibility of exploiting (temporary) monopolistic market power, stimulate growth. Spillover effects ensure that the social returns to these types of investment are not diminishing, so that the accumulation of human and knowledge capital (and therefore economic growth) can be sustained.

The question is, therefore, how integration can affect the productivity of physical capital, the intertemporal preferences of individuals, and the private motivations (costs and benefits) of investing in education, on the one hand; and innovation activity, on the other.

Consider a simple Solow model framework having a Cobb-Douglas production function with labour and capital as factors and a multiplicative factor representing exogenous technological progress, represented in Equation 2.7 and Figure 2.4.

$$Y(t) = A(t)\ K(t)^{\beta}\ L(t)^{(1-\beta)} \tag{2.7}$$

The opportunity of a more efficient allocation of resources offered by integration is represented in Figure 2.4 by an upward shift in the production function (and, assuming a constant saving ratio, in the saving function). The equilibrium point shifts from A^* to A' and the economy will experience a positive growth rate during the transition. In terms of the standard neo-classical growth model, the implementation of an integration programme therefore boosts growth, but only temporarily, and does not affect long-run growth. However, the new steady-state income per capita is higher.

In the endogenous growth framework, integration can boost growth if it alters the private costs and benefits of investing in new innovations. In this field, the path-breaking work is due to Grossman and Helpman [1991], who introduced trade into models with an endogenously determined growth rate. Since then, several articles have provided a broad perspective on how on-going economic integration processes can affect the long-run growth rate. These include Rivera-Batiz and Romer [1991], who analysed the effect of integration across similar economies; Baldwin [1992]; and Grossman and Helpman [1994].

This research has highlighted several ways in which participation in a larger integrated economy can affect a nation's growth. First, residents in an integrated economy can benefit from a higher level of technical knowledge than those living in relative isolation. Trade can facilitate the process of technological dissemination. Second, exposure to international competition may improve the quality of industrial research. A firm developing a product for a protected domestic market need only make use of technologies that are new to the local economy, whereas one that hopes to compete on the international market will be forced to generate ideas that are innovative on a global scale.

A third reason (Rivera-Batiz and Romer [1991]) suggests that international integration may bolster industrial research by expanding the size of potential customer base. The essential idea is that there are two sectors in each economy, the research sector and the goods sector. The research sector shows increasing returns to scale, coming from the fixed cost that must be incurred to design new goods. With integration, this fixed cost need be incurred only once.

Baldwin [1992a] analyses a fourth reason why integration can positively affect the long-run growth rate of the economies involved in the integration programme. He argues that the market structure of an economy's research sector is an important determinant of the process. Import competition may stimulate growth by reducing the market power of domestic innovators. Specifically, 'import competition forces domestic innovators to choose to either quicken their pace of innovation or be displaced by foreign innovators'.[3] While some of the domestic innovators may be forced out of the market, the overall rate of innovation, and therefore the growth rate of output, increases. A specific, sectoral point is worth noting here. As discussed earlier, in even the simplest growth models, the growth rate depends on differences between the intertemporal preference rate of individuals and the rate of return on investment. With an uncompetitive financial sector, the margin between the return earned by investors and the cost of funds to investors tends to be large, either due to inefficiency or monopoly rents. Competition from foreign financial firms can act to reduce this margin, and hence increase the resources devoted to innovation and the output growth rate.

2.2.3. Location effects

From the discussion in the two previous sections, it follows that positive effects on the level and growth of output in Europe as a whole are the expected consequences of the SMP. However, trade, investment and migration barriers also influence the location of productive activity.

In the perfectly competitive, basic neo-classical model, the expected effects on location are unambiguous: factors will flow between rich and poor countries until returns are equalized between countries. Hence, poor countries will converge on richer countries. However, the endogenous growth theories that offer a more appealing explanation of sustained growth, are typically associated with assumptions that violate those of the perfectly competitive model, allowing the possibility of cumulative causation effects and hence divergence in per capita incomes, even if the overall per capita income is higher.

There are many examples of possible cumulative causation effects. Lucas [1988] recognized that if spillover effects were allowed in his model, highly skilled workers would migrate toward economies with a higher average level of human capital, where wages are higher.

Rivera-Bertin and Romer [1991] specifically restricted their analysis to the case where the economies involved in the integration programme are similar in endowment and technologies, in order to highlight the scale effects induced by economic integration in the research sector.

3 Baldwin [1992a], p. 1.

They conclude:

> *In a general two-sector model, trade between economies that have different endowments and technologies will induce allocation effects that shift resources between the two sectors in each country.*

As noted by Grossman and Helpman [1990], more open trade will increase the profitability of R&D in a country or region only if its firms can hold their own with rival foreign firms. For potential innovators in a small or isolated country, or those operating where skilled labour is relatively scarce, this may not be the case.

Grossman and Helpman[4] construct several examples in which a policy of autarky might actually increase a country's long-run growth rate. First, a country with a relative abundance of natural resources and unskilled labour, and a relative paucity of skilled workers, may be induced by trade to specialize in activities that make use of these resources, at the expense of human-capital intensive activities like R&D. The result will be a lower long-run growth rate. Second, if technological spillovers are national in scope, then a researcher living in a country with a small knowledge base may find it difficult to compete with rivals in a country with more research experience. Such a country could, in principle, improve its long-run growth rate by catching up with more advanced countries before allowing free competition. They also note[5] that the existence of local or national technological externalities gives history an important role in the determination of dynamic comparative advantage. Such spillover effects can generate a self-perpetuating process whereby an initial lead, however generated, is sustained indefinitely into the future, regardless of a country's relative factor endowments. As a result, temporary policies can have long-lasting effects.

2.3. Empirical literature

2.3.1. Barro-style regressions

Barro [1991] popularized a simple empirical technique for studying the determinants of aggregate growth. Using cross-section data for a number of countries or regions, the change in per capita income over a long period (e.g. one or two decades) is regressed on the initial per capita income level, proxies for the initial stocks of human capital, and on a variety of other independent variables considered likely to affect economic growth in the long run, according to economic theory. The latter include, for example, the ratio of investment to GDP, the ratio of R&D spending to GDP, and the ratio of government consumption to GDP.

Since Barro's original work (Barro [1991]), the simplicity of the technique and the initial acceptance of the methodology stimulated a large number of subsequent studies. Levine and Renelt [1991] surveyed 41 studies, covering about 50 different explanatory variables. Some common features are summarized below.

By including the initial per capita income level as the only explanatory factor, it is possible to test for unconditional beta-convergence (the expected result is a negative, significant

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4 Grossman and Helpman [1991], Chapter 9.

5 Ibid., Chapter 8.

coefficient). This hypothesis has not typically been substantiated, but significant and correctly signed results have been found after the inclusion of other explanatory variables, supporting the hypothesis of conditional beta-convergence.

The additional variables can be classified into two groups:

(a) initial levels of state variables, such as the stock of physical capital and the stock of human capital (measured, say, by educational attainment and health indicators);
(b) 'control' or 'environmental' variables (some of which are under the control of governments or private agents).

Because data on physical capital are hardly reliable, the initial real per capita GDP is typically treated as a proxy. The following paragraphs discuss the expected signs on the coefficients of the variables.

The assumption of diminishing returns to reproducible factors in conventional neo-classical theory gives rise to a prediction that the state variables will have a negative coefficient. In the case of human capital, the contrary result has typically been found. This can be justified in terms of the Lucas model (and its generalized forms), and by theories of technological diffusion,[6] which usually assume that more human capital raises the ability to absorb new technologies. In the growth theories with endogenous technological changes, this process operates if the cost of imitating declines as human capital increases, which boosts spillover effects. Barro and Sala-i-Martin [1995] introduce an interaction term, given by the product of the two state variables, to capture these effects. A negative coefficient on this interaction term would mean that a higher starting level of human capital speeds up convergence, that is, it raises the responsiveness of the average growth rate to a lower starting level of per capita GDP.

In neo-classical growth theory, the expected effects of the control variables on the growth rate correspond to their influence on the steady-state position. For example, an exogenously higher value of the investment to output ratio raises the steady-state value of output per effective worker. The average growth rate of per capita output tends, therefore, to increase for given values of the state variables, and so a positive coefficient is expected. In conventional neo-classical theory, a change in a control variable only affects the equilibrium level of output per effective worker, not the long-run growth rate. In endogenous growth models, variables that affect human capital accumulation and R&D intensity also influence long-term growth. However, it is difficult to distinguish these two outcomes in empirical work since, even under conventional theory, the transition period could be sufficiently long for growth to be stimulated over much of the period of analysis.

2.3.2. Empirical results using Barro-style regressions

Levine and Renelt [1992] investigated the robustness of the relationships generally found in growth regressions estimated using data for 1960–89 and 119 countries, including LDCs, by focusing on selected variables in turn. The equations estimated take the following form:

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[6] Nelson and Phelps [1966].

(2.8) $$Y = b_i I + b_m M + b_z Z + u$$

where:
Y= average per capital output growth over the period;
I = a set of explanatory variables always included in the regressions. Levine and Renelt chose the following variables as most commonly included in previous empirical studies, and as likely to be important on the basis of economic theory:

INV = investment share on GDP,
RGDP60 = initial level of per capita GDP,
SEC = initial secondary-school enrolment rate,
GPO = average annual rate of population growth;

M = the variable of interest;
Z = a subset of variables chosen from the large number of variables identified in previous studies as possible explanatory variables (fiscal policy variables, trade variables, monetary and political indicators).

Levine and Renelt tested for the robustness of relationships involving M by estimating a base regression that includes only the I-variables and M, and then estimated a series of regressions adding up to three Z-variables. The variable M is 'robust' if the coefficient is always significant and does not change its sign. Otherwise it is classified as 'fragile'. The main results were:

(a) Positive and robust correlation between the average growth rates and the average share of investment on GDP. Levine and Renelt comment:

The causal relationship between the average growth rate and the investment–GDP ratio is ambiguous and the justification for including many variables in the growth regressions is that they may explain that ratio. If we include INV, the only channel through which other explanatory variables can explain growth differentials is the efficiency of resource accumulation.

(b) Qualified support for conditional beta-convergence in the 1969–89 period, when the equation includes a measure of the initial level of investment in human capital.

(c) A large variety of trade policy measures were not robustly correlated with growth when the equation included the investment share.

(d) However, in seeking to treat investment as a dependent variable, Levine and Renelt found a positive and robust correlation between the share of investment in GDP and the average share of trade in GDP.

(e) None of the broad array of policy indicators is robustly correlated with the average growth rate of per capita GDP or the average investment share on GDP. However, their conclusion that policy had no impact on growth was criticized by Sala-i-Martin [1994]: even if no specific policy indicator was found to be robust, Levine and Renelt had consistently found at least one policy variable as significant, suggesting that policy could not be dismissed as having no impact.

These results suggest that the main way in which trade affects growth is via accumulation of factors (investment) rather than their allocation.

Recently, Sachs and Warner [1995] presented cross-section evidence of a positive impact of openness to trade on growth and convergence: they concluded that open economies converge and grow systematically faster than do closed economies, even when the other growth factors are accounted for. They also found evidence of a positive effect of trade openness on the rate of accumulation of physical capital. Insofar as the SMP results in greater openness of the EU economies, the implication is clear: one would expect to find a tendency towards higher growth and greater convergence. However, this assumes that there has not been a corresponding reduction in openness to trade between the EU and the rest of the world.

2.3.3. Criticisms of the Barro-style regressions approach

Since these equations are interpreted as representing the reduced form of a larger implicit growth model, the control variables are likely themselves to be endogenously determined, as Barro and Sala-i-Martin [1995] acknowledge. Moreover, because growth is such a complex process, the residual term in these regressions probably includes many omitted variables which are likely to be co-determined with the included regressors, in which case the estimated coefficients would be biased. Lee, Pesaran and Smith [1995] have criticized the Barro-style equations from the standpoint of econometric theory, arguing that the estimator of the rate of convergence is biased, and the tests of significance using t-statistics are invalid.

Most of the empirical analysis carried out uses ordinary least squares (OLS) as the estimation method, with the endogeneity problem addressed by using only the initial levels for the right-hand side variables and income changes over quite long periods on the left-hand side. Recently (Barro and Sala-i-Martin [1995]), the instrumental variables (IV) technique has been applied, typically using lagged values of variables as instruments. The results are quite different. The investment ratio, for example, is no longer significant using IV. This suggests that the observed positive correlation between growth and investment reflects primarily the influence of growth on the propensity to invest:

> *Exogenous shifts in the investment ratio (captured by the relation of the current investment ratio to the past investment ratio and the other instrument) are not significantly correlated with growth.*[7]

The problem of endogeneity of the explanatory variables is likely to be fundamental when analysing the growth impact of the SMP. Since a substantial part of the growth impact is likely to come through increased accumulation, the inclusion of the investment ratio in a growth equation is likely to render any variable representing the SMP insignificant. For instance, de Melo, Panagaryia and Rodrik [1992] use data for 101 countries over 1960–85, and add dummy variables for various regional integration schemes to a Barro-style regression. They find that the only regional integration scheme that influenced growth over that period was the South African Customs Union. Subsequent debate revealed that their failure in finding significant growth effects of the regional integration schemes was consistent with the interpretation that integration schemes boosted growth by increasing factor accumulation. The same authors[8] found, for example, that the investment rate in Europe was higher during the period of integration, and have noted that the same increased investment effect accompanied the announcement of the NAFTA negotiations.

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7 Barro and Sala-i-Martin [1995], p. 433.

8 De Melo, Panagaryia and Rodrik [1993].

A second basic criticism of the Barro-style methodology has been made by Quah [1993a]. He starts from the idea underlying the procedure, i.e. that the environmental variables explain the permanent growth component or trend, while the initial conditions control for transitory dynamics. He argues that it is implicit in structure that each economy has a steady-state growth path, well approximated by a time trend. Such a view is necessary for the average growth rate 'to measure anything sensible, and thus for its proposed covariations with proposed explanatory variable to indicate something stable'.[9] But the data[10] do not confirm this implicit assumption, i.e. growth trends in actual economies do not seem to be stable and smooth as the Barro-style regressions implicitly assume. However, it is unclear what conclusions should be drawn from this criticism for the interpretation of the results of the Barro-style regressions.

2.4. The research strategy adopted for the present study

This study aims to summarize Europe's experience with respect to growth and convergence, and then to interpret it within the context of the literature discussed above.

Chapter 3 is essentially descriptive in character, summarizing growth and convergence trends in the EU prior to and since 1987, adopted as representing the first year of possible SMP effects (allowing for some anticipation of the legislative measures). In the chapter, descriptive statistics (essentially estimates of average growth rates) are calculated and compared for the two periods, to set out the facts that need to be explained.

While it is tempting to interpret any change in these statistics after 1987 as representing the effect of the SMP, there are various problems in doing so, as Italianer [1994] suggests. First, the theoretical understanding of what determines growth needs to be made explicit. For example, if these 'growth trends' are taken to represent steady-state rates, which are altered by the exogenous influence of the SMP, it should be recognized that this view of the world is quite different from the conventional neo-classical one, in which actual growth rates decrease as an economy catches up with a richer 'leader'.[11] This is not necessarily a criticism, but it demonstrates that interpretation can only be undertaken within some kind of theoretical framework, explicit or implicit.

Second, to attribute the change in growth trends post-1987 to the SMP would clearly be grossly simplistic, as Italianer himself notes. There are other factors affecting growth and convergence, and the path of any one of these may have differed in the periods before and after 1987. Obvious examples of special factors post-1987 include the impact of German re-unification, the world-wide recession of the early 1990s, the shake-out of the exchange-rate mechanism (ERM) in 1992, and the increase in scale of the Structural Funds. Obviously, the method adopted by Italianer (and repeated here) of controlling for growth trends over the same periods in Japan and the US is not sufficient to account for all these factors.

One method of attempting to adjust for other factors affecting growth is to include them explicitly in an econometric equation, together with a variable to represent the implementation

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9 Quah [1993a], p. 426.

10 Ibid., pp. 427–28.

11 In the endogenous growth framework, different steady-state growth trends are possible, typically explained by the fact that the transfer of ideas between economies is not costless.

of the SMP. Chapter 4 applies the methodology developed by Barro, estimating a variety of econometric equations on cross-section data for average growth rates in per capita output for the periods 1975–87 and 1987–93. Since this method uses average growth rates for a whole period, the representation of the SMP is necessarily crude: 'off' in the first period, and 'on' in the second. Equations are estimated for data at the level of the Member States, and below national level for NUTS 2 regions. In the analysis at Member State level the number of observations is small (12 countries per period). It was therefore decided to pool the data for the two periods and allow changes in coefficients on selected variables in the second period through the use of dummy variables. In the analysis at regional level this problem does not arise and so separate equations were estimated for the two periods.

Finally, given the criticism made of the Barro methodology on grounds of both econometric and economic theory, the method of Markov chain analysis (Quah [1993b]) is also applied in Chapter 4 to data at the regional level, providing an alternative set of results on evidence for convergence. It should be noted, however, that these results are more of the nature of descriptive statistics, since they simply provide a measure of the extent of convergence in the two periods, without controlling for the factors that may be responsible.

Figure 2.1. The Solow-Swan model

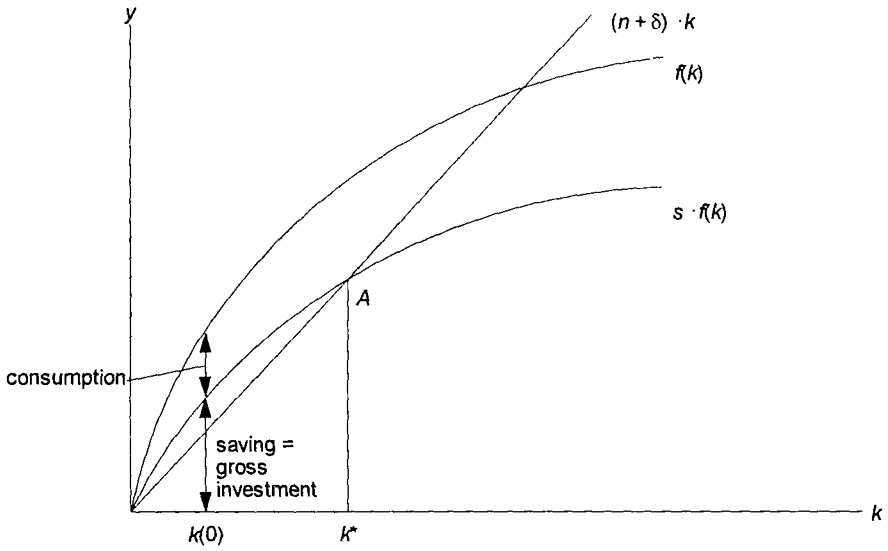


Figure 2.2. Unconditional beta-convergence in the Solow-Swan model

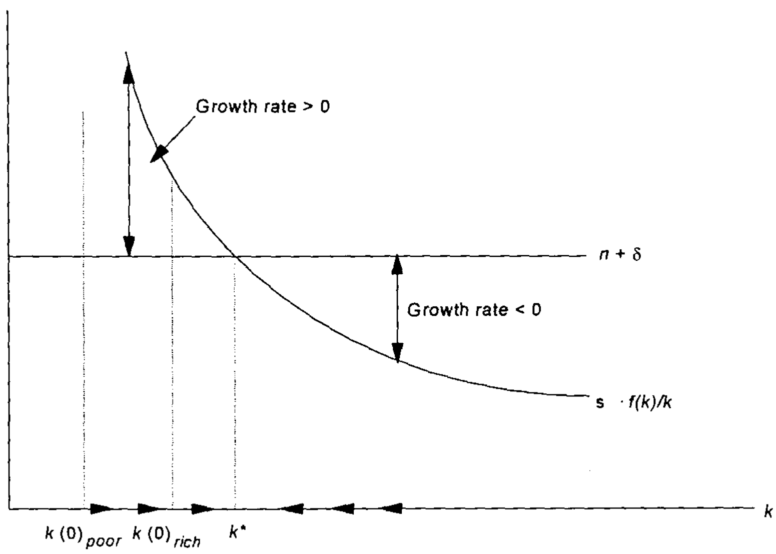


Figure 2.3. Conditional beta-convergence in the Solow-Swan model

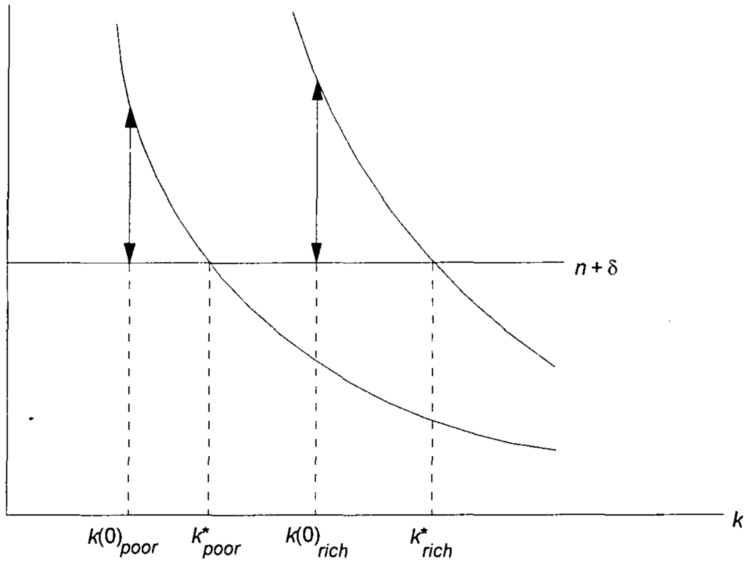
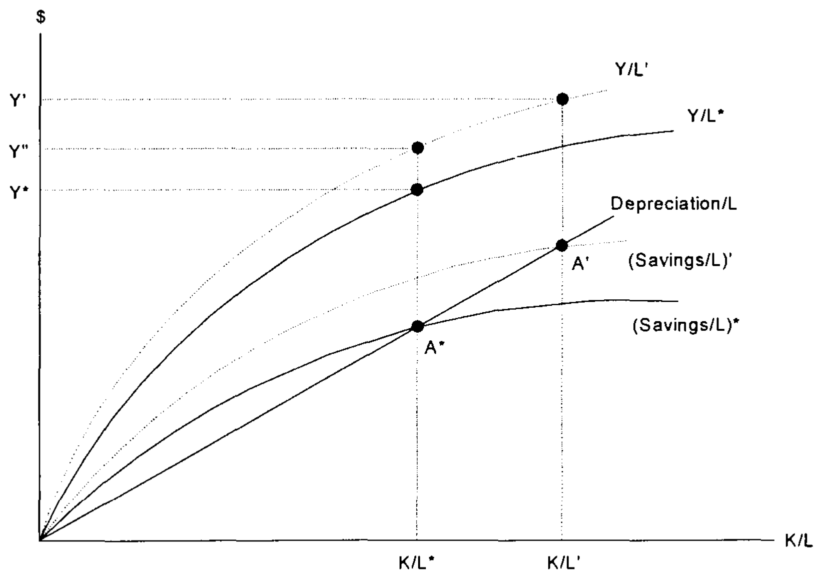


Figure 2.4. Induced capital formation in the Solow-Swan model



3. Growth and convergence trends in Europe, 1975–93

This chapter presents a historical analysis of the periods pre- and post-1987, intended to identify the major facts of the experience of the European economies over these two periods that need to be explained. The analysis is divided into two sections, reviewing the experience at the level of the European Union and Member States, and of the NUTS 2 regions.

3.1. Analysis at the European Union and Member State level

The Cecchini Report [1988] estimated that the implementation of the single market could enhance the EU's annual potential growth rate of both output and consumption by 1% for the period up to 1992. This figure represented the static effects only; the report stated that 'there would be good prospects that longer-run dynamic effects could sustain a buoyant growth rate further into the 1990s'.[12]

The report included an analysis of sectoral weaknesses in the European economies. It noted that, while the share of total output in the EU was comparable to that in the US and Japan for some industries with slow-growing demand (food, beverages, textiles, clothing, metalliferous ores, steel products, and financial services), the EU lagged well behind in the fastest growing high-tech industries, including data-processing equipment, office automation equipment, precision instruments, electrical goods and electronics, where the R&D critical mass 'is considerable and requires the active co-operation, if not the integration of European firms if the Community as a whole is to match the level and effectiveness of expenditure in this area by American and Japanese multinational companies'.[13] For these key sectors, their share in total Community output was well below those in Japan and the US, and this relative weakness of the European economies was reflected in a lower level of productivity.

These sectors, according to the report, were also those most likely to be affected by the implementation of the SMP, because of the large static and dynamic gains potentially arising from economies of scale.

Since 1988, the European economies have clearly been subject to important influences independent of the SMP, notably German re-unification in 1990, the shake-up in the ERM in 1992, and a world-wide recession in the early 1990s. These naturally hinder an ex-post evaluation of the SMP impact, particularly one based simply on descriptive statistics such as comparative growth rates. Using a relatively simple methodology, referred to here as 'growth trends analysis', Italianer [1994], confronting the economic performance of Europe with those of Japan and the US, argued for a positive impact of the SMP on European economic growth. In particular, he found that the EU performed better with respect to its trend during the 1980s than either the Japanese or US economies. His results are reproduced in Table 3.1.

The following sections describe the experience of the European economy before and after 1987, compared with those of the US and Japan at aggregate and sectoral levels. At the

[12] European Commission, [1988a], p. 19.

[13] Ibid., p. 25.

sectoral level, attention is given to the experience of the key industries highlighted by the Cecchini Report.

3.1.1. Growth trends: aggregate analysis

Following Italianer, Table 3.2 shows the growth rate of per capita GVA in Europe, Japan and the US over two periods, 1975–87 and 1987–93. Average growth over any period depends on the levels for the years selected to mark the start and end of the period, which may be influenced by temporary shocks to the economy and therefore may provide a misleading indication of underlying average annual growth. In order to minimize the role of period-end noise, GVA per capita growth has been estimated by fitting the trend growth curve $log(Y) = a + bt$, in which Y is the variable whose growth rate is being estimated, b is the trend exponential growth rate, and t is time. The same methodology is applied in Sections 3.1.2 and 3.1.3 below.

In terms of GVA per capita, comparison of columns 1 to 3 of Table 3.2 shows that the EU-12 as a whole grew slightly faster in the second sub-period than it did in the first, Japan saw a still smaller improvement, and the US saw slower growth post-1987 than before. These differences are quite small, but the remaining columns of the table show that when the change in the average growth rate is compounded over time (as in Italianer's analysis), there is an impact on comparative per capita GVA that cannot be described as negligible. In 1993, EU-12 per capita output was 1.1% higher than it would have been if the European economy had grown at the pre-1987 trend rate, while Japanese output was 0.2% higher and US output about 2% lower on the same basis. The historical performance is presented in Figure 3.1.

Table 3.3 shows that this impression of a relatively better EU-12 performance is reinforced when the same analysis is carried out for GVA (as opposed to GVA per capita). The EU-12 experienced a higher growth rate in the post-1987 period than earlier, whereas Japan and the US did not.

Within the EU-12, analysis of the performance of Member States grouped by their date of entry into the EU adds useful insights. In terms of GVA, the EU-6 and EU-9 performed much the same as the EU-12 as a whole, but the 'new entrants', Spain, Portugal and Greece, saw a larger relative improvement, their overall GVA in 1993 being nearly 7% higher than it would have been had pre-1987 growth trends continued. These, plus Ireland, form the group of what can be described as the 'Objective 1' countries (the main region excluded is southern Italy). In this case the picture is even more striking, with an improvement of nearly 9.5% in 1993 relative to an extrapolation of pre-1987 trends. This reflects the rapid growth of the Irish economy since 1987. With an average growth rate of about 8.5% p.a. post-1987, compared with 2.7% p.a. in the period up to 1987, Ireland's GVA in 1993 was about 40% higher than it would have been if its economy had continued to grow at the pre-1987 rate.

Examining GVA per capita, the comparison of actual and extrapolated levels ceases to be positive for the EU-6 and EU-9, while the improved performance for the 'new entrants' and 'Objective 1' (Ob1) countries is even higher. Figure 3.2 presents the historical performance.

Figure 3.3 shows population trends in the period 1975–93 in Ireland, Greece, and Spain (1975=100). After having experienced higher population growth than the EU-12 average in the early years, growth generally slowed.

It is, of course, difficult to disentangle the effect of the SMP from other effects that could be responsible for these changes. For example, the fast growth of the Irish economy has been driven by foreign investment (notably from the US and Japan), and this reflects active domestic policies to attract foreign investors, not just the attractions of the single market. On the other hand, it is clear that foreign investors located in Ireland to supply the European market.

Despite the caveats that must be noted with respect to causality, there is therefore a broad indication that some of the predictions of the simple neo-classical model have been validated: capital has flowed from the richest (inside and outside the EU) to the poorest economies, while labour has apparently migrated from the poorer to the richer countries. The result has been a faster growth in per capita income in the poorer economies. These mechanisms seem to have been enhanced during the period of the single market.

An examination of investment trends in the EU, Japan, and the US helps to reinforce the point. Figure 3.4 shows the aggregate investment to output ratio in the EU-12 compared with Ob1 countries, the US and Japan. At the EU-12 level, it is evident that the ratio rose in the boom post-1987, and then fell sharply. Comparison with the US experience is of some interest. The EU-12 investment to output ratio is higher in 1975, falls steadily until 1985, when it was equal to the US ratio, and has since risen above the US ratio again. However, the Japan ratio remains well above the EU average. Both the improvement after 1987 and the fall over 1991–93 are much more marked for Ob1 countries. Figure 3.5 shows this indicator for the countries separately, and demonstrates that the greatest effect is in Spain and Portugal. In both cases, however, the turning point seems to be 1985, when they joined the EU. On the other hand, Ireland saw a slight decline in its investment to output ratio because its output growth has been so rapid: Ireland's share of EU aggregate investment has actually increased since 1987, but not as fast as its share of output. Table 3.4 shows the average investment to output ratio in the different countries pre-1987 and post-1987, and the improvement in Spain and Portugal. Comparison with Figure 3.5 reveals that the lower investment to output average ratio in Greece in the second period is due to the decline over 1975–87, which was actually reversed after 1987.

The average R&D spending (see Table 3.5) to output ratio increased slightly in the second period (by about 0.4%) in the EU-12 as a whole, more in the EU-9 (0.4%) than in the 'new entrants' group (0.2%). The performances of the UK (0.5%) and, indeed, of the group of countries which entered the EU in 1973 (0.5%) have been slightly stronger than the average.

Southern Italy and Objective 1 Spain

In the earlier analysis identifying as a separate group countries receiving Ob1 funding, this group comprised Greece, Portugal, Ireland and Spain as a whole. However, this definition of the Ob1 group ignores the southern regions of Italy and includes parts of Spain that should be omitted. Southern Italy accounted for 36% of the Italian population (25% of total Italian GVA) in 1987, while that part of Spain receiving Ob1 funding accounted for 56% of the population (47% of the total GVA in Spain). An analysis has therefore been carried out distinguishing southern Italy and the Ob1 regions of Spain as two separate 'countries'.

As Tables 3.2 and 3.3 show, the growth performances over the period 1975–93 of these two 'countries' are strikingly different. In southern Italy, total GVA grew at 2.8% p.a. over the period 1975–87, faster than Europe as whole (2% p.a.) and slightly faster than Italy as a whole (2.7% p.a.) as well. Southern Italy's growth rate was considerably faster than that of the other Ob1 countries (1.8% p.a.). In the second period the reverse appears to be true. While Italy as a whole performed worse in the second period than it did in the first (1.75% p.a. against 2.6% p.a.), southern Italy did even worse, growing in the second period at only 1.6% p.a., lower than the EU-12 as a whole and the average of Ob1 countries (3% p.a.). Comparing growth trends over 1975–87 and 1987–93, the cumulative difference in 1993 for southern Italy is 2% lower than for Italy as a whole, 7% lower than for the EU-12, and around 15% lower than for the Ob1 countries.

Therefore, while in Europe as a whole disparities across economies were getting smaller over the second period with, generally, the poorer economies growing faster than the richer, southern Italy seems to have dropped out of this process of convergence. Within Italy the difference between north and south was increasing. Figure 3.6 shows the shares in national GVA of northern and southern Italy from 1975–93 (1975=100). The southern Italy share dropped in the period 1975–78 but returned to the 1975 level in 1984 (following the large financial transfers from the north to the south after the earthquake in 1980). Since then, the share of southern Italy in national GVA has been decreasing steadily. In terms of GVA per capita the picture is even more striking. Figure 3.7 shows the per capita ratio of the north compared to that of the south over 1975–93. With the exception of the 1981–83 period, this ratio has been steadily increasing. A possible interpretation is that the impact of the stricter budgetary discipline, recently imposed on Italian governments, has more than offset the opportunities, shared with the other poorest European economies, offered by the implementation of the SMP.

A quite different picture is presented for Ob1 Spain. In this case the poorer part of the country grew faster than Spain as a whole in both periods, the only difference being that over the post-1987 period, the performance of Spain as a whole improved relative to the average of the other European countries. These results are even more marked in terms of GVA per capita (see Table 3.2). While Ob1 Spain was growing more slowly than the rest of Spain in the first period (with the lowest growth rate – only 0.6% p.a. – of all European countries), the region has grown faster than the rest of Spain since 1989 (the average growth rate of about 2.5% p.a. over 1987–93 being one of the highest in Europe), reflecting the fact that population growth slowed more sharply over the second period in Ob1 Spain than in the richer part of the country. Hence, while Spain is closing the gap in terms of GVA per capita with the rest of Europe, disparities within Spain are also decreasing. Figures 3.8 and 3.9 show the GVA shares and the GVA per capita ratio between the two groups of Spanish regions. The steady increase in the GVA per capita ratio in favour of non-Ob1 Spain up to 1989 is clear, as is the reversal in the following years up to 1993.

Conclusion on aggregate analysis

The EU-12 has seen slightly faster GVA per capita growth in the period 1987–93 than during 1975–87, and its growth relative to the US and Japan has improved over the two periods. A rough quantification suggests that EU-12 per capita GVA was 3–3.5% higher in 1993 than would have been expected, if the trends relative to the US and Japan of the earlier period had been maintained. Whatever the cause, there is evidence of an improved relative performance in the period of implementation of the SMP.

On the same basis, some of the countries with lower per capita income (Spain, Portugal, Ireland) have shown an improvement in performance relative to the rest of the EU-12 since 1987. Greece and southern Italy, however, have not. In Spain and Portugal, the timing of EU entry makes it difficult to distinguish the SMP effect from the broader effects of their accession to the EU. However, Ireland grew much more rapidly from 1987, and the increase in the investment to output ratio accelerated after 1987 in Spain and Portugal, providing *prima facie* evidence for a role for the SMP.

In terms of measures of convergence, the dispersion in per capita income, as measured by the standard deviation of (log) per capita income ('sigma-convergence'), showed a tendency to decrease in the period after 1987, in contrast to the 1975–87 period, as Figure 3.10 shows. There is also some indication of a shift towards (unconditional) beta-convergence, in that there is a stronger indication of a negative relationship between starting level of GVA per capita and its average growth rate in the period post-1987, shown in Figure 3.11.

3.1.2. Growth trends: broad sectoral analysis

Sectoral growth trends: 1975–87, 1987–91

The Cecchini Report anticipated that the impact of the single market would not be uniform across sectors. In particular, it expected the major benefits to be in high-tech sectors where potential dynamic scale economies are higher, in industries more dependent on public procurement, and in sectors such as air transport and financial services where competition from foreign firms was still limited by domestic regulations. It also noted that high-tech, fast-growing industries (like office automation, data-processing, electronics, electric tools) were far better represented in Japan and the US than in Europe.

As a first stage in analysing sectoral performance, we consider the data for very broad sectoral groups: manufacturing, market services and construction. While it is usual to focus on manufacturing industry, sometimes identified with the goods sector, the SMP was specifically designed to address service sectors where little liberalization had occurred. As Baldwin and Venables note,[14] the various EU service sectors were more protected prior to 1987 than was manufacturing in general, and so tradable service providers (for example, air transport) would be expected to gain substantially from integration.

Note that the analysis only covers the period to 1991, because pan-EU sectoral data are less reliable thereafter. Hence, the two sub-periods in the analysis here and in Section 3.1.3 below are 1975–87 and 1987–91.

Table 3.6 shows the GVA growth rate pre-1987 and post-1987 in the manufacturing sector for each country, and for different groups of European countries, against the average growth rate in US and Japan. The overall growth effect of the single market on EU-12 manufacturing does not appear to be strong. European manufacturing output grew faster after 1987 than it did in the earlier period (by about 1.4% p.a. on average), and the cumulative gain by 1991 is about 6%, but this is less than for Japan, and the short period considered after 1987 does not justify any firm conclusion. Figure 3.12 shows that a modest acceleration after 1987 was

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14 Baldwin and Venables [1995], pp. 1–4.

subsequently reversed with the onset of the recession. Productivity growth (Table 3.7) actually slowed slightly after 1987.

Figure 3.13 shows the profile of manufacturing GVA for Spain, Portugal, Greece and Ireland. The dramatic increase in Ireland's growth rate after 1987 is apparent: growth over 1987–91 was over 8% higher than in the previous period. Portugal, and, to a lesser extent, Spain, also saw growth rates increase by more than that of the EU-12 as a whole, while Greece maintained a higher than average growth rate (about 4% p.a. in the period before 1987 and slightly less afterwards). Hence, on average, Ob1 countries saw an acceleration in the growth rate of manufacturing after 1987, but with an uneven distribution (Ireland was strongly favoured).

In market services, the picture is quite different. While Japan and the US saw slower growth in the second period than in the first, the EU-12 saw an increase, as Figure 3.14 shows; and in this case the EU-6 (Germany, Italy, France and Benelux) saw the biggest increase. The cumulative gain with respect to Japan and the US is more than 5% in 1991 for the EU-12 and more than 7% for the EU-6 (Table 3.8). The 'new entrants' countries seem to have seen slower growth after 1987, although the Spanish data are suspect and require further analysis. Certainly Portugal and Ireland saw a relative improvement, shown in Figure 3.15.

In conclusion, market services have seen an improved performance in terms of output during the post-1987 period, affecting not only the poorest countries, but also the most developed countries in Europe. Only the UK saw a weaker performance in the second period (2.5% p.a. versus 3.5% p.a.), apparently reflecting a rebound from the excessive growth of the late 1980s.

Construction has seen the most marked increase in output, particularly in Spain, Portugal and Greece. The EU-12 average growth rate in construction output was around 0.1% p.a. in the first period and about 3.6% p.a. in the second. Figure 3.16 shows the coincidence in timing between the acceleration in construction output and the start of the SMP. There was also a marked increase for the 'new entrants'. Figure 3.17 shows the performances of Spain, Portugal, Greece and Ireland, with Spain and Portugal seeing the largest effects. Clearly, the fact that EU regional funding is principally related to infrastructure work is a factor that needs to be distinguished from private sector investment stimulated by the SMP.

3.1.3. Growth trends: more detailed sectoral analysis

Sectoral growth trends: 1975–87, 1987–91

This section presents the analysis at a more disaggregated level than the broad sectors discussed in Section 3.1.2. Growth rates in 32 different industries are presented for the EU-12, EU-9 and Ob1 countries, and compared with the rates in the US and Japan in broadly similar sectors (data are from the OECD). Availability of data restricts the analysis to the period up to 1991. Hence, in comparing the growth rates of each sector with those in the US, it must be remembered that the US economy had reached the bottom of the economic cycle by 1991, while most of the European economies had yet to reach their trough.

The average growth rates for GVA, employment and productivity are presented in Tables 3.12 to 3.16. Each sector's share of total output is also presented for three base years: 1975, 1987 and 1991 (see Tables 3.17–3.21). For Japan, data are available only at a more aggregate level, so that aggregate sectors which broadly correspond to the sectors for which Japanese data are available are also included in the European tables (the first, labelled 'fabricated metal products', comprises agricultural and industrial machinery, office machines, electrical goods and transport equipment; the second, 'transport, storage and communications', comprises inland transport, sea and air transport, other transport and communications). These two groups of industries include most of the key industries highlighted by the Cecchini Report because of their high R&D intensity and growth rates. They are also the fastest growing groups of industries in the EU-12 over the two periods.

Fabricated metal products grew by 3.4% p.a. in the EU-12 over the second period, compared with an average of just 1.1% p.a. in the first period. This positive difference among growth rates is even more marked for the Ob1 countries' economies, where the sector's growth rate was 4.4% faster in the second period than in the first. In Japan, the trend growth rate is much higher than in Europe (9% p.a. in the first period, 11% p.a. in the second), but the difference between growth in the first and second periods is smaller. In the US, growth was slower in the second period. At a more disaggregated level, metal products, and agricultural and industrial machinery, are the industries characterized by the highest positive difference in the average growth rates over the two periods. Despite an increase in productivity growth rate in the second period, employment growth in these two industries was also positive in the second period, while it was negative in the first. By contrast, the acceleration in productivity growth in the office machines industry resulted in a faster decline in employment.

Growth in the second group, which includes the transport and communications-related industries, was also stronger in the second period than in the first, for the EU-12 as a whole. However, this positive difference appears only to be a feature of the EU-9 countries, while the Ob1 countries experienced slower growth. This finding is, however, subject to a caveat. Data for GVA in services in these countries is generally of poorer quality, and the positive difference between employment growth rates over the two periods suggests that Ob1 countries' transport and communication industries grew more rapidly in the second period than they did in the first.

Even accepting the Ob1 data, growth in the EU-12 as a whole in this group of industries has been considerably higher than in the US and slightly higher than in Japan. A marked acceleration in productivity growth, however, caused employment to fall in the second period. At a more disaggregated level (and limiting attention for the European countries to the EU-9, where detailed sectoral data are more reliable), the largest differences were in inland transport and sea and air transport. Different productivity growth rates in these two sectors have, however, resulted in different outcomes for employment. While employment increased in sea and air transport, it fell in inland transport. As a result of the high growth rates experienced by the transport and communications industries in the second period, the aggregate sector had the same share of total output in the EU-12 in 1991 as in the US and Japan (around 6%), compared with a much smaller share in 1975 and 1987.

The strong performance of the 'infrastructure' industries in the Ob1 countries is worth noting. Gas distribution grew by 17% p.a. over the second period in this group of countries (up by 8% on 1975–87), compared with only 1.2% p.a. in the EU-9. The electricity industry grew by 5.1% p.a. over 1987–93, considerably faster than in the earlier period (3.2% p.a.), while in the EU-9 the growth rate slowed markedly in the second period. As noted earlier, the construction sector also grew much more rapidly in the second period than in the first.

No simple conclusion about the impact of the SMP on different industries emerges from these simple comparisons. Lack of available data restricted the analysis for the period post-1987 to 1987–91, so that the mismatch of the economic cycle across the different countries appears to be more important than at aggregate level. Data for Japan were only available at a rather aggregate level. Some points are worth noting, however. First of all, much stronger growth across the whole EU in all the transport-related industries made this broad sector as important in overall economic activity in Europe as it is in the US or Japan. There are strong *a priori* grounds for expecting higher growth in these industries as a result of implementation of the SMP. Past experience reveals the impact of successive enlargements of the EU on the flow of goods between Member States: for example, after joining the EU, road traffic between the UK and the other Member States doubled in ten years. Similarly, in the three years following the integration of Spain into the EU, road freight transport between Spain and the rest of the EU is estimated to have increased by over 50%.[15] Second, the Ob1 countries have seen much stronger growth in the industries directly related to infrastructure, such as construction, gas distribution and electricity, a result consistent with the nature and scale of projects financed by Ob1 funding.

Trade and competitiveness

The Cecchini Report argued that the European economies were losing competitiveness with respect to other developed economies in certain key industries, including office machines, electrical equipment and electronics, industrial machinery, motor vehicles and other transport equipment. This loss was inferred from data showing faster growth over the period 1979–85 in import penetration from countries outside the EU than from intra-EU trade. In contrast, in more mature industries such as food, beverages and tobacco, chemicals, paper, steel and metal products, intra-EU trade (imports) grew more rapidly than did imports from outside the EU. Since productivity appears to have grown more rapidly over the period 1987–91 in the EU (but still more slowly than in the US) in most of the first group of industries, this trend in trade could have been altered.

In office machines, the ratio increased sharply from 1979 to 1985, but fell back sharply over 1985–87. Since 1988 there has been no strong trend. This pattern does not permit any strong conclusion concerning the impact of the SMP. In other industries in the first group, such as electrical goods (which includes electronics), transport equipment and agricultural and industrial machinery, the rapid increase in the trade ratio seen in the second half of the 1970s and the first half of the 1980s seems to have levelled off, but this change dates from 1984, well before the SMP.

Hence, while there is tentative evidence from disaggregated trade data of some improvements in the trade performances of the 'key' European industries, compared with the 1979–85 period, there is no clear break that can be readily attributed to the SMP.

3.2. Analysis at the regional level

This section summarizes trends in regional economic development before and after the SMP began. The regional focus is particularly apt, since the lowering of barriers associated with the

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15 *Europe in 2000*, ERECO [1995], p. 199.

SMP is expected to have fostered enhanced intra-EU trade and increased inter-regional factor mobility, particularly in greater investment in regions with lower than average wage costs. According to the neo-classical growth model, increased returns on investment will produce faster growth in the poorer regions, thus accelerating the catch-up phenomenon which neo-classical theory predicts; so we should see a differentiated impact of the SMP, according to type of region, as regions converge at different rates to the steady-state level of GVA per capita. One strand in the literature focuses on multiple equilibria and the possibility of convergence clubs. The subsequent analysis should also help throw some light on the existence of different equilibrium levels.

While it is anticipated that the impact of the SMP will be differentiated according to region type, numerous alternative groupings of regions are possible. The following definitions have been established to allow the expected regional variation in economic growth associated with catch-up to be detected. The emphasis is to some extent oriented around the idea of a rich centre and relatively poor periphery. However, this could be roughly translated as coinciding with the major areas of regional assistance (particularly the Ob1 regions), or even as a north–south division.[16] Economic structure is also a factor relevant to the analysis of differentiated growth. External shock, such as sectorally specific price rises, will have different regional effects according to sectoral specialization; and policy, working via investment to enhance growth, is also set partly on the basis of economic structure.

The present analysis is based on the 169 NUTS regions covering the EU-12 (excluding the eastern *Länder* of Germany), broken down as follows:

(a) Ob1 versus other regions;
(b) 'Objective 2' (Ob2) versus other regions;
(c) core versus periphery regions;
(d) northern versus southern regions;
(e) border versus interior regions; and
(f) manufacturing versus service versus agriculture regions.

The Ob1 regions are those designated prior to the recent revision, consisting of Ireland, Northern Ireland, Portugal, Greece, Spain (excluding most of northern and eastern Spain and Madrid), Corsica and Sardinia, and southern Italy.

Ob2 regions are those suffering serious industrial decline, and therefore tend to be urban areas or frontier regions, often with high levels of unemployment. They are usually regions with a high share of industrial employment in total employment and where industrial employment has tended to fall. The definition of Ob2 regions, in terms of the NUTS 2 regional system, is made difficult by the fact that designation is at the level of the smaller NUTS 3 regions. A translation has been made by Cambridge Econometrics to the NUTS 2 level with three grades of region: those NUTS 2 regions containing NUTS 3 regions partially eligible for Ob2 funding, those containing totally eligible regions, and those containing both partially and totally eligible regions. Using the set of NUTS 2 regions with at least minimal Ob2 support produces a map[17] which is to some extent a negative image of the Ob1 map. To reduce

16 See, for example, Neven and Gouyette [1994].

17 *European Regional Prospects 1993*, ERECO [1994], p. 252.

collinearity between these two variables, and focus on those regions receiving a higher level of support, it was decided to designate only those NUTS 2 regions which contained totally eligible NUTS 3 regions as Ob2 regions.

Again, somewhat arbitrarily, NUTS 2 regions more than 1,000 km from Luxembourg are classed as peripheral. Those NUTS 2 regions north of a line running roughly eastward from Bordeaux are treated as in the south, and the others are classed as northern regions. The south therefore consists of Portugal, Spain, Italy, Greece, and the French regions Corsica, Languedoc-Roussillon, Provence-Alpes-Côte-d'Azur, Midi-Pyrénées, Aquitaine, Limousin, Auvergne and Rhône-Alpes. Manufacturing regions are those in which manufacturing and energy employment as a share of total employment in 1975 is higher than the median share. Manufacturing and energy comprise the codes B06 and B30 of the NACE-CLIO R6 nomenclature. Similarly, service regions have a higher than median share of market services (B68) employment, and agricultural regions a higher than median share of agriculture, forestry and fisheries (B01) employment. Note that this regional classification is not exclusive; for example, regions can be both manufacturing and service regions.

3.2.1. Growth trends: aggregate analysis

This section focuses on the trends in the growth of total GVA per capita and total employment, with no sectoral disaggregation. As in Section 3.1, estimates of trend growth rates are calculated by fitting the equation $log(Y) = a + bt$ in which b is the trend growth rate and t is time, to minimize the effect of period-end noise.

Figure 3.18 shows that the GVA per capita growth accelerated for the Ob1 regions of the EU-12 from about 1987 onwards, although cyclical effects are also evident from the change of slope at the beginning and end of the 1980s. Table 3.22 shows that the trend GVA per capita growth rate for Ob1 regions was 1.7% p.a. before 1987, and 2.3% p.a. in the subsequent period (which included stronger regional policy assistance). This contrasts with the growth of non-Ob1 regions, which was slower after 1987 than before. This contrast is consistent with the view that, as barriers to trade were lowered, investment was stimulated by an enhanced flow of capital to poorer areas where the returns on investment are greater. However, it may simply reflect the impact of regional aid.

Figure 3.19 shows a similar phenomenon for the peripheral regions, with faster growth after 1987 (see Table 3.22). These increases in growth contrast with the slower average growth rate for the core regions and the EU-12 as a whole after 1987. A similar north–south contrast is apparent, with slower growth in the north apparent from Figure 3.20 and Table 3.22. This is consistent with the results for Ob1 and peripheral regions, since on the whole the south is poorer, more peripheral, and receives more regional aid than the north. Figure 3.21 and Table 3.22 show the results of analysing the data with regions classified by economic structure. While the generally slower post-1987 growth rate is evident, there is a suggestion that regions more specialized in industry outperformed the service regions. Figure 3.21 indicates that slower growth in the regions specializing in services is a feature of the whole of the period after 1987, and not simply the differentiated impact of the recession taking effect from about 1990. This finding of reduced growth in the services regions contrasts with the growth performances of services at the national level, and probably reflects faster growth in the regions with less developed services within each country.

GVA per capita in Ob2 regions evidently grew more slowly than in other regions before and after the implementation of SMP (Figure 3.22). Border regions, however, which tended to grow slightly faster than interior regions prior to the SMP, increased their growth advantage after 1987 compared with interior regions, where growth slackened noticeably (Table 3.22, Figure 3.23).

The above analysis has also been applied to total (i.e. cross-sector) employment by region. Figure 3.24 and Table 3.23 show the negative employment growth of the Ob1 regions in the period to 1987, when the level of employment was below its 1975 level with no real sign of deviation from a downward trend. In contrast, employment in other regions had started to recover in 1983 from the severe impact of the early 1980s recession, to stand 2.5% above its 1975 level in 1987. The record after 1987 is one of sharp contrast, with employment growth in the Ob1 regions becoming positive in all but two years, and the average annual growth rate changing from -0.2% p.a. pre-1987 to 0.7% p.a. post-1987. Unlike the period prior to the SMP, employment growth in the Ob1 regions is on a par with employment growth in other regions, although the level in 1993 remains only 1.8% above the 1975 level due to the low base from which growth commenced.

A similar picture emerges from Figure 3.25, which shows total employment in peripheral regions failing to grow in the late 1970s and recovering more sluggishly than the core regions from the early 1980s recession. By 1987, employment in the peripheral regions had recovered to about its 1975 level, while the core regions were 2.35% above their 1975 level. Employment growth after 1987 is faster in the periphery than in the core (see Table 3.22). Figure 3.26 shows how employment levels in the north have been much more volatile than those in the south, but the timing of an improved performance appears to precede the SMP. While employment in the south, which has, in the main, been falling, is now largely rising, growth commenced after 1984, and the improvement in the rate of growth after 1987 is less than in the north.

Figure 3.27 shows that total employment in regions more specialized in agriculture remained above its 1975 level through the recession of the early 1980s, but subsequent growth has been slower than for manufacturing and services regions. Table 3.23 indicates that employment growth (across all sectors) of manufacturing regions post-1987 has been faster than for the other regions.

Figure 3.28 shows a much stronger improvement in employment growth in Ob2 regions after 1987 than is the case for other regions. The timing of the acceleration is also clearly later. Figure 3.29 shows that, in employment terms, border regions underperformed compared to other regions in the period to the mid-1980s, but showed stronger growth thereafter.

3.2.2. The evolution of measures of inequality and clustering

Analysis across all regions

This section examines changes in the dispersion of levels of GVA per capita through time. According to neo-classical theory, convergence in GVA per capita levels by region to a common steady-state level (so-called beta-convergence) should be accompanied by convergence in the standard deviation of (the logarithm of) GVA per capita to a steady-state dispersion (sigma-convergence). One would normally expect the standard deviation to be relatively high at the start of the period and to fall smoothly to the steady state through time as sigma-convergence proceeded; but the series may also reflect the effects of shocks to the economy, causing the path to veer from the steady-state trajectory. Note also that, counterintuitively, if the standard deviation of GVA per capita across regions is initially less than the steady-state level, convergence would entail a rise in dispersion through time, with the cross-sectional standard deviations approaching the steady state from below. The analysis of standard deviation series is accompanied by the series of Gini coefficients which are an alternative inequality indicator (see Figure 3.31 for details).

Figure 3.30 shows that the standard deviation of log GVA per capita, calculated annually for the set of 169 regions, has fluctuated but with a suggestion of less volatile fluctuations after 1987, suggesting possible sigma-convergence beneath the general noise. A similar interpretation of reduced inequality emerges from the Gini coefficient series of Figure 3.31, which shows that, apart from 1992, the post-1987 years have below-average Gini coefficients. However, if there has been a trend towards a lower level of the Gini coefficient, it appears to have begun prior to 1987.

The Gini coefficient and the standard deviation are essentially aspatial measures of inequality based on lists of numbers and not their mapped distributions. This means that the standard deviation, for example, would be the same when the map of GVA per capita is a spatially highly clustered one, as when the same list of GVA per capita values happened to form a haphazard, spatially random mapped distribution. It is apparent, however, that, all things being equal, a clustered map pattern displays less convergence than a random pattern. A tendency for high GVA per capita regions to lie near to other high GVA per capita regions, with a similar concentration of low GVA per capita regions, is indicative of a polarized economy with rich and poor region groups. The elimination of systematic spatial variation, so that rich and poor show no obvious clustering or pattern, would indicate that some poorer regions had managed to catch up and surpass formerly more wealthy regions. Naturally, if the break-up of spatial organization was due to a combination of plummeting and skyrocketing GVA per capita levels, this could induce increases in the non-spatial inequality indicators. There is a need, therefore, to monitor evolving spatial patterns in conjunction with changing aspatial distributions. If there is a reduction in spatial pattern through time, accompanied by reducing standard deviations and Gini coefficients, this suggests progress towards convergence.

The magnitude and statistical significance of spatial clustering, or spatial autocorrelation, for any one map is given by (the standardized value, z, of) Moran's I (see Figure 3.32 for details). A declining sequence of (absolute) z values reflects falling autocorrelation through time. This is because the higher the probability (the lower the z value) of Moran's I in its randomization distribution, the less clustered the map pattern. The analysis is contingent on an operational definition of distance.

Figure 3.32 shows the fluctuating z series. The range of z variation is small compared with the mean level of z, and at all times GVA per capita is very significantly spatially autocorrelated, with z remaining consistently above two in absolute value (a value exceeded by only about 5% of realizations of the randomization distribution). The overall impression is one of a significant and enduring contrast between the richer core and poorer peripheral regions. Nonetheless, there is some suggestion of the advent of a trend towards lower clustering, but beginning long before the SMP.

Analysis within groups of regions

In this section, trends in measures of inequality of GVA per capita within groups of regions are summarized. A reduction in within-group inequality, compared with the all-region standard deviation and Gini coefficients, would indicate that regions within a group were becoming more alike at a faster rate than regions across the EU-12 as a whole. Analysis shows that this form of convergence is a notable feature within one group in particular, the Ob2 regions.

For selected groups of regions, Table 3.4 presents the two inequality indicators used here, expressed as the ratio of their value in the post-1987 period to that in the pre-1987 period. Hence, a value less than one indicates lower inequality in the post-1987 period. On both measures, the Ob2 regions are seen to be much more homogeneous in terms of GVA per capita than they were previously, with steep falls in inequality in about 1986–87 that were more or less maintained through the post-SMP period. Within-group convergence would be consistent with enhanced trade and factor mobility stimulating lagging (industrial) regions and hence promoting the homogeneity of regions' GVA per capita levels. Only one Ob2 region (using our modified definition), País Vasco, is within the Iberian Peninsula; but the stimulus to the Ob2 regions generally could have come from both SMP effects and the accession of Spain and Portugal.

A less prominent, but still notable, convergence of within-group GVA per capita is also evident within the border regions. Ob2 makes explicit reference to 'frontier' regions, so this similarity is to be expected. Nevertheless, the border regions form a much larger group than our limited set of 19 Ob2 regions, so the convergence is a more widespread feature.

Table 3.1. GDP growth and the impact from integration, 1987–93 cumulative difference with average annual observed growth rate for 1981–90 (%)

	1987	1988	1989	1990	1991	1992	1993
EU12	0.6	2.4	3.4	3.9	3.0	1.6	-1.2
US	0.5	1.9	2.0	0.2	0.2	-3.2	-3.1
Japan	-0.1	1.9	2.4	3.4	3.4	0.7	-3.1

Note(s) : 1993 data forecast.
Source(s) : Italianer (1994)

Table 3.2. GVA per capita growth rates after 1987 compared with 1975–87 trend

	% pa		pp	Cumulative impact (per cent)						
	1975-87	1987-93	Difference	1987	1988	1989	1990	1991	1992	1993
UK	1.82	0.38	-1.44	2.63	5.54	5.59	3.86	-0.23	-2.88	-3.00
PO	1.74	3.55	1.81	3.08	4.89	7.96	15.39	15.96	15.00	11.71
NL	0.88	2.00	1.12	-0.34	0.73	3.90	6.42	7.00	6.63	5.40
LX	2.20	2.59	0.39	-0.05	3.10	6.43	6.08	6.16	5.02	2.90
IT	2.41	1.50	-0.91	0.55	2.01	2.38	1.89	0.41	-1.46	-4.75
IR	1.73	8.60	6.87	3.97	8.46	19.00	23.78	29.88	38.78	48.05
FR	1.64	1.42	-0.22	0.18	2.56	4.66	4.49	3.16	2.18	-0.93
ES	0.85	2.40	1.55	4.66	8.72	12.40	14.98	16.18	15.85	13.61
EL	1.37	1.17	-0.20	-2.03	0.83	3.20	0.26	0.94	-0.00	-2.27
DW	1.90	2.60	0.70	-0.44	0.76	1.46	4.82	6.85	5.80	1.52
DK	2.15	0.95	-1.20	-1.98	-3.02	-4.64	-5.52	-6.94	-8.02	-8.98
BE	1.59	2.12	0.53	0.32	3.29	4.81	6.17	6.52	6.49	2.90
North Italy	2.53	1.67	-0.86	0.44	2.27	2.83	2.40	0.50	-0.92	-4.42
South Italy	2.27	1.17	-1.10	0.90	1.29	1.07	0.31	0.03	-3.24	-5.91
Non-obl Spain	1.13	2.36	1.23	4.24	8.28	12.21	14.15	14.88	13.98	11.53
Obl Spain	0.64	2.45	1.81	5.03	9.02	12.34	15.52	17.15	17.34	15.26
EU12	1.72	1.78	0.06	0.84	2.98	4.31	5.25	4.75	3.59	1.06
EU6	1.85	1.96	0.11	0.03	1.74	3.04	4.30	4.38	3.29	-0.14
EU9	1.84	1.68	-0.16	0.54	2.47	3.52	4.15	3.42	2.13	-0.48
73 entrants	1.83	0.75	-1.08	2.20	4.78	5.02	3.61	0.15	-1.88	-1.67
new entrants	1.00	2.39	1.39	3.34	7.00	10.41	12.90	13.99	13.51	11.18
Obl	1.05	2.87	1.82	3.38	7.09	10.96	13.62	15.08	15.32	13.96
Japan	3.15	3.18	0.03	0.44	3.05	4.18	5.49	6.07	3.88	0.19
US	1.53	0.72	-0.81	0.58	1.99	2.16	0.98	-2.78	-2.68	-2.03

Source(s) : CE's E3ME database, based on Eurostat Cronos, OECD.

Table 3.3. GVA growth rates after 1987 compared with 1975–87 trend

	1975-87	1987-93	Difference	1987	1988	1989	1990	1991	1992	1993
UK	1.91	0.69	-1.22	2.85	5.92	6.19	4.67	0.78	-1.64	-1.52
PO	2.67	2.74	0.07	2.58	3.83	6.31	8.02	7.50	5.90	2.02
NL	1.46	2.70	1.24	-0.28	0.87	4.09	6.74	7.54	7.34	6.23
LX	2.43	3.46	1.03	0.56	3.77	8.00	8.77	9.43	8.84	7.01
IT	2.68	1.71	-0.97	0.45	1.84	2.10	1.56	0.08	-1.85	-5.19
IR	2.68	8.48	5.80	3.08	6.47	15.33	18.80	24.59	32.35	40.58
FR	2.10	2.02	-0.08	0.15	2.55	4.70	5.11	3.81	2.90	-0.17
ES	1.57	2.62	1.05	4.07	7.66	10.83	12.88	13.53	12.76	10.09
EL	2.19	1.71	-0.48	-2.65	-0.40	1.45	-1.76	-0.78	-2.17	-4.90
DW	1.82	3.39	1.57	-0.34	1.56	3.37	7.25	10.48	10.35	6.82
DK	2.23	1.13	-1.10	-1.94	-3.00	-4.66	-5.47	-6.69	-7.60	-8.40
BE	1.65	2.43	0.78	0.34	3.59	5.42	7.02	7.63	7.84	4.48
North Italy	2.63	1.75	-0.88	0.31	2.04	2.50	2.09	0.24	-1.20	-4.73
South Italy	2.84	1.60	-1.24	0.87	1.23	0.87	-0.08	-0.45	-3.87	-6.65
Non-obl Spain	1.52	2.56	1.04	3.96	7.87	11.57	13.31	13.80	12.79	10.19
Obl Spain	1.62	2.69	1.07	4.20	7.46	10.05	12.44	13.28	12.77	10.03
EU12	2.02	2.18	0.16	0.77	2.98	4.46	5.40	5.11	4.10	1.68
EU6	2.07	2.50	0.43	0.04	1.98	3.63	5.23	5.72	4.95	1.78
EU9	2.05	2.15	0.10	0.57	2.68	4.01	4.92	4.53	3.51	1.13
73 entrants	1.97	1.02	-0.95	2.34	4.99	5.32	4.04	0.75	-1.13	-0.76
new entrants	1.77	2.48	0.71	2.77	5.93	8.82	9.98	10.58	9.63	6.84
Obl	1.83	2.95	1.12	2.79	5.96	9.25	10.57	11.55	11.29	9.44
Japan	3.89	3.54	-0.35	0.22	2.54	3.37	4.30	4.46	1.87	-2.22
US	2.56	1.60	-0.96	0.52	1.90	2.06	0.31	-3.40	-3.39	-2.83

Source(s) : CE's E3ME database, based on Eurostat Cronos, OECD.

Table 3.4. Average investment to output ratio

	1975-87	1987-93	Difference
UK	17.03	18.53	1.50
PO	27.11	31.43	4.32
NL	20.58	20.57	-0.01
LX	23.18	28.57	5.39
IT	23.24	22.85	-0.39
IR	26.59	19.62	-6.97
FR	21.38	21.71	0.33
ES	22.75	26.08	3.33
EL	27.72	22.68	-5.04
DW	21.20	20.87	-0.33
DK	19.88	17.88	-2.00
BE	18.39	19.69	1.30
North Italy	17.61	19.96	2.35
South Italy	40.30	31.57	-8.73
EU12	20.96	21.32	0.36
EU6	21.57	21.53	-0.04
EU9	20.66	20.84	0.18
73 entrants	17.61	18.50	0.89
new entrants	24.02	26.03	2.01
Obl	24.19	25.55	1.36
Japan	29.10	32.13	3.03
US	18.53	18.01	-0.52

Note(s) : Defined as the ratio of total gross domestic fixed capital formation to GDP.
Source(s) : CE's E3ME database, based on Eurostat Cronos, OECD.

Table 3.5. Average R&D spending to output ratio

	1975-87	1987-93	Difference
UK	1.40	1.94	0.54
PO	0.50	0.94	0.44
NL	0.93	1.10	0.17
LX	0.74	1.11	0.37
IT	0.47	0.89	0.42
IR	1.77	2.30	0.53
FR	1.17	1.52	0.35
ES	0.48	0.84	0.36
EL	0.49	0.67	0.18
DW	1.68	2.10	0.42
DK	0.57	0.96	0.39
BE	1.21	1.76	0.55
EU12	1.14	1.55	0.41
EU6	1.17	1.55	0.38
EU9	1.20	1.62	0.42
73 entrants	1.32	1.85	0.53
new entrants	0.48	0.82	0.34
Ob1	0.57	0.93	0.36

Note(s) : Defined as the ratio of R&D spending to GDP.
Source(s) : CE's E3ME database, based on Eurostat Cronos, OECD.

Table 3.6. GVA growth rates after 1987 compared with 1975–87 trend – manufacturing

	% pa		pp	Cumulative impact (per cent)				
	1975-87	1987-91	Difference	1987	1988	1989	1990	1991
UK	0.44	-0.05	-0.49	2.25	8.27	9.82	5.99	1.36
PO	2.20	4.50	2.30	0.89	2.00	6.43	9.35	9.29
NL	0.47	3.72	3.25	-0.60	0.85	6.19	9.80	11.57
LX	1.57	4.05	2.48	-2.38	5.35	10.78	9.44	8.74
IT	1.53	2.78	1.25	2.16	7.08	9.07	9.54	7.48
IR	3.37	11.49	8.12	2.22	9.02	26.78	28.12	37.59
FR	0.95	2.57	1.62	-1.12	2.59	5.67	6.56	5.23
ES	0.75	2.25	1.50	4.14	7.63	10.27	10.19	10.53
EL	3.99	3.79	-0.20	-1.94	1.05	1.74	-0.46	-1.73
DW	0.73	2.73	2.00	-2.06	-0.11	2.27	4.58	5.80
DK	3.06	1.86	-1.20	-4.63	-6.14	-6.45	-7.41	-9.89
BE	2.60	3.56	0.96	-1.27	1.46	3.97	5.97	1.75
EU12	0.98	2.41	1.43	0.11	3.69	6.27	6.82	5.90
EU6	1.03	2.81	1.78	-0.69	2.46	5.14	6.72	6.31
EU9	0.97	2.39	1.42	-0.21	3.40	5.97	6.56	5.52
73 entrants	0.76	0.69	-0.07	1.67	7.10	9.20	5.90	2.27
new entrants	1.06	2.59	1.53	3.47	6.70	9.45	9.61	9.85
Ob1	1.22	3.38	2.16	3.39	6.91	10.88	11.20	12.38
Japan	5.23	7.50	2.27	2.09	6.10	8.85	11.23	12.32
US	2.83	0.73	-2.10	1.65	4.03	2.14	-1.09	-6.13

Source : CE's E3ME database, based on Eurostat Cronos, OECD.

Table 3.7. GVA per worker growth rates after 1987 compared with 1975–87 trend – manufacturing

	% pa 1975-87	1987-91	pp Difference	Cumulative impact (per cent) 1987	1988	1989	1990	1991
UK	3.94	2.54	-1.40	-3.20	-0.87	-1.57	-5.81	-7.43
PO	2.34	3.51	1.17	3.19	6.15	8.55	9.86	7.56
NL	2.15	1.41	-0.74	-4.02	-4.87	-2.80	-6.48	-6.77
LX	4.22	4.05	-0.17	-2.42	2.66	5.44	1.45	-1.90
IT	2.85	2.84	-0.01	1.72	4.01	4.29	3.48	2.18
IR	4.39	8.88	4.49	3.57	7.41	19.04	15.53	24.90
FR	2.88	3.02	0.14	-0.48	3.13	4.10	2.67	0.76
ES	3.50	0.77	-2.73	-1.94	-2.92	-5.98	-11.48	-11.18
EL	2.14	3.82	1.68	1.86	8.64	9.19	8.71	10.75
DW	1.16	1.46	0.30	-2.58	-0.73	0.00	-0.63	-1.04
DK	2.62	5.77	3.15	-2.59	-1.80	-0.52	8.97	9.02
BE	5.68	3.80	-1.88	-2.14	-0.57	-3.03	-3.71	-9.46
EU12	2.69	2.43	-0.26	-1.59	0.38	0.60	-1.05	-2.00
EU6	2.23	2.27	0.04	-1.11	1.10	1.77	0.71	-0.57
EU9	2.71	2.60	-0.11	-1.75	0.30	0.79	-0.59	-1.67
73 entrants	3.92	3.20	-0.72	-3.02	-0.82	-0.82	-3.94	-4.70
new entrants	2.60	1.46	-1.14	0.69	2.00	0.63	-2.75	-2.48
Ob1	2.73	2.18	-0.55	0.81	2.36	2.11	-1.18	0.03
Japan	4.80	5.41	0.61	3.87	6.12	7.15	8.35	6.61
US	3.00	1.44	-1.56	1.08	1.04	-1.36	-3.04	-4.62

Source : CE's E3ME database, based on Eurostat Cronos, OECD.

Table 3.8. GVA growth rates after 1987 compared with 1975–87 trend – market services

	% pa 1975-87	1987-91	pp Difference	1987	Cumulative impact (per cent) 1988	1989	1990	1991
UK	3.54	2.46	-1.08	4.10	6.73	8.45	5.85	-0.44
PO	2.06	5.28	3.22	6.18	9.08	11.92	18.36	18.45
NL	2.57	4.38	1.81	5.23	5.46	6.13	11.22	11.97
LX	4.44	6.75	2.31	3.34	4.31	10.46	13.60	11.62
IT	2.69	3.33	0.64	0.71	2.14	2.87	3.54	3.52
IR	3.77	8.38	4.61	3.72	4.27	11.15	16.18	22.74
FR	3.00	2.99	-0.01	1.07	2.05	3.82	2.66	1.00
ES	1.77	-1.75	-3.52	3.16	6.33	-5.15	-6.23	-7.30
EL	2.83	3.45	0.62	-3.01	-0.97	0.57	-0.58	0.26
DW	3.29	5.69	2.40	0.37	2.30	3.62	7.51	10.63
DK	2.09	2.36	0.27	0.87	0.96	0.11	0.77	2.46
BE	2.22	3.76	1.54	1.60	4.90	7.17	6.57	8.85
EU12	2.94	3.45	0.51	1.81	3.61	4.10	4.72	4.14
EU6	2.95	4.15	1.20	1.09	2.55	3.87	5.37	6.14
EU9	3.05	3.81	0.76	1.68	3.35	4.74	5.41	4.83
73 entrants	3.39	2.61	-0.78	3.77	6.12	7.74	5.65	0.46
new entrants	1.86	-0.68	-2.54	3.11	6.19	-3.17	-3.38	-4.19
Obl	1.95	-0.09	-2.04	3.16	6.12	-2.33	-2.17	-2.42
Japan	4.62	4.52	-0.10	-0.88	-0.02	1.79	1.03	-1.33
US	3.27	2.14	-1.13	0.95	2.09	1.75	-0.81	-3.07

Source : CE's E3ME database, based on Eurostat Cronos, OECD.

Table 3.9. GVA per worker growth rates after 1987 compared with 1975–87 trend – market services

	% pa 1975-87	1987-91	pp Difference	1987	Cumulative impact (per cent) 1988	1989	1990	1991
UK	2.10	-0.80	-2.90	6.75	5.41	3.60	-0.40	-4.79
PO	1.05	2.01	0.96	5.95	6.89	5.78	9.89	9.49
NL	1.46	1.39	-0.07	-4.53	-5.67	-6.73	-4.41	-5.43
LX	2.17	0.19	-1.98	1.62	2.32	1.02	-0.22	-6.83
IT	-0.56	1.52	2.08	2.32	5.08	7.99	9.43	10.59
IR	3.41	6.66	3.25	3.76	2.59	8.28	11.27	16.99
FR	1.80	0.53	-1.27	-0.25	-1.11	-1.16	-3.50	-5.38
ES	2.02	-5.28	-7.30	-2.81	-3.88	-18.99	-24.01	-27.74
EL	1.76	1.09	-0.67	-4.84	-2.77	-3.56	-6.76	-6.09
DW	2.00	3.77	1.77	-2.69	-2.16	-1.95	4.04	3.57
DK	1.46	2.55	1.09	-1.40	-1.23	-1.01	0.73	3.28
BE	1.64	1.42	-0.22	-1.69	-1.02	-0.17	-2.82	-1.77
EU12	1.50	0.95	-0.55	0.62	0.59	-0.46	-0.52	-1.57
EU6	1.20	2.00	0.80	-0.73	-0.08	0.79	2.45	2.13
EU9	1.41	1.42	0.01	0.97	1.03	1.20	1.61	0.79
73 entrants	2.04	-0.37	-2.41	5.97	4.70	3.17	-0.19	-3.62
new entrants	1.72	-3.99	-5.71	-1.38	-1.55	-14.30	-17.92	-20.69
Ob1	1.80	-3.33	-5.13	-1.11	-1.33	-13.09	-16.28	-18.45
Japan	1.73	0.92	-0.81	-1.52	0.24	0.83	-1.74	-4.49
US	0.01	0.06	0.05	-0.14	0.71	0.14	-0.42	0.69

Source : CE's E3ME database, based on Eurostat Cronos, OECD.

Table 3.10. GVA growth rates after 1987 compared with 1975–87 trend – construction

	% pa 1975-87	1987-91	pp Difference	1987	Cumulative impact (per cent) 1988	1989	1990	1991
UK	2.98	2.48	-0.50	7.03	11.74	6.79	9.79	6.08
PO	2.01	4.86	2.85	5.87	14.76	16.79	18.81	18.91
NL	-1.95	4.77	6.72	2.18	15.69	20.85	26.86	31.05
LX	0.39	7.58	7.19	8.63	24.79	29.73	36.92	40.45
IT	-0.22	2.63	2.85	1.64	4.45	8.19	11.27	12.69
IR	-1.55	2.66	4.21	-4.29	-5.14	-0.28	9.64	9.98
FR	-0.23	3.22	3.45	0.75	9.17	10.49	12.85	16.56
ES	-0.74	10.17	10.91	9.06	20.23	34.79	45.84	53.58
EL	-1.51	3.59	5.10	-2.92	7.21	13.13	20.64	16.76
DW	-0.24	2.95	3.19	-1.63	0.60	4.84	7.97	10.85
DK	-0.85	-8.01	-7.16	5.12	-0.90	-6.94	-12.45	-23.25
BE	-2.85	7.11	9.96	5.36	19.32	29.76	40.72	45.95
EU12	0.06	3.58	3.52	2.56	8.24	11.05	15.19	17.05
EU6	-0.47	3.27	3.74	0.51	5.95	9.56	13.04	15.96
EU9	0.14	2.85	2.71	2.03	7.09	8.69	12.05	13.34
73 entrants	2.35	1.57	-0.78	6.55	10.08	5.43	8.03	4.08
new entrants	-0.65	9.06	9.71	7.25	18.16	30.74	40.76	46.75
Obl	-0.71	8.76	9.47	6.55	16.83	29.06	39.10	44.86
Japan	0.76	5.57	4.81	9.99	19.35	23.43	28.67	30.32
US	0.38	-1.89	-2.27	1.18	0.19	0.47	-1.27	-9.12

Source : CE's E3ME database, based on Eurostat Cronos, OECD.

Table 3.11. GVA per worker growth rates after 1987 compared with 1975 trend – construction

	% pa 1975-87	1987-91	pp Difference	1987	Cumulative impact (per cent) 1988	1989	1990	1991
UK	3.57	-0.27	-3.84	-1.85	-3.22	-16.81	-15.99	-13.50
PO	2.50	1.97	-0.53	3.43	6.11	5.03	4.01	1.98
NL	0.77	3.26	2.49	-8.10	-0.52	0.85	2.03	3.50
LX	1.21	2.58	1.37	-5.82	-3.43	0.69	1.40	-1.09
IT	0.31	1.71	1.40	2.24	4.84	8.83	9.17	7.29
IR	-0.45	2.39	2.84	-2.88	-2.15	7.59	10.47	5.81
FR	2.11	2.24	0.13	-2.31	2.11	-0.50	-1.19	0.24
ES	3.65	1.84	-1.81	-6.86	-10.31	-11.53	-13.28	-14.34
EL	1.44	3.41	1.97	-4.64	8.44	6.46	10.57	5.39
DW	0.64	1.14	0.50	-1.15	0.47	2.67	0.79	1.29
DK	0.54	-3.15	-3.69	1.00	-3.91	-5.48	-6.70	-15.56
BE	0.99	2.60	1.61	1.52	7.22	7.55	9.93	8.54
EU12	1.69	1.21	-0.48	-1.51	0.12	-2.08	-2.47	-2.52
EU6	0.96	1.84	0.88	-0.87	2.47	3.72	3.23	3.31
EU9	1.42	1.30	-0.12	-0.75	1.53	-0.45	-0.56	-0.18
73 entrants	3.06	-0.32	-3.38	-1.28	-2.64	-14.21	-13.36	-12.01
new entrants	2.65	2.99	0.34	-3.33	-2.70	-2.09	-1.57	-1.95
ObI	2.48	2.93	0.45	-3.38	-2.79	-1.82	-1.17	-1.70
Japan	0.68	2.58	1.90	10.82	15.15	16.17	19.57	18.40
US	-2.13	-1.11	1.02	1.25	-0.18	1.71	2.63	5.01

Source : CE's E3ME database, based on Eurostat Cronos, OECD.

Table 3.12. EU-12 sectoral growth trends

% per annum

	GVA			Employment			Productivity		
	1975-87	1987-91	Difference	1975-87	1987-91	Difference	1975-87	1987-91	Difference
Agriculture etc	0.02	0.02	0.00	-0.03	-0.04	-0.01	0.05	0.06	0.01
Coal & Coke	-4.34	-4.19	0.15	-5.13	-13.51	-8.38	0.83	10.78	9.95
Oil & Gas Extraction	1.24	-1.95	-3.19	3.78	2.19	-1.59	-2.45	-4.05	-1.60
Gas Distribution	3.95	1.68	-2.27	1.59	-2.72	-4.31	2.32	4.52	2.20
Refined Oil	-1.55	1.68	3.23	-2.21	-1.39	0.82	0.67	3.11	2.44
Electricity etc	3.04	2.35	-0.69	0.83	-1.05	-1.88	2.19	3.44	1.25
Water Supply	na	na	na	na	na	na	na	na	na
Ferrous & Non-F Metal	-0.10	1.82	1.92	-4.47	-2.30	2.17	4.57	4.22	-0.35
Non-metallic Min.Pr.	-0.50	2.86	3.36	-2.86	0.36	3.22	2.43	2.49	0.06
Chemicals	4.02	2.71	-1.31	-1.17	0.38	1.55	5.25	2.32	-2.93
Metal Products	-0.51	4.07	4.58	-1.90	1.88	3.78	1.42	2.15	0.73
Agri. & Indust. Mach.	-1.19	2.46	3.65	-1.94	0.49	2.43	0.76	1.96	1.20
Office Machines	3.96	4.23	0.27	-0.40	-0.95	-0.55	4.38	5.23	0.85
Electrical Goods	4.11	3.93	-0.18	-1.30	0.41	1.71	5.48	3.51	-1.97
Transport Equipment	1.34	2.83	1.49	-1.54	-0.36	1.18	2.93	3.20	0.27
Food. Drink & Tobacco	0.93	2.02	1.09	-1.14	-0.46	0.68	2.09	2.49	0.40
Tex., Cloth. & Footw.	-0.20	0.40	0.60	-2.78	-1.83	0.95	2.65	2.27	-0.38
Paper & Printing Pr.	1.74	2.64	0.90	-0.12	1.44	1.56	1.86	1.18	-0.68
Rubber & Plastic Pr.	2.42	3.89	1.47	-0.82	2.55	3.37	3.27	1.31	-1.96
Recycling/Emiss Abate	na	na	na	na	na	na	na	na	na
Other Manufactures	-0.89	2.32	3.21	-1.75	0.67	2.42	0.88	1.64	0.76
Construction	0.06	3.58	3.52	-1.63	2.37	4.00	1.72	1.18	-0.54
Distribution etc	1.83	2.55	0.72	0.48	1.80	1.32	1.34	0.74	-0.60
Lodging & Catering	0.95	2.31	1.36	1.86	2.91	1.05	-0.89	-0.58	0.31
Inland Transport	0.33	4.87	4.54	0.04	-2.53	-2.57	0.29	7.59	7.30
Sea & Air Transport	0.18	3.94	3.76	-3.68	1.97	5.65	4.01	1.93	-2.08
Other Transport	1.33	3.82	2.49	1.32	1.39	0.07	0.01	2.40	2.39
Communications	6.09	5.06	-1.03	0.96	1.18	0.22	5.08	3.83	-1.25
Bank. Finance & Ins.	3.70	2.04	-1.66	1.99	1.52	-0.47	1.68	0.51	-1.17
Other Market Serv.	4.07	4.15	0.08	3.44	4.95	1.51	0.61	-0.76	-1.37
Non-market Services	1.95	1.59	-0.36	1.89	1.27	-0.62	0.06	0.32	0.26
Unallocated	2.77	7.14	4.37	na	na	na	na	na	na
Fabricated Metal Products	1.06	3.38	2.32	-1.60	0.50	2.10	2.70	2.87	0.17
Transport Storage Comm	2.24	4.66	2.42	0.17	-0.58	-0.75	2.07	5.27	3.20

Source(s): CE's E3ME database based on Eurostat Cronos, OECD

Table 3.13. EU-9 sectoral growth trends

% per annum

				Employment			Productivity		
	1975-87	1987-91	Difference	1975-87	1987-91	Difference	1975-87	1987-91	Difference
Agriculture etc	0.03	0.02	-0.01	-0.03	-0.03	0.00	0.06	0.05	-0.01
Coal & Coke	-4.95	-5.08	-0.13	-5.29	-13.81	-8.52	0.36	10.13	9.77
Oil & Gas Extraction	1.13	-1.96	-3.09	3.88	2.38	-1.50	-2.65	-4.24	-1.59
Gas Distribution	3.87	1.21	-2.66	1.50	-3.11	-4.61	2.33	4.46	2.13
Refined Oil	-1.75	1.27	3.02	-2.88	-1.82	1.06	1.16	3.15	1.99
Electricity etc	3.04	2.00	-1.04	0.57	-1.36	-1.93	2.46	3.41	0.95
Water Supply	na	na	na	na	na	na	na	na	na
Ferrous & Non-F Metal	-0.18	1.68	1.86	-4.44	-2.03	2.41	4.46	3.79	-0.67
Non-metallic Min.Pr.	-0.39	2.61	3.00	-2.65	-0.03	2.62	2.32	2.64	0.32
Chemicals	4.19	2.79	-1.40	-1.19	0.26	1.45	5.44	2.52	-2.92
Metal Products	-0.38	3.99	4.37	-1.86	1.86	3.72	1.51	2.09	0.58
Agri. & Indust. Mach.	-1.22	2.45	3.67	-1.84	0.43	2.27	0.63	2.01	1.38
Office Machines	3.62	4.46	0.84	-0.48	-1.26	-0.78	4.12	5.79	1.67
Electrical Goods	4.18	4.02	-0.16	-1.29	0.16	1.45	5.54	3.85	-1.69
Transport Equipment	1.38	2.65	1.27	-1.51	-0.53	0.98	2.93	3.20	0.27
Food, Drink & Tobacco	0.78	1.97	1.19	-1.20	-0.97	0.23	2.00	2.97	0.97
Tex., Cloth. & Footw.	-0.20	0.37	0.57	-3.33	-2.61	0.72	3.24	3.06	-0.18
Paper & Printing Pr.	1.69	2.75	1.06	-0.09	1.24	1.33	1.78	1.49	-0.29
Rubber & Plastic Pr.	2.52	4.15	1.63	-0.72	2.80	3.52	3.26	1.31	-1.95
Recycling/Emiss Abate	na	na	na	na	na	na	na	na	na
Other Manufactures	-0.86	2.50	3.36	-1.65	0.72	2.37	0.80	1.77	0.97
Construction	0.14	2.85	2.71	-1.27	1.54	2.81	1.43	1.29	-0.14
Distribution etc	1.89	2.86	0.97	0.59	1.61	1.02	1.29	1.23	-0.06
Lodging & Catering	0.76	3.04	2.28	1.59	3.19	1.60	-0.82	-0.15	0.67
Inland Transport	0.24	5.47	5.23	0.16	-3.29	-3.45	0.08	9.06	8.98
Sea & Air Transport	-0.10	4.07	4.17	-0.85	1.85	2.70	0.76	2.18	1.42
Other Transport	1.30	4.12	2.82	0.93	2.03	1.10	0.37	2.05	1.68
Communications	6.14	5.39	-0.75	0.95	0.64	-0.31	5.14	4.72	-0.42
Bank. Finance & Ins.	3.91	2.38	-1.53	2.10	2.08	-0.02	1.77	0.29	-1.48
Other Market Serv.	4.22	4.44	0.22	3.80	4.60	0.80	0.40	-0.15	-0.55
Non-market Services	1.79	1.31	-0.48	1.54	0.79	-0.75	0.25	0.52	0.27
Unallocated	2.55	4.42	1.87	na	na	na	na	na	na
Fabricated Metal Products	1.08	3.36	2.28	-1.55	0.35	1.90	2.67	3.00	0.33
Transport Storage Comm	2.18	5.06	2.88	0.44	-0.97	-1.41	1.73	6.09	4.36

Source(s): CE's E3ME database based on Eurostat Cronos, OECD

Table 3.14. Objective 1 sectoral growth trends

% per annum

	GVA			Employment			Productivity		
	1975-87	1987-91	Difference	1975-87	1987-91	Difference	1975-87	1987-91	Difference
Agriculture etc	0.01	0.01	0.00	-0.03	-0.04	-0.01	0.04	0.05	0.01
Coal & Coke	4.25	4.60	0.35	8.51	-4.46	-12.97	-3.93	9.48	13.41
Oil & Gas Extraction	10.45	2.97	-7.48	4.55	0.85	-3.70	5.64	2.10	-3.54
Gas Distribution	8.75	16.80	8.05	9.11	9.36	0.25	-0.33	6.80	7.13
Refined Oil	-0.40	3.76	4.16	0.36	0.00	-0.36	-0.76	3.76	4.52
Electricity etc	3.25	5.12	1.87	3.30	1.75	-1.55	-0.05	3.31	3.36
Water Supply	na	na	na	na	na	na	na	na	na
Ferrous & Non-F Metal	0.70	3.50	2.80	-4.70	-3.92	0.78	5.67	7.72	2.05
Non-metallic Min.Pr.	-1.24	5.15	6.39	-3.74	2.36	6.10	2.60	2.73	0.13
Chemicals	3.08	2.85	-0.23	-0.85	1.38	2.23	3.96	1.45	-2.51
Metal Products	-2.01	5.04	7.05	-2.16	2.17	4.33	0.15	2.81	2.66
Agri. & Indust. Mach.	-0.12	2.56	2.68	-3.44	1.81	5.25	3.44	0.74	-2.70
Office Machines	15.61	12.38	-3.23	4.89	5.77	0.88	10.22	6.25	-3.97
Electrical Goods	3.58	5.51	1.93	-1.18	3.77	4.95	4.82	1.68	-3.14
Transport Equipment	0.83	4.63	3.80	-1.87	0.90	2.77	2.75	3.70	0.95
Food, Drink & Tobacco	2.02	2.74	0.72	-1.02	1.31	2.33	3.07	1.41	-1.66
Tex., Cloth. & Footw.	-0.28	0.73	1.01	-0.85	0.46	1.31	0.57	0.27	-0.30
Paper & Printing Pr.	1.87	1.46	-0.41	-0.48	3.27	3.75	2.36	-1.75	-4.11
Rubber & Plastic Pr.	1.08	1.18	0.10	-1.52	0.77	2.29	2.64	0.41	-2.23
Recycling/Emiss Abate	na	na	na	na	na	na	na	na	na
Other Manufactures	-1.12	0.99	2.11	-2.06	0.77	2.83	0.96	0.22	-0.74
Construction	-0.71	8.76	9.47	-3.20	5.82	9.02	2.57	2.78	0.21
Distribution etc	1.41	0.46	-0.95	-0.07	2.75	2.82	1.48	-2.23	-3.71
Lodging & Catering	1.75	-0.65	-2.40	3.15	1.70	-1.45	-1.36	-2.31	-0.95
Inland Transport	1.36	-2.57	-3.93	-0.66	1.30	1.96	2.03	-3.82	-5.85
Sea & Air Transport	3.69	2.50	-1.19	-10.01	2.47	12.48	15.22	0.03	-15.19
Other Transport	1.82	-0.72	-2.54	4.42	-3.27	-7.69	-2.49	2.64	5.13
Communications	5.72	1.15	-4.57	0.84	5.81	4.97	4.84	-4.40	-9.24
Bank. Finance & Ins.	2.22	-0.57	-2.79	1.56	-2.66	-4.22	0.65	2.15	1.50
Other Market Serv.	2.09	-0.20	-2.29	-0.39	8.90	9.29	2.49	-8.36	-10.85
Non-market Services	3.92	4.40	0.48	4.72	3.98	-0.74	-0.76	0.40	1.16
Unallocated	6.12	26.65	20.53	na	na	na	na	na	na
Fabricated Metal Products	1.25	5.60	4.35	-1.89	2.23	4.12	3.20	3.30	0.10
Transport Storage Comm	3.10	-0.31	-3.41	-1.36	1.81	3.17	4.52	-2.08	-6.60

Source(s): CE's E3ME database based on Eurostat Cronos, OECD

Table 3.15. Japan sectoral growth trends

% per annum

	1975-87	1987-91	Difference	1975-87	1987-91	Difference	1975-87	1987-91	Difference
Agriculture	0.00	-0.01	-0.01	-0.03	-0.02	0.01	0.03	0.01	-0.02
Mining	-1.40	4.67	6.07	-3.09	-3.41	-0.32	1.74	8.37	6.63
Food	1.26	2.72	1.46	1.03	1.55	0.52	0.23	1.15	0.92
Textile	0.41	-4.14	-4.55	-1.50	-0.31	1.19	1.94	-3.84	-5.78
Wood	na	na	na	na	na	na	na	na	na
Paper	3.67	6.60	2.93	0.17	1.41	1.24	3.49	5.12	1.63
Chemicals	4.36	4.39	0.03	-1.69	2.23	3.92	6.15	2.11	-4.04
Non-metallic	2.51	3.79	1.28	-2.28	1.43	3.71	4.90	2.33	-2.57
Basic Metal	2.33	4.36	2.03	0.49	0.79	0.30	1.83	3.54	1.71
Fabricated metal product	9.18	11.06	1.88	1.42	2.91	1.49	7.65	7.92	0.27
- metal products	na	na	na	na	na	na	na	na	na
- agricult and ind machinery	na	na	na	na	na	na	na	na	na
- office and data process	na	na	na	na	na	na	na	na	na
- electrical goods	na	na	na	na	na	na	na	na	na
- transport equipment	na	na	na	na	na	na	na	na	na
Other Manufacturing ind.	3.58	4.65	1.07	0.00	1.85	1.85	3.58	2.75	-0.83
Electricity Gas and Water	4.24	5.96	1.72	0.94	1.01	0.07	3.27	4.90	1.63
Construction	0.76	5.57	4.81	0.08	2.99	2.91	0.68	2.51	1.83
Wholes/ret/rest/hotels	na	na	na	na	na	na	na	na	na
- wholesale and retail	5.21	5.03	-0.18	1.26	1.02	-0.24	3.90	3.97	0.07
- restaurants and hotels	na	na	na	na	na	na	na	na	na
Transport storage comm	2.60	4.45	1.85	0.37	2.22	1.85	2.22	2.18	-0.04
- communication	na	na	na	na	na	na	na	na	na
Finance Ins Real est busi	4.95	3.76	-1.19	3.00	2.87	-0.13	1.89	0.87	-1.02
- financ and insurance	na	na	na	na	na	na	na	na	na
- real est and business serv	na	na	na	na	na	na	na	na	na
Community social pers serv	5.32	5.43	0.11	3.74	4.14	0.40	1.52	1.24	-0.28
Government Services	2.70	0.22	-2.48	0.72	-0.05	-0.77	1.97	0.27	-1.70
Other Producers	4.35	2.62	-1.73	3.29	2.78	-0.51	1.03	-0.16	-1.19

Source(s): CE's E3ME database based on Eurostat Cronos, OECD

Table 3.16. US sectoral growth trends

% per annum

	1975-87	1987-91	Difference	1975-87	1987-91	Difference	1975-87	1987-91	Difference
Agriculture	0.03	0.03	0.00	0.00	0.00	0.00	0.03	0.03	0.00
Mining	-0.27	1.69	1.96	0.28	-0.87	-1.15	-0.55	2.58	3.13
Food	1.72	-0.05	-1.77	-0.61	0.34	0.95	2.34	-0.39	-2.73
Textile	1.33	1.12	-0.21	-2.09	-2.34	-0.25	3.49	3.54	0.05
Wood	1.99	-3.96	-5.95	0.55	-2.05	-2.60	1.43	-1.95	-3.38
Paper	2.57	0.28	-2.29	1.87	0.97	-0.90	0.69	-0.68	-1.37
Chemicals	2.96	0.72	-2.24	0.40	0.79	0.39	2.55	-0.07	-2.62
Non-metallic	0.64	-0.23	-0.87	-1.45	-1.67	-0.22	2.12	1.46	-0.66
Basic Metal	-3.59	0.83	4.42	-4.61	-0.52	4.09	1.07	1.36	0.29
Fabricated metal product	4.48	1.48	-3.00	0.39	-1.17	-1.56	4.07	2.68	-1.39
- metal products	1.55	-1.10	-2.65	-1.01	-0.88	0.13	2.59	-0.22	-2.81
- agricult and ind machinery	0.29	3.19	2.90	-0.46	-0.53	-0.07	0.75	3.74	2.99
- office and data process	3.19	5.98	2.79	1.82	-1.28	-3.10	1.35	7.35	6.00
- electrical goods	5.90	4.80	-1.10	1.58	-1.65	-3.23	4.25	6.56	2.31
- transport equipment	2.02	-3.15	-5.17	0.76	-1.56	-2.32	1.25	-1.62	-2.87
Other Manufacturing ind.	1.23	2.56	1.33	-1.27	0.13	1.40	2.53	2.43	-0.10
Electricity Gas and Water	2.79	2.72	-0.07	2.21	1.18	-1.03	0.57	1.52	0.95
Construction	0.38	-1.89	-2.27	2.50	-0.78	-3.28	-2.07	-1.12	0.95
Wholes/ret/rest/hotels	3.08	1.68	-1.40	2.59	1.04	-1.55	0.48	0.63	0.15
- wholesale and retail	3.15	1.65	-1.50	2.52	0.97	-1.55	0.61	0.67	0.06
- restaurants and hotels	1.40	2.24	0.84	3.48	1.94	-1.54	-2.01	0.29	2.30
Transport storage comm	2.45	3.39	0.94	1.21	1.18	-0.03	1.23	2.18	0.95
- communication	5.50	3.49	-2.01	0.98	0.35	-0.63	4.48	3.13	-1.35
Finance Ins Real est busi	3.55	1.88	-1.67	5.45	2.18	-3.27	-1.80	-0.29	1.51
- financ and insurance	3.40	2.09	-1.31	3.70	0.50	-3.20	-0.29	1.58	1.87
- real est and business serv	3.59	1.82	-1.77	6.57	3.03	-3.54	-2.80	-1.17	1.63
Community social pers serv	3.50	2.74	-0.76	3.15	3.74	0.59	0.34	-0.96	-1.30
Government Services	1.21	1.91	0.70	1.00	1.61	0.61	0.21	0.30	0.09
Other Producers	na	na	na	na	na	na	na	na	na

Source(s): CE's E3ME database based on Eurostat Cronos, OECD

Table 3.17. EU-12 sectoral shares

	1975	1987	1991
		per cent of total EU12 output	
Agriculture etc	3.4	3.2	3.0
Coal & Coke	0.2	0.1	0.1
Oil & Gas Extraction	0.4	0.4	0.4
Gas Distribution	0.5	0.6	0.6
Refined Oil	2.6	1.9	1.8
Electricity etc	0.9	1.0	1.0
Water Supply	0.4	0.3	0.2
Ferrous & Non-F Metal	1.4	1.0	1.0
Non-metallic Min.Pr.	1.5	1.2	1.2
Chemicals	1.8	2.3	2.3
Metal Products	2.4	1.8	1.9
Agri. & Indust. Mach.	3.1	2.1	2.0
Office Machines	0.6	0.7	0.7
Electrical Goods	1.9	2.4	2.5
Transport Equipment	2.5	2.4	2.3
Food, Drink & Tobacco	3.8	3.4	3.2
Tex., Cloth. & Footw.	2.5	1.9	1.7
Paper & Printing Pr.	1.8	1.8	1.7
Rubber & Plastic Pr.	0.9	0.9	0.9
Recycling/Emiss Abate	na	na	na
Other Manufactures	1.5	1.1	1.1
Construction	7.0	5.6	5.7
Distribution etc	12.7	12.5	12.2
Lodging & Catering	2.6	2.2	2.2
Inland Transport	2.4	2.0	2.2
Sea & Air Transport	0.7	0.6	0.6
Other Transport	1.1	1.1	1.1
Communications	1.3	2.1	2.3
Bank. Finance & Ins.	4.2	5.2	5.0
Other Market Serv.	15.2	19.2	20.0
Non-market Services	14.6	13.9	13.2
Unallocated	4.3	5.2	6.0
Fabricated Metal Products	10.4	9.4	9.5
Transport Storage Comm	5.6	5.8	6.2

Source(s): CE's E3ME database based on Eurostat Cronos, OECD

Table 3.18. EU-9 sectoral shares

		per cent of total EU9 output	
	1975	1987	1991
Agriculture etc	3.0	2.9	2.7
Coal & Coke	0.2	0.1	0.1
Oil & Gas Extraction	0.5	0.5	0.4
Gas Distribution	0.5	0.7	0.6
Refined Oil	2.5	1.7	1.6
Electricity etc	0.9	1.0	0.9
Water Supply	0.4	0.2	0.1
Ferrous & Non-F Metal	1.4	1.0	1.0
Non-metallic Min.Pr.	1.5	1.2	1.2
Chemicals	1.7	2.3	2.3
Metal Products	2.4	1.8	1.9
Agri. & Indust. Mach.	3.3	2.2	2.2
Office Machines	0.6	0.7	0.8
Electrical Goods	2.0	2.5	2.6
Transport Equipment	2.5	2.4	2.3
Food, Drink & Tobacco	3.8	3.2	3.1
Tex., Cloth. & Footw.	2.4	1.8	1.6
Paper & Printing Pr.	1.8	1.8	1.8
Rubber & Plastic Pr.	0.8	0.9	1.0
Recycling/Emiss Abate	na	na	na
Other Manufactures	1.5	1.1	1.1
Construction	6.9	5.5	5.5
Distribution etc	12.5	12.3	12.3
Lodging & Catering	2.3	2.0	2.0
Inland Transport	2.5	2.1	2.2
Sea & Air Transport	0.7	0.6	0.6
Other Transport	1.2	1.1	1.2
Communications	1.4	2.2	2.4
Bank. Finance & Ins.	4.1	5.2	5.1
Other Market Serv.	15.5	19.9	21.0
Non-market Services	15.1	14.1	13.2
Unallocated	4.6	5.2	5.5
Fabricated Metal Products	10.8	9.7	9.8
Transport Storage Comm	5.7	5.9	6.4

Source(s): CE's E3ME database based on Eurostat Cronos, OECD

Table 3.19. Objective 1 sectoral shares

	1975	1987	1991
	per cent of total Ob1 countries' output		
Agriculture etc	8.1	7.1	6.3
Coal & Coke	0.1	0.1	0.1
Oil & Gas Extraction	0.1	0.1	0.1
Gas Distribution	0.1	0.2	0.3
Refined Oil	3.7	2.9	2.9
Electricity etc	1.0	1.2	1.2
Water Supply	0.5	0.6	0.3
Ferrous & Non-F Metal	1.3	1.0	1.0
Non-metallic Min.Pr.	2.3	1.6	1.7
Chemicals	2.2	2.6	2.5
Metal Products	2.3	1.5	1.5
Agri. & Indust. Mach.	1.0	0.8	0.7
Office Machines	0.1	0.7	0.9
Electrical Goods	1.2	1.5	1.6
Transport Equipment	2.3	2.1	2.2
Food, Drink & Tobacco	5.0	4.9	4.7
Tex., Cloth. & Footw.	3.4	2.6	2.3
Paper & Printing Pr.	1.4	1.4	1.3
Rubber & Plastic Pr.	0.9	0.8	0.8
Recycling/Emiss Abate	na	na	na
Other Manufactures	1.6	1.1	1.0
Construction	8.6	6.4	7.7
Distribution etc	14.3	13.6	12.1
Lodging & Catering	4.8	4.8	4.1
Inland Transport	1.9	1.8	1.4
Sea & Air Transport	0.5	0.5	0.5
Other Transport	0.8	0.7	0.6
Communications	1.1	1.8	1.6
Bank. Finance & Ins.	5.3	5.6	4.8
Other Market Serv.	12.6	12.6	10.9
Non-market Services	10.3	12.8	13.0
Unallocated	1.6	4.6	9.9
Fabricated Metal Products	6.9	6.5	7.0
Transport Storage Comm	4.2	4.8	4.2

Source(s): CE's E3ME database based on Eurostat Cronos, OECD

Table 3.20. Japan sectoral shares

	1975	1987	1991
		per cent of total Japan output	
Agriculture	5.0	2.9	2.2
Mining	0.5	0.3	0.3
Food	4.4	2.9	2.7
Textile	1.2	0.7	0.5
Wood	na	na	na
Paper	0.7	0.7	0.7
Chemicals	2.6	3.1	2.9
Non-metallic	1.2	1.0	1.0
Basic Metal	2.5	2.2	2.1
Fabricated metal product	7.3	13.0	16.6
- metal products	na	na	na
- agricult and ind machinery	na	na	na
- office and data process	na	na	na
- electrical goods	na	na	na
- transport equipment	na	na	na
Other Manufacturing ind.	4.3	4.3	4.2
Electricity Gas and Water	3.1	3.0	3.1
Construction	11.4	8.2	8.4
Wholes/ret/rest/hotels	na	na	na
- wholesale and retail	11.4	13.2	13.1
- restaurants and hotels	na	na	na
Transport storage comm	7.8	6.2	6.0
- communication	na	na	na
Finance Ins Real est busi	13.6	15.8	15.0
- financ and insurance	na	na	na
- real est and business serv	na	na	na
Community social pers serv	12.5	13.5	13.5
Government Services	9.0	7.5	6.2
Other Producers	1.8	1.9	1.7

Source(s): CE's E3ME database based on Eurostat Cronos, OECD

Table 3.21. US sectoral shares

	1975	1987	per cent of total US output 1991
Agriculture	2.2	2.0	2.1
Mining	3.7	2.4	2.5
Food	2.2	1.9	1.8
Textile	1.1	1.0	1.0
Wood	0.9	0.9	0.7
Paper	2.0	2.1	1.9
Chemicals	2.9	3.3	3.1
Non-metallic	0.7	0.6	0.5
Basic Metal	1.5	0.8	0.8
Fabricated metal product	6.7	8.8	8.8
- metal products	1.4	1.4	1.2
- agricult and ind machinery	2.5	2.3	2.4
- office and data process	0.6	0.6	0.8
- electrical goods	1.3	2.1	2.4
- transport equipment	2.5	2.6	2.1
Other Manufacturing ind.	0.4	0.3	0.3
Electricity Gas and Water	3.2	3.0	3.1
Construction	5.6	4.6	3.9
Wholes/ret/rest/hotels	16.0	17.0	17.0
- wholesale and retail	15.2	16.2	16.3
- restaurants and hotels	0.8	0.7	0.8
Transport storage comm	6.1	6.4	6.8
- communication	2.1	2.9	3.1
Finance Ins Real est busi	21.0	23.1	23.3
- financ and insurance	4.8	5.1	5.2
- real est and business serv	16.2	18.0	18.1
Community social pers serv	8.4	9.2	9.4
Government Services	14.0	11.4	11.4
Other Producers	0.0	0.0	0.0

Source(s): CE's E3ME database based on Eurostat Cronos, OECD

Table 3.22. Trend growth in GVA per capita in selected groups of regions (% p.a.)

	1975–87	1987–93
Ob1	1.71	2.25
Non-Ob1	1.72	1.50
Periphery	1.70	2.26
Core	1.72	1.45
Ob2	1.21	1.16
Non-Ob2	1.71	1.68
Agriculture	2.01	1.89
Manufacturing	1.74	1.79
Services	1.62	1.42
Border	1.75	2.04
Interior	1.60	1.36
EU-12	1.66	1.64

Note: Growth rates based on the regional data differ slightly from those based on data at Member State level.

Table 3.23. Trend growth in employment in selected groups of regions (% p.a.)

	1975–87	1987–93
Ob1	-0.15	0.69
Non-Ob1	0.05	0.65
Periphery	-0.04	0.81
Core	0.03	0.62
Ob2	-0.90	1.46
Non-Ob2	0.11	0.58
Agriculture	0.12	0.54
Manufacturing	0.03	0.94
Services	0.00	0.64
Border	-0.08	0.88
Interior	0.08	0.52
EU-12	0.02	0.66

Note: Growth rates based on the regional data differ slightly from those based on data at Member State level.

Table 3.24. Comparison of per capita GVA inequality indicators for region groups pre-1987 and post-1987

	Gini coefficient	Standard deviation
Ob1	1.034	1.053
Periphery	1.063	1.069
South	1.020	1.030
Manufacturing	0.9858	0.9914
Services	0.9943	0.9830
Agriculture	1.020	1.028
Ob2	0.7315	0.7160
Border	0.9273	0.9792
EU-12	1.0222	1.0000

Note: For each indicator, the value shown is the ratio of the indicator's value in the period 1987-93 to its value in the period 1975-87.

Figure 3.1. GVA per capita levels

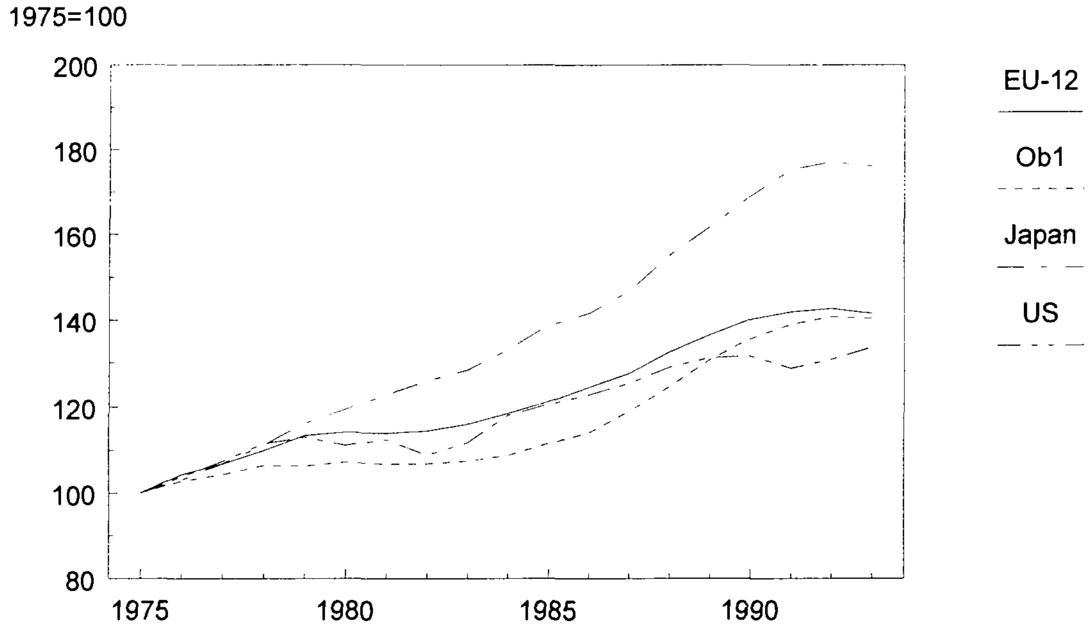


Figure 3.2. GVA per capita levels

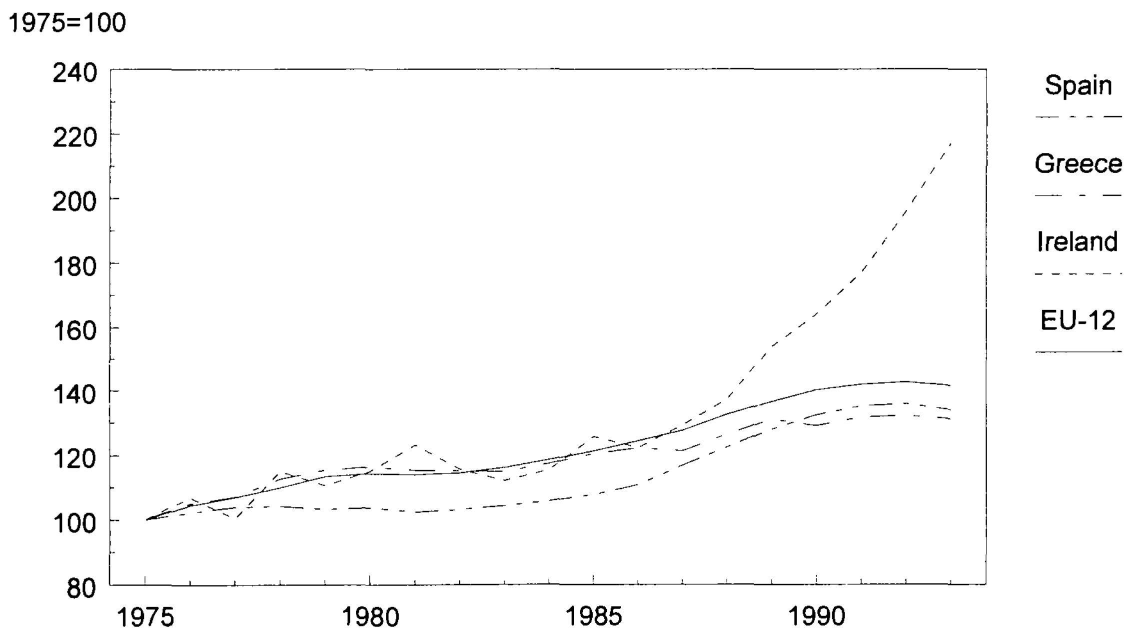


Figure 3.3. Population levels

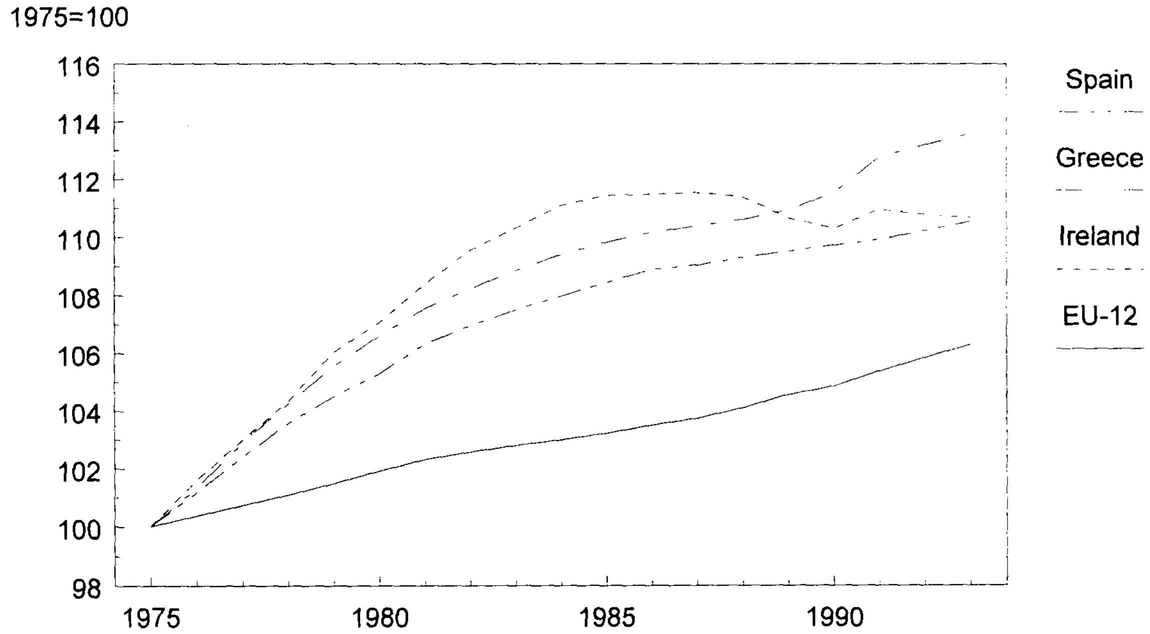


Figure 3.4. Investment to output ratio

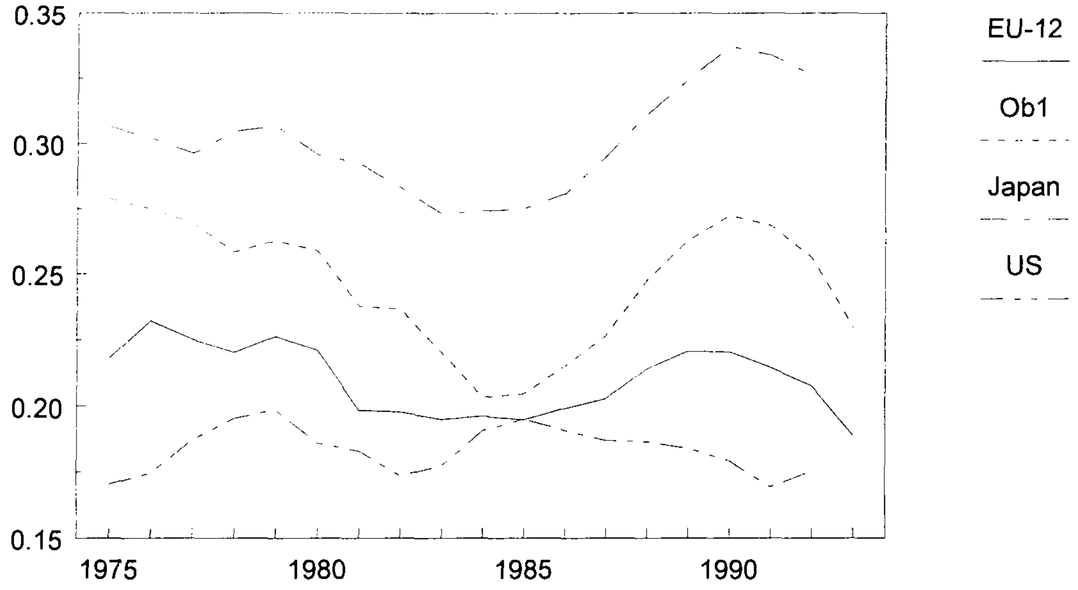


Figure 3.5. Investment to output ratio

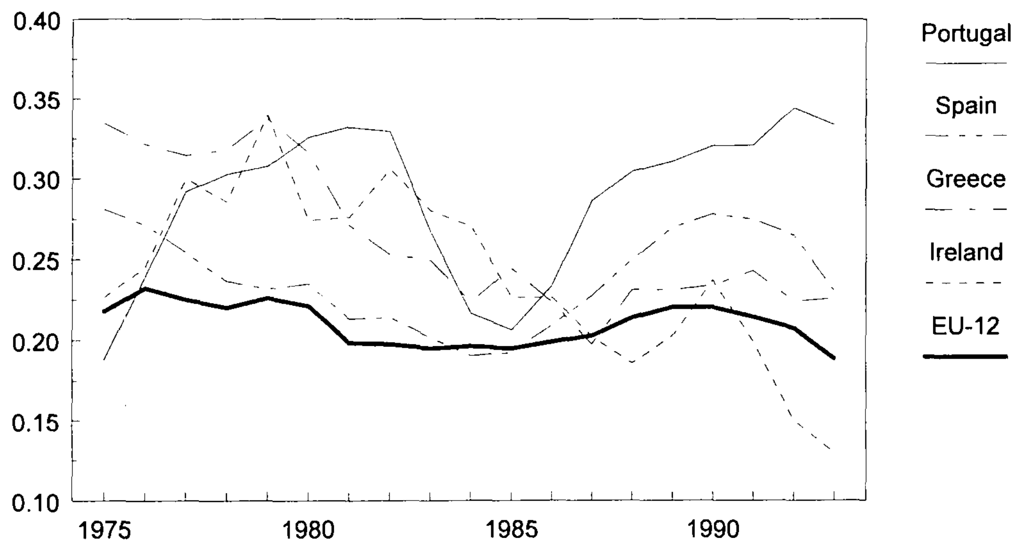


Figure 3.6. Italy – GVA shares

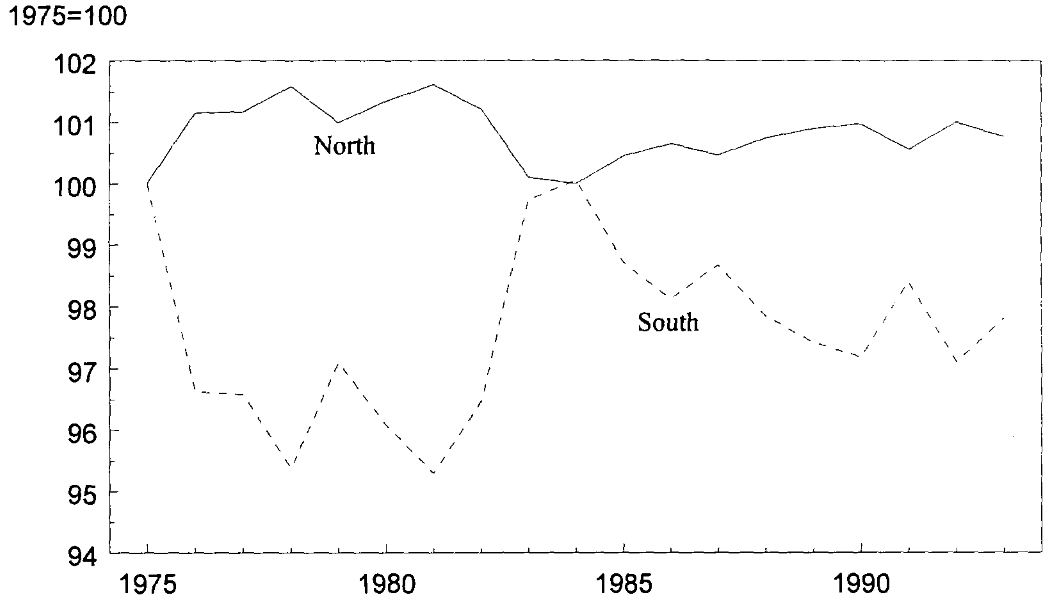
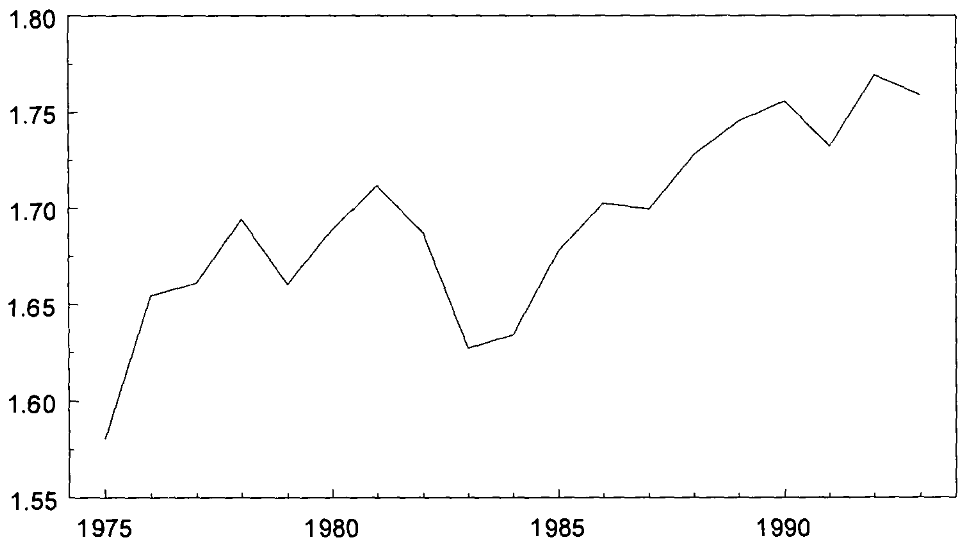


Figure 3.7. GVA per capita ratio (Italy)



Note: Ratio of GVA per capita in northern Italy to that in southern Italy.

Figure 3.8. Spain – GVA shares

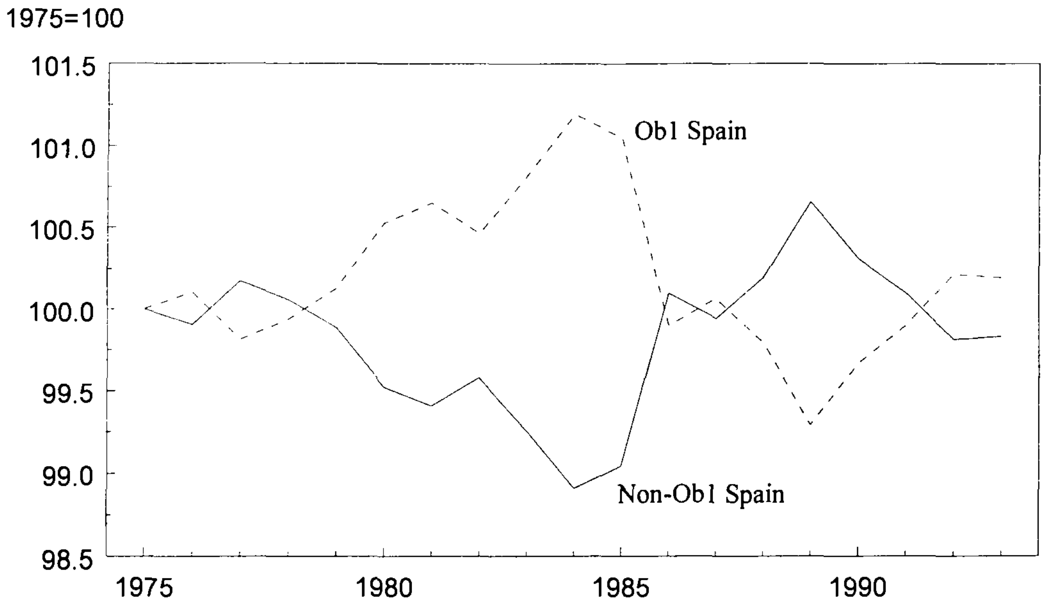
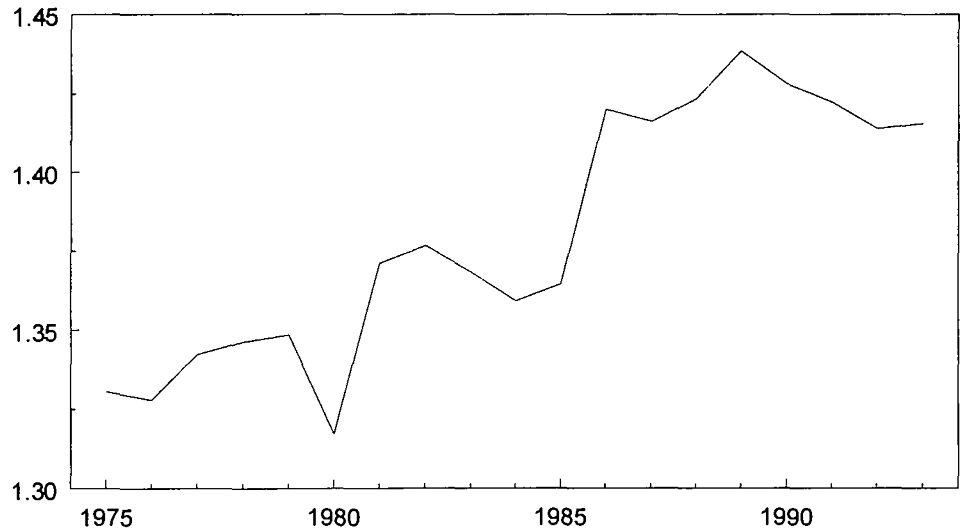


Figure 3.9. GVA per capita ratio (Spain)



Note: Ratio of GVA per capita in non-Ob1 Spain to that in Ob1 Spain.

Figure 3.10. Standard deviation of log GVA per capita levels, 1975-93, across Member States

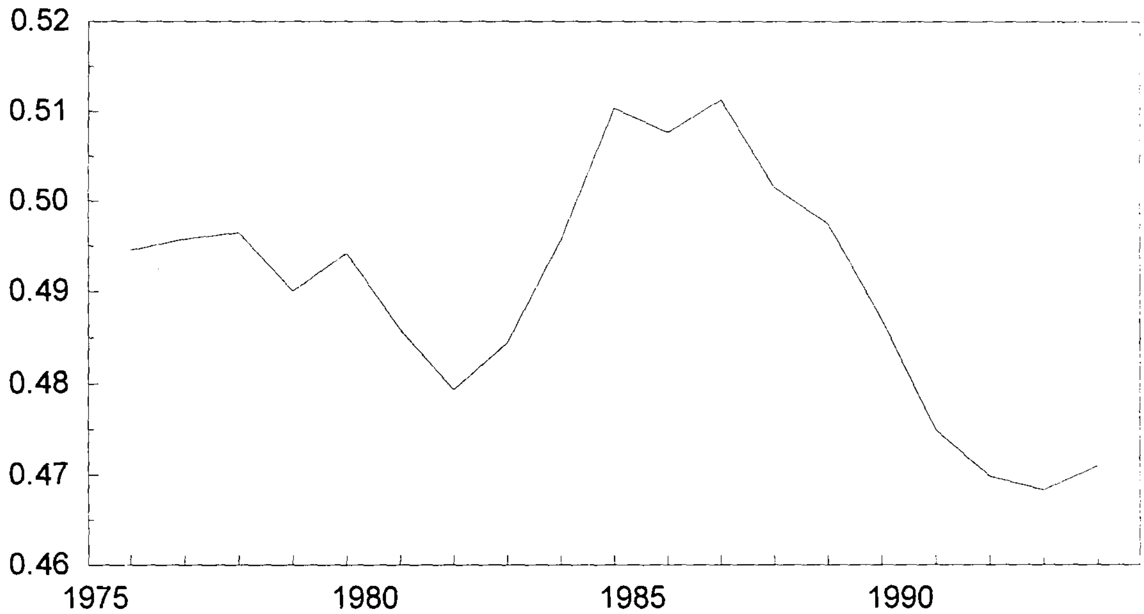


Figure 3.11. Beta-convergence

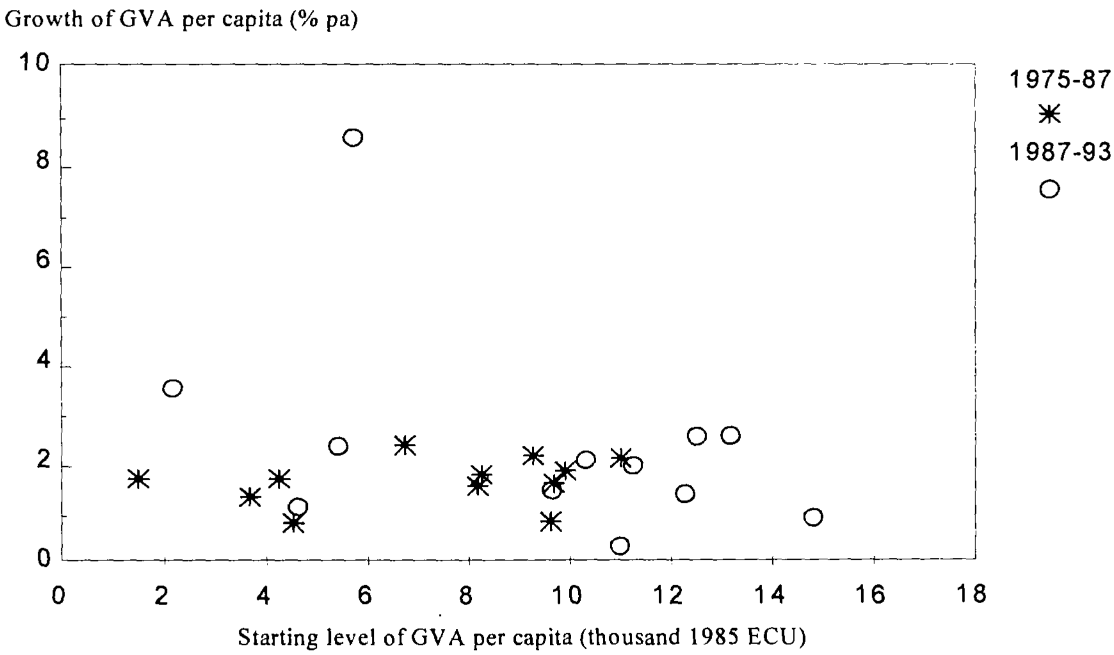


Figure 3.12. GVA levels – manufacturing

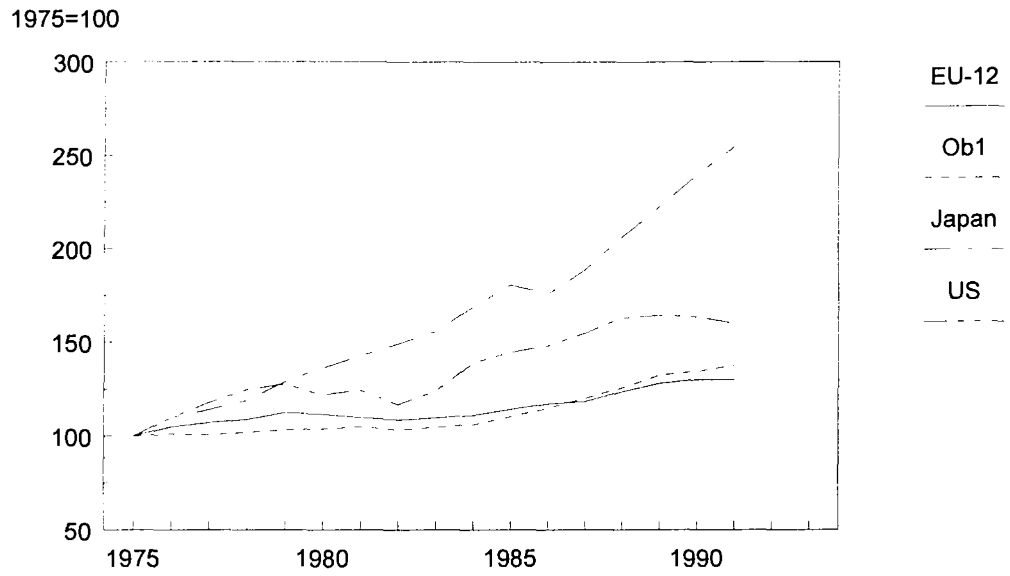


Figure 3.13. GVA levels – manufacturing

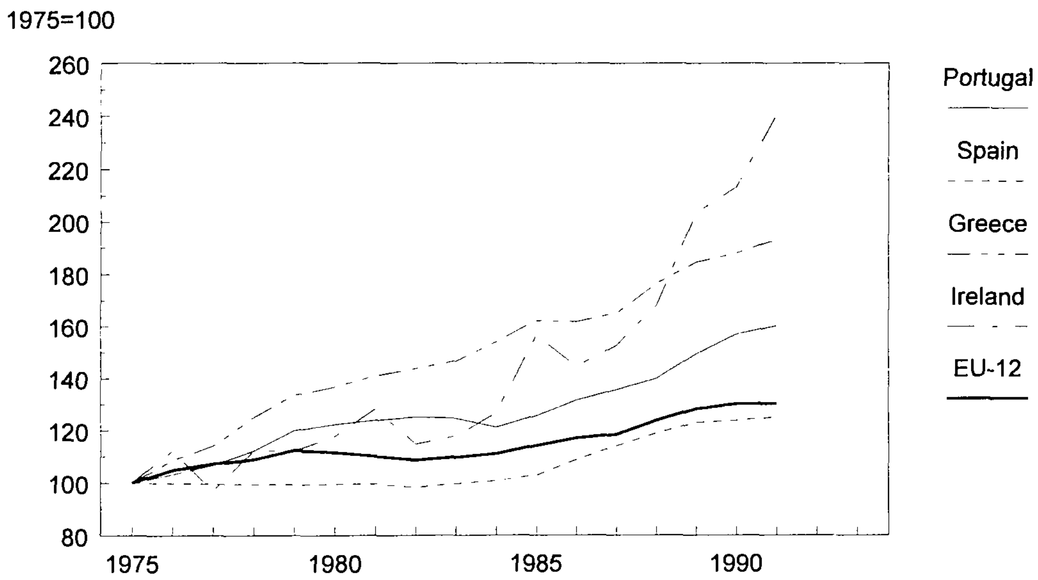


Figure 3.14. GVA levels – market services

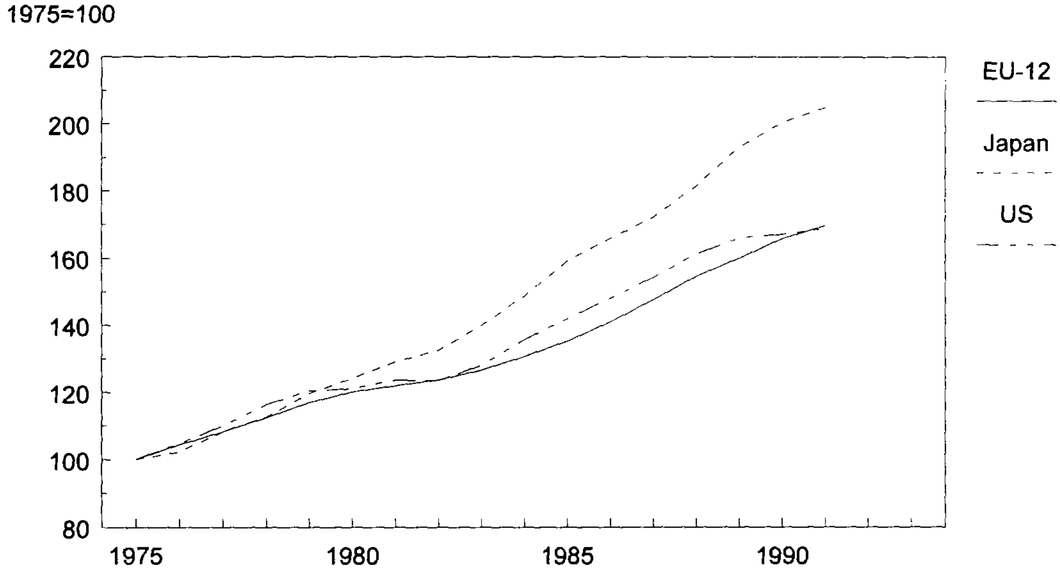


Figure 3.15. GVA levels – market services

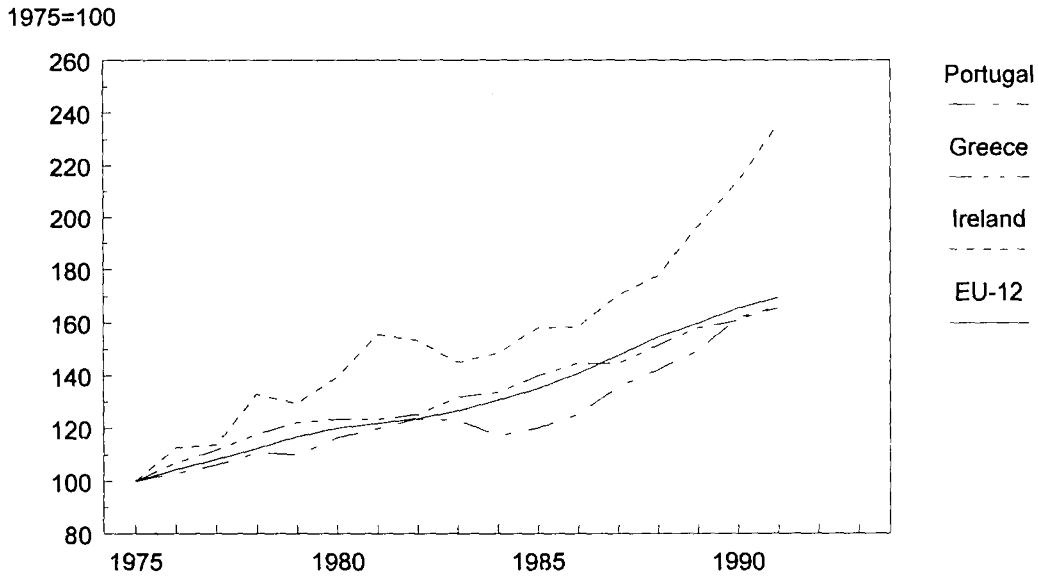


Figure 3.16. GVA levels – construction

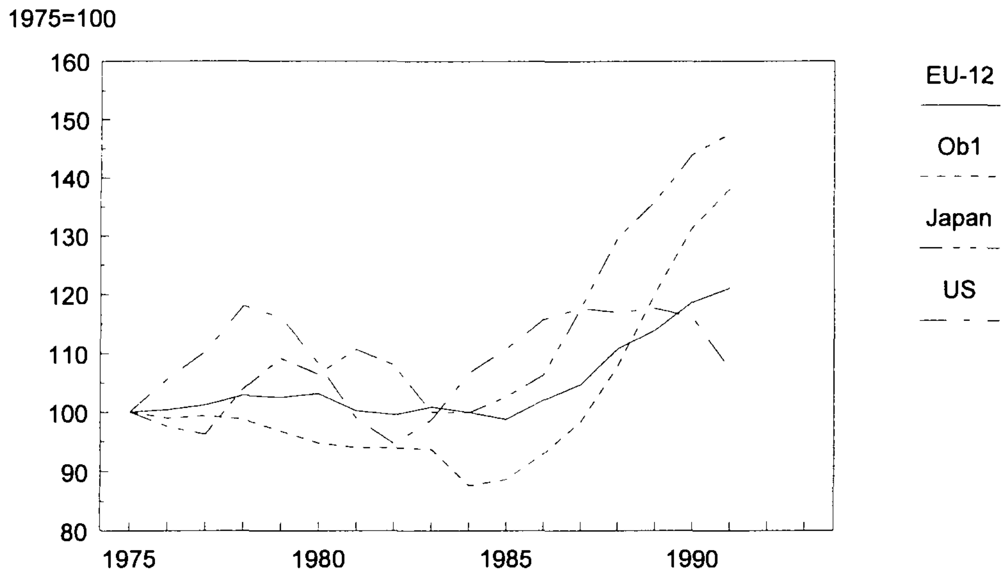


Figure 3.17. GVA levels – construction

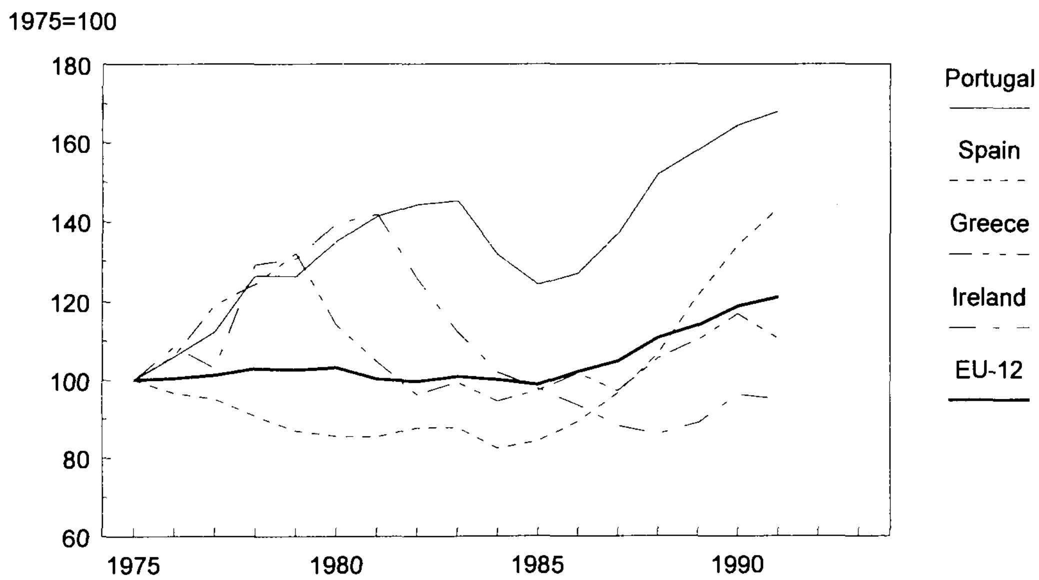


Figure 3.18. GVA per capita – Objective 1 regions

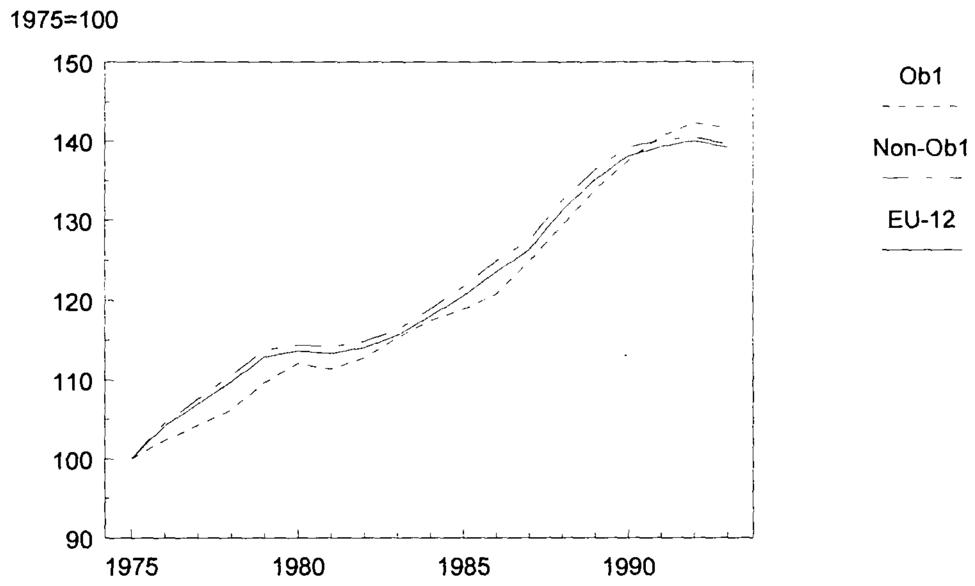


Figure 3.19. GVA per capita – periphery regions

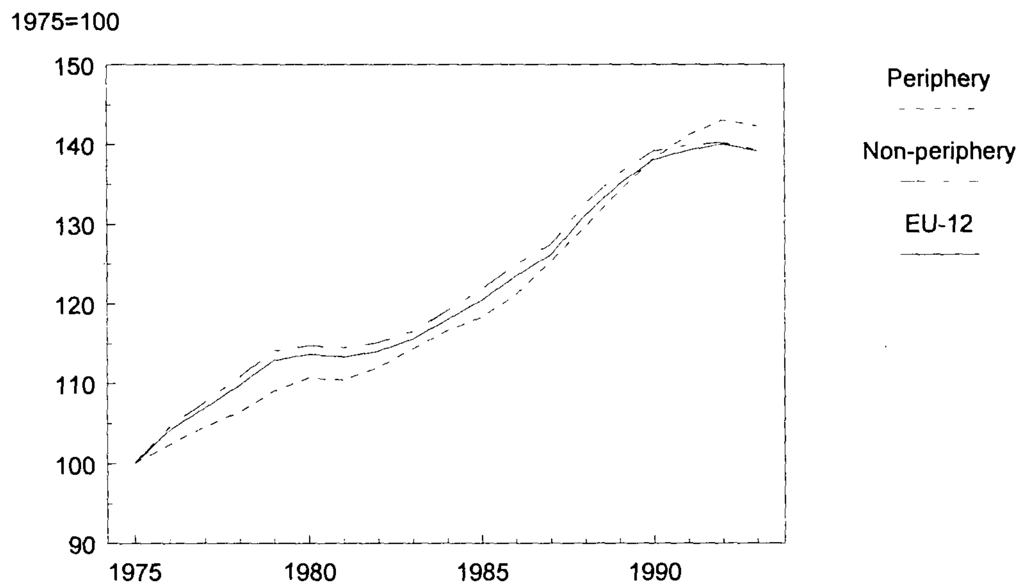


Figure 3.20. GVA per capita – northern versus southern regions

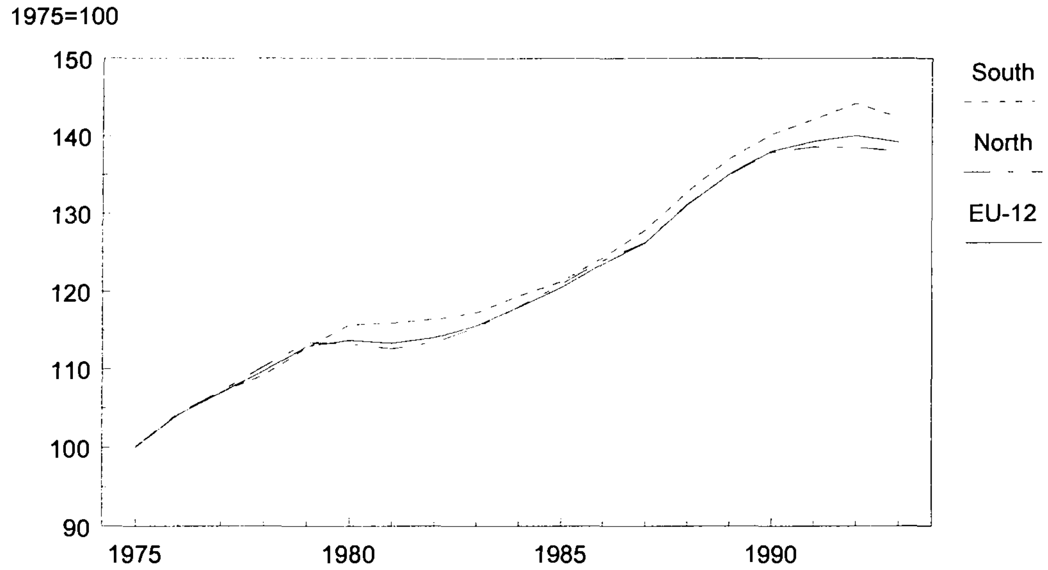


Figure 3.21. GVA per capita – regions distinguished by economic structure

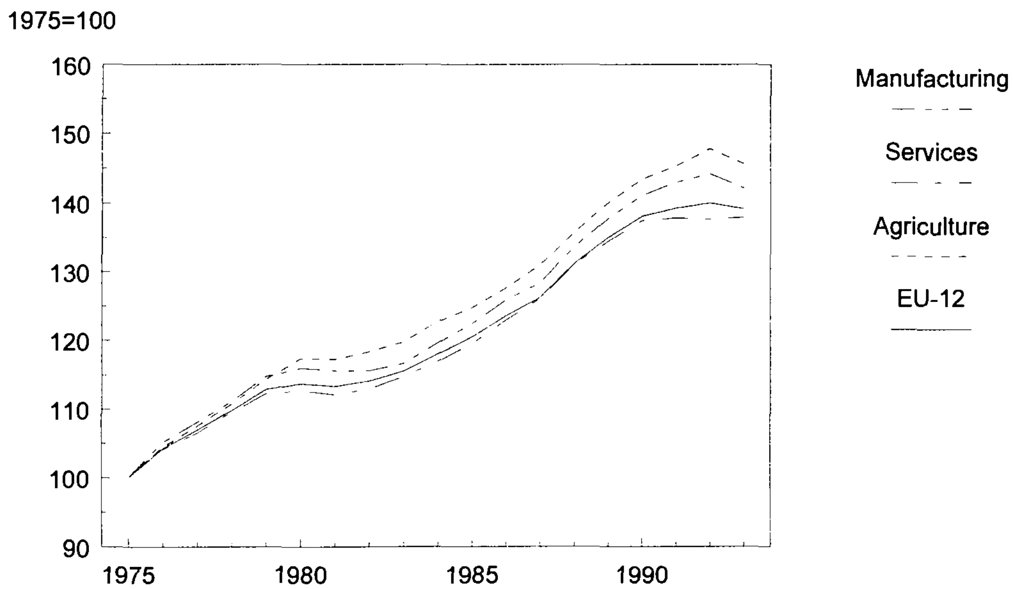


Figure 3.22. GVA per capita – Objective 2 regions

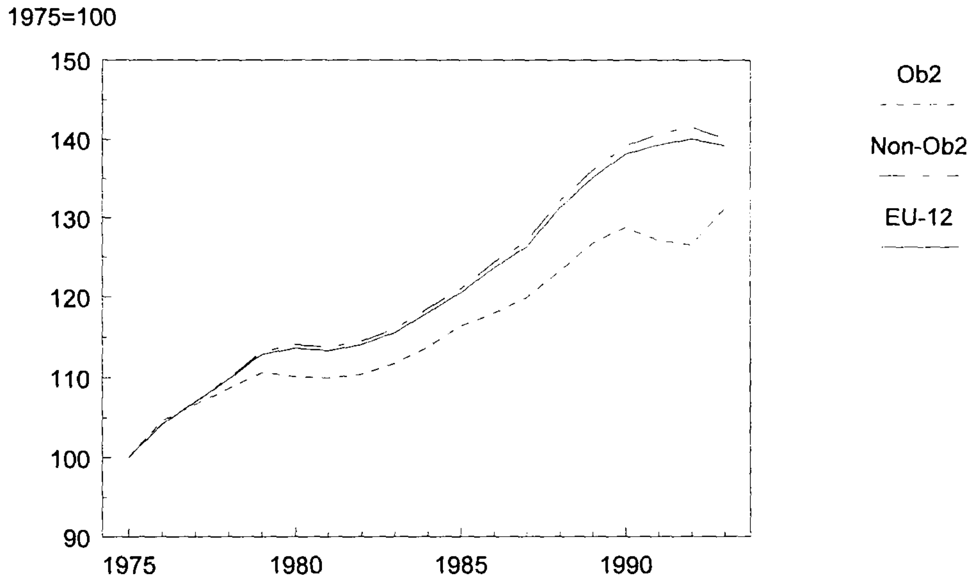


Figure 3.23. GVA per capita – border regions

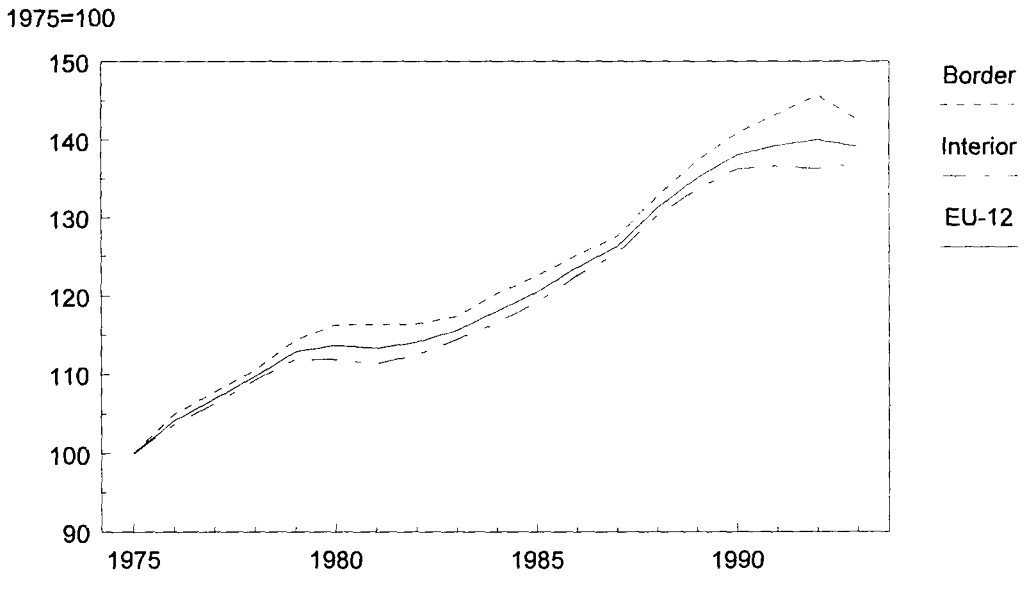


Figure 3.24. Employment – Objective 1 regions

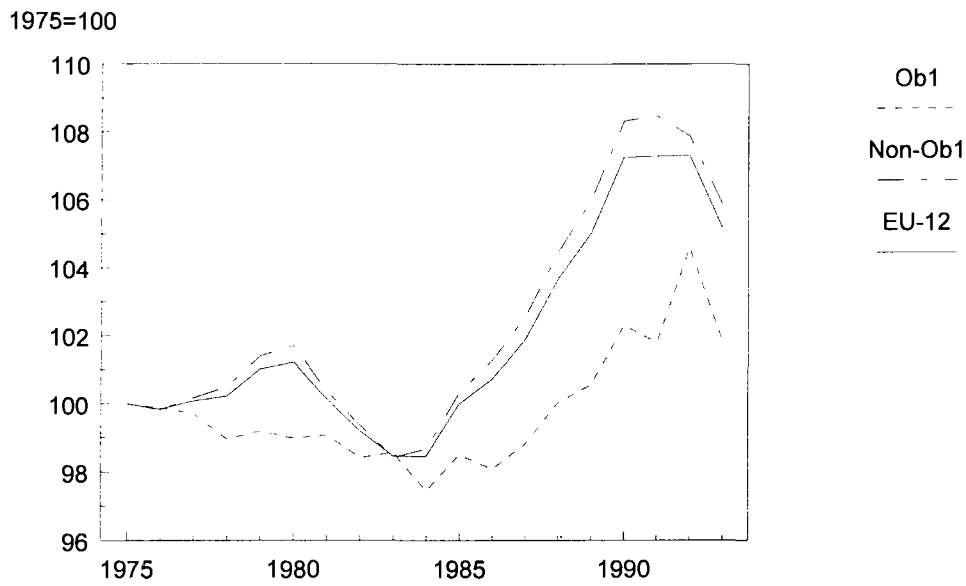


Figure 3.25. Employment – periphery regions

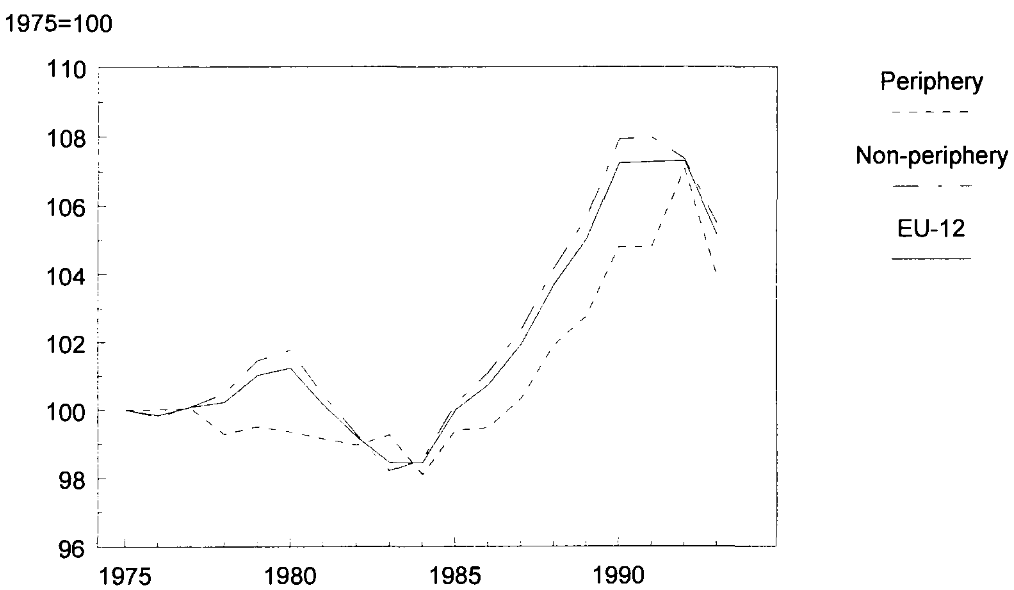


Figure 3.26. Employment – northern versus southern regions

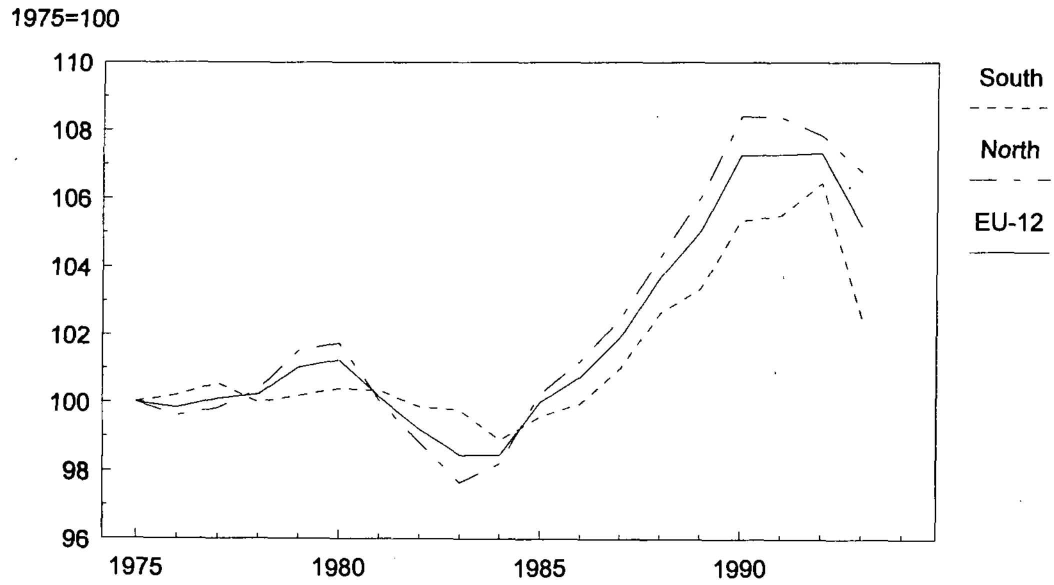


Figure 3.27. Employment – regions distinguished by economic structure

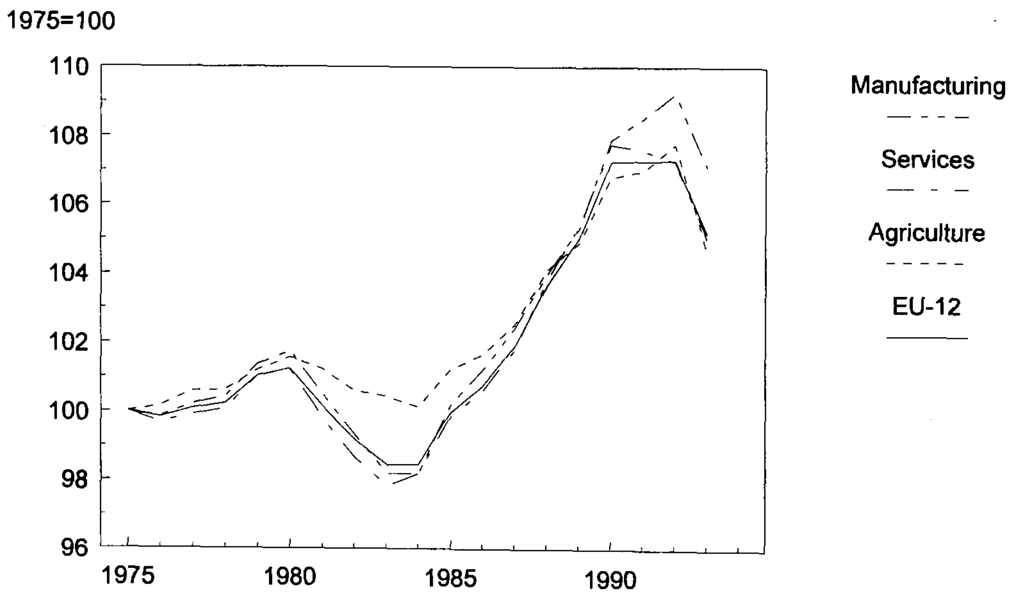


Figure 3.28. Employment – Objective 2 regions

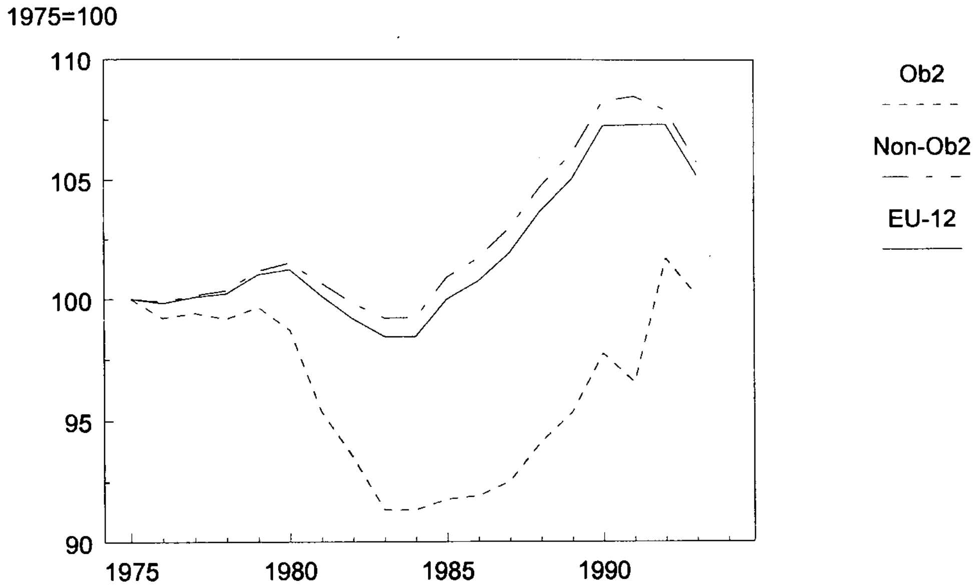


Figure 3.29. Employment – border regions

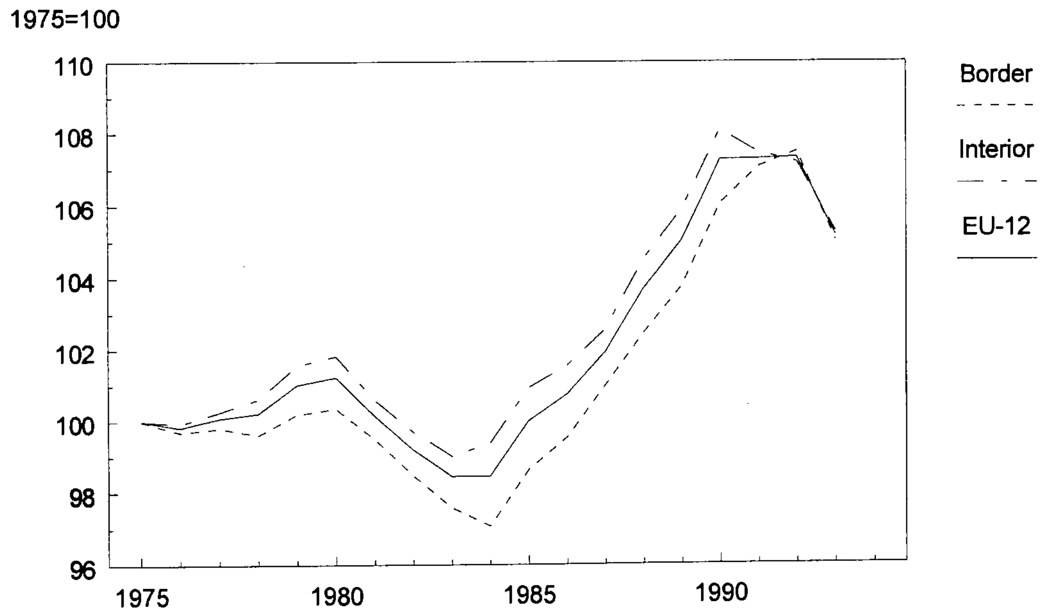


Figure 3.30. Standard deviation of log GVA per capita levels, 1975-93, across regions

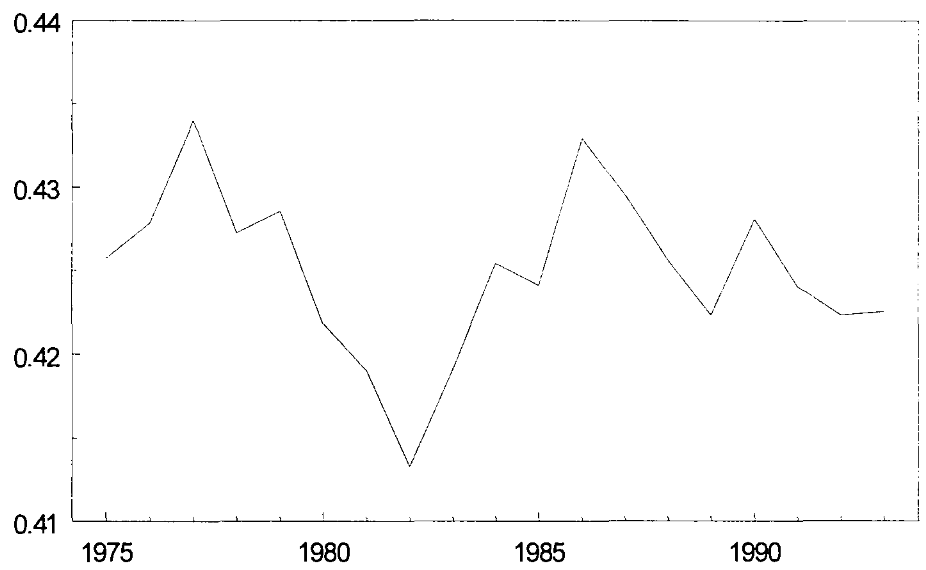


Figure 3.31. The Gini coefficient, 1975-93, for GVA per capita in the EU-12

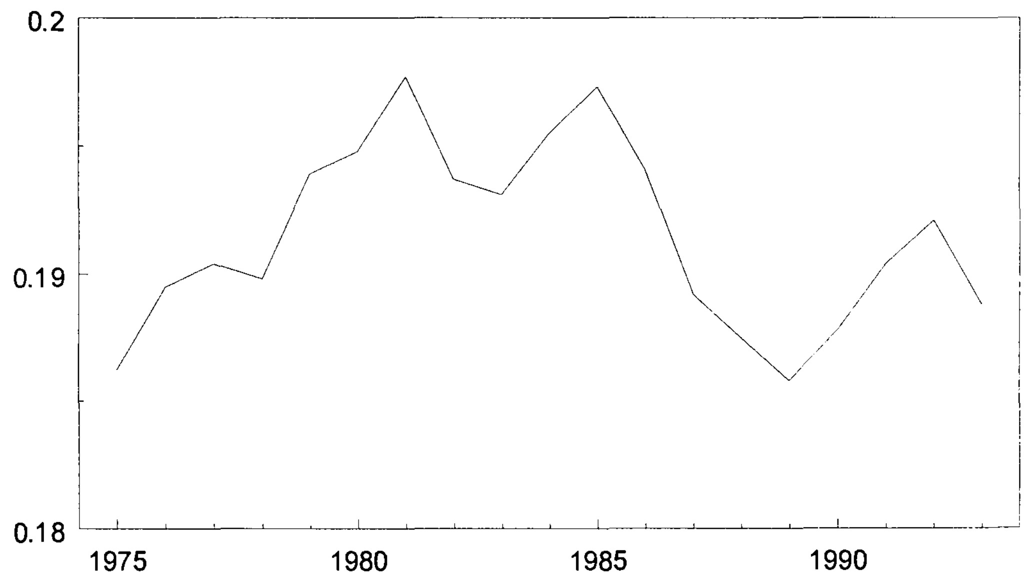
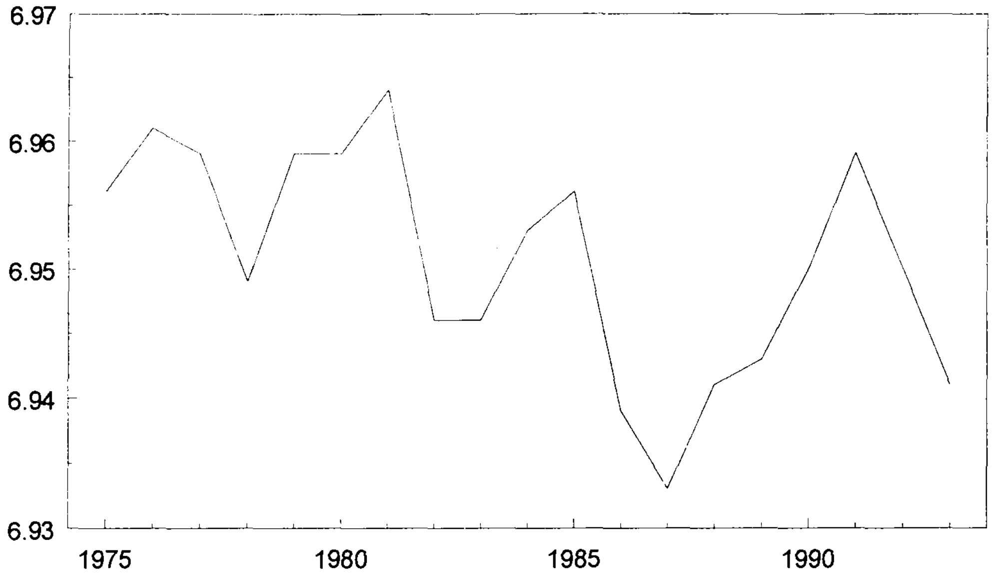


Figure 3.32. The standardized Moran's I, 1975-93, for GVA per capita in the EU-12



4. Econometric analysis of growth and convergence

This chapter describes a model based on the assessment of the aggregate impact of the SMP on GVA per capita growth in Europe, based mainly on the sort of regression popularized by Barro [1991] and discussed in Chapter 2.

4.1. Analysis at Member State level

This section presents the results of the analysis carried out at the level of Member States. It should be noted that the small number of observations available for the exercise means that the estimates are generally imprecise. The results are therefore suggestive, rather than definitive.

4.1.1. Description of the model

Model specification and variables

The general form of model used is as follows:

(4.1) $$G_{ct} = G(SM_{ct}, D_{EU\,ct}, I_{ct}, R_{ct}, L_{ct}, E_{ct}, G_{csy}, ACCEL_{ct})$$

where:
G_{ct} = growth in GVA per capita;
SM_{ct} = a policy variable designed to proxy for the SM programme (a dummy taking the value 1 from 1987);
D_{EU} = a dummy variable for EU membership;
I_{ct} = investment–output ratio;
R_{ct} = R&D–output ratio;
L_{ct} = changes in labour force participation rate;
E_{ct} = a proxy for human capital;
G_{csy} = log of the level of GVA per capita in the start year;
$ACCEL_{ct}$ = $SM_{ct}*G_{csy}$ is an interaction term, allowing for a change from 1987 in the coefficient on the initial level of GVA per capita, interpreted as the conditional beta-convergence indicator.

The various subscripts denote the following:
c = country (1...12);
t = time: two separate periods (1975–87 and 1987–93).

The equation is essentially in the tradition of the literature discussed in Chapter 2.

The basic neo-classical model (Solow [1956]) assumes the existence of a common steady-state level of GVA per capita to which each country is converging. A country's growth rate depends on how far the economy is from the steady state. G_{csy} in the above equation represents the state variable. It determines how far the economy is from the steady state and therefore the coefficient on G_{csy} gives the speed of convergence. A negative coefficient means that, apart from the influence of other variables, a process of convergence has been proceeding over the period. An interaction term *($ACCEL_{ct}$)* is included to allow this coefficient to change over the two different sub-periods. A negative coefficient on this term means that the convergence process accelerated after 1987. The human capital proxy (represented in this case by the percentage of graduates in the whole population) represents the second state variable (see Chapter 2). Conventional neo-classical theory predicts a negative coefficient on this term, but a positive coefficient has been found in other studies and interpreted as reflecting some of the effects predicted by the more recent endogenous growth theories (see Chapter 2).

The introduction of control variables allows for different steady states across economies. The investment to output and R&D to output ratios take into account the effect of physical capital and knowledge accumulation on growth. As asserted in Levine and Renelt [1992], the causal relationship between investment to output ratio and growth is ambiguous. In a pure neo-classical model, the long-run or steady-state growth rate is given by the rate of exogenous technological progress. The investment rate should affect only the steady-state GVA per capita level. In fact, even in a pure neo-classical model like Solow's, if the adjustment to a new steady state takes a long time, the growth effect of a variable such as the investment to output ratio lasts a long time. Empirical findings in early studies have yielded varying results. Levine and Renelt [1992] found the investment to output ratio the only variable positively (and significantly) correlated to growth in all the regressions they estimated, and, in general, this robust and positive relationship between the growth rate and the investment to output ratio is consistent with a wide assortment of other studies. In contrast, Barro and Sala-i-Martin [1995] found that the investment to output ratio was no longer significant when instrumental variables (IV) estimation was used. They argued that this could be due to the fact that the positive partial correlation between growth rates and investment reflects a reverse causation, from growth to investment rather than from investment to growth. Once the other explanatory variables are held constant, exogenous shifts in the investment to output ratio (i.e. shifts captured by the relationship of the investment ratio to the variables used as instruments) are not significantly related to growth. The introduction of the R&D to output ratio among regressors is consistent with endogenous growth theories, according to which variables influencing R&D intensity also influence long-run growth rates.

Insofar as the SMP has affected growth mainly by changing the investment and R&D behaviour of oligopolistic firms, these growth effects would be captured in the regression by these two variables. To minimize endogeneity problems, the values at the beginning of each period are used for the investment to output ratio and the R&D spending to output ratios. Instrumental variables estimation has also been tried, using as instruments the average ratios in the five years before the start of each period (1970–74 and 1982–86). Equations were also estimated in which the investment and R&D spending to output ratios were excluded.

Changes in the labour force participation rate are included to represent the supply of labour (unadjusted for skill differences) in the period. Dummy variables are used to represent the effects of joining the EU (1 after the country joined EU), and the SMP (1 from 1987 onwards). A dummy variable was also introduced to control for Ob1 funding (1 for Spain, Portugal, Greece and Ireland). Because preliminary analysis suggested that Ireland's performance had been atypical, a dummy for Ireland was also introduced. As with the starting level of GVA per capita, the coefficients on the Ob1 and Ireland dummies were allowed to change over the two periods by the introduction of an interaction term for each of them, given by the product of these dummies and the SMP dummy.

The southern Italian regions receive Ob1 funding, and from preliminary analysis it appeared that they were experiencing less of a 'catch-up' than other Ob1 countries, notably Portugal or Ireland. Using data from the regional database, Italy was separated into two parts, south and north, and only the former was treated as an Ob1 'country'. Spain was also segmented in this way, distinguishing the group of regions receiving Ob1 funding. The same equations were then estimated using the 14 'countries' created in this way.

For each variable, the average for the period is generally used apart from the investment and R&D to output ratios (see above) and, of course, the starting value of GVA per capita.

L_{ct} was calculated simply as the difference between the value of the labour force participation rate at the beginning and end of each period. Due to the lack of data, the human capital proxy is for 1991 only.

Representing the SMP

Various candidates to represent the SMP were considered. Levine and Renelt [1992] provide a possible list of candidates to represent economic integration:

(a) ratio of imports, exports and total trade to GDP ratio;
(b) growth of import and export share in GDP;
(c) absolute growth of imports and exports;
(d) measures of openness based on import penetration (see also Leamer [1988]).

These are all trade-based variables, assuming that more economic integration implies a growth of trade across integrated economies. However, the fact that the intra-EU share in total trade actually levelled off after 1987 (see Baldwin and Venables [1995]) means that a trade-based measure is likely to indicate less rather than more integration after 1987. Moreover, the model specified above is to be estimated across countries, not across time. Hence, any variable that has the same value for all countries and which differs only between the two periods would be perfectly collinear with a dummy defined as 0 before 1987 and 1 afterwards. This simple dummy variable was therefore adopted as the best proxy available for this sort of growth equation.

4.1.2. Results at Member State level

Unconditional beta-convergence

A simple regression, with the average growth rate on the left-hand side and the starting level of GVA per capita on the right-hand side, was estimated separately for the two time-periods.

Table 4.1 shows the beta-coefficient for the two periods (with t-statistics in parentheses). The beta-coefficient is positive for the first period, and negative for the second, but not significant in either case. The introduction of a dummy for Ireland does not change the sign of the beta-coefficient, but its t-statistic in the second period is closer to the critical value, and the quality of the fit is improved.

The same regressions were run using the 14-observations data set, and the results did not change much. However, after introducing a dummy for southern Italy, the coefficient on this variable is positive in the first period and negative in the second. The southern regions of Italy seem to have performed better than expected in the first period, given their starting value of GVA per capita, but worse in the second. The opposite was the case for the Ob1 part of Spain (but the positive coefficient in the second period was very close to 0).

Results with a fuller specification

Tables 4.2 to 4.7 show the results of the different estimation exercises with various explanatory variables.

The data for the two sub-periods were pooled, with particular attention paid to the sign and significance of the SMP dummy.

Tables 4.2 and 4.3 show respectively the results of the OLS and IV estimations using the EU-12 group of countries as observations. Table 4.4 shows the results of the same regressions, but excluding the investment and R&D to output ratios from the set of explanatory variables.

In the tables, the first column shows the results of the basic regression, without any interaction term or Ob1 or Ireland dummies. The coefficient on the starting level of GVA per capita is negative (with relatively high t-statistics, although not generally significant) and in Table 4.2 the coefficient on the SMP dummy is positive, but close to 0. Removing the investment and R&D term increases the significance of the SMP term. This finding would be consistent with that reported by Baldwin and Venables [1995], i.e. that in most of the studies employing Barro-style regressions to investigate the effect on growth of the implementation of integration schemes, the proxy for integration proved to be insignificant because of the inclusion among the regressors of the investment to output ratio. An interpretation could be that the impact of the SMP has operated through a stimulus to investment and R&D. IV estimation does not support this view, because the coefficient on the SMP dummy is smaller than in the fully specified OLS regression. However, this appears to be due to Ireland alone (see below).

The negative coefficient on the starting level of GVA per capita is consistent with the view that a general process of convergence, conditional on the other elements explaining growth, has been proceeding in the last 20 years among European countries. To test for the impact of the SMP, an 'acceleration' term was introduced to allow the coefficient on the starting level of GVA (i.e. the speed of convergence) to change in the second period. Results are reported in the second column of the tables. The coefficient on the acceleration term is negative, although not significant. A negative term is consistent with the view that the speed of convergence increased in the second period: the poorest countries would be catching up faster post-1987 than over 1975–87.

The Ob1 countries deserve particular attention, both because of their relevance for EU policies and because, as the simple analysis of growth trends in Chapter 3 shows, some of them have seen a substantial change in their growth experience since the implementation of the SMP. A dummy for Greece, Spain, Portugal and Ireland was then introduced, taking the value of 1 for the whole period, and an interaction term was included to allow the coefficient to change between the first and second periods. Results are reported in the third column of Tables 4.2 to 4.4. The inclusion of these dummy variables has the effect of substantially improving the fit of the equation (from around 20% to around 40% of the variance).

The coefficient on the Ob1 countries is negative in the first period and positive (and significant) in the second. This implies that Ob1 countries were not growing as fast as would have been expected given their starting level of GVA per capita (and the other factors explaining growth) in the first period, but faster in the second period. This effect is compounded by the positive coefficient on the change in the labour participation rate, since

Ob1 countries experienced the biggest increases in labour participation rates in the second period. However, the direction of causality is open to question.

In these equations, however, the coefficients indicating convergence change sign. Although the coefficient on the starting level of GVA per capita is negative (but not significantly so), the coefficient on the 'acceleration' term is positive. A possible interpretation is as follows. The rich core of Europe (Germany, France, Italy, the UK, Denmark, Belgium, the Netherlands and Luxembourg) experienced convergence among its members before 1987, but not subsequently. In the first period the Ob1 countries were diverging from the rich core, but are now catching up. The overall process of convergence, detected in the equations without Ob1 dummies, could be the result of compounding these effects.

An important question to raise is whether the catch-up process of the poorest European countries is explained by their joining the EU, or by the SMP. It is difficult to disentangle the two effects because of the temporal coincidence between joining the EU and the implementation of the SMP for two of them (Greece joined in 1981, Portugal and Spain in 1986). The inclusion of the EU dummy is intended to control for this, and its coefficient is generally low (or even negative), suggesting that the SMP period was more important for growth in the Ob1 countries. The temporal coincidence between stronger Irish growth and the implementation of the SMP also supports this interpretation. However, the empirical evidence does not permit any strong conclusion to be drawn on this point. Entry to the EU and implementation of the SMP both represented steps towards integration in the broader European economy for these countries, and we would expect the impact to be in the same direction.

The coefficient on the SMP dummy in the OLS regression (Table 4.2, third column) is now negative and significant, indicating that the impact was to reduce growth in the second period.

Hence, if growth in the poorer economies accelerated in the second period (and this conclusion appears to be robust to alternative specifications and estimation techniques), this does not seem to be true for the rest of the European countries. Having controlled for the effect on growth of the higher investment and R&D to output ratios, higher labour participation (generally speaking) and the higher growth of the poorest countries, the rich core of Europe appears to have grown more slowly in the second period than in the first.

The positive impact of the SMP period on growth therefore particularly reflects the experiences of Ob1 countries in the second period. Because preliminary analysis suggested that the Irish growth performance was atypical, a dummy for Ireland was introduced and the coefficient on this variable was allowed to change from the first to the second period by introducing an interaction term, the aim being to examine whether the positive results concerning the Ob1 countries were dominated by the change in Ireland. Results are shown in the fourth column of Tables 4.2 to 4.4. The introduction of the Ireland dummy raises the adjusted R-squared of the regressions to around 80–90% from around 40% for the previous group of regressions. Most of the variance in the growth rate is therefore due to the Irish growth. Evidence for a positive impact of the SMP on the growth of the poorest countries is now weaker, but still present. Ireland outperformed the other Ob1 countries in both periods, but by a greater margin in the second. The coefficients on the Ob1 dummies are smaller, but still significant. The convergence coefficients and that on the SMP dummy are not greatly affected by the introduction of the dummies for Ireland.

When Ireland dummies are included, the investment term has a positive and significant coefficient in the OLS regressions, but it becomes insignificant when IV estimation is used. With the Ireland dummies, the negative coefficient on the SMP dummy becomes smaller in absolute value, and close to 0 when the investment and R&D term is dropped from the regression. These findings are consistent with much of the empirical literature on growth, as discussed in Section 2.3. In other words, if the case of Ireland (with the strongest growth rate of income per capita associated with the lowest investment to output ratio) is excluded, the results are consistent with the view that the SMP effect has operated through higher investment and R&D.

Results when controlling for southern Italy and non-Ob1 Spain

A fifth group of regions receiving Ob1 funding are the regions of southern Italy, excluded from the Ob1 countries in the analysis described thus far, and some regions of Spain. Using regional data, Italy and Spain were divided into 'Ob1' and 'non-Ob1' parts. The results of the regressions are shown in Tables 4.5 to 4.7. The general conclusions drawn earlier also hold with this enlarged set of 14 'countries'. However, some differences are worth noting. When not controlling for Ob1 countries, convergence is reinforced in the first period and weaker in the second. When Ob1 dummies are introduced, the coefficient on the Ob1 dummy remains negative, but it is smaller in absolute value; while the coefficient on the interaction term is still positive but no longer significant. Moreover, evidence for divergence among the rich countries in the second period is weaker, probably due to the rapid growth of non-Ob1 Spain in the period.

The more precise definition of Ob1 countries has the effect of weakening the estimated impact of Ob1 status on growth. Southern Italy and Ob1 Spain outperformed the other Ob1 countries in the first period, but underperformed in the second, even when we control for Ireland (Tables 4.5 to 4.7, fourth columns).

Tables 4.5 to 4.7, fifth and sixth columns, show the results of the regression when only the dummies for southern Italy and Ob1 Spain are added to the set of variables used in the basic regression. While the coefficients on the Ob1 Spain dummies are very close to 0 and in line with the signs showed by the other Ob1 dummies (when introduced), for southern Italy the reverse is true. The coefficient on the 'pure' dummy is positive, while the coefficient on the interaction term is (nearly significantly) negative. There is therefore some indication that southern Italy did not participate in the general process of convergence characterizing the period 1987–93 and coinciding with the implementation of the SMP.

Purchasing power exchange rates

In the analysis described thus far, GVA per capita is measured in constant 1985 prices converted to ECU using 1985 market exchange rates. However, differences in price levels across countries can make this measure misleading, particularly with respect to the starting level of per capita GVA. Poorer economies are often characterized by lower prices, when converted at market exchange rates. Because of this effect, the earlier analysis risks understating the income of poorer countries, so that the results for convergence could be misleading. To test the robustness of the earlier results, the terms measuring the starting values of per capita GVA were converted using 1985 PPS exchange rates, and the equations reestimated. In fact, the results were not greatly affected: if anything, the positive impact of the SMP on convergence appears to be stronger.

Results from analysis of sectoral data

Theoretically, the SMP should have had a positive impact on productivity growth (see Chapter 2). However, the positive impact may not be equal, as suggested in Chapter 3. Therefore, cross-country regressions for each of the 31 NACE-CLIO industries were estimated with the same specification as for the analysis of total GVA per capita growth, using GVA per worker for a given industry as the dependent variable. It is important to note here the difficulties over quality of data at such a disaggregated level, particularly for Greece, Portugal, Spain and Ireland. Also, as is well known, data on productivity in services are less reliable than for manufacturing: in some cases, value added is itself inferred from employment data. Because of data constraints, Luxembourg and Greece were dropped from the set of countries and for services only Germany, France, Italy, Belgium, the Netherlands, Denmark and the UK were included. As a consequence, the number of degrees of freedom is smaller than in the regressions run at aggregate level, and so the results are only suggestive.

There is some indication of a positive impact of the SMP on convergence in productivity across the European economies for a group of industries that could be described as more traditional: coal and coke; gas supply; electricity; food, drink and tobacco; and textiles, clothing and footwear. In these industries, there is no evidence of a positive impact of the SMP on productivity growth in the richest countries. In a number of engineering industries, including electrical goods, transport equipment, agricultural and industrial machinery and metal products, the opposite appears to be true. The coefficient on the SMP dummy was positive (but typically not significant) only when Ob1 dummies, which appear with a negative coefficient, were included in the regression. As for services, there is an indication of a positive impact on productivity growth (in the seven countries listed above) in banking, finance and insurance and inland transport.

It is clearly unwise to draw any strong conclusions from such a limited data set. The results suggest that the impact of the SMP may have differed by industry, but this conclusion needs to be corroborated by other evidence.

4.2. Analysis including other OECD countries

The empirical results discussed in the previous section indicated that, after taking account of changes in factor inputs, growth accelerated in the poorer economies following the implementation of the SMP, but not in the EU-12 as a whole. The rich core of Europe appeared instead to have experienced slower growth for given factor inputs in the second period. To examine whether this result was a feature of the European experience only, or is also apparent in the experience of non-EU economies (and hence not attributable to the SMP), data for other OECD countries were included in the analysis. In a first attempt, the dependent variable in the equation was changed from GVA per capita growth to the difference in this growth rate compared with growth in the US and Japan aggregate output. This procedure is equivalent to using the growth rate in the US and Japan as an explanatory variable, and imposing an elasticity equal to 1. The results did not change much. It remained the case that there was a positive (and significant) coefficient on the SMP dummy only when controlling neither for Ob1 countries and for the investment and R&D to output ratios. Once these were included, the SMP coefficient became (sometimes significantly) negative.

As a second exercise, the set of countries included in the estimation was expanded to encompass the 24 OECD countries. Availability of data prevented estimation of the same specification of model as in Section 4.1. In particular, data for expenditure on human capital and R&D were not available. To ensure consistency in the data set, OECD data were used for all countries with output now represented by GDP (by expenditure) expressed in 1985 US dollar prices (instead of GVA in 1985 ECU).

4.2.1. Results for OECD data set

Unconditional beta-convergence

As in Section 4.1, the possibility of unconditional beta-convergence across OECD countries was investigated by estimating growth equations having the starting level of GDP per capita as the only explanatory variable. Separate equations were estimated for two time periods. Dummy variables for EU members, Ob1 country status and Ireland were tried, to investigate whether these factors made a difference to performance. Results are shown in Tables 4.8 and 4.9.

The positive coefficient on the starting level of GDP per capita (see Table 4.8, first column) indicates that convergence was not a feature of growth across OECD countries over the period 1975–92. In contrast, the coefficient obtained by estimating the same equation over the second period is significantly negative.

This result simply shows that, in the group of OECD countries, the poorest showed faster growth than the rest of the countries over the second period, but slower growth over the first. The addition of the EU dummy gives useful insights. As shown in the third and fourth columns of Table 4.8, the coefficient on the EU dummy is negative (and not significantly different from 0) over the first period, and significantly positive in the second. Hence, insofar as the starting level of per capita income is a good predictor of subsequent growth, the EU economies showed faster growth in the second period than was expected. This is far from a conclusive result, since the explanatory power of the equation is weak. In other words, only a small part of the difference in growth performance of the OECD economies can be explained by catch-up factors, and so not much has been controlled for to extend the simple growth trends analysis reported in Chapter 3.

The addition of the Ob1 dummy (see fifth and sixth columns of Tables 4.8 and 4.9) does not modify the sign and significance of the coefficients on the EU dummy. The signs of the coefficients on the Ob1 dummy itself suggest, as before, that Ob1 countries performed worse than the rest of European countries over the first period and better in the second, when we control for their lower starting value of GDP per capita. However, evidence is statistically very weak, given the low value of the t-statistics on the Ob1 coefficients. Consistent with this, the addition of the Ob1 dummy adds little to the explanatory power of the regression. The positive sign on the Ob1 dummy is not robust to the addition of a dummy for Ireland (which greatly improves the quality of the fit, a result consistent with the findings reported earlier).

Results with fuller specification

The data set available during the study permitted only the investment to output ratio as an additional explanatory variable. Subject to this restriction, equations of the same kind as presented in Section 4.1 were estimated.

The following points about the interpretation of the role of variables in the regression are worth noting. In Section 4.1, the EU dummy served to control for the impact of joining the EU on Greece, Spain and Portugal, to distinguish this impact from that related to the implementation of the SMP. In the broader OECD data set, the EU dummy mainly serves to distinguish the European countries from the other OECD countries. Since there are now observations for non-EU countries in the second period, the coefficient on the SMP variable now acts as an 'interaction term' on the EU dummy, indicating the extent to which being an EU member gave a further boost to growth in the second period.

The results are presented in Table 4.10, the first column of which shows the result of the basic regression. The investment term is the only variable bearing a significant coefficient. This result is robust to any of the modifications of the basic regression analysed below, a feature which is slightly different from that reported in Section 4.1, but consistent with much of the empirical literature on growth.

The 'convergence term' has a coefficient very close to 0, which implies that there has not been a general process of convergence over the two periods across the OECD countries; and when the 'acceleration' term is added (second column) it bears a negative coefficient, which could indicate that once controlled for the investment ratio, convergence only concerned EU countries. In fact, this result is very weak in statistical terms, so that any conclusion must be taken with the maximum of caution. The dummy for EU membership is positive and nearly significant, and the SMP dummy also bears a positive coefficient. Taking these two results together, one could interpret it as EU membership giving a stimulus to growth in general, and more so over the second period.

Adding the Ob1 dummies modifies the signs of the coefficients on EU and SMP dummies. Controlling for slower-than-expected growth of the Ob1 countries over the first period, and faster-than-expected (the INTOB1 term bearing a significantly positive coefficient) growth over the second, the effects are to raise the coefficient on EU membership, and to reduce the coefficient on the SMP variable (in fact it becomes negative). A possible interpretation could be that the positive impact on growth of the SMP detected in the absence of these dummies, was actually a feature of the Ob1 countries, while the rich core of Europe did not benefit. The introduction of Ob1 dummies also changes the sign of the coefficient on the 'acceleration' term. Convergence in the second period did not accelerate across the richest countries of Europe; if anything, there is (weak) evidence of divergence. The introduction of dummies for Ireland does not change the sign of coefficients on the Ob1 variables. However, the t-statistics on these variables are now below the critical values, which suggests that much of the stimulus to growth detected earlier was due to an improved performance of Ireland.

4.2.2. Conclusions

Although the earlier caveats with regard to the statistical significance of the results apply, the results are consistent with the view that there has been a positive impact of the SMP on the overall growth of the European economies, mainly due to faster growth in the Ob1 countries (particularly Ireland), so that the convergence process inside the EU was fostered. From the discussion above it seems that convergence was more a feature of the EU countries than of the OECD as a whole.

Hence, these results are broadly consistent with those noted in Section 4.1, using a completely different data set and a different specification of the model (given the availability of data for a wider set of variables for the EU countries than for the other OECD countries).

4.3. Analysis at regional level

This section analyses data at the level of the NUTS 2 regions of the EU-12. Models are fitted to data for the period 1975–87 and for 1987–93, with a focus on changes in the convergence rate and other estimated parameters between the two periods.

4.3.1. Description of the model

In the simplest model specification, total GVA per capita growth is the dependent variable, and the level of total GVA per capita is the state variable, with the beta-coefficient measuring the unconditional rate of (beta-) convergence. Equation 4.3 presents the regression model in the tradition of Barro and Sala-i-Martin [1995].

(4.2)
$$(1/T)\ln(y_t/y_{t-T}) = \alpha - (1 - e^{-\beta T})(1/T)\ln(y_{t-T}) + u_t$$

where:
T = the number of time periods (years) over which growth has occurred;
β = the convergence rate;
u = the effect of random shocks.

Note that in the specification adopted here, a positive value for β will imply convergence, in contrast to the specification adopted in Sections 4.1 and 4.2.

The unconditional convergence model assumes the existence of a common steady-state level of GVA per capita (related to α) to which each region's economy is converging. A model specification which includes national dummies involves a relaxation of the assumption of a single steady state, allowing regions to converge to national steady states (national dummies also conveniently tend to eliminate spatial autocorrelation among the model residuals due undoubtedly to missing variables). Other studies (for example, Armstrong [1995]) have found that national dummy variables considerably enhance the model's quality of fit. The model incorporating national dummies is referred to as the model of 'within-country beta-convergence', with all regions assumed to converge at the same rate to their own national steady states. Models combining country dummies and other conditioning variables provide estimates of within-country conditional convergence.

The conditional convergence specification similarly allows for the effects of control variables on the steady-state total GVA per capita, and therefore the growth rate. In this analysis we explore the significance of a peripherality index (distance between each region's centroid and Luxembourg), which represents relative proximity to the markets and inputs concentrated in the EU's core. Additionally, three dummy control variables are included to distinguish regions with Ob1 and Ob2 status, and also border regions; the latter being of particular interest for the SMP. An economic structure variable, represented by manufacturing as a share of total employment in 1975, is also included. Measures of economic structure have been used (Barro and Sala-i-Martin [1995]) to eliminate bias due to asymmetrical shocks. For instance, price shocks may have differentiated effects because of regional differences in industrial structure.

Investment in human capital is also introduced as an additional (state) variable. Ideally, this would be represented by a measure such as the start-of-period, higher-schooling enrolment rate by region. Data limitations have, however, meant that human capital has been proxied by the number of new graduates per thousand population p.a. by country, thus treating each region within a country as if it has the same level of human capital. Also, because of data limitations, the proxy is based on the total number of graduates in 1991 (the value for Luxembourg was approximated using the EU average), the implicit assumption being that changes in human capital over the period are small enough to be ignored.

Clearly the set of conditioning variables could have been extended, but pan-European data at the regional level are limited. A key factor in the choice of regressors, consistent with the theoretical underpinnings of the reduced form model, is that they should enhance growth via additional factor inputs or via enhanced efficiency of resource allocation. A number of variables have been introduced by other researchers, such as investment as a proportion of GDP, and policy or trade variables (see Levine and Renelt [1992]) for a review of the range of variables).

4.3.2. Results at regional level

OLS estimates without country dummies

Tables 4.11 and 4.12 present the estimates of unconditional and conditional convergence for the pre-1987 and post-1987 periods. The unconditional convergence models show an indication of faster convergence since the advent of the SMP, with convergence at a rate of about 0.5% (approximately $-100*(1-e^{-\beta T})(1/T)$p.a.) in the post-SMP period, compared with about 0.3% p.a. prior to SMP. The pre-SMP unconditional convergence rate does not differ significantly from 0.

The effect of each variable can be partitioned into a direct effect and an indirect effect, which operates via other variables. The estimated regression coefficient of a variable in a regression model containing the other intermediate variables provides a measure of the direct effect of that variable. The estimated regression coefficient of the variable in an equation estimated without the intermediate variables, can be interpreted as providing a measure of the total effect of that variable, where the total effect is defined as the direct effect plus the indirect effect. When the total effect equals the direct effect, the effect of the variable is neither indirect nor through its influence on intermediate variables. When there is a significant total effect, but no direct effect (in other words the effect is significant when the variable enters the regression as the sole regressor, but is insignificant when there are additional regressors), the entire effect of a variable is indirect. An alternative way of looking at regression coefficients which change in the presence of additional regressors, is to treat the total effect as partly an apparent effect caused by the variable's correlation with other variable(s) which themselves possess direct effects. In other words, the apparently true (i.e. direct) effect is biased due to collinearity.

The direct conditional estimates in Tables 4.11 and 4.12 are based on the full set of state and control variables for which data are available, so in this specification the regression coefficients reflect the explanatory power of each variable additional to that of the other regressors. In other words, they represent the direct effects of each variable on growth. The change in the value of the border region dummy variable in the post-SMP period is particularly evident, indicating that the policy changes were particularly effective in promoting growth in these regions (this interpretation is qualified somewhat below). Also, there is some indication that growth in the peripheral, Ob1 and Ob2 regions was slower than would have been expected from their starting per capita income levels in the pre-SMP period, and this effect is much weaker (and insignificant) in the post-1987 period. Once these additional effects have been taken into account, the (conditional) rate of convergence is slower post-1987.

The results therefore suggest that 'problem' regions (border, Ob1 and Ob2) saw an improved relative performance after 1987, since convergence was proceeding at a slightly faster rate, and these regions were no longer performing 'below par' (where 'par' is the growth rate expected on the basis of starting per capita income – the equation suggests that, all things being equal, poorer regions would experience faster growth). The results also suggest that the indication that the (unconditional) rate of convergence accelerated post-1987 is accounted for by the improved performance of 'problem' regions.

OLS estimates with country dummies

The above equations suffer from spatial autocorrelation; that is the residuals from equations are 'spatially organized', indicating that the equations fail to capture some explanation of growth which is related to a region's location. This is clearly evident from the standardized values of Moran's I for (raw) regression residuals, which are given in parentheses in Tables 4.11 and 4.12 below the actual values of Moran's I. These standardized values, since they are well above the critical value of plus or minus 2.0, indicate the presence of a significant spatial pattern among the regression residuals, for the model without country dummies.

Country dummies were therefore introduced as a way of eliminating residual spatial autocorrelation, with the effect that convergence is conditional on the set of variables, correlated with the country dummies, that are responsible for residual autocorrelation. In this case, the beta-estimates given in the first column of both Tables 4.13 (post-SMP) and 4.14 (pre-SMP) are estimated within-country convergence rates. The addition of the remaining regressors for which we have data, provides estimates of within-country conditional convergence. Since data limitations have made it necessary to assume that human capital is the same for all regions of a country, this variable is collinear with the country dummies and cannot be included. Table 4.13 shows a (statistically insignificant) indication of within-country convergence in the post-SMP period. The border region effect, directly significant in the previous analysis in Table 4.11, becomes insignificant with the introduction of country dummies. Border region effect does not, therefore, have much explanatory power for within-country differences in regional growth rates. This suggests that the border effect is a feature of a particular country or subset of countries, although further analysis has confirmed that this was not simply due to the enhanced growth rate of Ireland (as may have been suggested by the fact that the Ireland country dummy effectively removes Ireland from the analysis), since neither Ireland nor Luxembourg possesses NUTS 2 regions. This example highlights how, in principle, the country dummies, as a catch-all for a number of other variables, may block the detection of potentially more interesting policy-orientated effects.

Within-country unconditional convergence was apparently faster in the period up to 1987 than it was in the following period, as is shown by comparing the size of the coefficient of the starting value of per capital GVA in column 2 of Tables 4.13 and 4.14. This could be interpreted as indicating that an increased rate of convergence between Member States has been the main reason for the apparent increased rate of convergence between regions: within Member States there is no indication of rate of (unconditional) convergence.

For the earlier period, Ob1 and Ob2 status had a significant negative direct effect on growth. These direct effects, detected in the presence of the country dummies, lend support to the view that the conclusions for Ob1 and Ob2 effects drawn earlier are probably valid, in spite of the likely presence of omitted correlated variables in the residuals. Hence, Ob1 and Ob2 status significantly reduced a region's GVA per capita growth in the period leading up to the advent of the SMP, but post-1987 these effects have become much weaker, either because of economic integration or as the impact of enhanced regional policy has become effective. The fact that any enhanced growth in Spain and Portugal has been allowed for in the estimates in Tables 4.13 and 4.14 indicates that these effects are not simply due to their entry into the EU in 1986.

Testing the robustness of the OLS estimates: instrumental variable estimation

This section reports the results of a supplementary analysis using instrumental variables (IV) estimation, to provide a check on the robustness of the OLS analysis, reported above. In the IV analysis, each of the potentially endogenous variables, or variables exposed to measurement error, is replaced by instrumental variables based on exogenous variables, namely the indicator of peripherality (luxdij), the dummy variables, and ten-level factor variables with levels corresponding to ranges of values of the regressand (an alternative would be to use the rank orders of the endogenous variables as instruments).

The results of the IV estimation are summarized in Appendix C, Tables C.1 to C.4. These estimates support interpretations which are quite similar to the interpretations made of the OLS models, but the statistical significance of the results is generally reduced. This is evident from a comparison of Tables 4.11 and C.1. In Table C.1, the larger standard errors associated with IV estimation lead to smaller t ratios, most notably for the post-SMP unconditional convergence rate, which under IV is only significantly different from 0 in a one-tailed test (α=0.10). However, the estimate of the rate of post-SM convergence is essentially the same under either method. Similarly, the significance of the border effect is more muted under IV.

As is evident from comparing Tables 4.13 and C.3, the IV estimates indicate significant and faster post-SM within-country convergence than suggested by OLS. The other conclusions based on OLS remain essentially unaltered. In particular, the significantly slower pre-SMP growth in the Ob1 and Ob2 regions reappears under IV. It also (largely) disappears in the second period.

Testing the robustness of the OLS estimates: spatially organized residuals

In order to identify outlier regions whose experience may differ from the trends identified above, a more detailed analysis of the regression residuals has been carried out. Standardized residuals have been calculated for each region, using the unconditional convergence model and the conditional convergence model with direct effects (that is, including all the regressors in the same model). This is repeated for both time periods, and including and excluding the national dummies, giving, in total, eight series of residuals which are displayed in map form in Figures 4.1 to 4.8. While the maps distinguish regions with residuals greater in absolute magnitude than 1, the commentary below focuses on the most extreme cases (absolute value greater than 3).

Ireland stands out as having much faster growth than expected under all the models that exclude country dummies. In other words, Ireland's growth was faster than expected both pre- and post-SMP, and this additional growth is not explained by the additional variables introduced into the regressions, namely Ob1 and Ob2 status, peripherality, economic structure, human capital, or border region status. Note that in the presence of the country dummies, the Ireland residual is 0 since Ireland has no NUTS 2 regions, and so the significance of the 'Ireland effect' is absorbed by the national dummy.

Other regions which show much stronger than expected growth in the post-1987 period are the Algarve and Grampian, apparently reflecting local factors (the expansion of tourism, and the oil industry, respectively). Only Dytika Makedonia shows much slower growth than expected in this period.

As noted earlier, it is clear from the values of Moran's I given in Tables 4.11 to 4.14, that a large part of the residual autocorrelation is absorbed once the country dummies are introduced. Nonetheless, visual inspection of Figures 4.1 to 4.8 and the near significance of some of the standardized values of Moran's I suggest that there may be an underlying tendency for neighbouring residuals to be similar in value. While the pattern of residuals is not obviously suggestive of additional (missing) regressors, there is one factor (namely, spillover effects between regions), which may be playing a part in the processes under study. Since NUTS 2 regions are on the whole administrative regions rather than self-contained functional regions, and since regional barriers have been lowered by EU policy measures, it seems reasonable to assume that a change in one region can influence economic growth in an adjacent region. Also, decentralization in city regions will mean that employment and output may be spatially segregated, being connected by commuting flows. Given these possibilities, some experimental models involving spillover effects (autocorrelated errors models, as described by Upton and Fingleton [1985] and Anselin [1988]) are fitted in order to investigate the robustness of the model results thus far reported.

The autocorrelated errors model used for the analysis is as follows:

(4.3) $$y = Xb + e$$

(4.4) $$e = \rho We + u \qquad u \text{ is distributed as } N(0, \sigma^2 I)$$

in which:
y = the (vector of) growth of per capita GVA by region;
X = a matrix of the explanatory variables already proposed;
e = an error term;
W = an n x n matrix specifying the extent of spatial interaction involving the n errors; and
ρ = the autoregressive error parameter to be estimated.

More specifically, W is structured so that interaction is restricted to regions with centroids no more than 250 km apart, and within this radius there is a distance decay effect downweighting the influence of the furthest regions. Note that the 'same' W was used in the analysis involving

Moran's I (but was unstandardized). The conclusions are thus conditional on this W specification, and although it is somewhat arbitrary, a single W specification is sufficient for the test of robustness of the OLS results required here.

To simplify the analysis and the process of comparison, only two models are fitted, the unconditional convergence model and the conditional convergence model (direct effects). These models correspond to the first two columns of Tables 4.11 to 4.14. In the unconditional convergence model, the columns of the matrix X comprise the constant and the start of period log level of GVA per capita. In the conditional direct effects model, X contains the full set of regressors. Also, both models were estimated with and without country dummies, in which case X is extended to accommodate these additional variables.

The method of estimation involves an iterative routine to maximize the likelihood function, and the eigenvalues of the W matrix are used to calculate the variance-covariance matrix which provides the estimated standard errors.

The models were fitted for the pre- and post-SMP periods, giving eight models in total. The results are summarized in Tables C.5 to C.8.

The interpretations made of the Table 4.13 maximum likelihood (ML) estimates are in broad agreement with the interpretations based on OLS and IV estimation. In particular, earlier evidence pointing to a significant negative impact of Ob1 and Ob2 status in the earlier period is supported by the ML analysis. As found in the OLS and IV analysis, the significant border effect of the post-SMP period is also detected via ML, particularly in the analysis excluding country dummies.

On the other hand, the OLS and IV evidence pointing to faster post-SMP unconditional convergence is not present in the ML estimates, although the ML model does not appear to be robust to the inclusion of country dummies. ML estimation, excluding country dummies, produces very significant positive autoregressive error parameters (ρ estimates), since the error process evidently captures both the dummy effects and the putative spillover effects involving neighbouring regions. When the country dummies are also introduced, the estimated parameter is negative, an implausible result.

The effect of excluding the country dummies from the model is to produce ML estimates similar to the OLS estimates for models including the country dummies, although the advantage of the ML model is that one is able simultaneously to incorporate the human capital variable. This link between the spatial interaction errors and the country dummies may also explain why unconditional convergence is faster post-SMP under OLS and IV, but not in the ML model.

As with the earlier OLS and IV estimates, the ML estimate for the rate of conditional convergence (direct effects) excluding country dummies is faster in the pre-SMP period than after 1987. We take this to indicate that the lower rate of unconditional convergence in the pre-SMP period is attributable in particular to the weaker performance of the Ob1 and Ob2 regions.

With the introduction of country dummies, ML estimation suggests faster pre-SMP within-country convergence than evident after 1987. This is also a feature of the OLS analysis (Tables 4.12 and 4.14), but does not appear in the IV analysis (Tables C.3 and C.4). However, in all of these convergence rate comparisons, the differences between the pre-SMP and post-SMP estimates are not large when compared with the typical values of the estimated standard errors.

Testing the robustness of the OLS estimate: recursive cross-sectional regression analysis

As a supplement to the two-period regression analyses based on the pre-1987 and post-1987 data, a further sequence of regressions has been fitted for annually incremented series. The intention in this analysis is to provide additional evidence (supporting that in Figures 3.18 to 3.34) regarding the impact of the onset of the SMP in 1987 on various economic indicators. The sequence of recursive-style regressions commences with a cross-sectional regression fitted to the growth over the one-year period 1975–76 in 169 NUTS 2 regions, with the final regression fitted to growth over the entire 18-year period 1975–93. Thus, for any one model specification, 18 separate models are fitted, and this provides an 18-year time series of parameter estimates for each parameter of the model.

Time series were obtained for parameters from four alternative model specifications identical to the alternative two-period models described in Tables 4.11 to 4.14. The four specifications are total effects models (i.e. omitting covariates) with and without country dummies, and direct effects models with and without country dummies. Hence, for a given model parameter, there are four 18-year series, depending on the model specification adopted. Figures 4.9 to 4.12 give the series for the variables lgvapc, ps[1], ps[2] and border, representing the convergence effect; and the effects of the dummy variables indicating Ob1 status, Ob2 status and border region status.

Figure 4.9 shows the series are for models in which there are no covariates and no country dummies. Hence, in the case of lgvapc, they represent a sequence of unconditional convergence estimates, and for the other variables they are the direct effects. On the whole there are no dramatic changes in the series for any single year, so that while 1987 does not stand out as an obvious point at which parameter estimates change, it is not an inappropriate choice. Note that because the period of estimation in every case begins in 1975, a shift of regime may be reflected by only a gradual shift in the parameter estimate.

For the convergence parameter series in Figure 4.9, it is apparent that the post-SMP period is characterized by a stable sequence of estimates, compared with the pre-SMP period which showed on a downward path. This is also apparent from the convergence series in Figure 4.11. However, a much more level path is shown in Figures 4.10 and 4.12, which represent model specifications which include country dummies, indicating that while within-country unconditional convergence was slower in the post-SMP period (Tables 4.13 and 4.14), the shift was not a very strong one.

Figure 4.9 also shows the Ob1 series of estimates. The low point reached by about 1987 in these total effects without country dummies is followed by a mainly higher sequence reflecting the better performance of the Ob1 regions noted in the earlier analysis. This stable or rising trend is also apparent to a lesser extent for the Ob1 series based on the other model specifications, as shown in Figures 4.10, 4.11, and 4.12.

Probably the clearest indication of support for the choice of 1987 as a break-point is provided by the Ob2 series shown in Figures 4.9 to 4.13. All show a quite distinct shift at or close to 1987, reflecting the results in Tables 4.11 to 4.13. This is also evident for the border region series, although more so in the absence of country dummies, as shown in Figures 4.9 to 4.11.

Distinguishing the Structural Funds effect

One of the conclusions of the analysis thus far is that the Ob1 status had a significantly negative effect on growth in the pre-SMP period, but not in the post-SMP period. Since spending under the Structural Funds was also stepped up in the post-SMP period, it is unclear whether the improved growth in the Ob1 regions is due to the effects of the SMP, or to the effects of enhanced Structural Funds spending.

Ideally, one would like to incorporate into the regressions a measure of Structural Funds spending by region before and after 1987, to control for this effect. Unfortunately, a comprehensive set of Structural Funds spending data covering both pre- and post-SMP periods is not available, although the European Commission's Directorate-General for Economic and Financial Affairs (DG II) has made provisional indicative data available for the period 1989–93. This at least makes it possible to analyse the effects of Structural Funds spending variations on growth across the cross-section of regions over 1989–93.

In fact, there is very little difference in the results of the equation using a dummy variable for Ob1 regions (Table 4.13) and the equation in which this variable is replaced by the Structural Funds indicator. In the absence of Structural Funds data for the pre-1987 period, it is impossible to draw definitive conclusions to distinguish the Structural Funds effect from the SMP effect, but this cross-section evidence suggests that the Structural Funds may not be the major factor.

A selection of equations have been estimated including the variable ob1_ecu, which measures Structural Funds spending per capita by region over the period 1989–93. Tables C.34 and C.35 summarize the results of fitting models both with and without national dummies for the post-SMP period. In some of these models ob1_ecu replaces the Ob1 dummy (ps[1]), and in others both ob1_ecu and ps[1] are both present. In addition, some extra models have been fitted to the data for Ob1 regions alone, and this provides an alternative way of isolating the Ob1 dummy from the Structural Funds spending variable. In these latter models (also summarized in Tables C.34 and C.35), the Ob2 variable ps[2] is, of course, redundant.

Comparing the results of the various specifications given in Tables C.34 and C.35 with Tables 4.11 and 4.13, it is evident that the replacement of ps[1] by ob1_ecu makes very little difference to the model parameter estimates. In none of the models fitted are cross-region Structural Funds spending variations significant. In our view, the absence of a significant effect due to Structural Funds spending variations by region, can be cautiously interpreted as evidence that at least part of the improved performance of the Ob1 regions in the post-SMP period is apparently due to the effect of the SMP.

The results of the analysis therefore indicate that, in the post-SMP period, variations in Structural Funds spending do not appear to have had a significant effect on regional growth variations.

4.3.3. The Markov chain analysis

Recently, Quah [1993a,b] has employed Markov chain methods to model growth dynamics. The rationale of his approach is that the empirical data lend little support for the assumptions of the neo-classical model which underpins the foregoing analysis, and Markov chains provide an alternative empirical methodology which is not based on the implicit assumptions of the neo-classical approach.

The basic Markov chain approach assumes that, given I income level states, each region has a probability $p_i(t)$ of being in state i at time t and a transition probability $m_{ij}(t)$ of being in state j at time $t+1$. If we make some simplifying assumptions regarding these probabilities, it is possible to establish a number of fundamental features, such as the average number of time periods it takes for a region in state i to reach state j, and the equilibrium probabilities for the states.

A particularly simple Markov model follows from the assumption that all transition probabilities are unchanging over time, i.e. that $m_{ij}(t)=m_{ij}$ for all t. Ordering these stationary probabilities as the I by I transition matrix M, and $p_i(t)$ as the time-dependent elements of the $1xI$ row vector $p(t)$, then

(4.5) $$p(t+1)=p(t)\,M=p(0)\,M^t$$

where M^t represents the product of t identical M matrices.

A notable consequence of Equation 4.5 is the existence of an equilibrium probability $1xI$ row vector s which is such that:

(4.6) $$s = s\,M$$

This vector may be thought of as the vector to which each of the rows of M^t tends as t tends to infinity.

The Markov model described above allows for the possibility that significant inter-regional GVA per capita discrepancies could be a permanent feature of the system at equilibrium, if a steady state probability vector emerges with large estimated polar state probabilities. There is no hypothesis of a tendency towards convergence, as proposed by the neo-classical approach.

The approach adopted here consists of constructing a two-way I by I cross-tabulation with total GVA per capita levels defining the I states of the transition matrix. With $I=4$, we have four Markov states defined as poor, below mean, above mean, and rich. 'Poor' defines those regions with GVA per capita below 75% of the mean level at each time. 'Rich' regions have GVA per capita above 125% of the mean level. The counts in the cross-tabulation are the number of regions in state i at time 1 and state j at time 2, and these observed frequencies yield estimates of the stationary transition probabilities.

The method of analysis involves first of all constructing the cross-tabulation using the years 1975 as time 1 and 1987 as time 2, as in Table 4.15. Table 4.15 is the cross-tabulation of the 169 NUTS 2 regions for the period 1975–87. In this period, the majority of regions were 'stayers', remaining in the same state throughout. However, there are some 'movers': for example, 12 regions moved from below mean to above mean states, and 12 moved in the reverse direction.

Table 4.16 displays the transition probabilities which are based on the observed cross-tabulation. These transition probabilities are assumed to be stationary and, using Equations 4.6 and 4.7, they are used to estimate the equilibrium probability vector: the proportion of regions at each of the four income levels in the steady state. These are displayed in Table 4.17. It should be noted that the estimated half-life for this convergence process, the time by which the state probabilities are half-way to their steady-state values, is 134 years (using the transition probability matrix calculated from the observed cross-tabulation for the period 1975–87), which indicates a slow process of change.

It is evident that the trend towards convergence, as a result of extrapolating from the period 1975–87, was in fact to a steady state in which the probability of a region remaining poor was quite high. This is apparent from Table 4.17 which shows that at equilibrium 13% of the regions remain in the poor state, although this is an improvement on the situation in 1975, when 21% of regions were poor. Also, 21% of regions are rich, compared with 17% in 1975, and 26% are in the below mean state, compared with 22% in 1975. Overall, therefore, it can be argued that the trend of the 1975–87 period was a slow convergence to a steady state in which most regions had a higher probability of being better off than in 1975, although a substantial minority of poor regions would remain.

The results of this analysis are compared with the results of an identical analysis using the 1987–93, post-SMP cross-tabulation of observed frequencies as the basis of the stationary transition matrix. Table 4.18 displays the cross-tabulation and Table 4.19 the resulting transition probabilities. The equilibrium probability vector derived from these data is presented in Table 4.20. In contrast to Table 4.17, this shows effectively zero probability of poor regions. This has the effect that the below mean state now accounts for 48% of all regions, compared with 24% in 1987 and 23% in 1975. Also, only 29% of regions are in the above average state at equilibrium, compared with 38% in 1987 and 39% in 1975. There is, however, an increase in the proportion of rich regions, from 18% to 23% of all regions. In addition, the half-life according to the 1987–93 transition probabilities is reduced to 44 years.

The conclusions we draw from this analysis are that the post-1987 period indicates a much faster approach to a steady state than is suggested by the pre-1987 data, a conclusion consistent with the Barro-style regression analysis. Additionally, the post-1987 data suggest a much less polarized distribution at equilibrium than is suggested by the analysis based on the pre-1987 cross-tabulation. While there is a larger proportion of regions in the below average state, poor regions have been practically eliminated. Although the proportion of rich regions increases in the steady state, the net effect of these changes is that 77% of regions are neither rich nor poor in the steady state based on the post-1987 data, compared with 66% using the pre-1987 data, and 62% in 1975.

There are a number of caveats which apply to these results, particularly the limited sample size on which the analysis is based. A number of alternative transition matrices may be consistent with the cross-tabulations, and these may possibly lead to different conclusions, although initial experimentation indicates that in fact the conclusions we have made based on the observed frequencies (rather than say a model-based approximation to them) are robust. While alternative interpretations of the observed frequencies in Tables 4.15 and 4.18 leading to different transition matrices will evidently lead to marginally different equilibrium probability vectors, it appears from preliminary analysis at least that the broad thrust of our interpretation is correct.

An additional caveat is the arbitrary nature of the defined states. While it is true that different state spaces will also produce different conclusions, it is inescapable that some definition must be adopted for practical purposes. The one chosen has the virtue that it accords well with the definition of Ob1 status (i.e. 75% of the mean defines our poor state), and the natural counterpart of this is that 125% should define the rich state. Even if this definitional problem could ever be resolved, a similar inescapable problem is apparent from the system of regions adopted, since the results are conditional on the NUTS 2 regionalization.

4.3.4. Analysis of regional productivity and employment growth by sector

Productivity analysis

The earlier analysis focuses on growth in overall GVA per capita by region. An analysis was also carried out to examine GVA per worker growth rates by broad sector, to see if important sectoral differences emerged. The results of the Barro-style regression models are presented in Tables C.9 to C.28. In the models, for a given sector the growth of productivity is regressed on the level of productivity at the start of each of the two periods, pre-SMP and post-SMP. The same set of regressors is used as in the analysis of total output per capita.

Tables C.9 to C.12 show that the rate of unconditional convergence of agricultural productivity was faster post-SMP than pre-SMP. The main cause seems to have been slower growth in peripheral, Ob1 regions pre-SMP, since controlling for these influences produces similar rates of (direct conditional) convergence. The introduction of country dummies produces faster productivity convergence pre-SMP than post-SMP. Evidently, the faster convergence post-SMP described above is mainly attributable to convergence between national productivity levels.

Tables C.1 to C.16 show that manufacturing and energy productivity experienced no significant convergence in the post-SMP period, although there is evidence that in regions with a higher level of manufacturing specialization (as indicated by the economic structures (*es*) variable), productivity grew significantly faster in the post-SMP period. Productivity growth was also faster in regions with a higher level of human capital. In contrast, in the pre-SMP period, there is strong evidence of significant conditional and unconditional convergence in manufacturing productivity. Manufacturing productivity grew significantly more slowly in peripheral or Ob1 regions, but there appears to have been a boost to productivity growth in Ob2 regions, as is evident from both the direct and total pre-SMP effects.

The analysis of manufacturing productivity growth including country dummies indicates much faster rates of within-country convergence. In the post-SMP period, economic structures (*es*) again stand out as a significant direct and total effect, with regions specialized in manufacturing seeing faster productivity growth; while in the pre-SMP period, Ob2 status is the most salient influence promoting faster productivity growth. Note that the within-country rate of manufacturing productivity convergence is approximately 9% p.a. in the pre-SMP period, and only about 2% p.a. post-SMP.

Post-SMP construction productivity growth appears to have been divergent, and this is an enduring characteristic across the range of model specifications not involving country dummies. This appears to be due to divergence between national productivity rates, since divergence is no longer apparent in the analysis using country dummies (see Tables C.17 to C.20).

Productivity in market services also appears to have shown divergent growth post-SMP, although this is attributable to national divergence, since the introduction of country dummies leads to within-country convergence. Tables C.21 to C.24 show that the only significant direct effect post-SMP is human capital, although this appears to be picking up the effect of the national dummies. The pre-SMP market services productivity growth is significantly convergent, both with and without the presence of country dummies. There is also evidence of slower growth pre-SMP in peripheral and Ob1 regions. There are both total and direct effects due to these variables, and they are present both with and without the presence of country dummies.

The growth of non-market services productivity shows a very similar pattern to that of market services, as is evident from Tables C.25 to C.28. The only major difference is that the slower growth evident pre-SMP in peripheral and Ob1 regions is eliminated by the presence of country dummies. As with market services, overall convergence seems to have been faster pre-SMP than post-SMP.

An interpretation of this result, in the context of the opposite indication for GVA per capita growth, is that the countries and regions that have seen faster GVA per capita growth in the post-SMP period have seen faster employment growth than the richer countries; and that there has been some convergence on the richer countries' labour force activity rates.

The overall picture of faster unconditional productivity convergence pre-SMP is supported by the results of Markov chain analysis of productivity growth rates by sector, although it should be stressed at the outset that these results are based on very sparse data. For each sector, the estimated half-life is longer if based on the post-SMP transition matrices than if the transition matrices are calculated with the observed cross-tabulation using productivity levels for 1975 and 1987.

In summary, the above analysis using Markov chains has tended to confirm the impression given by the Barro-style regressions of slower progress towards the convergence of productivity levels post-SMP compared with pre-SMP. There is some suggestion that the equilibria to which productivity levels are converging (at a slower rate) is one in which there would be fewer regions with the lowest levels of productivity and more regions at the highest level of productivity. This may be due to the elimination of the significant negative effects on productivity growth due to peripherality and to Ob1 status, which appeared fairly consistently in the regression analysis of the pre-SMP data, but which on the whole had disappeared or become weaker in the post-SMP data.

Employment analysis

In this section the analysis focuses on the growth of employment in the European regions. The impact of the SMP in reducing barriers to factor mobility should, according to a conventional neo-classical view of the European economy, be felt in terms of lower rates of unemployment in regions with an over-supply of labour, due both to out-migration and to the inflow of capital creating employment. However, increased economic activity will also affect the extent of labour force participation or activity rates, which will tend to increase as the demand for labour increases, so unemployment rates could be slow to adjust. Another factor which could keep unemployment high would be a fast rate of population growth, which would also add to the labour supply. In contrast, other regions will receive in-migrant labour and may experience falling activity rates as labour market conditions tend to become equalized across regions.

In the analysis described in this section, the dependent variable is the growth of the employment rate, which is defined as employment divided by total population. As previously, the approach adopted is to fit models for the two periods, pre-SMP and post-SMP. The models fitted to these data are similar to those fitted to the GVA per capita data, using the same explanatory variables plus some additional variables. In the model, the level of employment per capita at the start of the period performs the same role as the level of GVA per capita in our previous analyses, the intention being to explore whether there is evidence of faster growth in the employment rate in regions with lower initial employment rates. The additional variables present in the employment rate regressions which were not represented in the GVA per capita analyses are the growth of the participation rate, where the participation rate is the working population divided by the total population, and the growth of GVA per capita. The inclusion of the growth of the participation rate controls for the effect of increasing labour supply on the growth of the employment rate. The growth of GVA per capita turns out to be a significant 'explanatory' variable, as is evident in Tables C.30 and C.31. Output growth is associated with employment growth, although the direction of causality could be from employment to output and not as specified.

In Table C.30, the estimates presented relate to the post-SMP period, and focus on just two model specifications, the unconditional model, in which the (log) level of employment in 1987 is the single explanatory variable; and the direct effects model, which contains all of the explanatory variables. This is repeated with country dummies also included in both cases. For the analysis without country dummies, the table shows that there does appear to be a significant unconditional convergence effect involving employment in the post-SMP period. However, the effect of the start-of-period employment rate level disappears in the direct effects specification, in which the two principal variables are the growth of the participation rate and the growth of GVA per capita.

The explanation for the weaker evidence for convergence in the employment rate in the direct effects model is provided in Table C.32, which presents the regression coefficients and corresponding t ratios for the conditional models, indicating the total effects of each of the explanatory variables. The most salient feature in these estimates is the very significant total effect of the growth of the participation rate on the growth of the employment rate in the post-SMP period. Also, the growth of the participation rate is very strongly associated with the level of employment in 1987, so that the effect of the latter when both variables are present is negligible. A similar pattern occurs with the model for the total effect of GVA per capita growth.

So it appears that post-SMP, growth in the employment rate is largely associated with growth in output and growth in the participation rate, and these account for much of the convergence in the employment rate.

In the post-SMP employment rate analysis including country dummies, the unconditional model indicates significant within-country convergence, though this is diluted in the presence of the other variables in the direct effects model. The direct effects model produces a similar coefficient for GVA per capita as in the model without country dummies, but the country dummy effects pick up a greater proportion of the participation rate effect, which nevertheless remains significant. It is also evident that peripheral regions grew faster, and Ob1 regions grew significantly more slowly. However, since these are highly correlated variables, there is an element of doubt relating to the interpretation of these variables.

Additional results to aid interpretation is again provided by the estimates from the total effects models presented in Table C.32. These add weight to the suggestion that the employment rate grew more slowly in Ob1 status regions, after allowing for other factors, and that this is not attributable to country effects. Also, the strong association of employment rate growth with participation rate and GVA per capita growth is supported by the evidence from these models.

The pre-SMP employment rate analysis, which is summarized in Tables C.31 and C.33, indicates that there was faster unconditional convergence of the employment rate than was the case for the post-SMP period. With the inclusion of the other explanatory variables, the 'negative correlation' between the initial level of employment and subsequent growth rate remains in evidence, unlike the post-SMP analysis. The regression coefficients indicate that the rate of catch-up would have been approximately 4% p.a., were it not for the effects of the additional regressors which on the whole tended to slow the growth of the employment rate. In particular, peripherality, Ob1, Ob2 and border region status all had a significant negative impact on employment rate growth in the pre-SMP period. In contrast, in the post-SMP period, these negative impacts are not as apparent or as significant. Also, while participation rate and GVA per capita growth are significantly positively associated with employment rate growth, the elasticities are smaller, suggesting that the growth of the employment rate was less responsive to changes in labour supply or output growth than was the case in the post-SMP period.

The total effect models summarized in Table C.33 support these interpretations, particularly the very significant negative impacts of peripherality and Ob1 status.

The analysis including the country dummies reaffirms the stronger tendency towards the convergence of employment rates in the pre-SMP period after controlling for other factors. While the effects of some of the other variables are to an extent absorbed by the national effects in the form of country dummies, peripheral regions, Ob1, Ob2 and regions with border status remain as mainly significant negative impacts on the growth of the employment rate in this pre-SMP period. The positive association with participation rate growth and GVA per capita growth remains, though as in the post-SMP analysis, the presence of country dummies dilutes the effect of participation rate to the extent that it is only marginally significant as both a direct and a total effect.

To summarize, the analysis suggests that the major role played by the SMP in terms of its effect on regional employment rate growth differentials has been to eliminate the significant negative pre-SMP impacts on the growth of the employment rate which were evident in the policy-assisted regions of the EU. These impacts are most consistently evident in the Ob1 regions, but also in evidence are strong negative associations between growth and peripherality and between growth and Ob2 status. There appears to have been a stronger autonomous element of convergence in regional employment rates in the pre-SMP period which is not largely attributable to growth in participation rates or to varying growth rates of GVA per capita. In the post-SMP period, controlling for these variables removes the significance of the start-of-period employment level, so it appears that post-SMP convergence is largely attributable to participation rate and GVA per capita growth convergence. (For list of variables, see Tables C.36 and C.37.)

Table 4.1. Unconditional beta-convergence

	1975–87	1987–93	1975–87	1987–93	1975–87	1987–93
Constant	1.218	6.09	1.183	3.74	1.273	3.77
	(1.85)	(2.17)	(1.64)	(3.13)	(1.80)	(3)
gvapv	0.214	-1.64	0.228	-0.824	0.196	-0.820
	(0.67)	(-1.33)	(0.65)	(-1.59)	(0.58)	(-1.57)
ire			0.099	6.402	0.062	6.365
			(0.17)	(7.12)	(0.11)	(7.09)
sita					0.705	-0.986
					(1.25)	(-1.11)
spa					-1.152	0.045
					(-1.99)	(0.05)
R-BAR	*	0.06	*	0.85	0.20	0.82

Notes: Figures in parentheses denote t-statistics.
The symbol * denotes negative R-BAR.

Table 4.2. Growth regression: OLS estimates (EU-12 countries)

Explanatory variables				
Constant	-0.08	-0.52	3.15	7.57
	(-0.03)	(-0.16)	(0.89)	(2.62)
pogvapc	-1.450	-0.78	-3.58	-2.55
	(-1.75)	(-0.51)	(-1.76)	(-2.45)
accel		-1.04	6.33	3.74
		(-0.53)	(2.15)	(2.16)
poedu	1.81	1.79	3.00	0.17
	(0.69)	(0.66)	(1.23)	(0.13)
poavlab	0.167	0.132	0.223	0.2155
	(0.98)	(0.70)	(1.34)	(2.41)
poinv	0.0700	0.0601	0.187	0.1656
	(0.74)	(0.61)	(1.78)	(2.56)
porsd	1.702	1.710	1.787	0.741
	(1.82)	(1.78)	(2.26)	(1.58)
poaveu	0.68	-0.03	-0.81	-4.91
	(0.34)	(-0.01)	(-0.39)	(-1.64)
poim	0.516	2.73	-15.19	-8.48
	(0.66)	(0.64)	(-2.19)	(-2.06)
poire				4.84
				(2.01)
intire				1.02
				(0.38)
poobl			-3.44	-6.48
			(-1.64)	(-2.53)
intobl			7.95	7.58
			(2.89)	(2.42)
R-BAR	0.205	0.168	0.434	0.863

Note: Figures in parentheses denote t-statistics.

Table 4.3. Growth regression: IV estimates (EU-12 countries)

Explanatory variables				
Constant	-8.074	-8.072	2.624	7.889
	(-1.345)	(-1.4354)	(0.649)	(2.217)
pogvapc	-1.360	-1.362	-5.707	-2.720
	(-1.321)	(-0.7053)	(-2.108)	(-1.877)
accel		0.002	8.853	4.027
		(0.0007)	(2.369)	(1.584)
poedu	2.472	2.472	4.276	0.286
	(0.733)	(0.7156)	(1.446)	(0.209)
poavlab	0.062	0.062	0.168	0.217
	(0.282)	(0.2632)	(0.871)	(2.359)
poinv	0.346	0.346	0.388	0.184
	(1.736)	(1.7942)	(2.172)	(1.429)
porsd	2.471	2.471	2.211	0.759
	(1.950)	(1.8916)	(2.295)	(1.224)
poaveu	1.674	1.675	-0.574	-5.312
	(0.653)	(0.5239)	(-0.244)	(-1.305)
poim	0.428	0.424	-21.070	-9.143
	(0.438)	(0.0777)	(-2.402)	(-1.513)
poire				5.189
				(1.546)
intire				0.623
			-5.905	(0.159)
poobl			(-2.038)	-6.982
			10.635	(-1.696)
intobl			(2.960)	8.169
				(1.622)
R-BAR	*	*	0.272	0.862

Notes: Figures in parentheses denote t-statistics.
The symbol * denotes negative R-BAR.

Table 4.4. Growth regression: OLS estimates (EU-12 countries)

Explanatory variables				
Constant	2.02	1.25	4.33	4.44
	(1.44)	(0.63)	(1.06)	(1.43)
pogvapc	-1.473	-0.76	-1.88	-1.08
	(-1.70)	(-0.48)	(-0.96)	(-1.07)
accel		-1.10	4.21	0.91
		(-0.55)	(1.38)	(0.57)
poedu	4.00	4.06	4.05	-0.28
	(1.76)	(1.75)	(1.83)	(-0.21)
poavlab	0.169	0.127	0.253	0.181
	(0.98)	(0.66)	(1.33)	(1.76)
poinv				
porsd				
poaveu	0.66	-0.05	-0.84	-0.62
	(0.32)	(-0.02)	(-0.35)	(-0.21)
poim	1.156	3.53	-9.65	-1.68
	(1.64)	(0.81)	(-1.34)	(-0.44)
poire				1.25
				(0.53)
intire				5.57
				(2.33)
poob1			-1.42	-1.60
			(-0.75)	(-0.78)
intob1			5.64	1.50
			(2.07)	(0.60)
R-BAR	0.168	0.105	0.233	0.862

Note: Figures in parentheses denote t-statistics.

Table 4.5. Growth regression: OLS estimates (EU-12 + 2 countries)

Explanatory variable						
Constant	-0.04	-0.23	2.17	3.33	-0.58	-0.28
	(-0.01)	(-0.08)	(0.54)	(1.78)	(-0.18)	(-0.09)
pogvapc	-1.270	-0.92	-3.30	-2.14	-0.54	-0.85
	(-1.77)	(-0.77)	(-1.24)	(-1.64)	(-0.40)	(-0.67)
accel		-0.56	4.36	1.30	-1.08	-0.71
		(-0.36)	(1.24)	(0.77)	(-0.62)	(-0.42)
poedu	0.71	0.57	1.70	-1.09	0.68	0.78
	(0.29)	(0.23)	(0.66)	(-0.75)	(0.24)	(0.28)
poavlab	0.159	0.140	0.243	0.1332	0.122	0.125
	(1.04)	(0.85)	(1.39)	(1.57)	(0.69)	(0.70)
poinv	0.0676	0.0594	0.130	0.0550	0.0550	0.0651
	(0.76)	(0.64)	(1.20)	(1.02)	(0.57)	(0.65)
porsd	1.793	1.819	1.668	0.366	1.803	1.760
	(2.01)	(1.99)	(1.86)	(0.83)	(1.90)	(1.79)
poaveu	0.86	0.58	1.48	1.95	0.12	0.35
	(0.52)	(0.31)	(0.67)	(1.61)	(0.05)	(0.17)
poim	0.304	1.47	-10.14	-2.62	2.72	1.83
	(0.44)	(0.45)	(-1.26)	(-0.67)	(0.72)	(0.50)
posspa						-0.68
						(-0.39)
intsspa						0.46
						(0.20)
posita					1.07	
					(0.63)	
intsita					-1.79	
					(-0.82)	
poire				0.134		
				(0.14)		
intire				6.99		
				(6.17)		
poob1			-1.80	-1.308		
			(-0.96)	(-1.51)		
intob1			4.17	0.37		
			(1.61)	(0.29)		
R-BAR	0.223	0.188	0.226	0.838	*	*

Notes: Figures in parentheses denote t-statistics.
The symbol * denotes negative R-BAR.
Italy and Spain are divided into their Ob1 and non-Ob1 parts.

Table 4.6. Growth regressions: IV estimates (EU-12 + 2 countries)

Explanatory variable						
Constant	-9.269	-8.409	0.839	3.614	-9.317	-7.600
	(-1.381)	(-1.4665)	(0.182)	(1.838)	(-1.5584)	(-1.3091)
pogvapc	-1.274	-1.644	-6.239	-1.557	-1.390	-1.413
	(-1.399)	(-1.0551)	(-1.778)	(-0.938)	(-0.7639)	(-0.8938)
accel		0.601	8.105	0.569	0.288	0.244
		(0.2937)	(1.756)	(0.267)	(0.1221)	(0.1159)
poedu	1.872	1.863	2.634	-1.504	2.228	1.924
	(0.556)	(0.5502)	(0.857)	(-0.889)	(0.5919)	(0.5513)
poavlab	0.046	0.075	0.230	0.139	0.058	0.057
	(0.219)	(0.3540)	(1.175)	(1.596)	(0.2520)	(0.2603)
poinv	0.377	0.364	0.353	0.015	0.383	0.342
	(1.722)	(1.8257)	(1.922)	(0.170)	(1.8655)	(1.7932)
porsd	2.515	2.479	2.177	0.284	2.447	2.400
	(2.049)	(2.0105)	(2.026)	(0.582)	(1.8468)	(1.8670)
poaveu	2.434	2.614	3.834	1.442	2.370	1.878
	(1.050)	(1.0155)	(1.320)	(0.947)	(0.7904)	(0.7141)
poim	0.253	-1.009	-18.781	-0.935	-0.189	-0.241
	(0.287)	(-0.2326)	(-1.775)	(-0.190)	(-0.0369)	(-0.0532)
posspa						-1.360
						(-0.6258)
intsspa						1.307
						(0.4599)
posita						
					0.901	
intsita					(0.4077)	
					-1.360	
poire				0.370	(-0.4760)	
				(0.344)		
intire				6.962		
				(5.964)		
poob1			-3.837	-1.000		
			(-1.553)	(-0.970)		
intob1			6.635	-0.095		
			(2.013)	(-0.063)		
R-BAR	*	*	0.025	0.832	0.127	0.101

Notes: Figures in parentheses denote t-statistics.
The symbol * denotes negative R-BAR.
Italy and Spain are divided into their Ob1 and non-Ob1 parts.

Table 4.7. Growth regressions: OLS estimates (EU-12 + 2 countries)

Explanatory variable						
Constant	1.85	1.47	3.39	3.80	1.00	1.58
	(1.53)	(0.84)	(0.80)	(2.10)	(0.51)	(0.86)
pogvapc	-1.245	-0.94	-1.91	-1.40	-0.56	-0.83
	(-1.65)	(-0.76)	(-0.81)	(-1.38)	(-0.40)	(-0.64)
accel		-0.49	2.89	0.37	-1.01	-0.82
		(-0.31)	(0.93)	(0.28)	(-0.57)	(-0.48)
poedu	3.34	3.31	3.62	-1.28	3.37	3.39
	(1.73)	(1.68)	(1.84)	(-1.16)	(1.50)	(1.65)
poavlab	0.163	0.143	0.256	0.1371	0.121	0.120
	(1.04)	(0.83)	(1.37)	(1.65)	(0.66)	(0.66)
poaveu	0.79	0.59	0.46	1.369	0.17	0.27
	(0.48)	(0.33)	(0.23)	(1.45)	(0.08)	(0.13)
poim	0.942	1.97	-6.23	-0.38	3.24	2.73
	(1.51)	(0.58)	(-0.86)	(-0.12)	(0.84)	(0.74)
posspa						-0.82
						(-0.46)
intsspa						0.03
						(0.01)
posita					1.07	
					(0.60)	
intsita					-1.93	
					(-0.84)	
poire				0.396		
				(0.44)		
intire				7.17		
				(6.84)		
poob1			-0.77	-0.899		
			(-0.45)	(-1.19)		
intob1			3.16	-0.28		
			(1.33)	(-0.26)		
R-BAR	0.141	0.105	0.119	0.842	0.046	0.33

Notes: Figures in parentheses denote t-statistics.
The symbol * denotes negative R-BAR.
Italy and Spain are divided into their Ob1 and non-Ob1 parts.

Table 4.8. Unconditional beta-convergence over the period 1975–87 (OECD countries)

Explanatory variable				
Constant	-0.97	-0.89	-0.34	0.16
	(-0.47)	(-0.43)	(-0.13)	(0.06)
gvapc	0.324	0.322	0.262	0.211
	(1.38)	(1.35)	(0.90)	(0.72)
aveu		-0.153	-0.147	-0.248
		(-0.49)	(-0.46)	(-0.76)
Ob1			-0.177	-0.466
			(-0.37)	(-0.86)
lre				0.993
				(1.13)
R-BAR	3.8	0.4	*	*

Note: Figures in parentheses denote t-statistics.

Table 4.9. Unconditional beta-convergence over the period 1987–93 (OECD countries)

Explanatory variable				
Constant	10.74	6.84	4.54	6.35
	(2.34)	(1.56)	(0.89)	(1.33)
gvapc	-1.016	-0.667	-0.417	-0.614
	(-2.01)	(-1.41)	(-0.75)	(-1.19)
aveu		1.504	1.304	1.293
		(2.55)	(2.06)	(2.21)
Ob1			0.870	-0.11
			(0.88)	(-0.11)
Ire				3.21
				(2.14)
R-BAR	11.6	29.4	28.6	39.5

Note: Figures in parentheses denote t-statistics.

Table 4.10. Growth regression: OLS estimates (OECD countries)

Explanatory variable				
Constant	-0.92	-1.83	-1.82	-2.14
	(-0.30)	(-0.56)	(-0.52)	(-0.64)
pogdppc	-0.097	-0.002	-0.028	-0.030
	(-0.35)	(-0.01)	(-0.08)	(-0.10)
accel		-0.598	2.39	-0.01
		(-0.82)	(1.60)	(-0.01)
poinv	0.1273	0.1299	0.1394	0.1543
	(2.65)	(2.69)	(2.96)	(3.43)
poaveu	0.735	0.763	0.802	0.740
	(1.60)	(1.65)	(1.79)	(1.70)
poim	0.913	6.20	-21.3	0.7
	(1.82)	(0.95)	(-1.57)	(0.04)
poire				1.17
				(0.95)
intire				2.41
				(1.25)
poob1			-0.205	-0.493
			(-0.31)	(-0.70)
intob1			3.58	0.77
			(2.20)	(0.38)
R-BAR	20.8	20.2	25.8	33.6

Note: Figures in parentheses denote t-statistics.

Table 4.11. Regressions based on 1987-93 growth (without country dummies)

Unconditional		Conditional						
		Direct effects	Total effects					
Constant	0.02590 (6.076)	0.029549 (2.661)	0.03963 (4.401)	0.02557 (5.975)	0.02975 (3.882)	0.02577 (6.039)	0.02424 (5.892)	0.02717 (6.259)
lgvapc[87]	0.00471 (2.371)	0.006634 (1.707)	0.00964 (2.724)	0.00574 (2.502)	0.00633 (1.883)	0.00452 (2.266)	0.00507 (2.652)	0.00363 (1.722)
luxdij		-0.000960 (-0.282)	-0.00483 (-1.728)					
es[75]		0.006548 (0.632)		0.00873 (0.919)				
ps[1]		-0.001050 (-0.269)			-0.00203 (-0.605)			
ps[2]		-0.003306 (-1.232)				-0.00235 (-0.893)		
border[93]		0.005703 (2.962)					0.00641 (3.911)	
hcap		-0.000564 (-0.861)						-0.00085 (-1.433)
Moran's I	0.2129 (7.96)	0.1363 (5.90)	0.1948 (7.51)	0.2093 (7.95)	0.2086 (7.92)	0.2115 (7.93)	0.1469 (5.73)	0.1977 (7.76)

Note: Figures in the parentheses denote t-statistics.

Table 4.12. Regressions based on 1975–87 growth (without country dummies)

	Unconditional	Conditional						
		Direct effects	Total effects					
Constant	0.02485 (6.734)	0.05059 (5.033)	0.04140 (5.171)	0.02454 (6.570)	0.03717 (5.577)	0.02419 (6.613)	0.024795 (6.652)	0.02520 (6.610)
lgvapc[75]	0.00282 (1.463)	0.01281 (2.981)	0.00952 (2.612)	0.00347 (1.542)	0.00880 (2.534)	0.00214 (1.116)	0.002834 (1.463)	0.000252 (1.207)
luxdij		-0.00546 (-1.654)	-0.00627 (-2.322)					
es[75]		0.00654 (0.656)		0.00529 (0.577)				
ps[1]		-0.00608 (-1.623)			-0.00709 (-2.209)			
ps[2]		-0.00595 (-2.304)				-0.00561 (-2.234)		
border[93]		-0.00199 (-1.071)					0.000187 (0.114)	
hcap		-0.00080 (-1.267)						-0.00022 (-0.386)
Moran's I	0.1451 (5.53)	0.1355 (5.84)	0.1555 (6.05)	0.1515 (5.84)	0.1612 (6.16)	0.1411 (5.40)	0.1457 (5.68)	0.1392 (5.60)

Note: Figures in parentheses denote t-statistics.

Table 4.13. Regressions based on 1987–93 growth (with country dummies)

	Unconditional	Conditional					
		Direct effects	Total effects				
Constant	0.02985 (3.229)	0.028185 (2.421)	0.026810 (2.527)	0.029850 (3.220)	0.03540 (3.294)	0.029787 (3.219)	0.028855 (3.103)
lgvapc[87]	0.00517 (1.375)	0.006536 (1.429)	0.004211 (1.031)	0.005585 (1.400)	0.00748 (1.680)	0.005097 (1.354)	0.005108 (1.359)
luxdij		0.007376 (1.544)	0.002336 (0.587)				
es[75]		0.005444 (0.531)		0.002863 (0.326)			
ps[1]		-0.005350 (-1.466)			-0.00324 (-1.012)		
ps[2]		-0.002796 (-1.166)				-0.001748 (-0.773)	
border[93]		0.001902 (1.069)					0.001640 (0.979)
Moran's I	-0.0001 (1.54)	-0.0213 (0.90)	-0.0018 (1.55)	-0.0014 (1.52)	-0.0069 (1.30)	0.0005 (1.58)	-0.0022 (1.51)

Note: Figures in parentheses denote t-statistics.

Table 4.14. Regressions based on 1975–87 growth (with country dummies)

	Unconditional	Conditional					
		Direct effects	Total effects				
Constant	0.04403 (5.971)	0.05256 (6.020)	0.05087 (6.064)	0.04363 (5.922)	0.05724 (7.284)	0.04210 (5.758)	0.04368 (5.853)
lgvapc[75]	0.01017 (2.768)	0.01655 (3.800)	0.01278 (3.127)	0.01170 (2.974)	0.01716 (4.016)	0.00905 (2.511)	0.01013 (2.749)
luxdij		0.00233 (0.582)	-0.00582 (-1.678)				
es[75]		0.00958 (1.127)		0.00965 (1.252)			
ps[1]		-0.01049 (-3.578)			-0.00995 (-3.846)		
ps[2]		-0.00595 (-2.976)				-0.00471 (-2.375)	
border[93]		-0.00026 (-0.174)					0.00050 (0.340)
Moran's I	-0.0092 (1.16)	-0.0413 (0.26)	-0.0278 (0.47)	-0.0037 (1.42)	-0.0476 (-0.38)	-0.0095 (1.16)	-0.0110 (1.14)

Note: Figures in parentheses denote t-statistics.

Table 4.15. Cross-tabulation of regions, 1975–87

		1987			
		Poor[1]	Below[2]	Above[3]	Rich[4]
	Poor[1]	34	2	0	0
1975	Below[2]	1	25	12	0
	Above[3]	0	12	47	7
	Rich[4]	0	1	5	23

Notes:
[1] Less than 75% of mean per capita GVA.
[2] Between 75% and 100% of mean per capita GVA.
[3] Between 100% and 125% of mean per capita GVA.
[4] More than 125% of mean per capita GVA.

Table 4.16. Transition probabilities

	Poor	Below	Above	Rich
Poor[1]	0.9444	0.0556	0	0
Below[2]	0.0263	0.6579	0.3158	0
Above[3]	0	0.1818	0.7121	0.1061
Rich[4]	0	0.0345	0.1724	0.7931

Notes:
[1] Less than 75% of mean per capita GVA.
[2] Between 75% and 100% of mean per capita GVA.
[3] Between 100% and 125% of mean per capita GVA.
[4] More than 125% of mean per capita GVA.

Table 4.17. Equilibrium probability vector using the 1975–87 observed transition probabilities

	Equilibrium	1975
Poor[1]	0.1357	0.2130
Below[2]	0.2564	0.2249
Above[3]	0.4028	0.3905
Rich[4]	0.2051	0.1716

Notes:
[1] Less than 75% of mean per capita GVA.
[2] Between 75% and 100% of mean per capita GVA.
[3] Between 100% and 125% of mean per capita GVA.
[4] More than 125% of mean per capita GVA.

Table 4.18. Cross-tabulation of regions, 1987–93

		1993			
		Poor[1]	Below[2]	Above[3]	Rich[4]
	Poor[1]	32	3	0	0
1987	Below[2]	0	37	3	0
	Above[3]	0	8	51	5
	Rich[4]	0	0	3	27

Notes:
[1] Less than 75% of mean per capita GVA.
[2] Between 75% and 100% of mean per capita GVA.
[3] Between 100% and 125% of mean per capita GVA.
[4] More than 125% of mean per capita GVA.

Table 4.19. Transition probabilities

	Poor	Below	Above	Rich
Poor[1]	0.9143	0.0857	0	0
Below[2]	0	0.9250	0.0750	0
Above[3]	0	0.1250	0.7969	0.0781
Rich[4]	0	0	0.1000	0.9000

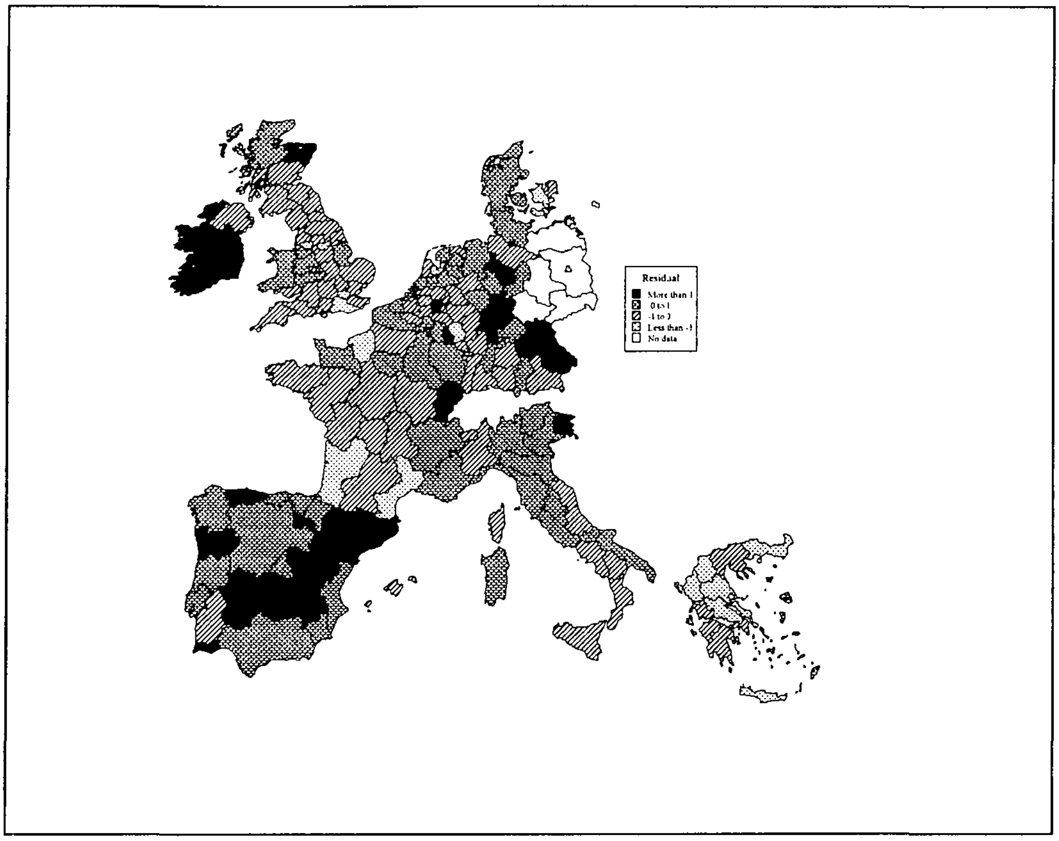
Notes:
[1] Less than% of mean per capita GVA.
[2] Between 75% and 100% of mean per capita GVA.
[3] Between 100% and 125% of mean per capita GVA.
[4] More than 125% of mean per capita GVA.

Table 4.20. Equilibrium probability vector using the 1987–93 observed transition probabilities

	Equilibrium	1987
Poor[1]	0.0002	0.2071
Below[2]	0.4838	0.2367
Above[3]	0.2899	0.3787
Rich[4]	0.2261	0.1775

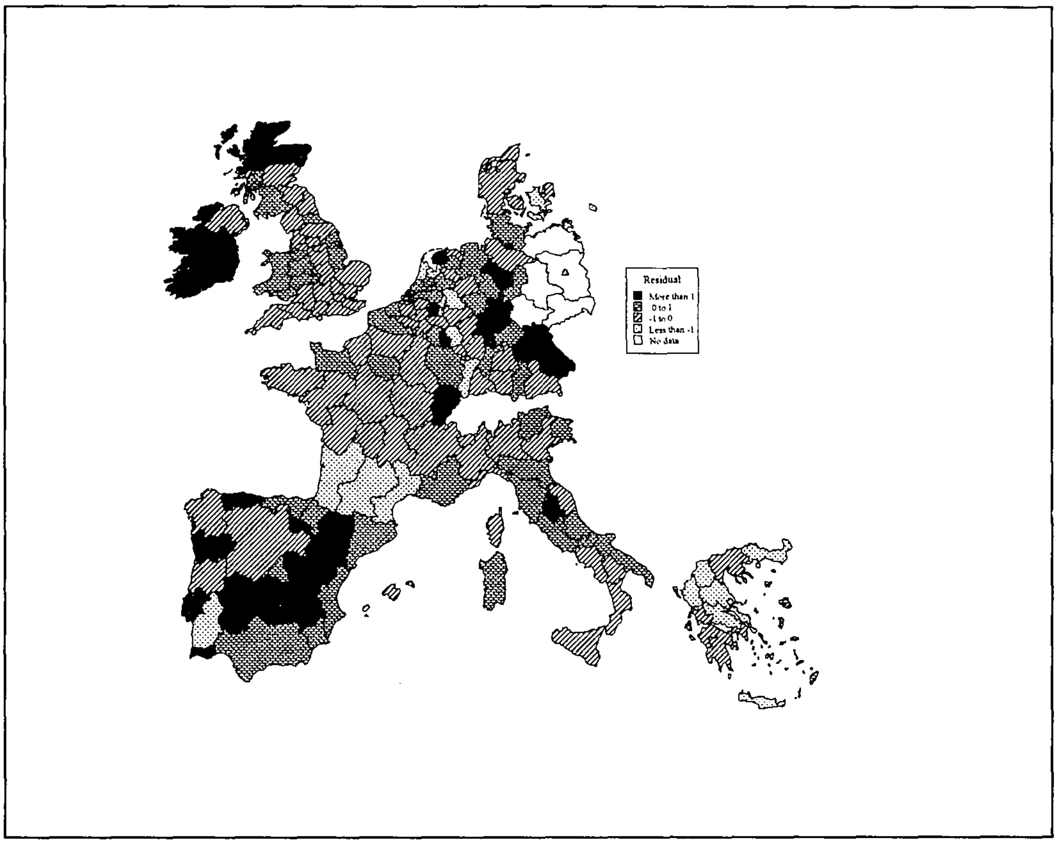
Notes:
[1] Less than 75% of mean per capita GVA.
[2] Between 75% and 100% of mean per capita GVA.
[3] Between 100% and 125% of mean per capita GVA.
[4] More than 125% of mean per capita GVA.

Figure 4.1. Residuals from regression based on 1987–93 growth: unconditional convergence (without country dummies)



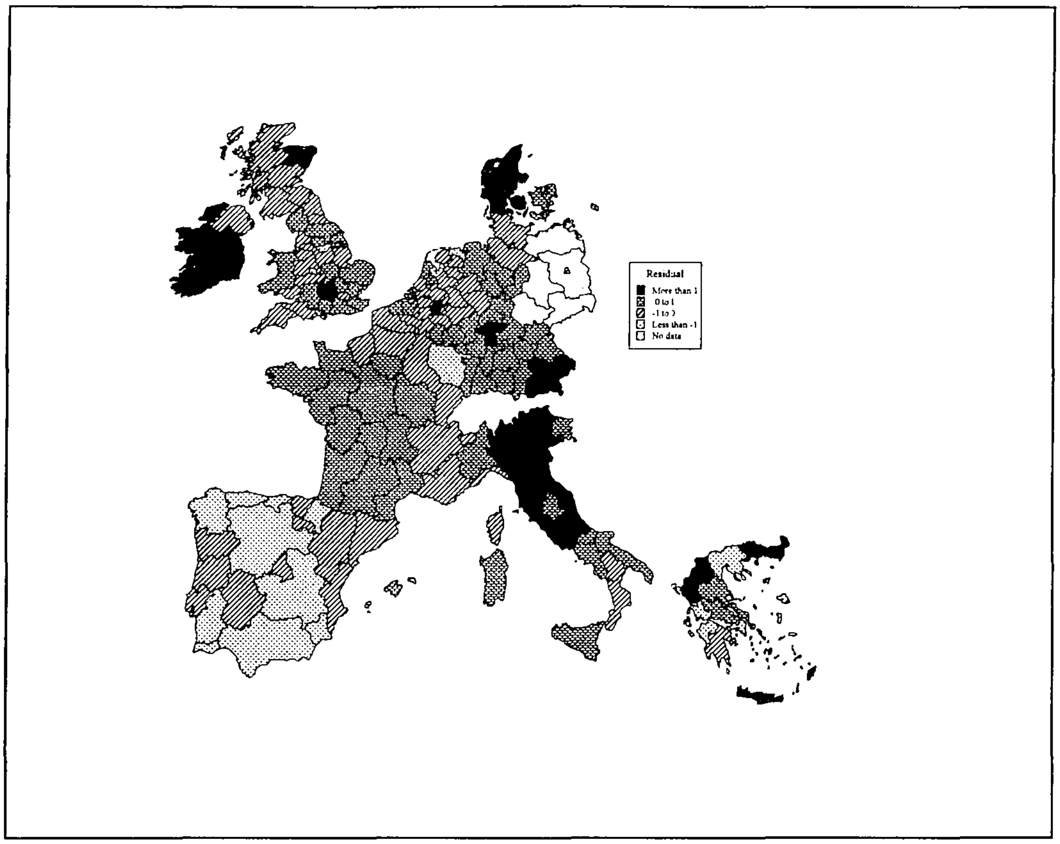
Note: The residuals correspond to the equation coefficients presented in column 1 of Table 4.11. A positive residual indicates that the region's actual growth rate exceeded the value predicted by the model.

Figure 4.2. Residuals from regression based on 1987–93 growth: conditional convergence, direct effects (without country dummies)



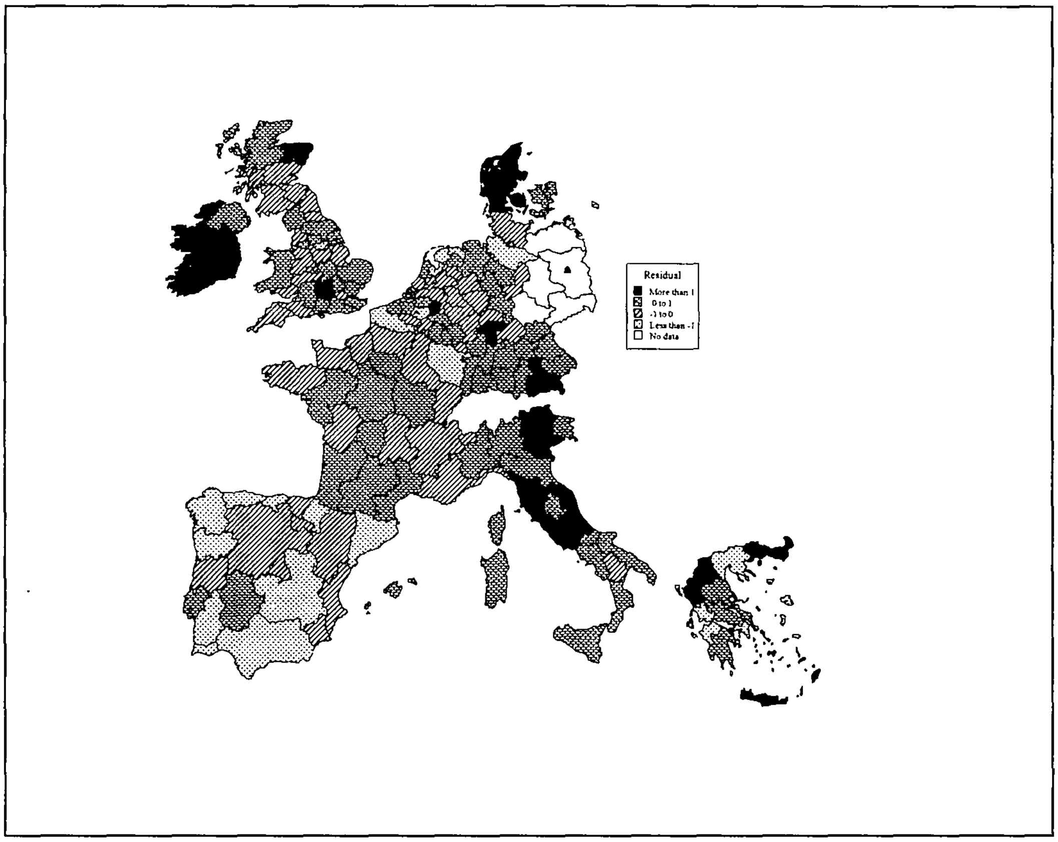
Note: The residuals correspond to the equation coefficients presented in column 2 of Table 4.11. A positive residual indicates that the region's actual growth rate exceeded the value predicted by the model.

Figure 4.3. Residuals from regression based on 1975–87 growth: unconditional convergence (without country dummies)



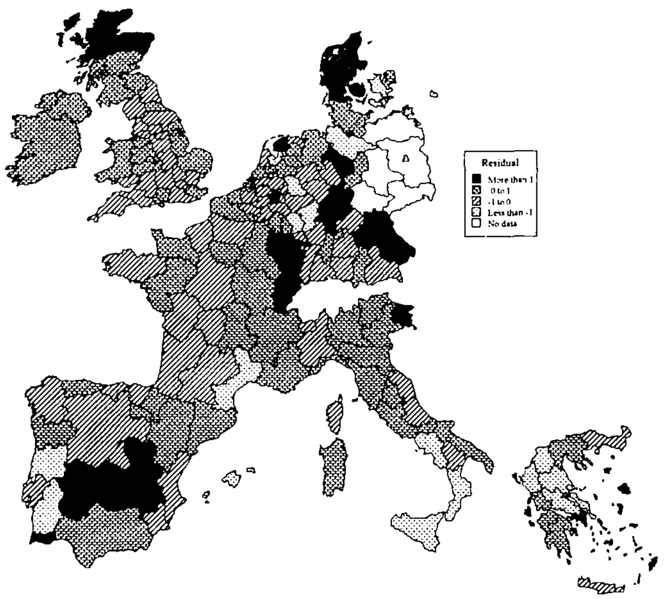
Note: The residuals correspond to the equation coefficients presented in column 1 of Table 4.12. A positive residual indicates that the region's actual growth rate exceeded the value predicted by the model.

Figure 4.4. Residuals from regression based on 1975–87 growth: conditional convergence, direct effects (without country dummies)



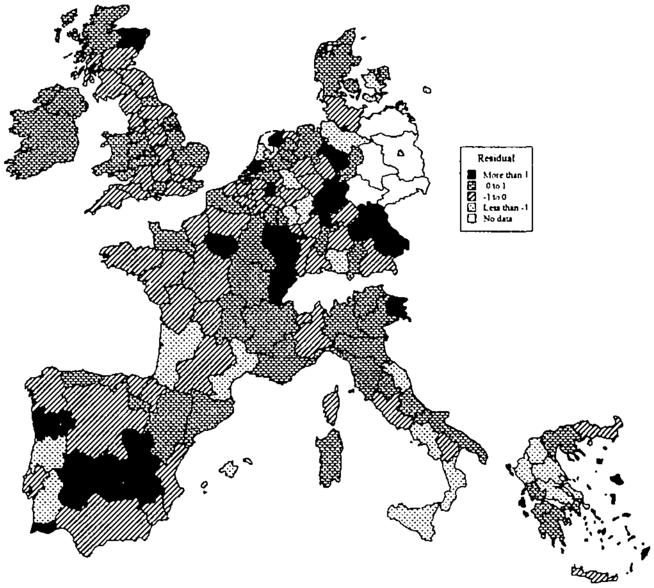
Note: The residuals correspond to the equation coefficients presented in column 2 of Table 4.12. A positive residual indicates that the region's actual growth rate exceeded the value predicted by the model.

Figure 4.5. Residuals from regression based on 1987–93 growth: unconditional convergence (with country dummies)



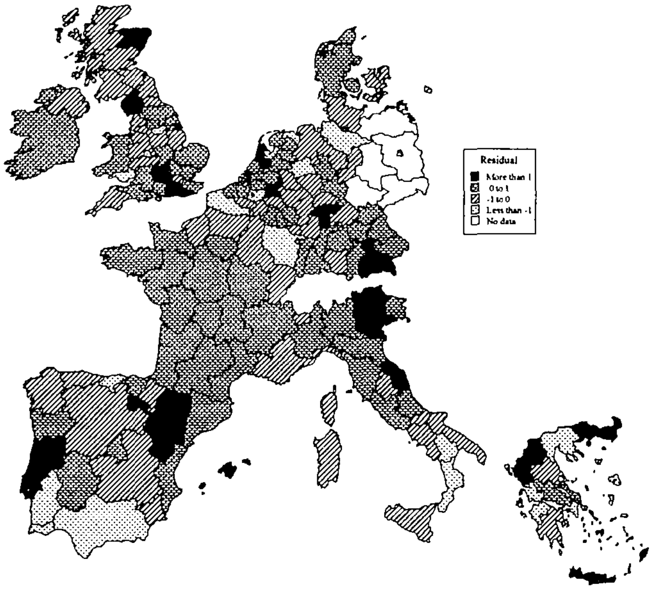
Note: The residuals correspond to the equation coefficients presented in column 1 of Table 4.13. A positive residual indicates that the region's actual growth rate exceeded the value predicted by the model.

Figure 4.6. Residuals from regression based on 1987–93 growth: conditional convergence, direct effects (with country dummies)



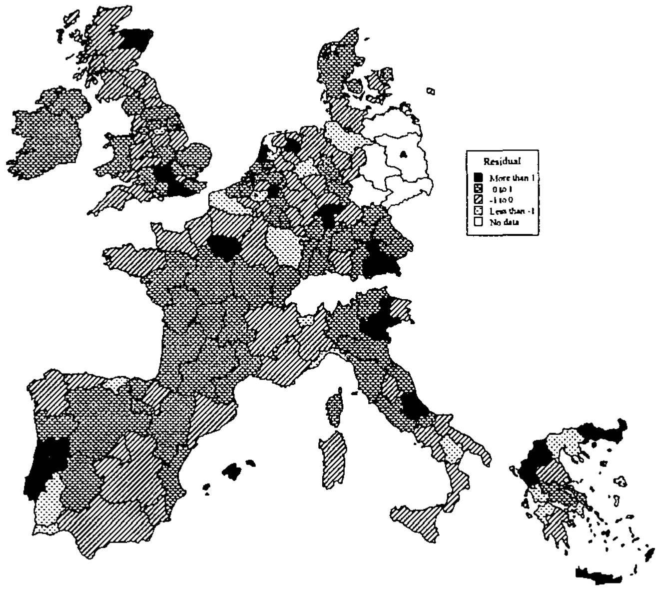
Note: The residuals correspond to the equation coefficients presented in column 2 of Table 4.13. A positive residual indicates that the region's actual growth rate exceeded the value predicted by the model.

Figure 4.7. Residuals from regression based on 1975–87 growth: unconditional convergence (with country dummies)



Notes: The residuals correspond to the equation coefficients presented in column 1 of Table 4.14. A positive residual indicates that the region's actual growth rate exceeded the value predicted by the model.

Figure 4.8. Residuals from regression based on 1975–87 growth: conditional convergence, direct effects (with country dummies)



Notes: The residuals correspond to the equation coefficients presented in column 2 of Table 4.14. A positive residual indicates that the region's actual growth rate exceeded the value predicted by the model.

Figure 4.9. Recursive parameter estimates: total effects without country dummies

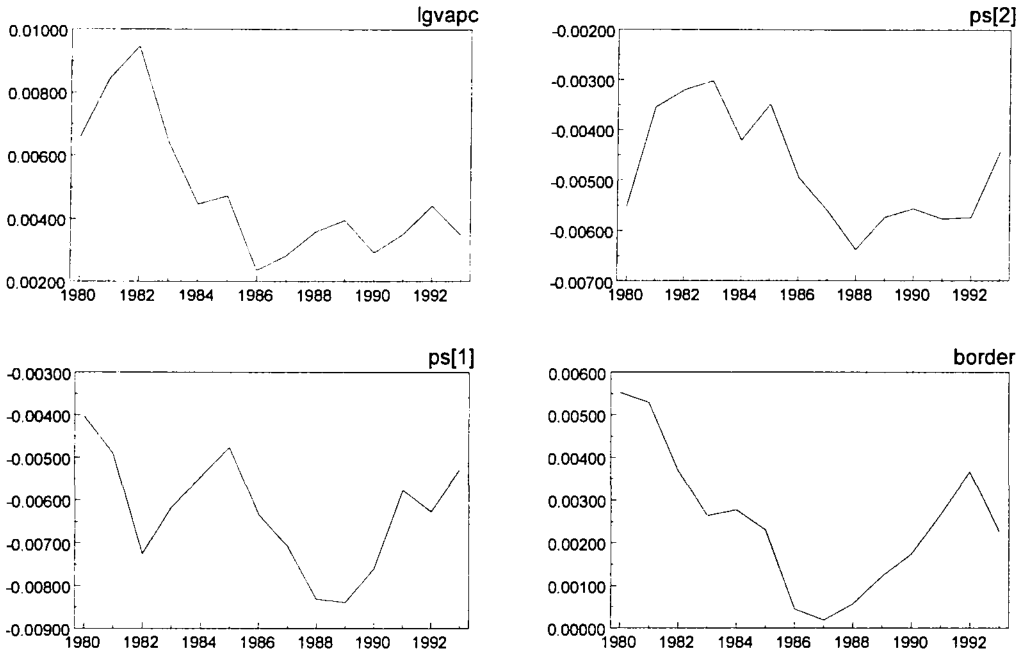


Figure 4.10. Recursive parameter estimates: total effects with country dummies

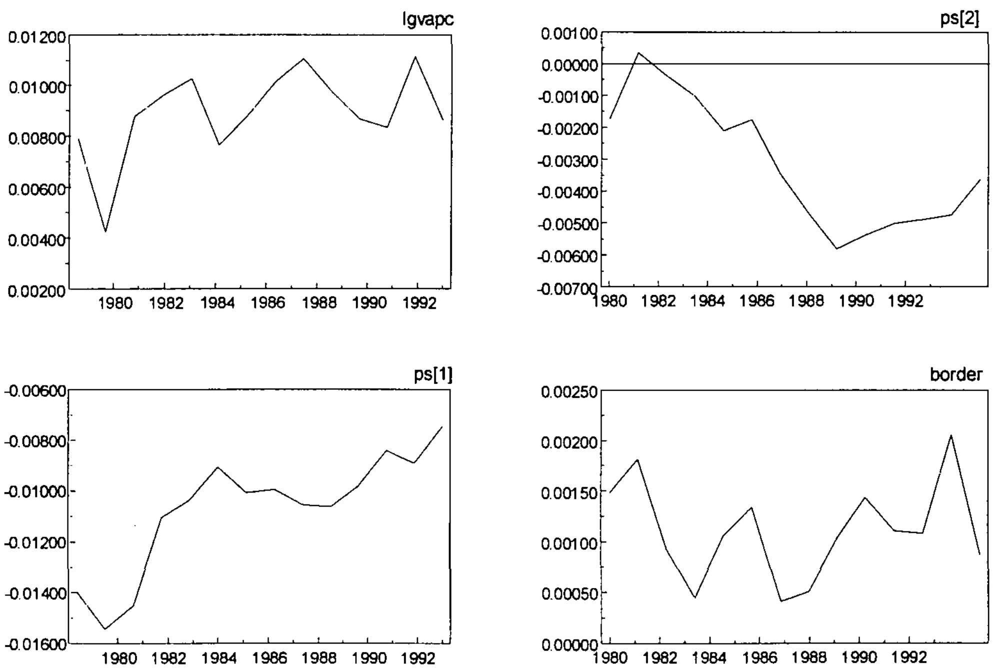


Figure 4.11. Recursive parameter estimates: direct effects without country dummies

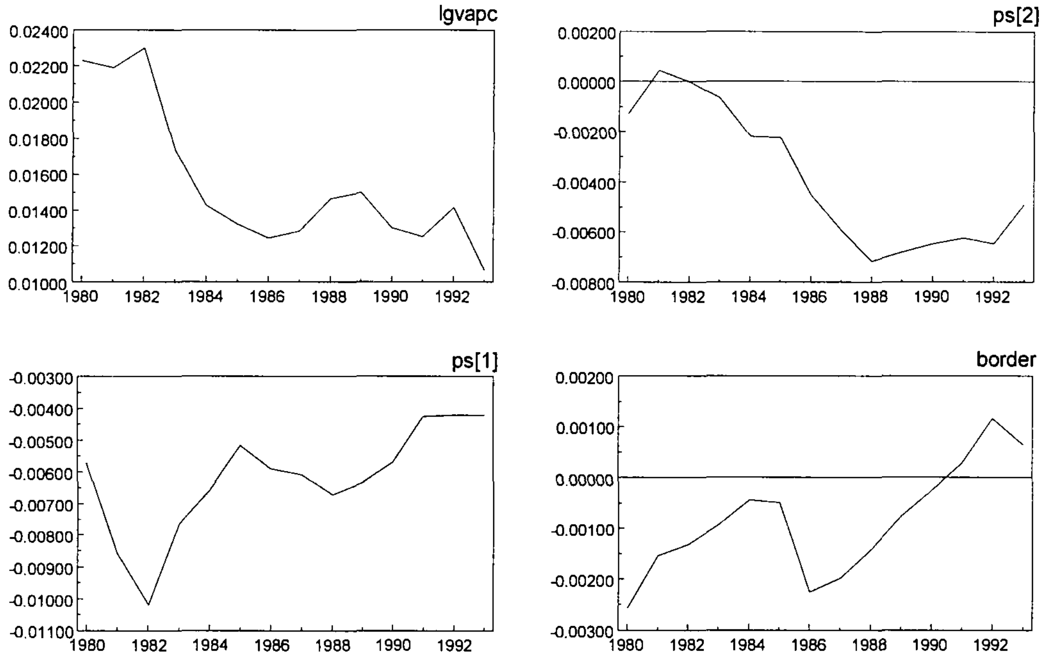
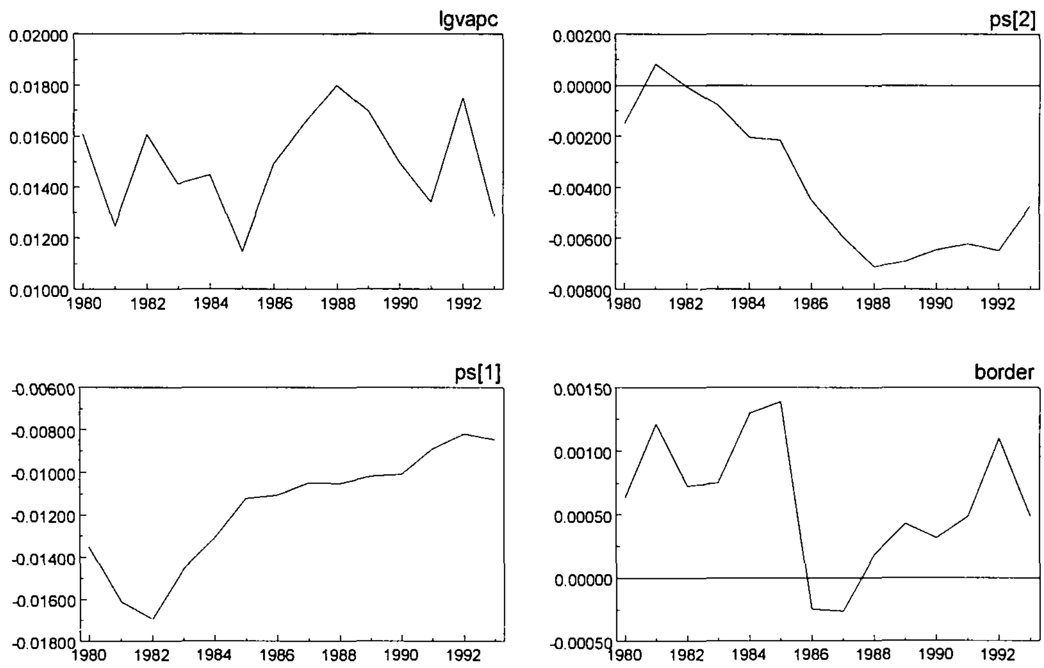


Figure 4.12. Recursive parameter estimates: direct effects with country dummies



APPENDIX A

The database

Pan-European empirical studies have typically been hindered by the lack of consistent data across Member States. This problem becomes more severe the greater the level of sectoral disaggregation required, and is particularly serious for regional data. Indeed, it would easily have been possible to absorb the entire resources available for this project simply in preparing a consistent data set, even given the data available from Eurostat. Cambridge Econometrics has already invested considerable resources in developing a European databank, with substantial sectoral and regional data building on the data available from Eurostat, which provide a key foundation for the present study. The data are described below.

A.1. Member State level

In the development of the E3ME model (European Energy Model for Europe) a large European database has been set up with the data being made consistent for each Member State. The data are on an annual basis for the period 1960–93. The model is based around the 25 NACE-CLIO sectors expanded to 32 sectors with disaggregation of the energy and environment industries, and is estimated and solved for 11 of the EU-12 countries (Greece is currently omitted due to lack of sufficient data). The data classifications are largely determined by the form in which the official Eurostat data are prepared. The use of these regularly supplied official data establishes a comparable basis across Member States, but the Eurostat database is not sufficiently complete to meet all of E3ME's requirements. Figure A.1 provides an indication of the quality of data, by geographical area, used in E3ME. While it is not feasible to list all the variables available for each country, the three categories of excellent, good and poor have the following meaning:

(a) Excellent. Data in these areas have been cross-checked and completed using national sources.
(b) Good. Various international sources, such as the OECD Stan database, have been used to complete the databases for these areas.
(c) Poor. International sources have been used wherever possible, but for the most part the data rely on CRONOS (see Section A.3.2 below).

The data have been obtained from a variety of sources including the Eurostat–CRONOS database, DG II's Quest database, OECD data sources including the OECD ANBERD databank; and from national data sources and organizations around the EU which include: Bureau Fédéral du Plan (Brussels); Chambre de Commerce de Paris (Paris); and IFO Institute for Economic Research (Munich). These organizations and others supplied data, and verified data on a national level. This is a continuous process. Data for human capital (number of graduates in each country) have been recently obtained from Eurostat.

A.2. Regional level

Through the publication *European Regional Prospects* (co-ordinated by CE and published annually by the European Economic Research and Advisory Consortium), a large and wide-ranging database has been established at the NUTS 2 regional level (see Figure A.2) for the years 1975–93. These data consist of employment and GVA for the following five sectors:

(a) agriculture,
(b) energy and manufacturing,
(c) construction,
(d) market services,
(e) non-market services.

For each region there are also data on population, working population, number of births and deaths, unemployment level and compensation of employees. These data are based on Eurostat's REGIO database, but have been extended, completed, updated and verified from the regional consultant network within the European Economic Research and Advisory Consortium (ERECO).

The NUTS 2 disaggregation available defines the Ob1 regions (see Figure A.2) and identifies the NUTS 2 regions in which the Ob2 areas lie (see Figure A.3).

A.3. Improvements to data

Cambridge Econometrics has undertaken considerable work to achieve the consistency and continuity of the original Eurostat sources in its own databases. The main adjustments are highlighted below.

A.3.1. REGIO

REGIO presents various problems for the user. First, the REGIO data are of highly variable quality, across countries and across time. In some cases, the data contain a clear break in the series (for example, because all years after a major census are on a different basis from the preceding period), but REGIO makes no attempt either to indicate data that are on a different basis, or to produce estimates on a time-consistent basis. There are also cases where there are inconsistencies between totals at the national or NUTS 1 levels and those available for NUTS 2 regions, or between the total and the detailed sectors – presumably because the data have been updated from different sources at different dates. Second, the REGIO data rarely present a continuous series at the NUTS 2 level, but only data for particular years. Third, the REGIO data on values (e.g. for gross value added) are expressed in current prices only. Fourth, the latest year for which data are available differs among the different EU Member States, and there is typically a considerable delay between the release of new regional data by the national statistical authorities and their incorporation in REGIO.

The following principles have been followed in carrying out the processing of REGIO data.

The REGIO data have been processed to fill gaps and extend the series to more recent years using national data where available. For most of the series, the regions have been scaled to agree with CRONOS data, the national accounts database. This database is more reliable and some backwards updates have been carried out. Extensive checks have revealed some important areas of inconsistency, and these are noted below.

National totals normally exclude 'extra' regions, such as French *Départements d'outre-mer* or Spanish overseas territories. However, the gross value added in the UK includes the continental shelf. In this case the national totals are therefore larger than the sum of the standard regions. The national data for Germany do not include the data for the eastern *Länder* prior to 1992. For 1992 onwards, the five eastern *Länder* are included in the total and 'Berlin' is the aggregation of east and west Berlin.

Where an incomplete series exists at the NUTS 2 level, interpolation methods have been used which fill gaps in the series from complete series available for aggregates of NUTS 2 regions. The totals of regions containing interpolated values are constrained to sum to known totals at higher levels of the spatial hierarchy.

Current price data have been transformed to constant price estimates in 1985 ECU, using national GVA deflators at a sectoral level and 1985 exchange rates.

Data for years following the latest available year in REGIO have been estimated using national sources.

A.3.2. CRONOS

The Eurostat database is not sufficiently complete to enable the construction of a large-scale sectoral model, and thus requires gaps in the data to be filled with estimates. Data entries in the databank therefore take place in one of the following three stages:

In Stage 1, the raw Eurostat data put on the databank in matrices (or vectors) with the appropriate dimension *n* x time where *n* is one of the adopted MEGEVE-E3ME classifications and time covers 1960–93. Missing data are set to -9999999.

To get from the incomplete to the complete matrix, four alternative procedures are consulted in Stage 2. First, where a total might be available for, for example, manufacturing production, but data are missing for the disaggregated sectors, shares can be supplied to split up this total. Second, at present, most Eurostat data end in 1991, but growth rates for 1992–93 (or any other year) can be imposed. If gaps in the data still exist, a mechanical interpolation procedure is used, and if -9999999s remain at the ends of the series, these are filled using the average growth rate over five years (or less if data are not available) after or before the missing data points.

For some variables for some countries, no data at all are available in the Eurostat database, and so the two above stages are not appropriate. Furthermore, for other variables the data might be so poor that Stage 2 becomes too cumbersome. Stage 3 is therefore more flexible as the updating procedures depend on the problem in question. For example, gross output in constant prices for Belgium is not available but has been estimated using gross output in current prices and the GVA deflator.

The final part of the updating process, Stage 4, makes a link with international data sources such as the OECD International Sectoral Database and DG II's Quest database, the aim being to ensure that the individual sectors sum up to reported national aggregates.

Data for the US, Japan and the other OECD countries come from the OECD Main Aggregates and Sectoral Database, without further checking.

Figure A.1. Data coverage at Member State level

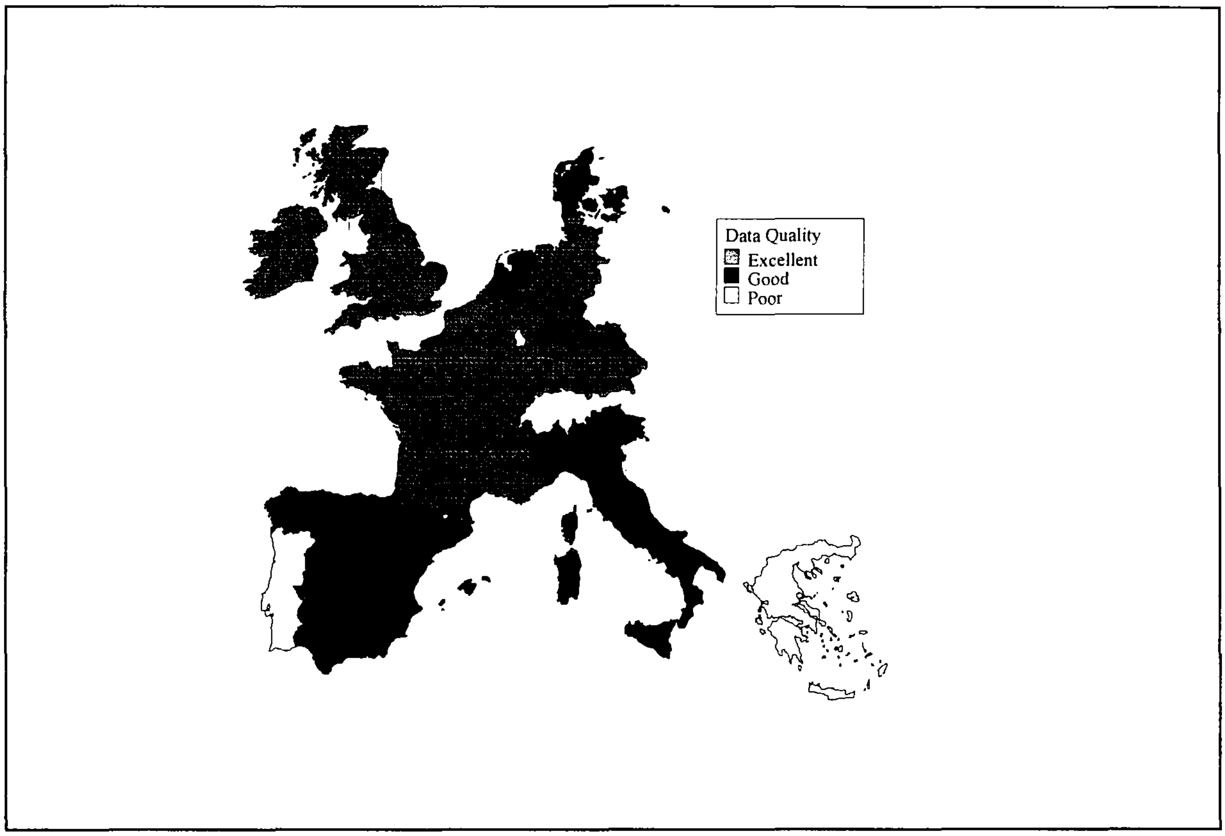


Figure A.2. Objective 1 regions

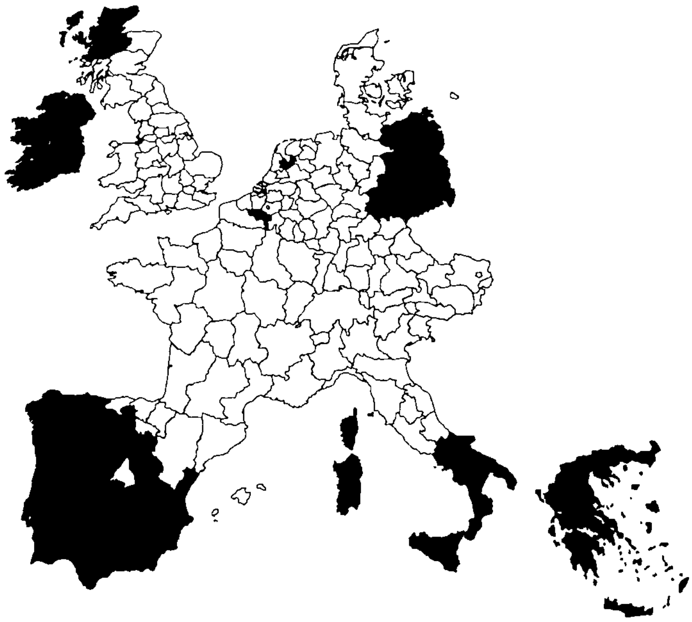
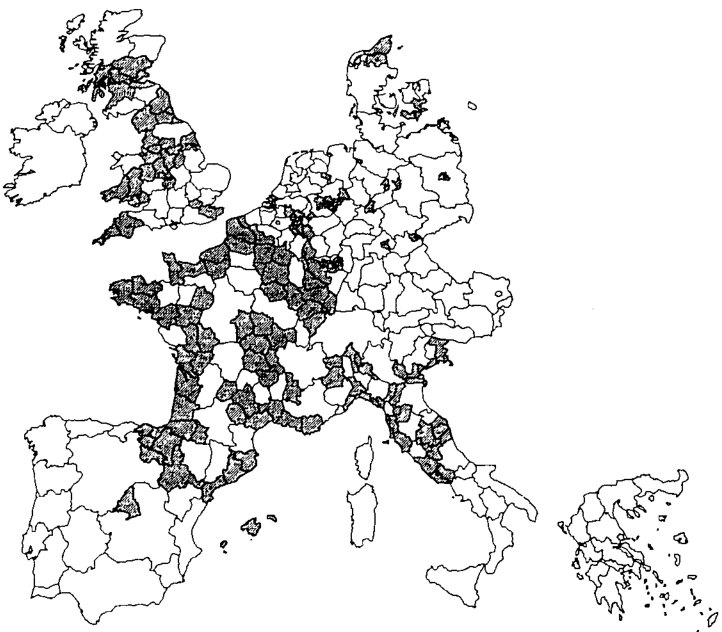


Figure A.3. Objective 2 regions



Note: Shaded areas include Objective areas (defined below NUTS 2 level).

APPENDIX B

Analytical tools

The **Gini coefficient** G is a commonly used measure of inequality which possesses the property of scale independence. In Equation B.1, $y_1, \ldots, y_n$ represents regional GVA per capita (decreasing in size order), and n is the number of regions.

(B.1) $$G = 1 + {}^{1}\!/_{n} - (2 / n^2 y)[y_1 + y_2 + y_3 + \ldots + n y_n]$$

Moran's I statistic (Equation B.2) provides a method of monitoring the changing spatial pattern of GVA per capita through time. In Equation B.3, W_{ij} is the element of the so-called weights matrix W for locations i and j; this matrix specifies the assumed linkage pattern for spatial autocorrelation under the alternative hypothesis (the null hypothesis is no spatial autocorrelation, the alternative is that spatial autocorrelation exists).

(B.2) $$I = ({}^{n}\!/_{s_0}) \sum \sum W_{ij} (y_j - y)(y_i - y) / \sum_i (y_i - y)^2$$

(B.3) $$W_{ij} = {}^{1}\!/_{d_{ij}^2}, {}^{i} i, {}^{j} j = 1, \ldots, n \text{ for } d_{ij} < 250\ km \text{ else } W_{ij} = 0$$

The variable y_i is the level of GVA per capita at locality i. Strictly speaking, a subscript t should be added to denote the fact that there is one value of I for each year analysed.

In the W matrix defined in Equation B.3, the interregional distances d_{ij} are the distances between region centroids (calculated using MAPINFO software).

APPENDIX C

Tables

Table C.1. Regressions based on 1987–93 growth (without country dummies)

	Unconditional	Conditional						
		Direct effects	Total effects					
Constant	0.02580	0.03410	0.0414	0.0258	0.0300	0.0256	0.0242	0.0273
	(5.391)	(1.557)	(2.426)	(3.370)	(2.088)	(3.362)	(3.197)	(3.197)
lgvapc[87]	0.00470	0.0068	0.0103	0.0049	0.0064	0.0045	0.0050	0.0031
	(1.314)	(0.876)	(1.533)	(1.176)	(1.020)	(1.250)	(1.433)	(0.812)
luxdij		-0.0015	-0.0053					
		(-0.233)	(-1.021)					
es[75]		-0.0016		0.0016				
		(-0.0831)		(0.094)				
ps[1]		-0.0022			-0.0021			
		(-0.307)			(-0.345)			
ps[2]		-0.0026				-0.0024		
		(-0.544)				(-0.513)		
border[93]		0.0056					0.0064	
		(1.599)					(2.178)	
hcap		-0.0008						-0.0012
		(-0.718)						(-1.123)

Note: Figures in parentheses denote t-statistics.

Table C.2. Regressions based on 1975–87 growth (without country dummies)

	Unconditional	Conditional						
		Direct effects	Total effects					
Constant	0.0251	0.0563	0.0445	0.0250	0.0395	0.0244	0.0250	0.0251
	(5.446)	(4.175)	(4.259)	(5.404)	(4.559)	(5.329)	(5.402)	(5.303)
lgvapc[75]	0.0029	0.0153	0.0110	0.0030	0.0100	0.0022	0.0030	0.0029
	(1.223)	(2.537)	(2.263)	(1.072)	(2.186)	(0.929)	(1.223)	(1.128)
luxdij		-0.0065	-0.0071					
		(-1.553)	(-2.067)					
es[75]		0.0001		0.0007				
		(0.011)		(0.059)				
ps[1]		-0.0071			-0.0080			
		(-1.510)			(-1.955)			
ps[2]		-0.0056				-0.0056		
		(-1.746)				(-1.818)		
border[93]		-0.0019					0.0002	
		(-0.841)					(0.096)	
hcap		-0.0005						0.00000
		(-0.701)						(0.001)

Note: Figures in parentheses denote t-statistics.

Table C.3. Regressions based on 1987–93 growth (with country dummies)

	Unconditional	Conditional					
		Direct effects	Total effects				
Constant	0.0738	0.0733	0.0677	0.0739	0.0911	0.0738	0.0717
	(4.266)	(3.225)	(3.290)	(4.264)	(4.496)	(4.252)	(4.109)
lgvapc[87]	0.0237	0.0282	0.0215	0.0253	0.0320	0.0237	0.0234
	(3.003)	(2.803)	(2.451)	(2.981)	(3.273)	(2.988)	(2.970)
luxdij		0.0156	0.0042				
		(1.709)	(0.552)				
es[75]		0.0113		0.0092			
		(0.574)		(0.550)			
ps[1]		-0.0136			-0.0098		
		(-1.992)			(-1.620)		
ps[2]		-0.0035				-0.0012	
		(-0.781)				(-0.287)	
border[93]		0.0030					0.0029
		(0.902)					(0.916)

Note: Figures in parentheses denote t-statistics.

Table C.4. Regressions based on 1975–87 growth (with country dummies)

	Unconditional	Conditional					
		Direct effects	Total effects				
Constant	0.0594	0.0656	0.0637	0.0593	0.0729	0.0577	0.0585
	(6.918)	(5.883)	(6.226)	(6.890)	(7.597)	(6.721)	(6.716)
lgvapc[75]	0.0187	0.0246	0.0206	0.0200	0.0267	0.0176	0.0186
	(3.971)	(4.081)	(3.810)	(3.916)	(4.577)	(3.777)	(3.930)
luxdij		0.0048	-0.0033				
		(0.951)	(-0.776)				
es[75]		0.0072		0.0068			
		(0.665)		(0.727)			
ps[1]		-0.0106			-0.0094		
		(-2.905)			(-2.898)		
ps[2]		-0.0056				-0.0044	
		(2.248)				(-1.831)	
border[93]		0.0007					0.0011
		(0.360)					(0.631)

Note: Figures in parentheses denote t-statistics.

Table C.5. Regression based on 1987–93 growth: maximum likelihood estimates (without country dummies)

Constant	0.03303 (5.279)	0.027033 (2.3913)
lgvapc[87]	0.00762 (2.642)	0.005731 (1.5233)
luxdij		0.000067 (0.0165)
es[75]		0.001817 (0.1810)
ps[1]		0.001283 (0.3296)
ps[2]		-0.002500 (-1.0259)
border[93]		0.004067 (2.1091)
hcap		-0.000133 (-0.1467)
error autoregression	0.70 (6.36)	0.57 (4.07)

Note: Figures in parentheses denote t-statistics.

Table C.6. Regression based on 1975–87 growth: maximum likelihood estimates (without country dummies)

Constant	0.04031 (7.090)	0.04307 (3.930)
lgvapc[75]	0.01117 (3.605)	0.01554 (3.766)
luxdij		-0.00145 (-0.335)
es[75]		0.01420 (1.483)
ps[1]		-0.00535 (-1.431)
ps[2]		-0.00622 (-2.716)
border[93]		0.00043 (0.225)
hcap		0.00098 (0.960)
error autoregression	0.75 (7.50)	0.73 (6.64)

Note: Figures in parentheses denote t-statistics.

Table C.7. Regression based on 1987–93 growth: maximum likelihood estimates (with country dummies)

Constant	0.03042 (3.545)	0.031283 (3.501)
lgvapc[87]	0.00497 (1.423)	0.008216 (2.296)
luxdij		0.009350 (3.005)
es[75]		0.009033 (1.211)
ps[1]		-0.007350 (-2.855)
ps[2]		-0.003500 (1.943)
border[93]		0.002000 (1.619)
error autoregression	-0.67 (-3.19)	-0.59 (-2.81)

Note: Figures in parentheses denote t-statistics.

Table C.8. Regression based on 1975–87 growth: maximum likelihood estimates (with country dummies)

Constant	0.04342 (6.217)	0.05693 (7.168)
lgvapc[75]	0.00982 (2.829)	0.01783 (4.355)
luxdij		0.00051 (0.149)
es[75]		0.00546 (0.707)
ps[1]		-0.01104 (-4.275)
ps[2]		-0.00587 (-3.205)
border[93]		-0.00016 (-0.121)
error autoregression	-0.19 (-0.90)	-0.30 (-1.43)

Note: Figures in parentheses denote t-statistics.

Table C.9. Regressions based on 1987–93 productivity growth (without country dummies) – agriculture

	Unconditional	Conditional						
		Direct effects	Total effects					
Constant	0.11135	0.06370	0.09694	0.10036	0.12138	0.11140	0.1107	0.11345
	(7.417)	(2.430)	(4.422)	(6.540)	(6.248)	(7.398)	(7.360)	(7.333)
lgvapc[87]	0.03566	0.03279	0.03099	0.04224	0.03987	0.03579	0.03638	0.03401
	(4.899)	(3.731)	(3.553)	(5.363)	(4.369)	(4.878)	(4.941)	(4.389)
luxdij		0.03198	0.00673					
		(2.884)	(0.903)					
es[75]		0.11663		0.08390				
		(3.021)		(2.609)				
ps[1]		-0.02437			-0.00745			
		(-1.768)			(-0.815)			
ps[2]		-0.00741				0.00196		
		(-0.741)				(0.199)		
border[93]		0.00628					0.00556	
		(0.914)					(0.866)	
hcap		-0.00261						-0.00130
		(-1.070)						(-0.582)

Note: Figures in parentheses denote t-statistics.

Table C.10. Regressions based on 1975–87 productivity growth (without country dummies) – agriculture

	Unconditional	Conditional						
		Direct effects	Total effects					
Constant	0.08762	0.10403	0.11314	0.08380	0.10543	0.08762	0.08609	0.07747
	(13.698)	(7.848)	(12.257)	(11.533)	(13.415)	(13.657)	(13.320)	(10.804)
lgvapc[75]	0.02380	0.03554	0.03429	0.02549	0.03383	0.02377	0.02419	0.02761
	(5.632)	(6.280)	(6.220)	(5.568)	(6.215)	(5.574)	(5.705)	(6.092)
luxdij		-0.00695	-0.01554					
		(-1.054)	(-3.714)					
es[75]		-0.02836		0.2186				
		(-1.238)		(1.107)				
ps[1]		-0.01081			-0.01879			
		(-1.328)			(-3.660)			
ps[2]		-0.00322				-0.00033		
		(-0.541)				(-0.056)		
border[93]		0.00590					0.00554	
		(1.443)					(1.448)	
hcap		0.00313						0.00372
		(2.177)						(2.902)

Note: Figures in parentheses denote t-statistics.

Table C.11. Regressions based on 1987–93 productivity growth (with country dummies) – agriculture

	Unconditional	Conditional					
		Direct effects	Total effects				
Constant	0.05627	0.03702	0.06231	0.03835	0.06215	0.05540	0.05585
	(2.775)	(1.575)	(2.943)	(1.844)	(3.008)	(2.730)	(2.745)
lgvapc[87]	0.00961	0.01672	0.01039	0.01584	0.01215	0.00948	0.01008
	(1.164)	(1.851)	(1.247)	(1.826)	(1.419)	(1.148)	(1.204)
luxdij		0.00967	-0.01386				
		(0.534)	(-0.990)				
es[75]		0.09475		0.09180			
		(2.408)		(2.853)			
ps[1]		-0.00821			-0.01471		
		(-0.629)			(-1.373)		
ps[2]		0.00011				0.00843	
		(-0.012)				(0.975)	
border[93]		-0.00133					0.00290
		(-0.199)					(0.488)

Note: Figures in parentheses denote t-statistics.

Table C.12. Regressions based on 1975–87 productivity growth (with country dummies) – agriculture

	Unconditional	Conditional					
		Direct effects	Total effects				
Constant	0.10434	0.09570	0.10263	0.10202	0.10600	0.10441	0.10407
	(11.868)	(7.977)	(10.635)	(10.375)	(11.756)	(11.854)	(11.753)
lgvapc[75]	0.03967	0.04277	0.03920	0.04085	0.04104	0.03956	0.04000
	(6.092)	(5.874)	(5.955)	(5.848)	(6.014)	(6.070)	(6.034)
luxdij		0.01531	0.00368				
		(1.400)	(0.434)				
es[75]		0.02057		0.01067			
		(0.855)		(0.531)			
ps[1]		-0.01028			-0.00547		
		(-1.304)			(-0.845)		
ps[2]		-0.00589				-0.00336	
		(-1.066)				(0.650)	
border[93]		0.00165					0.00129
		(0.407)					(0.332)

Note: Figures in parentheses denote t-statistics.

Table C.13. Regressions based on 1987–93 productivity growth (without country dummies) – manufacturing

	Unconditional	Conditional						
		Direct effects	**Total effects**					
Constant	0.02468	-0.03188	0.02998	0.02017	0.05235	0.02866	0.02246	0.02152
	(1.249)	(-1.009)	(1.048)	(1.052)	(2.173)	(1.426)	(1.139)	(1.131)
lgvapc[87]	0.00062	-0.00170	0.00190	0.00565	0.00823	0.00206	-0.00080	0.00655
	(0.107)	(-0.231)	(0.246)	(0.942)	(1.140)	(0.342)	(-0.138)	(1.087)
luxdij		0.01709	-0.00140					
		(2.133)	(-0.257)					
es[75]		0.07834		0.07399				
		(2.976)		(3.498)				
ps[1]		-0.07834			-0.01197			
		(-0.855)			(-1.974)			
ps[2]		-0.00248				0.00738		
		(-0.362)				(1.072)		
border[93]		-0.00387					-0.00689	
		(-0.845)					(-1.565)	
hcap		0.00414						0.00544
		(2.568)						(3.834)

Note: Figures in parentheses denote t-statistics.

Table C.14. Regressions based on 1975–87 productivity growth (without country dummies) – manufacturing

	Unconditional	Conditional						
		Direct effects	**Total effects**					
Constant	0.12690	0.18543	0.17731	0.12419	0.14903	0.12915	0.12549	0.12498
	(11.462)	(8.950)	(10.857)	(11.065)	(10.378)	(11.779)	(11.451)	(11.195)
lgvapc[75]	0.03911	0.06552	0.06302	0.04107	0.05042	0.04106	0.03983	0.04118
	(6.635)	(5.984)	(6.207)	(6.629)	(6.009)	(6.830)	(6.769)	(6.571)
luxdij		-0.01878	-0.01627					
		(-3.096)	(-4.055)					
es[75]		-0.02932		0.02206				
		(-1.470)		(1.354)				
ps[1]		0.00215			-0.01132			
		(0.311)			(-2.373)			
ps[2]		0.01278				0.01181		
		(2.519)				(2.360)		
border[93]		0.00362					0.00725	
		(1.038)					(2.240)	
hcap		0.00054						0.00137
		(0.442)						(1.234)

Note: Figures in parentheses denote t-statistics.

Table C.15. Regressions based on 1987–93 productivity growth (with country dummies) – manufacturing

	Unconditional	Conditional					
		Direct effects	Total effects				
Constant	0.07861 (2.539)	0.06376 (1.919)	0.08362 (2.751)	0.05418 (1.747)	0.07901 (2.571)	0.08466 (2.681)	0.07862 (2.535)
lgvapc[87]	0.02088 (2.042)	0.01985 (1.940)	0.02020 (2.023)	0.01998 (2.022	0.02102 (2.069)	0.02302 (2.173)	0.02135 (2.074)
luxdij		-0.01455 (-1.319)	-0.02319 (-2.729)				
es[75]		0.04826 (2.039)		0.06189 (3.223)			
ps[1]		0.00036 (0.046)			-0.01184 (-1.830)		
ps[2]		0.00095 (0.167)				0.00534 (0.971)	
border[93]		-0.00159 (-0.388)					0.00273 (0.681)

Note: Figures in parentheses denote t-statistics.

Table C.16. Regressions based on 1975–87 productivity growth (with country dummies) – manufacturing

	Unconditional	Conditional					
		Direct effects	Total effects				
Constant	0.19571 (14.567)	0.18984 (11.134)	0.19359 (14.127)	0.19097 (12.671)	0.19504 (14.421)	0.19852 (14.904)	0.19346 (14.285)
lgvapc[75]	0.09340 (7.474)	0.09337 (7.160)	0.09272 (7.455)	0.09197 (7.374)	0.09278 (7.430)	0.09660 (7.489)	0.09282 (7.485)
luxdij		0.00609 (0.828)	0.00457 (0.806)				
es[75]		0.00538 (0.332)		0.00914 (0.698)			
ps[1]		0.00208 (0.397)			0.00227 (0.531)		
ps[2]		0.00726 (1.936)				0.00787 (2.261)	
border[93]		0.00314 (1.160)					0.00315 (1.213)

Note: Figures in parentheses denote t-statistics.

Table C.17. Regressions based on 1987–93 productivity growth (without country dummies) – construction

	Unconditional	Conditional						
		Direct effects	Total effects					
Constant	-0.02402 (-1.159)	-0.01264 (-0.340)	-0.01207 (0.371)	-0.02374 (-1.141)	-0.00854 (-0.294)	-0.02418 (-1.157)	-0.02431 (-1.165)	-0.02290 (-1.099)
lgvapc[87]	-0.01445 (-2.327)	-0.00999 (-1.0389)	-0.01153 (-1.305)	-0.01364 (-2.007)	-0.01013 (-1.182)	-0.01452 (-2.307)	-0.01444 (-2.318)	-0.0126 (-1.818)
luxdij		0.00093 (0.093)	-0.00328 (-0.478)					
es[75]		-0.00251 (-0.076)		0.00840 (0.308)				
ps[1]		-0.00595 (-0.507)			-0.00623 (-0.763)			
ps[2]		-0.00177 (-0.207)				-0.00060 (-0.074)		
border[93]		0.00127 (0.213)					0.00087 (0.168)	
hcap		0.00102 (0.492)						0.00118 (0.636)

Note: Figures in parentheses denote t-statistics.

Table C.18. Regressions based on 1975–87 productivity growth (without country dummies) – construction

	Unconditional	Conditional						
		Direct effects	Total effects					
Constant	0.10947 (11.230)	0.15241 (10.053)	0.16945 (14.064)	0.09861 (10.450)	0.15294 (14.580)	0.11008 (11.305)	0.10956 (11.147)	0.09594 (10.463)
lgvapc[75]	0.04280 (7.676)	0.07402 (8.547)	0.07243 (8.410)	0.04870 (8.444)	0.06787 (8.740)	0.04358) (7.718)	0.04279 (7.650)	0.04925 (8.788)
luxdij		-0.01416 (-2.785)	-0.02342 (-7.081)					
es[75]		0.01277 (0.750)		0.07230 (4.802)				
ps[1]		-0.00899 (-1.504)			-0.02788 (-7.161)			
ps[2]		0.00047 (0.106)				0.00658 (1.326)		
border[93]		-0.00400 (-1.314)					-0.00028 (-0.088)	
hcap		0.00287 (2.702)						0.00580 (5.933)

Note: Figures in parentheses denote t-statistics.

Table C.19. Regressions based on 1987–93 productivity growth (with country dummies) – construction

	Unconditional	Conditional					
		Direct effects	Total effects				
Constant	0.05457 (1.060)	0.06951 (1.175)	0.05804 (1.007)	0.05400 (1.047)	0.06707 (1.257)	0.05464 (1.058)	0.05404 (1.043)
lgvapc[87]	0.00755 (0.439)	0.00905 (0.474)	0.00854 (0.454)	0.00507 (0.292)	0.01181 (0.645)	0.00754 (0.437)	0.00724 (0.417)
luxdij		0.00165 (0.098)	-0.00182 (-0.136)				
es[75]		-0.03161 (-0.910)		-0.01961 (-0.679)			
ps[1]		-0.01308 (-1.124)			-0.00868 (-0.901)		
ps[2]		-0.00052 (-0.064)				-0.00181 (-0.236)	
border[93]		0.00019 (0.032)					-0.0081 (-0.141)

Note: Figures in parentheses denote t-statistics.

Table C.20. Regressions based on 1975–87 productivity growth (with country dummies) – construction

	Unconditional	Conditional					
		Direct effects	Total effects				
Constant	0.23297 (21.155)	0.24173 (19.631)	0.24649 (23.224)	0.22190 (19.275)	0.23605 (21.975)	0.23296 (21.083)	0.23102 (20.976)
lgvapc[75]	0.18678 (5.518)	0.20795 (5.004)	0.21018 (4.992)	0.18539 (5.686)	0.19704 (5.277)	0.18678 (5.501)	0.18672 (5.552)
luxdij		-0.01908 (-3.142)	-0.02299 (-4.974)				
es[75]		0.00712 (0.552)		0.03029 (2.755)			
ps[1]		-0.00255 (-0.591)			-0.01158 (-3.208)		
ps[2]		-0.00130 (-0.428)				0.00013 (0.042)	
border[93]		0.00118 (0.529)					0.00374 (1.664)

Note: Figures in parentheses denote t-statistics.

Table C.21. Regressions based on 1987–93 productivity growth (without country dummies) – market services

	Unconditional	Conditional						
		Direct effects	Total effects					
Constant	-0.02697 (-1.505)	0.03222 (0.758)	-0.03180 (-0.901)	-0.02944 (-1.639)	-0.05224 (-1.956)	-0.02747 (-1.531)	-0.03172 (-1.765)	-0.02261 (-1.264)
lgvapc[87]	-0.01024 (-2.050)	-0.00277 (-0.277)	-0.01140 (-1.298)	-0.01302 (-2.464)	-0.01672 (-2.417)	-0.01053 (-2.106)	-0.01229 (-2.449)	-0.01183 (-2.383)
luxdij		-0.01623 (-2.052)	0.00096 (0.159)					
es[75]		-0.00999 (-0.451)		-0.02623 (-1.395)				
ps[1]		0.00632 (0.784)			0.00776 (1.274)			
ps[2]		-0.00091 (-0.159)				-0.00479 (-0.863)		
border[93]		-0.01081 (-2.744)					-0.00686 (-1.870)	
hcap		-0.00375 (-2.511)						-0.00240 (2.039)

Note: Figures in parentheses denote t-statistics.

Table C.22. Regressions based on 1975–87 productivity growth (without country dummies) – market services

	Unconditional	Conditional						
		Direct effects	Total effects					
Constant	0.08569 (8.600)	0.20751 (12.885)	0.18053 (14.230)	0.08524 (8.706)	0.13875 (12.719)	0.08575 (8.580)	0.08554 (8.431)	0.07531 (7.443)
lgvapc[75]	0.02582 (6.078)	0.07719 (8.004)	0.06774 (8.481)	0.02966 (6.425)	0.04947 (8.288)	0.02590 (6.058)	0.02573 (5.381)	0.02607 (6.311)
luxdij		-0.02333 (-6.059)	-0.02503 (-9.641)					
es[75]		-0.01516 (-1.228)		0.03206 (2.645)				
ps[1]		-0.01238 (-2.957)			-0.02337 (-7.822)			
ps[2]		-0.00167 (-0.548)				0.00091 (0.245)		
border[93]		-0.00259 (-1.234)					-0.00021 (-0.084)	
hcap		-0.00178 (-2.195)						0.00262 (3.438)

Note: Figures in parentheses denote t-statistics.

Table C.23. Regressions based on 1987–93 productivity growth (with country dummies) – market services

	Unconditional	Conditional					
		Direct effects	Total effects				
Constant	0.11469	0.12451	0.11910	0.11119	0.11301	0.11540	0.11488
	(3.022)	(2.910)	(2.928)	(2.913)	(2.699)	(3.032)	(3.023)
lgvapc[87]	0.02795	0.02800	0.02912	0.02484	0.02731	0.02802	0.02735
	(2.236)	(2.008)	(2.199)	(1.974)	(1.991)	(2.240)	(2.196)
luxdij		-0.00707	-0.00199				
		(-0.833)	(-0.293)				
es[75]		-0.01574		-0.01641			
		(-0.868)		(-1.086)			
ps[1]		0.00053			0.00061		
		(0.083)			(0.113)		
ps[2]		-0.00215				-0.00374	
		(-0.503)				(-0.934)	
border[93]		-0.00308					-0.00339
		(-0.980)					(-1.142)

Note: Figures in parentheses denote t-statistics.

Table C.24. Regressions based on 1975–87 productivity growth (with country dummies) – market services

	Unconditional	Conditional					
		Direct effects	Total effects				
Constant	0.21004	0.22381	0.22014	0.21103	0.22154	0.21004	0.21002
	(15.875)	(17.562)	(16.785)	(15.983)	(17.718)	(15.825)	(15.841)
lgvapc[75]	0.09538	0.10613	0.10160	0.10046	0.10690	0.09536	0.09531
	(7.756)	(7.752)	(7.850)	(7.429)	(8.008)	(7.731)	(7.695)
luxdij		-0.00470	-0.01213				
		(-1.0740)	(-3.464)				
es[75]		-0.00250		0.01220			
		(-0.262)		(1.443)			
ps[1]		-0.01162			-0.01290		
		(-3.705)			(-5.063)		
ps[2]		-0.00122				-0.00032	
		(-0.553)				(-0.145)	
border[93]		-0.00117					-0.00010
		(-0.723)					(-0.060)

Note: Figures in parentheses denote t-statistics.

Table C.25. Regressions based on 1987–93 productivity growth (without country dummies) – non-market services

	Unconditional	Conditional						
		Direct effects	Total effects					
Constant	-0.06865	-0.05671	-0.07848	-0.06748	-0.08345	-0.06860	-0.6883	-0.06176
	(-5.659)	(-2.740)	(-4.661)	(-5.588)	(-5.660)	(-5.680)	(-5.657)	(-5.045)
lgvapc[87]	-0.02301	-0.02374	-0.02540	-0.02496	-0.02710	-0.02325	-0.02290	-0.02402
	(-6.104)	(-4.856)	(-5.446)	(-6.460)	(-6.261)	(-6.199)	(-6.046)	(-6.479)
luxdij		-0.00459	0.00296					
		(-0.825)	(0.842)					
es[75]		-0.01115		-0.02602				
		(-0.609)		(-1.754)				
ps[1]		0.00455			0.00710			
		(0.701)			(1.744)			
ps[2]		-0.00434				-0.00718		
		(-0.913)				(-1.591)		
border[93]		0.00014					0.00137	
		(0.041)					(0.463)	
hcap		-0.00199						-0.00242
		(-1.680)						(-2.547)

Note: Figures in parentheses denote t-statistics.

Table C.26. Regressions based on 1975–87 productivity growth (without country dummies) – non-market services

	Unconditional	Conditional						
		Direct effects	Total effects					
Constant	0.09195	0.14200	0.11854	0.09160	0.10806	0.09190	0.09178	0.09210
	(11.850)	(11.134)	(11.236)	(11.672)	(11.744)	(11.808)	(11.846)	(11.282)
lgvapc[75]	0.04175	0.05688	0.05401	0.04230	0.05042	0.04180	0.04095	0.04172
	(9.161)	(8.748)	(8.579)	(8.669)	(8.757)	(9.131)	(8.989)	(9.044)
luxdij		-0.01304	-0.01027					
		(-2.931)	(-3.583)					
es[75]		-0.01381		0.00445				
		(-0.919)		(0.340)				
ps[1]		-0.00572			-0.01043			
		(-1.079)			(-3.080)			
ps[2]		0.00123				0.00104		
		(0.316)				(0.266)		
border[93]		-0.00695					-0.00316	
		(-2.598)					(-1.237)	
hcap		-0.00231						-0.00005
		(-2.419)						(-0.059)

Note: Figures in parentheses denote t-statistics.

Table C.27. Regressions based on 1987–93 productivity growth (with country dummies) – non-market services

	Unconditional	Conditional					
		Direct effects	Total effects				
Constant	0.08938	0.10081	0.08928	0.09572	0.8918	0.9150	0.09401
	(2.657)	(2.969)	(2.645)	(2.837)	(2.638)	(2.735)	(2.812)
lgvapc[87]	0.02819	0.02950	0.02823	0.02813	0.02811	0.02888	0.02907
	(2.146)	(2.231)	(2.141)	(2.152)	(2.131)	(2.202)	(2.219)
luxdij		-0.00328	0.00068				
		(-0.479)	(0.128)				
es[75]		-0.01352		-0.01853			
		(-0.929)		(-1.547)			
ps[1]		-0.00140			0.00043		
		(-0.286)			(0.107)		
ps[2]		-0.00411				-0.00553	
		(-1.191)				(-1.700)	
border[93]		-0.00406					-0.00464
		(-1.604)					(-1.928)

Note: Figures in parentheses denote t-statistics.

Table C.28. Regressions based on 1975–87 productivity growth (with country dummies) – non-market services

	Unconditional	Conditional					
		Direct effects	Total effects				
Constant	0.20369	0.20265	0.20337	0.20411	0.20326	0.20372	0.20401
	(21.511)	(20.310)	(21.311)	(21.088)	(21.443)	(21.371)	(21.438)
lgvapc[75]	0.13791	0.13634	0.13789	0.13772	0.13718	0.13797	0.13789
	(8.545)	(8.467)	(8.521)	(8.515)	(8.565)	(8.493)	(8.524)
luxdij		0.00342	0.00100				
		(0.887)	(0.339)				
es[75]		-0.00189		-0.00153			
		(-0.229)		(-0.227)			
ps[1]		-0.00405			-0.00221		
		(-1.466)			(-1.000)		
ps[2]		-0.00018				-0.00009	
		(-0.095)				(-0.048)	
border[93]		-0.00049					-0.00065
		(-0.341)					(-0.482)

Note: Figures in parentheses denote t-statistics.

Table C.29. Summary of productivity transitions by sector using Markov chain analysis

Sector	Period	Start probabilities				Equilibrium probabilities				Half-life
		1	2	3	4	1	2	3	4	
Agriculture	1987-93	0.33	0.20	0.24	0.24	0.19	0.21	0.29	0.32	17.6
	1975-87	0.35	0.18	0.23	0.24	0.28	0.21	0.26	0.26	30.3
Manufacturing	1987-93	0.13	0.40	0.34	0.13	0.25	0.26	0.35	0.15	76.2
	1975-87	0.21	0.34	0.27	0.18	0.03	0.48	0.39	0.10	13.9
Construction	1987-93	0.15	0.27	0.44	0.14	0.20	0.40	0.36	0.04	13.8
	1975-87	0.18	0.42	0.26	0.14	0.08	0.26	0.49	0.16	20.8
Market services	1987-93	0.14	0.33	0.38	0.16	0.08	0.04	0.57	0.31	158.9
	1975-87	0.14	0.36	0.35	0.16	0.13	0.28	0.41	0.19	35.3
Non-market services	1987-93	0.18	0.28	0.34	0.20	0.00	0.27	0.28	0.44	135.5
	1975-87	0.14	0.28	0.39	0.19	0.64	0.16	0.13	0.07	79.0

Table C.30. Regressions based on 1987–93 employment growth: OLS estimates

Without country dummies

Constant	-0.01972 (-2.79)	-0.01421 (-1.72)
lemppc	0.02364 (2.80)	0.00406 (0.57)
luxdij		0.00502 (1.64)
es		-0.00198 (-0.18)
ps[1]		-0.00656 (-1.67)
ps[2]		0.00173 (0.59)
border		0.00177 (0.83)
hcap		0.00089 (1.27)
partrg		0.09619 (8.62)
gvapcgr		0.05279 (3.70)

With country dummies

Constant	-0.01801 (-2.88)	-0.02347 (-3.24)
lemppc	0.01857 (2.82)	0.01127 (1.43)
luxdij		0.01361 (2.75)
es		0.00617 (0.60)
ps[1]		-0.01012 (-2.84)
ps[2]		-0.00032 (-0.12)
border		0.00167 (0.90)
partrg		0.05372 (4.66)
gvapcgr		0.04766 (3.48)

Note: Figures in parentheses denote t-statistics.

Table C.31. Regressions based on 1975–87 employment growth: OLS estimates

Without country dummies

Constant	-0.02965 (-5.89)	-0.03196 (-5.51)
lemppc	0.03688 (4.45)	0.04193 (5.84)
luxdij		-0.00564 (-2.56)
es		0.00790 (1.01)
ps[1]		-0.00678 (-2.45)
ps[2]		-0.00437 (-2.12)
border		-0.00509 (-3.65)
hcap		-0.00037 (-0.76)
partrg		0.00818 (2.48)
gvapcgr		0.02584 (5.17)

With country dummies

Constant	-0.02758 (-6.75)	-0.03193 (-6.90)
lemppc	0.05051 (6.37)	0.05287 (6.92)
luxdij		-0.00638 (-1.88)
es		-0.00141 (-0.19)
ps[1]		-0.00592 (-2.42)
ps[2]		-0.00309 (-1.79)
border		-0.00239 (-1.93)
partrg		0.00598 (2.03)
gvapcgr		0.02401 (4.39)

Note: Figures in parentheses denote t-statistics.

Table C.32. Regressions based on 1987–93 employment growth: OLS estimates

	luxdij	es	ps[1]	ps[2]	border	hcap	partrg	gvapcgr
Without country dummies								
lemppc	0.0283	0.0268	0.0331	0.0235	0.0195	0.0291	0.0038	0.0149
t ratio	(3.03)	(2.99)	(3.33)	(2.78)	(2.39)	(3.26)	(0.64)	(1.96)
total effect	-0.0032	0.1461	-0.0065	0.0005	0.0064	0.0017	0.1117	0.0856
t ratio	(-1.34)	(1.24)	(-2.14)	(0.15)	(2.80)	(2.25)	(10.63)	(5.19)
With country dummies								
lemppc	0.0157	0.0188	0.025	0.0187	0.0173	*	0.0102	0.0181
t ratio	(1.80)	(2.30)	(2.79)	(2.28)	(2.14)		(1.38)	(2.34)
total effect	0.0054	0.0040	-0.0068	-0.0005	0.0027	*	0.0595	0.0594
t ratio	(1.22)	(0.41)	(-2.05)	(-0.20)	(1.43)		(4.94)	(4.05)

Table C.33. Regressions based on 1975–87 employment growth: OLS estimates

	luxdij	es	ps[1]	ps[2]	border	hcap	partrg	gvapcgr
Without country dummies								
lemppc	0.0392	0.0414	0.0452	0.0367	0.0386	0.0414	0.0330	0.0348
t ratio	(5.12)	(4.81)	(5.49)	(4.46)	(4.53)	(4.72)	(4.15)	(4.60)
total effect	-0.0089	0.0261	-0.0115	0.0037	-0.0022	0.0014	0.0099	0.0296
t ratio	(-6.44)	(3.38)	(-6.77)	(-1.50)	(-1.39)	(2.65)	(2.35)	(4.97)
With country dummies								
lemppc	0.0564	0.0509	0.0572	0.0498	0.0510	*	0.0454	0.0478
t ratio	(6.61)	(6.36)	(6.79)	(6.45)	(6.39)		(5.85)	(6.79)
total effect	-0.0089	0.0047	-0.0084	-0.0045	-0.0013	*	0.0068	0.0305
t ratio	(-3.02)	(0.71)	(-3.88)	(-2.52)	(-1.00)		(2.06)	(5.57)

Table C.34. Regressions based on 1987–93 growth (without country dummies)

	All regions				Ob1 regions	
	Direct effects	Total effects	Direct effects	Total effects	Direct effects	Total effects
Constant	0.029714 (2.61)	0.02980 (3.55)	0.029775 (2.60)	0.02999 (3.55)	0.03658 (1.09)	0.0333 (1.65)
lgvapc[87]	0.006752 (1.65)	0.00637 (1.73)	0.006745 (1.64)	0.00644 (1.74)	0.00727 (0.58)	0.00846 (0.98)
luxdij	-0.000990 (-0.29)		-0.000929 (-0.27)		-0.00895 (-0.80)	
es[75]	0.006670 (0.65)		0.006547 (0.63)		0.00247 (0.08)	
ob1_ecu	-0.001705 (-0.26)	-0.00317 (-0.54)	-0.000873 (-0.09)	-0.00073 (-0.07)	-0.00027 (-0.02)	-0.00426 (-0.24)
ps[1]			-0.000651 (-0.11)	-0.00168 (-0.28)		
ps[2]	-0.003315 (-1.23)		-0.003318 (-1.23)			
border[93]	0.005716 (2.97)		0.005711 (2.95)		0.01557 (2.02)	
hcap	-0.000550 (-0.85)		-0.000562 (-0.85)		0.00054 (0.18)	

Table C.35. Regressions based on 1987–93 growth (with country dummies)

	All regions				Ob1 regions	
	Direct effects	Total effects	Direct effects	Total effects	Direct effects	Total effects
Constant	0.026763 (2.27)	0.03378 (3.15)	0.027424 (2.33)	0.03499 (3.23)	0.03684 (1.10)	0.04743 (2.40)
lgvapc[87]	0.005761 (1.26)	0.00680 (1.54)	0.006318 (1.37)	0.00731 (1.63)	0.01817 (0.96)	0.01810 (1.42)
luxdij	0.006015 (1.30)		0.007529 (1.57)		0.01139 (0.95)	
es[75]	0.005305 (0.51)		0.005982 (0.58)		-0.01205 (-0.30)	
ob1_ecu	-0.007427 (-1.00)	-0.00487 (-0.73)	0.006270 (0.45)	0.00452 (0.38)	0.00184 (0.09)	0.00296 (0.15)
ps[1]			-0.00797 (-1.16)	-0.00512 (-0.77)		
ps[2]	-0.002633 (-1.10)		-0.002815 (-1.17)			
border[93]	0.001917 (1.07)		0.001907 (1.07)		-0.00589 (-0.69)	

Table C.36. List of variables used in the Member State regressions

Explanatory variables	
Conditional beta-convergence	
Constant	
pogvapc	(log) starting level of GVA per capita in 1985 ECU prices
accel	Acceleration term = poim * pogvapc
poedu	Percentage of graduates in the whole population
poavlab	Change in labour force participation rate
poinv	Investment to output ratio
porsd	R&D spending to output ratio
poaveu	Dummy for joining the EU
poim	Dummy for SMP period (1 from 1987–93)
sspa	Dummy for Objective 1 part of Spain
intsspa	poim * sspa
sita	Dummy for Objective 1 part of Italy
intsita	poim * sita
poire	Dummy for Ireland
intire	poim * poire
poob1	Dummy for Objective 1 countries
intob1	poim * poob1
Unconditional beta-convergence	
gvapc	(log) starting level of GVA per capita in 1985 prices
sita	Dummy for Objective 1 part of Italy
spa	Dummy for Objective 1 part of Spain
ire	Dummy for Ireland
aveu	Dummy for joining the EU
Ob1	Dummy for Objective 1 countries

Table C.37. List of variables used in the regional regressions

Explanatory variables	
Constant	
lgvapc	(log) starting level of GVA per capita
luxdij	Distance from Luxembourg
es	Manufacturing share of total employment
ps[1]	Dummy for Objective 1 regions
ps[2]	Dummy for Objective 2 regions
border	Dummy for border regions
hcap	Percentage of graduates in the whole population
lemppc	(log) starting level of employment rate
portrg	Participation rate growth
gvapcgr	GVA per capita growth

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The Single Market Review

SUBSERIES VI AGGREGATE AND REGIONAL IMPACT

Volume 1 Regional growth and convergence

EUROPE

This report has been written as part of a major review of the Single Market undertaken by the European Commission. The 1996 Single Market Review assesses the progress made in implementing the Single Market Programme since 1992, through a series of 39 separate reports on specific business sectors or single market issues. This research amounts to the first extensive analysis of what has been happening to the European economy as a result of the Single Market Programme.

Written by leading subject experts under the coordination of the Directorates-General 'Internal Market and Financial Services' (DG XV) and 'Economic and Financial Affairs' (DG II) of the European Commission, this Review provides essential information to all those worldwide who are interested or involved in the development of the Single Market. It also gives invaluable insight into specific industry sectors for investors, analysts and corporate strategists.

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