CONTRIBUTIONS TO ECONOMICS

Sascha Sardadvar

Economic Growth in the Regions of Europe

Theory and Empirical Evidence from a Spatial Growth Model

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Preface

This book is based on the doctoral thesis of the same title, which was completed in April 2009. The study was inspired by the emphasis the European Union puts on its various regions in general, and on the issues of regional development and convergence in particular. Despite growing interest regarding regional economies, theoretical approaches to modelling regional growth appeared unsatisfactory and have motivated the approach adopted in the study. The work could not have been done without encouragement and support from first advisor Manfred M. Fischer, as well as constructive suggestions and valuable advice from second advisor Ingrid Kubin, to both of whom the author owes a debt of gratitude. Technical assistance throughout the time of developing was provided by Monika Bartkowska, Judith Kast-Aigner, Aleksandra Riedl, Petra Staufer-Steinnocher and Anita Wolfartsberger, whose help is greatly appreciated by the author. Special thanks for valuable comments go out to Roger Bivand, Gerlinde Fellner, Wolfgang Fellner, Alexia Fürnkranz-Prskawetz, James LeSage, Thomas Scherngell and Achim Zeileis. Furthermore, the author would like to thank Meaghan Burke for proofreading, and Barbara Feß for editing.

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Chapter 1
Introduction

Some decrease, others persist or even widen: regional disparities continue to constitute one of the major challenges for European economic policy. The accession of twelve countries to the European Union (EU) on May 1, 2004 and January 1, 2007 has led to two major statistical effects, namely a decrease in the gross domestic product (GDP) per capita of the European Union, and an increase in the gap between the most and the least developed regions. The relative importance of structural policy is reflected in the financial allocation in the current financial framework for 2007–2013: of a total budget of 864 billion euros (price-level of 2004), 308 billion euros are set aside for cohesion policy (European Council 2006, Article 19). Of these, 251 billion euros (European Council 2006, Article 19) are provided to "promote growth-enhancing conditions and factors leading to real Convergence for the least-developed Member States and regions" (European Commission 2006, p. 2, upper cases in the original), of which 153 billion euros are destined for the twelve new member states and their regions (European Commission 2006, p. 3).

The origins of assistance for less developed regions lie in the *Treaty of Rome* (Treaty Establishing the European Economic Community, EEC Treaty), based on which the European Investment Bank was established in order to "facilitate the financing of (...) projects for developing less developed regions" (European Economic Community 1957, Article 130). Back in those days, however, the European Community (EC) of then six member states was relatively evenly developed, with the exception of the less productive Southern Italian regions. The situation changed when the United Kingdom and the Republic of Ireland joined the EC in 1973, which led to a significant increase in regional disparities. Nevertheless, despite the Treaty of Rome's declaration, it was not until 1975 that the European Regional Development Fund was created, since an effective policy on regional structures was seen as "an essential prerequisite to the realization of economic and monetary union" (European Council 1975). The fund's assistance was set to be allocated according to the relative severity of regional imbalances. Regional disparities in the European Community increased again with the accession of Greece in 1981 and that of Portugal and Spain in 1986. These countries, together with the Republic of Ireland forming the so-called cohesion countries, henceforth benefited from substantial financial support.

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As a consequence of these steps toward horizontal integration, the EC as of 1986 consisted of 12 member states, twice as many as when it was founded. A major step toward vertical integration followed the same year with the Single European Act, which defines the internal market (nowadays referred to as *European Single Market*) as "an area without internal frontiers in which the free movement of goods, persons, services and capital is ensured in accordance with the provisions of this Treaty" (European Communities 1987, Article 13, upper case in the original), which had to be established by December 31, 1992. The same treaty declares *convergence* as an objective of the Community, by adding the title "Economic and Social Cohesion" to the EEC Treaty (European Communities 1987, Article 23):

> In order to promote its overall harmonious development, the Community shall develop and pursue its actions leading to the strengthening of its economic and social cohesion.
>
> In particular, the Community shall aim at reducing disparities between the levels of development of the various regions and the backwardness of the least favoured regions or islands, including rural areas.

Although not made explicit in the Single European Act, it is commonly understood that the simultaneous strengthening of cohesion policy was intended to counterbalance negative effects that the completion of the internal market could have on some countries and regions. Such risks of "aggravated imbalances in the course of market liberalisation" were seen to be best alleviated by "adequate accompanying measures to speed up adjustments in structurally weak regions and countries" (European Commission 2008, p. 9). The respective added article of the EEC treaty reads (European Communities 1987, Article 23):

> The European Regional Development Fund is intended to help redress the principal regional imbalances in the Community through participating in the development and structural adjustment of regions whose development is lagging behind and in the conversion of declining industrial regions.

In 1989, the European Regional Development Fund was brought together with the European Social Fund and the Guidance Section of the European Agricultural Guidance and Guarantee Fund to form the Structural Funds. The period 1989–1993 saw almost a doubling of cohesion policy's relative share of the EU budget, from 16% in 1988 to over 30% in 1993, which means that the financial allocations to the Structural Funds reached 20.5 billion ECU in 1993 (price-level of 1993) (European Commission 2008). Since then, regional policy of the European Community has still grown in volume. Despite its sizeable funding, the main principle of the policies of the European Union still aims at allowing economic mechanisms to function as reflected in the *Treaty on European Union* (Maastricht Treaty), which allows for free factor movement.

Considering primarily international disparities, the importance of understanding economic growth was poignantly formulated by Robert E. Lucas Jr. (1988, p. 5), when he commented that "the consequences for human welfare (...) are simply staggering: once one starts to think about them, it is hard to think about anything else". Although economic growth has been investigated by economists for generations, there is still disagreement about its underlying causes (Armstrong and Taylor

2000, p. 65). Neoclassical growth theory has been proven to be able to explain a number of phenomena of national economies' growth, but problems arise when one tries to translate these to regional economies. The usual assumption of closed economies and abstraction from interaction have so far placed serious limits on the explanation power with respect to regional growth.

At least since the introduction of cohesion policy, convergence between the European Union's economic entities has been observed on the whole. Yet within the EU's member states, disparities tend to persist or even increase. In recent years, new economic geography has provided formal analyses of how regional disparities may emerge as an equilibrium outcome, for instance as a consequence of lowered trade barriers. Models in the spirit of Paul Krugman's (1991a and 1991b) core-periphery model help expand the understanding of mechanisms of interrelated regions' development, but are less successful regarding prospects of growth and long term development. Fingleton (2003, p. 25) notes that "in essence the theory is primarily an exercise in formal, deductive modelling, in which mathematical tricks are employed to allow a neat, general equilibrium solution rather than because they are necessarily realistic."

Probably due to the aforementioned limitations, conventional neoclassical theory so far provides only limited explanatory power for issues of regional growth; in particular, it fails to explain how empirically both divergence and convergence processes are observed at the same time, depending on the choice of spatial aggregation or observation area. This study acknowledges the role of space that is emphasised in new economic geography by developing a strictly neoclassical model of regional growth, where the development of one region is dependent on the development of others, and vice versa. Regions are defined for purposes of this study as economically open, politically interdependent and spatially connected economies that jointly form a superordinate economic system. The *research objective of the study* is thus to develop a neoclassical model of regional growth with spatial dependence, to transform the theoretical model into a spatial econometric specification and to test the model empirically for European regions.

Mankiw, Romer and Weil (1992) have improved the explanation of variation of output of various economies by enhancing Robert Solow's (1956, 1957) contribution to growth theory with the inclusion of human capital. This study builds on the Mankiw-Romer-Weil model by enhancing it for the possibility of factor movement, in particular of choice of location for gross fixed capital formations. These investment decisions are assumed to be based on expected rates of return, but the investor's information is limited to neighbouring regions, and hence his operating range is spatially bounded. Expected rates of return depend on current marginal productivity of physical capital, which in turn is a function of the current endowment with production factors. Output growth of one region is dependent on the evolution of its endowment with production factors, which is in turn influenced by its own as well as its neighbours' factor endowments. These interdependencies result in a system of N connected economies, where the development of the superordinate economic system is of interest in its own right. In equilibrium, all regions are at their identical steady states of factors and output, but during transition periods both convergence and divergence processes may occur.

The model's growth equation is derived via a Taylor approximation, which results in a system of N differential equations. These equations are solved for output growth between two points in time and directly transformed into a spatial econometric model specification which is tested using 255 European regions for the observation period 1995–2004. The results are in line with the predictions of the model, where human capital constitutes a critical determinant of regional growth: disposability of human capital has a positive impact on productivity and hence attracts investments. It is, however, a mixed blessing, as human capital is to the benefit of a region's growth if it is found within that region, but is disadvantageous to a region's prospects on growth if found in neighbouring regions. This negative influence of human capital on neighbouring regions is finally found to serve as a potential answer for the simultaneous observation of regional convergence on a pan-European scale, and divergence between specific groups of regions.

The book is structured in three parts: after the Introduction (Chap. 1), Part I explores neoclassical growth theory in detail, by examining its standard models (Chap. 2), growth models that have acknowledged the role of space (Chap. 3), and the related convergence debate (Chap. 4). Part II sets the focus on characteristics of regional growth as opposed to national economies (Chap. 5), the resulting assumptions and structure of the model (Chap. 6), its implications for growth (Chap. 7), and the transformation to an econometrically testable specification (Chap. 8). Finally, Part III discusses availability of data in relation to the model's assumptions (Chap. 9), explores the spatial econometric model specification and estimation (Chap. 10), and interprets and concludes based on the results (Chap. 11). The study's three main parts are followed by the Summary (Chap. 12), the References, and four Appendices. In more detail, the study's three parts are structured as follows:

- Part I starts with a brief history of growth theory (Sect. 2.1) before a detailed discussion of the models of neoclassical growth theory on which this study's model is based on. These include the Solow model in its basic outline (Sect. 2.2), its solution with the particular case of a Cobb-Douglas production function (Sect. 2.3), and its more recent augmentation with human capital (2.4), which has become known as the Mankiw-Romer-Weil model. The relative location in space has so far been largely ignored in neoclassical growth models, with the exception of two recent approaches, one of which considers regions with identical steady states (Sect. 3.1), and one of which features steady states dependent on the relative location in space (Sect. 3.2). The question of whether various economies tend to converge over time arises intuitively from thoughts on economic growth and will be discussed for national economies (Sect. 4.1). This is followed by an exploration of the formal derivation of a convergence equation (Sect. 4.2) and some conclusions, as well as still unanswered questions (Sect. 4.3).
- Before the model is laid out in detail, the first section of Part II is devoted to non-neoclassical regional economics, in particular the issues of agglomeration effects, increasing returns and polarisation, and includes a note on new economic geography (Sect. 5.1). The discussion results in a reconsideration of standard assumptions on saving and investment (Sect. 5.2) and the mobility

of investments in physical capital (Sect. 5.3). The model's definitions and assumptions are laid out in detail (Sect. 6.1), followed by a specification with a Cobb-Douglas production function (Sect. 6.2). Changes in output levels are determined by the evolution of production factors, which serve as the model's foundation of dynamics (Sect. 6.3). After the derivation of the model's steady states (Sect. 7.1), its development over time is studied in detail, both by simulation (Sect. 7.2) and formally (Sect. 7.3). A Taylor approximation of the model gives a differential equation of economic growth (Sect. 8.1), whose solution provides a testable spatial econometric specification (Sect. 8.2). Finally, conclusions regarding the model's implications and an outlook on possible future research are discussed (Sect. 8.3).

- The first question to be tackled in view of the empirical study in Part III concerns the model's concepts and assumptions and how they are reflected in connection with Europe's ongoing vertical as well as horizontal economic integration (Sect. 9.1), completed by a discussion on the availability, quality, and appropriateness of data (Sect. 9.2). Based on these considerations, a summary of the data in connection with an exploratory analysis is given (Sect. 9.3). Spatial econometrics and the related issue of spatial weight matrices are introduced (Sect. 10.1), to be followed by a detailed description of the spatial econometric specification derived in Part II (Sect. 10.2), which is estimated by maximum likelihood (Sect. 10.3). Results from empirical tests of the model are presented for regions of the European Union and European Free Trade Association on the NUTS 2 and equivalent level (Sect. 11.1), and finally discussed and interpreted (Sect. 11.2).

Part I
Theory of Economic Growth

Robert Solow's articles from 1956 and 1957, in which he outlined the basics of what is now referred to as neoclassical growth theory, are widely accepted as marking the starting point of modern growth theory. In the 50 years that followed, this theory has been continually further developed, while remaining controversial. Like any model, a neoclassical growth model is a simplified conception of the world. Interestingly, this particular issue has been pointed out and discussed already in Solow's own contributions but has nevertheless been the primary object of criticism. "Neoclassical growth theory in some sense represents an 'ideal theory'" (Krelle 1988, p. 86, quotation marks in the original)[1]: by building on a small number of reasonable assumptions, it manages to explain a large number of observable phenomena and simultaneously rules out inconsistent developments. It seems inevitable that its attempt at simplifying highly complex social relationships simultaneously constitutes its major strength and weakness.

So far, economic growth is understood in a broader sense and as such in most cases implicitly or explicitly refers to national economies. The issue of appropriateness of neoclassical theory is taken up again in Chap. 5 in connection with questions of regional development, whereas in this part of the study the framework of neoclassical growth theory will be explored in detail, after a brief introduction to the history of growth theory. Therefore Chap. 2 sets the focus on the development and application of a neoclassical production function, in particular by focussing on its conclusions for the long run. Chapter 3 examines the few extensions of the original Solow model that consider relative location in space as a determinant of growth. The derivation of an econometrically testable convergence equation and some conclusions drawn from empirical tests can be found in Chap. 4.

[1] "In gewisser Weise ist die neoklassische Wachstumstheorie eine ‚ideale Theorie'."

Chapter 2
Neoclassical Growth Theory and Standard Models

Thoughts and theories on economic growth can be traced back to the classical economists of the eighteenth and nineteenth century, whose works are briefly reviewed alongside the transition to neoclassical growth theory in Sect. 2.1. The basic outline of neoclassical growth models as first developed by Solow (1956) and Swan (1956) is presented in Sect. 2.2. The familiar but nonetheless special case of a Cobb-Douglas production function is examined in Sect. 2.3 in connection with the derivation of steady state levels of factors of production and output. Finally, Sect. 2.4 examines the inclusion of human capital as an additional factor of production and provides a note on endogenous growth theory.

2.1 From Classical to Neoclassical Growth Theory

Adam Smith's "An Inquiry into the Nature and Causes of the Wealth of Nations" includes some considerations on what is now referred to as economic growth. Although Smith (1776) does not develop a long run growth theory as such, conclusions on growth may be deduced, as he refers to the importance and effects of increasing labour productivity as well as saving. The *stationary state* is defined as a condition where capital accumulation and population size have reached their ceilings, and as a consequence the economy may not progress any more (Smith 1776, p. 82). In contrast to this rather pessimistic view, Smith also refers to technical progress, which raises aggregate output (Smith 1776, p. 75), but considers division of labour as an even more important potential for improving labour productivity (Smith 1776, p. 207).[1] However, division of labour may not be improved perpetually: whether long run growth of the aggregate economy is possible in Smith's model is open to interpretation. The crucial point in Smith's theorising is population growth – either it would grow to its maximum possible level, or it could be controlled. It follows implicitly that if the latter case were to be achieved, an increase of output per capita in the long run would be possible.

[1] Smith famously exemplifies this with the production of pins.

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