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Equity-Efficiency Trade-Off:
Adding Dynamics to Martin's Model

**Prof. Dr. Dietmar Meyer**

**Jörg Lackenbauer**

April 2005

Andrássy Working Paper Series No. XIII

**Author's adress and affiliation:**

*Prof. Dr. Dietmar Meyer*
Budapest University of Technology and Economics
Stoczek u. 2 St. ép. 413
H-1111 Budapest
E-Mail: dmeyer@lucifer.kgt.bme.hu

*Jörg Lackenbauer*
Otto-Friedrich University Bamberg
Feldkirchenstrasse 21
D-96045 Bamberg
E-Mail: joerg.lackenbauer@sowi.uni-bamberg.de

# EU Cohesion Policy and the Equity-Efficiency Trade-Off: Adding Dynamics to Martin's Model

Dietmar Meyer,Budapest University of Technology and Economics
Jörg Lackenbauer, Otto-Friedrich University of Bamberg

April 27, 2005

## Abstract

As a result of the combination of endogenous growth theory with the approach of the new economic geography (NEG), several models have been developed to explain spatial income inequality and to formulate possible policy strategies taking into account the equity-efficiency trade-off. The dynamics of this problem should be considered as fundamentally important for the enlargement of the EU, because with respect to the new Member States from Central and Eastern Europe (CEECs), EU cohesion policy is confronted with a double challenge: how can it contribute to attain higher national growth (and therefore convergence towards the EU average income per capita) and at the same time contribute to the decrease of regional disparities within the new Member States? This analysis is particularly appealing against the background of the alleged equity-efficiency trade-off that regional policies often suffer from. After the introduction, in the second part of this paper, some light is shed on this equity-efficiency trade-off in the framework of an overview surveying the theoretical literature on the issue. In the third part of the paper, a model presented by Philippe Martin (1999) is presented. Martin's model combines the approaches of NEG and endogenous growth theory. In the fourth part, we develop a very simple dynamic version of the Martin model, followed by its formal analysis. We examine the effect of a monetary transfer to the poorer region, financed by the EU in the context of its cohesion policy interventions. In the fifth part, we derive some regional policy implications of the dynamised version of the Martin model. We find that there is a case for a "two step regional policy approach" in order to tackle the equity-efficiency trade-off challenge: this approach first aims to support the richer region and thus aggregate growth in the whole integrated area, and then to pursue an equity-oriented cohesion policy by fostering firm creation and innovation in the poorer region.

# 1. Introduction

As is widely known, there is a general economic backwardness in Central and Eastern European countries (CEECs) with respect to the "old" EU Member States (EU-15), due to the legacy of the socialist era. On the other hand, the transition from centrally planned economies to market economies and the ongoing integration with the EU have led to a strong rise of regional inequalities within the CEECs. Hence, EU cohesion policy faces a double challenge, and a central question of this paper is how the Union's regional policy can contribute to attain higher national growth (and therefore convergence towards the EU average income per capita) and at the same time contribute to the decrease of regional disparities within the new Member States.

The approach followed in this paper to answer this central question is a theoretical one, based on a model framework that combines endogenous growth theory with the approach of the new economic geography. In this context, several models have been developed to explain spatial income inequality and to formulate possible policy strategies taking into account the equity-efficiency trade-off. According to Martin (1998, p. 773), "[t]he new growth theory and the new geography provide a natural conceptual framework to analyze effects of regional policies, and to identify possible important tradeoffs between regional equity and aggregate efficiency." For the enlargement of the EU, as well as for future EU cohesion policy interventions, the dynamics of this problem should be considered as fundamentally important. This is why a dynamic version of the model presented by Martin (1999a and 1999b) is presented in this paper, together with an effort to derive some regional economic policy implications and recommendations.

The remainder of the paper is organised as follows: Section 2 aims at providing some theoretical underpinnings to the problem that regional policies often face an equity-efficiency trade-off. Section 3 outlines and analyses the model of Martin (1999a), which – in a static way – combines new economic geography and endogenous growth theory. In particular, the effects of a simple monetary transfer from a richer to a poorer region as well as the effects of a regional policy targeted at innovation are examined. In Section 4, the model is extended: a dynamic version of the model is presented, and the stability properties are scrutinised. In Section 5, the regional policy implications of the dynamic model are examined. This section aims at coming up with some policy recommendations for future EU cohesion policy interventions. Section 5 also shortly concludes.

## 2. Regional policies and the equity-efficiency trade-off: some theoretical underpinnings

This section examines the equity-efficiency trade-off that regional policies possibly face. In the second half of the 1990s as well as most recently, several innovative contributions in the literature started to combine new economic geography settings with endogenous growth theory frameworks (e.g. Walz, 1996; Martin and Ottaviano, 1999; Martin, 1999a and 1999b). Many of these contributions have in common that they provide a well founded theoretical description of the trade-off between aggregate growth (on the country level) and interregional (within-country) cohesion. Moreover, they have common precursors: some of their essential ideas can be traced back to the "uneven development theories" of the 1950s and 1960s, whose most prominent contributions are – inter alia – those provided by Kuznets (1955), Perroux (1955), Myrdal (1957), Hirschman (1958), and Williamson (1965). The crucial difference is that the new approaches managed to formalize the ideas verbally outlined already then.

### 2.1 The Williamson hypothesis

In an early contribution, Williamson (1965) provided a formulation of the potential trade-off between national and regional development, predicting "increasing divergence among geographic units within national borders and perpetuation of "pôles de croissance"" (Williamson, 1965, p. 5) in catching-up countries, whereas later during the course of development, "instead of divergence in interregional levels of development, convergence becomes the rule" (Williamson, 1965, p. 9). According to Williamson, the relationship between national growth and regional inequalities takes the form of an inverted U-curve: "The expected result is that a statistic describing regional inequality will trace out an inverted "U" over the national growth path" (Williamson, 1965, pp. 9-10).[1]

Williamson's main argument is that in the catching-up process of countries, interregional linkages, factor movements and public policies interact in favour of growth pole effects and the main agglomerations. Hence, more rapid growth in the growth pole areas (e.g. the capital

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[1] Williamson's inverted U-shaped curve can be seen as a special Kuznets curve making reference to interregional (not interpersonal) income inequalities. Ten years before Williamson (1965), Kuznets (1955) already argued that in the early stages of a country's development, the distribution of earnings (i.e interpersonal income inequality) widens (with labour shifting from low productivity sectors to higher productivity sectors), whereas later (when the higher productivity sector dominates the economy), income disparities narrow. The result is an inverted U-shaped curve, when growth is measured on the horizontal axis and income inequality on the vertical axis of a

city regions) leads to an increase of regional disparities. In fact, it seems plausible that countries at the beginning of their catching-up process prefer to promote national development by concentrating public investment on a few growth poles, often the main agglomerations. In these relatively early stages of catching-up, regional equity is hardly a priority. In later stages of development, however, regional disparities may decrease due to a higher aggregate level of income and spread effects: diseconomies of agglomeration (e.g. high labour costs or congestion effects) may emerge in the growth poles and the lagging regions of the by now mature country might benefit from technological diffusion and knowledge spillovers. Moreover, the objective of spatial equity may now be given greater political priority (Williamson, 1965, pp. 3-10; Davies and Hallet, 2002, pp. 4-5 and 9).

Most economists would probably classify the new EU Member States in Central and Eastern Europe under the heading "catching-up countries": hence, in Williamson's scheme, they would belong to the group of countries experiencing increasing regional disparities. Indeed, in the CEECs public investment is often focused on the main agglomerations and the maximisation of national growth (i.e. national catching-up) is mostly given priority, at the expense of lagging, peripheral regions.

## 2.2 Economics of agglomeration

In the context of the model approaches integrating new economic geography and endogenous growth theory, the most important source of a potential trade-off between regional equity (cohesion) and aggregate growth is the often strongly positive correlation between the spatial agglomeration of economic activities (and thus the inequality in terms of the location patterns) and the overall growth rate. Agglomeration has countervailing effects: often positive in terms of efficiency, but potentially negative with regard to equity (Martin, 1999a, p. 12).[2]

The growth benefits of agglomeration that the various strands of literature usually refer to are general "Marshallian externalities"[3], local spillovers of information, knowledge, and

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graph. As mentioned before, however, Kuznets (1955) had interpersonal inequality in mind, whereas Williamson (1965) explicitly refers to the spatial dimension of development, i.e. to interregional disparities.

[2] It should be emphasized that "efficiency" always denotes overall/aggregate growth, whereas "equity" can stand for interregional equity in terms of per capita income ("income equity") as well as for equity in terms of the (then even) distribution of economic activity ("locational equity"). Hence, efficiency can be subject to a trade-off with potentially two kinds of equity.

[3] "Marshallian externalities" can be traced back to a quotation by Alfred Marshall (1920, p. 225), which explains the name. Importantly, Marshallian externalities are a mixture of technological externalities (dealing with the

technology, and economies of scale. More precisely, the formation of clusters (and thus the move towards a potentially efficient, but uneven interregional pattern of economic activities) is mainly due to "centripetal forces" such as the availability of specialized input services, the formation of a highly specialized labour force, the localised accumulation of human capital, the existence of modern infrastructure, and mass production giving rise to scale economies (Fujita and Thisse, 2002, p. 8).

The relation between aggregate growth and regional inequality is not monocausal: on the one hand, growth processes can trigger agglomeration dynamics and thus lead to an uneven development within a country. On the other hand, agglomeration and regional inequality can lead to more growth when localised technological spillovers are at play. In the model presented by Martin and Ottaviano (2001) e.g. there is a circular causation between (endogenous) growth and agglomeration: growth fosters agglomeration, since the expansion of an innovative sector attracts new firms to locate in the core. At the same time, agglomeration reduces the cost of innovation and thereby increases the growth rate in the core. Consequently, they find that "[s]patial agglomeration of economic activities on the one hand and economic growth on the other hand are parallel processes" (Martin and Ottaviano, 2001, p. 947).[4]

Seeking interregional cohesion and thus being a policy of relocation (of firms to peripheral regions), EU cohesion policy in this context is often blamed for impeding economies from exploiting localised intra-industry externalities and from realizing agglomeration gains (Martin, 2002, p. 6; Midelfart, 2004, pp. 13 and 20).

Puga (2002, p. 374) speaks of "the trade-off between the economic advantages of the clustering of activity and the inequalities it may bring." Baldwin and Martin (2003, p. 3) point out the "strong positive correlation between growth and geographic agglomeration of economic activities", which may well entail aggregate economic efficiency, but trigger spatial

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effects of nonmarket interactions) and pecuniary externalities (economic interactions for which there are market and price mechanisms). This distinction goes back to Scitovsky (1954) (Fujita and Thisse, 1996, p. 345; Fujita and Thisse, 2002, pp. 7-8).
[4] However – as always with theoretical results hinging on crucial assumptions – one has to be cautious and refrain from generalising both causalities: to give an example, inequality may not lead to enhanced efficiency when there are signs of over-agglomeration and congestion (Crozet and Koenig, 2004, p. 2). Yet, as the aim of this section is to give a theoretical underpinning to the equity-efficiency trade-off, dispersion or "centrifugal" forces are refrained from here, and the focus is on agglomeration or "centripetal" forces able to explain the trade-off between overall growth and spatial equity.

disparities. Along these lines, Boldrin and Canova (2001, p. 215) emphasize that "[o]ne must carefully distinguish between overall economic efficiency and inter-regional equality."

*2.3 The "growth pole" concept*

The "growth pole" concept is very strongly related to the notion of agglomerations induced by spillovers and economies of scale. Therefore, it shall only be examined briefly in this chapter. In his famous "Note sur la notion de "pôle de croissance"" ("Note on the concept of growth poles"), Perroux (1955, p. 307) observes that "[m]odels … of equally diffused growth of an economy do not correspond to observed facts. Economic growth originates in certain zones and proceeds with unequal intensity." Perroux's contribution may be considered as the genesis of the concept of "growth poles": it is one of the first contributions to describe how the proximity of various economic actors leads to an intensification of economic activity, i.e. to spatial growth agglomeration processes. These growth processes are accompanied by increasing interregional disparities, and hence by a potential equity-efficiency trade-off (Perroux, 1955, pp. 317-318).

Parr (1999) gets to the heart of the central idea behind growth pole strategies:

> "[I]f a given level of public investment on infrastructure and inducements to the private sector could be focused within the region at a limited number of locationally favoured centres, the impact on the economy in terms of inward investment (leading to increased employment opportunities and higher per capita incomes) would be greater than under a strategy which sought to assist the least-favoured parts of the region or one which allocated expenditures on a purely proportionate basis in terms of population or employment" (Parr, 1999, p. 1200).

In fact, one can argue that the interregional allocation of public capital is efficient if it is invested in highly productive regions (the growth poles). However, whereas this is the recipe for a *growth* policy by the central government, *regional* policy normally (also) pursues equity goals and thus allocates more public investment to lagging regions. If the latter are less productive[5] than the growth poles, this way of allocating capital clearly is at the expense of

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[5] Clearly, an important substantiation has to be added: it is important to distinguish whether "productivity" refers to the average productivity or the marginal productivity of capital and workers in a given region. Whereas the concept of marginal productivity refers to neoclassical economics, the idea of average productivity is more compatible with endogenous growth theory. What actually is the relevant criterion for determining interregional equality or disparities is a rather controversial issue (cf e.g. Sasaki, 1978; Mera, 1978) and depends on the validity and empirical relevance of the contesting growth theories. In this study, the view is taken that

the overall growth rate and regional policy thus faces a trade-off between equity and efficiency.

*2.4 Equity, efficiency, and the case for regional policies*

Trying to directly influence the allocation of resources, EU cohesion policy as carried out by the European Commission aims at reducing the degree of agglomeration that is determined by the market. Such a policy can only be justified on efficiency grounds if there is an allocative market failure in the form of an over-agglomeration, i.e. if the market processes lead to too much agglomeration (Fujita and Thisse, 1996; Südekum, 2002, pp. 130 and 132).

Hence, one has to figure out whether the degree of agglomeration is desirable from a social welfare perspective, i.e. is there more or less spatial inequality than a "benevolent social planner" would allow for? Hence, is there too much, too little or just the optimal degree of agglomeration (Baldwin et al., 2003, p. 252, Pflüger and Südekum, 2004 and 2005)? Martin and Rogers (1995) as well as Boldrin and Canova (2001, p. 215) argue that from the perspective of endogenous growth theory and new economic geography frameworks, the market-determined level of agglomeration is characterised by too little (not too much) agglomeration, and hence public intervention ought to foster regional clustering and disparities for the sake of overall efficiency.

In their model, Pflüger and Südekum (2004 and 2005) show that for high trade costs, there is over-agglomeration in the market equilibrium (hence, regional policies should foster dispersion, since the welfare losses of agglomeration due to congestion… are too important), whereas for low trade costs, there is under-agglomeration.[6] Consequently, policymakers should foster the dispersion of firms only if there are high trade costs, whereas for low trade costs, regional policies should foster agglomeration (Pflüger and Südekum, 2004, pp. 2-3).

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endogenous growth theory combined with new economic geography probably describes best actual regional economics, given the frequent empirical occurrence of economies of scale, imperfect competition, and interregional differences in human capital endowments.

[6] For *very* high and very low as well as for intermediate trade costs, the market equilibrium and the socially desirable degree of agglomeration coincide (Pflüger and Südekum, 2004, pp. 2-3).

Trade costs can most probably be considered as low in the EU with its Single Market, Economic and Monetary Union and deep economic integration.[7] As a consequence, the EU's Single Market may well be characterised by under-agglomeration. Hence, EU cohesion policy which aims at fostering dispersion in general may well be counterproductive from an efficiency perspective. Yet, this is just an analysis on efficiency grounds. Depending on the underlying normative objective functions, on equity grounds there may still be a case for a policy aiming at equity in terms of an interregionally even distribution of economic activity.

So far, one important question has been neglected: after all, can the gainers compensate the losers so that, according to the Kaldor-Hicks-criterion established in welfare theory, everybody (including the initially lagging regions) would be (absolutely, but maybe even relatively) better-off (Pflüger and Südekum, 2005)? In the model of Martin and Ottaviano (1999) e.g. the "winning country's" welfare gain from more agglomeration (in the optimal geography than in the market-determined outcome) is big enough to make both countries gain. Hence, the best approach seems to accept the level of agglomeration determined by the market or even increase agglomeration, and then compensate regions/individuals that stand to lose from this – ideally via lump-sum capitation taxes that do not entail any distortions (Südekum, 2002, p. 132).[8]

However, at least three problems occur:

- Firstly, it is quite established in public finance theory that such a non-distortionary redistribution mechanism is hardly feasible in practice. Thus, compensation payments would have to be financed through distortionary taxes (Martin, 2000, p. 71; Südekum, 2002, p. 132). The induced distortions may well eat up the efficiency gains of increased agglomeration.
- Secondly, even such an agglomeration-fostering and potentially welfare-improving regional policy would still entail a trade-off between overall welfare and equity in terms of the locational distribution of industrial activity.
- Thirdly, the approach of the European Commission's regional policy is very different from that of a compensatory policy: it explicitly aims at attracting economic activity to

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[7] Yet, they probably cannot be considered as *very* low or inexistent (which would entail another policy recommendation), since there are still various remaining distortions, think e.g. of the still rather limited services trade).

peripheral regions by influencing the resource allocation. The European Commission (2001, p. 117) itself emphasizes that its aim is to "influence factor endowment and resource allocation … cohesion policies … are not specifically concerned … with redistribution of income." Hence, the Commission tries to keep production factors in the poorer regions (or even to move them there) – clearly an equity-oriented policy, that may come at the expense of efficiency at the pan-European level. From a growth policy perspective, it is unwise to intervene against economic concentration in the growth poles (Pflüger and Südekum, 2005; Südekum, 2002, pp. 133 and 138).

*2.5 The equity-efficiency trade-off in models combining new economic geography and endogenous growth theory*

Importantly however, even now it still cannot be concluded (neither from theory nor from the empirical evidence) that regional policies *always* go hand in hand with an equity-efficiency trade-off, even if in many cases overall growth and regional cohesion seem to be competing goals. The reason why one shouldn't generalise is that there is no *general* regional policy approach, and one always has to distinguish between the various instruments and options for EU cohesion policy: the latter can take the form of direct income transfers, subsidies to producers, infrastructure investments reducing interregional or intraregional transaction costs, education subsidies, innovation programmes…. Clearly, the existence and the extent of an equity-efficiency trade-off depend on the instrument(s) used by EU cohesion policy and the way the latter is implemented and financed (via distortionary taxes or lump-sum ones, via national taxes or taxes on industrial agglomeration…) (Walz, 1996; Martin, 1999a and 1999b; Baldwin et al., 2003; Midelfart, 2004).

Based on models combining new economic geography and endogenous growth theory, Walz (1996), Martin (1999a and 1999b), and Baldwin et al. (2003) show that different public policies (namely transfers, infrastructure policies and technology/innovation subsidies) have very different effects on growth, regional income disparities and economic geography.

As shown in Section 3, in the contributions of Martin (1999a and 1999b) as well as Baldwin et al. (2003), regional policies often face an equity-efficiency trade-off, for there is nearly always at least one unfortunate consequence: a direct transfer/subsidy to the poor region leads

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[8] In this context, various authors (e.g. Franzmeyer, 2001; Südekum, 2002…) argue that EU cohesion policy should be reformed towards a fiscal equalisation mechanism based on unconditional transfers.

to reduced regional disparities, but at the expense of the rate of innovation and hence the country's rate of growth, which are both lowered. The same negative effect together with an increase of regional income disparities within the country is the result of infrastructure projects within the poorer region. When infrastructure projects aim at connecting the core and the periphery, companies relocate to the richer region and there is thus an increase in agglomeration. Thus, as indicated above, regional policies seem to face a trade-off between equity and efficiency. The only exception in the cited work is a policy fostering innovation and technology/knowledge spillovers.

Like Martin (1999a and 1999b), Walz (1996) also finds that in the case of interregional transport infrastructure policies, the less developed regions become even more peripheralized. Another common ground of both models: the results for the case of investment in *intra*regional infrastructure (i.e. *within* the recipient region) are each very different from the case of *inter*regional infrastructure policies. Moreover, for transfers from the rich to the poor region, Walz (1996) also finds indications for a trade-off between equity and efficiency (which he defines as the unionwide growth rate in the economic union under scrutiny).

## 3. The Martin model[9]

The model whose assumptions, results and implications for regional policy shall be studied is the one developed by Martin (1999a and 1999b)[10]: like some of the model approaches discussed before, it "marries" an endogenous growth theory framework to a new economic geography model.[11] An important reason why we choose the approach of Martin (1999a) is that the model with its interplay between several effects working in opposite direction ("home market effect", local spillovers, "competition effect"…) doesn't lead to "circular causation", i.e. a core-periphery pattern as in Krugman (1991a and 1991b) or already in Myrdal (1957),

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[9] Section 3 is to a considerable extent based on Martin (1999a and – to a lesser extent – 1999b) and Baldwin et al. (2003), which is itself based on Martin (1999b).

[10] The essay "Are European regional policies delivering?" (Martin, 1999a) won the First Prize in the EIB Prize essay competition of the European Investment Bank (EIB). Martin's article "Public policies, regional inequalities and growth", which has been published in the Journal of Public Economics (Martin, 1999b), features the same model approach, yet in a more analytical form. The same is true for Chapter 17 of Baldwin et al. (2003), for which Martin's studies have served as a basis. For the study here, the EIB Prize winning essay is chosen as the main basis, since it is more straightforward and intuitive (whereas the mathematics would not yield much added value for the aims pursued here), and since the simpler model is a more suitable basis for the dynamisation approach followed in Section 4.

[11] The model of Martin (1999a and 1999b) is based on previous work by Martin and Rogers (1995) and Martin and Ottaviano (1999). The endogenous growth framework follows Romer (1990) and Grossman and Helpman (1991). The endogenous geography is introduced in a similar way as in Helpman and Krugman (1985) and Krugman (1991a).

where all firms will decide to produce only in the richer region. The aforementioned effects and the freely moving endogenous capital in Martin's model lead to interior solution equilibria, in which production takes place in both regions, generally in an uneven spatial pattern. This clearly increases the relevance for the discussion of regional policy implications.

*3.1 The assumptions, variables, and the relationship between growth, regional income disparities and agglomeration*

Martin's model features two regions: a capital-rich region and a relatively poor one. If we apply this structure to the case of Hungary e.g., we could think of Budapest as the former and of Eastern Hungary as the latter. Transaction costs exist between regions as well as within regions, and they are affected by public infrastructure policies. As is often the case in models combining new economic geography and endogenous growth theory, there is a homogeneous ("traditional") good and a composite ("differentiated") good. The production of the latter takes place under monopolistic competition and involves economies of scale (as in Dixit and Stiglitz, 1977). The model is then elaborated on the basis of three theses.

*Thesis 1*: When transaction costs between the regions are reduced, the spatial concentration of firms in the rich region increases, since it always pays off to produce in the richer area, where economies of scale can be maximised, while sales to the poor region can continue, thanks to reduced transaction costs. When regional income disparities increase, the agglomeration degree also increases: because of economies of scale, firms always locate where demand and income are highest. This effect is the so-called "home market effect". The resulting equilibrium relationship (with firms' profits eventually being equal in both regions) is

$$A = A(R), \text{ with } A'(R) > 0, \tag{1}$$

where $A$ is an agglomeration index, and $R$ is an index of regional income inequality.

*Thesis 2*: As agglomeration (in the richer region) increases, the cost of innovation falls in the richer region, due to the aforementioned (localised) spillovers of information, knowledge and technology. Hence, an increase of spatial concentration leads to an increase of innovation and consequently to an increase in the (aggregate) growth rate. This is the so-called "spillovers effect". The equilibrium relationship (between agglomeration and long-term growth) is

$$g = g(A), \text{ with } g'(A) > 0, \tag{2}$$

where $g$ is the rate of growth (and the rate of innovation).

*Thesis 3*: A high rate of innovation leads to more market entries by new firms, which compete with incumbent firms and reduce their profits and thus existing incomes. As monopolistic firms are more numerous in the rich region than in the poor region, the decline of their profits leads to a reduction of regional income disparities. The respective effect could be called "competition effect". The respective equilibrium relationship is:

$$R = R(g), \text{ with } R'(g) < 0 \tag{3}$$

If theses 2 and 3 are summed up, the following relationship is obtained:

$$R = R(g(A)) = R(A), \text{ with} \tag{4}$$
$$R'(A) < 0$$

**Figure 2: The relationship between growth, regional income disparities and agglomeration**
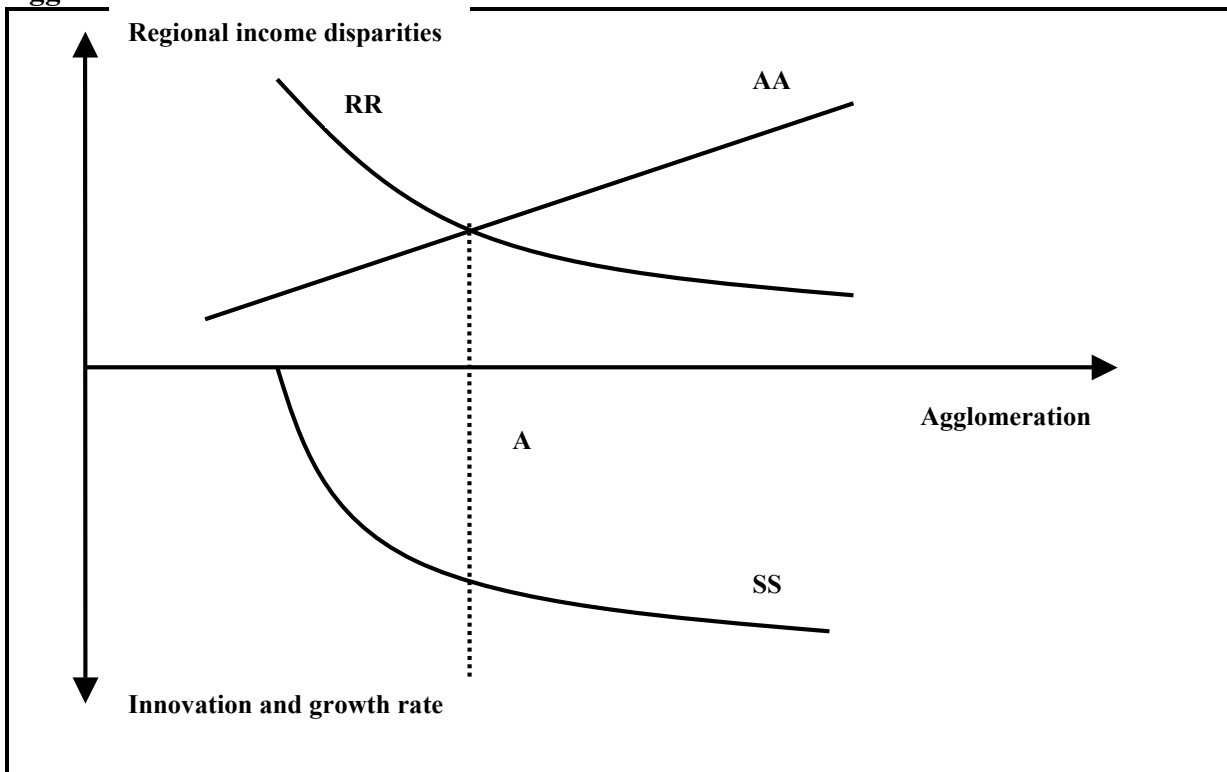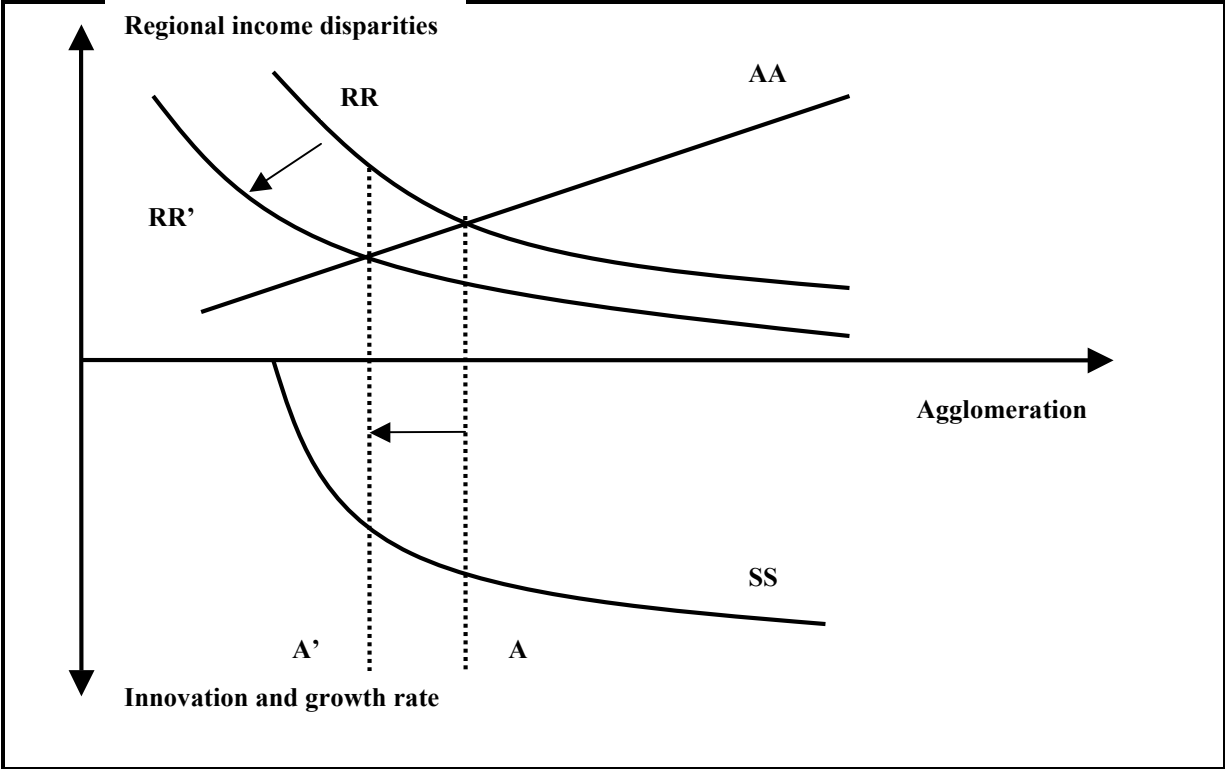


Source: Martin (1999a, p. 14).

Figure 2 sums up Equations 1 to 4, i.e. the respective equilibrium relationships. The intersection of the two curves AA and RR in Figure 2 denotes the equilibrium levels of agglomeration and income inequality. The equilibrium rate of innovation is indicated by the intersection of the line A (which stands for the equilibrium level of agglomeration) with the curve SS (the latter's positive slope shows the positive relation between agglomeration and innovation/growth).

Now the effects of various types of regional policies shall be examined in the theoretical framework provided by Martin (1999a).

*3.2 The effects of income transfers and regional policies targeted at innovation*

**Figure 3: The effects of an income transfer to the poor region**



Source: Martin (1999a, p. 17).

The initial impact of a simple monetary transfer from the rich to the poor region (e.g. from Budapest to Eastern Hungary) is to decrease regional income inequality. Hence, in Figure 3, the curve RR shifts downwards/to the left. As a consequence, the extent of agglomeration will be reduced. Thus, there is a move along the AA curve to the left. This is not surprising, since the transfer of purchasing power to the poor region increases the market size there and attracts firms to the poor region. The more dispersed economic geography following the decrease of

agglomeration however is less conducive to spillovers and thus innovation and growth are lowered. Summing up, regional disparities and inequalities in terms of industrial location become less unequal (both equity goals are thus achieved), but at the expense of overall efficiency. There is an equity-efficiency trade-off.

$$R(g) \Downarrow \rightarrow A(R) \Downarrow \rightarrow g(A) \Downarrow. \tag{5}$$

The decisive question is: Is there an approach to regional policy able to contribute simultaneously to higher growth and spatial equity? As can be seen from Figure 4, in contrast to the "traditional" transfer policies, a policy aimed at reducing regulatory barriers to innovation or the costs of innovation, makes it possible simultaneously to achieve objectives of reducing agglomeration, regional inequalities, and increasing the rate of innovation/growth. The regional policies involved could be information and communication infrastructures, R&D subsidies, education infrastructure (i.e. human capital, which is a *conditio sine qua non* for innovation and technology adoption) or making capital markets more conducive to new start-ups.

$$g(A) \Uparrow \rightarrow R(g) \Downarrow \rightarrow A(R) \Downarrow. \tag{8}$$

**Figure 4: The effects of a regional policy fostering innovation and technology spillovers**
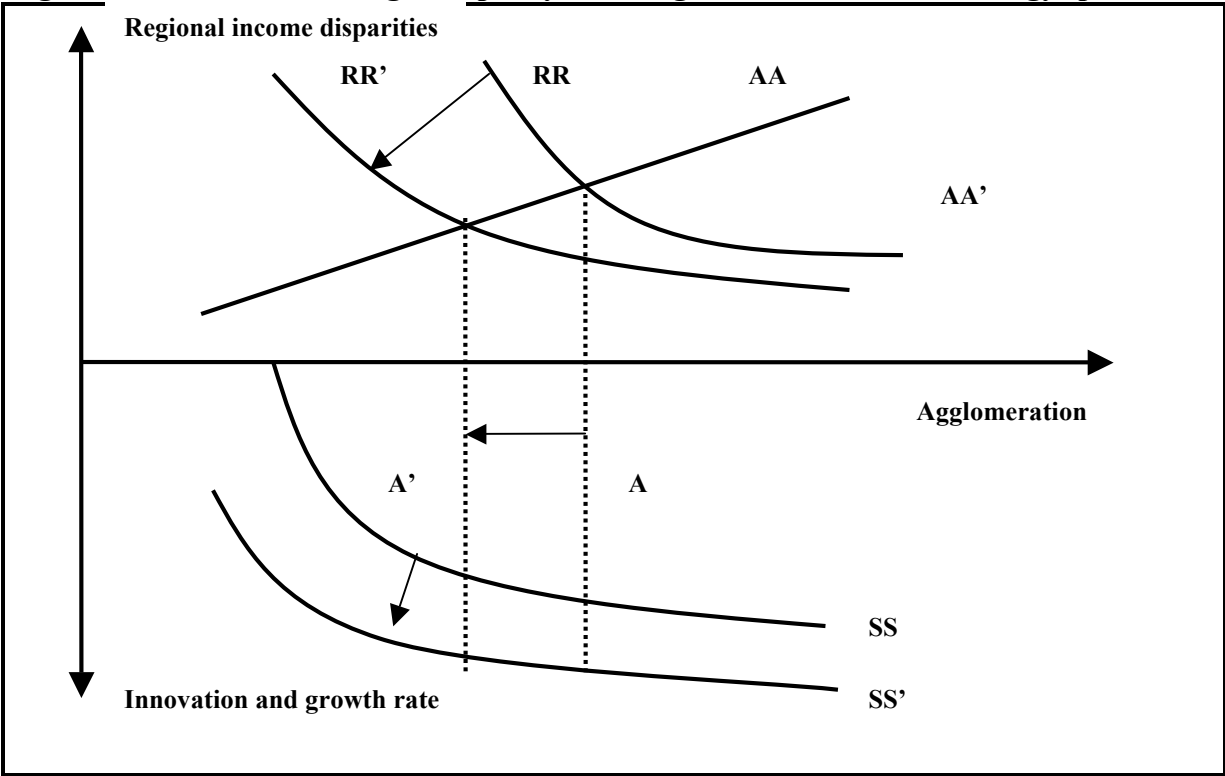


Source: Martin (1999a, p. 19).

Suppose that the policymaker reduces the cost of innovation by facilitating its diffusion, e.g. by improving information and communication infrastructures, which makes it easier for lagging regions to innovate and to adopt new technologies. Obviously, with the cost of innovation being reduced, the growth rate increases (SS becomes SS' in Figure 4). More firms enter the market, which boosts competition, reduces the profits of monopolistic businesses (which are more numerous in the rich region than in the poor region) and ultimately the income disparities between the capital city and its periphery (we move from RR to RR'). As a consequence, agglomeration is reduced, too (a move to the left along the curve AA).

The "secret" behind the regional policy approach fostering innovation or knowledge spillovers is that it makes the localised spillovers that are built in the model less localised. As Baldwin et al. (2003, p. 433) put it, "making knowledge spillovers more global is both pro-growth and pro-dispersion", since on the one hand, the lagging regions benefit more from spillovers, and this increases the growth rate of the aggregate space (e.g. the whole country of Hungary).

As mentioned above, possible policy approaches in this context could include policies that improve telecommunication and IT infrastructures or the human capital base in the lagging region (thus enabling technology transfer). Again, to follow Baldwin et al. (2003, p. 433), "[o]ne could think of this type of policy as one that facilitates trade in ideas rather than trade in goods." Hence, this innovative approach focuses on the removal or reduction of transaction costs on ideas and technologies, not on the traditional elimination of transaction costs on goods. It is important to emphasize that any policy able to reduce the cost of innovation may yield the desirable outcomes sketched in Figure 4. Hence, the respective policy could also be an R&D subsidy or a policy improving the education infrastructure or increasing competition.

## 4. Adding dynamics to Martin's model

Although Martin (1999a) in his line of reasoning mentions several times the process-related character of the results of his model, he doesn't take into account the time dependency of the variables. Instead, he contents himself with a comparative analysis of the initial points and end points in equilibrium. In this section, we address the dynamics of Martin's model in the framework of a simple model.

Indeed, a major difference to Martin's line of reasoning follows from the dynamic method of analysis – as opposed to Martin's static approach. In the original model, Martin (1999a) in a sense can/has to emanate from institutionally given income disparities, whose extent changes due to economic policy interventions, whereas the dynamic approach requires the specification of an own pathway of the evolution of regional income disparities over time.

*4.1 A dynamic version of Martin's model*

We continue examining two regions of an integrated area – a capital-rich region, and a relatively poor region. The former has a higher degree of agglomeration than the latter. The regional incomes should not be understood in terms of the earnings obtained, but in terms of variables which are different from the earnings obtained due to economic policy interventions.

$N_t$ is the number of firms in the integrated area at time $t$. These companies proliferate at a constant rate $g_N$.[12] The number of firms located in the richer region at time t is $N_t^A$, with $N_t^A < N_t$; consequently, the number of firms in the in the poorer region is $N_t - N_t^A$. The expression $\dfrac{N_t^A}{N_t}$ is an indicator for the degree of agglomeration (remember Martin's agglomeration index $A$, Eq. (1) and Martin, 1999a, pp. 12-13). Hence, $A_t = \dfrac{N_t^A}{N_t}$. The growth rate of the degree of agglomeration is thus

$$g_A = g_{N^A} - g_N,$$ (9)

or, respectively,

$$\frac{\dot{A}_t}{A_t} = \frac{\dot{N}_t^A}{N_t^A} - \frac{\dot{N}_t}{N_t}.$$ (10)

---

[12] This somewhat unrealistic assumption can be refrained from without major difficulty: it could be assumed e.g. that the number of firms evolves along a logistic function, i.e. that the aforementioned growth rate instead of the constant value $g_N$ takes the form $g_N - nN$, where $n$ is a positive number. This wouldn't alter essentially the following comments.

Furthermore, $y^A$ is the income of a firm in the rich region. Hence, the income of that region is given by $y^A N^A$. If the aggregate income of the integrated area at time t is $Y_t$, then the income share of the richer region at time t is given by $\frac{y_t^A N_t^A}{Y_t}$. In the model of Martin, the corresponding index is $R$, the index of inequality of regional incomes (Eq. (1) and (3) and Martin, 1999a, p. 13). Here, $R_t = \frac{y_t^A N_t^A}{Y_t}$. Consequently, the growth rate of regional income disparities is given by

$$\frac{\dot{R}_t}{R_t} = \frac{\dot{y}_t^A}{y_t^A} + \frac{\dot{N}_t^A}{N_t^A} - \frac{\dot{Y}_t}{Y_t}. \tag{11}$$

It is central to Martin's model that the growth rate of income is a growing function of the degree of agglomeration (Eq. (2) and Martin, 1999a, p. 13). This relationship shall be given by

$$\frac{\dot{y}_t^A}{y_t^A} = f(A_t), \text{ mit } f'( ) > 0. \tag{12}$$

Eq. (11) and (12) together result in

$$\frac{\dot{R}_t}{R_t} = f(A_t) + \frac{\dot{N}_t^A}{N_t^A} - \frac{\dot{Y}_t}{Y_t}. \tag{13}$$

The income of the poorer region can be expressed as $Y_t - y_t^A N_t^A = Y_t(1 - R_t)$. One part of this income is used to develop that region, i.e. measures are taken that promote the creation of firms in the poorer region or the relocation of firms from the richer to the poorer region. The other part of the income is used for the consumption of goods that are produced in the richer region. This stimulates production in the richer region, thereby leading to a growing number of firms. The share of income of the poorer region which is used to buy goods produced in the other region shall be given by $\beta Y_t(1 - R_t)$, with $\beta$ being subject to economic policy interventions. Apart from the poorer region's consumption of goods produced in the richer region, another variable influences the number of firms in the richer region: the local demand

in the richer region, which can be expressed as $\beta^A y_t^A N_t^A$, with $\beta^A$ being the richer region's propensity to consume. Regarding the relation between $\beta$ and $\beta^A$, we assume that $\beta > \beta^A$.[13] Hence, the number of firms in the richer region changes according to:

$$\dot{N}_t^A = h\left(\beta \, Y_t \left(1 - R_t\right) + \beta^A \, y_t^A N_t^A\right) = h\left(\beta \, Y_t \left(1 - R_t\right) + \beta^A \, R_t Y_t\right),\text{[14]} \qquad (14)$$

where $h$ is linear homogeneous in $Y_t$ and $h'(\ ) > 0$.

Consequently, the growth rate of firms in the richer region is

$$\frac{\dot{N}_t^A}{N_t^A} = \frac{Y_t \, h\left(\beta \left(1 - R_t\right) + \beta^A \, R_t\right)}{N_t^A}. \qquad (15)$$

With this result, the growth rate of the degree of agglomeration is

$$\frac{\dot{A}_t}{A_t} = \frac{Y_t h\left(\beta \left(1 - R_t\right) + \beta^A \, R_t\right)}{N_t^A} - g_N. \qquad (16)$$

Equations (13) and (16) describe the dynamics of the two regions within the integrated area through the variables $A_t$ and $R_t$. If, for the sake of simplicity, we assume constant labour productivity for the richer region, then $\frac{Y_t}{N_t^A} = k$ and thus $\frac{\dot{N}_t^A}{N_t^A} = \frac{\dot{Y}_t}{Y_t}$. If we assume furthermore – also for the sake of simplicity – that $h(\ )$ is a constant and both $h(\ )$ and $f(A_t)$ are linear functions, then Eq. (13) and (16) yield the following expressions:

---

[13] This reflects the fact that the poorer region hardly produces any higher value-added products on its own. Hence, it is obliged to import those from the richer region. This approach corresponds to the conditions prevalent in the literature, i.e. that both regions produce agricultural products, but manufactured goods are only produced in the richer region (cf e.g. Martin and Ottaviano, 2001; Ottaviano, Tabuchi, and Thisse, 2002). Araujo and Teixeira (2004) argue that "Southern" countries typically produce and export primary (i.e. agricultural) goods, whereas "Northern" countries typically produce and export industrial (i.e. manufactured) goods. In this context, the South (the "poor region") heavily depends on Northern (the "rich region's") capital goods. The relatively lower income elasticity of demand for agricultural products is seen as one of the main reasons for the declining share of consumer expenditures on Southern goods, and thus for international/interregional inequalities.

[14] The function $h(\ )$ describes the reaction rate of firm creation or firm closure in the richer region when demand changes.

$$\frac{\dot{R}_t}{R_t} = -\alpha_0 + \alpha_1 A_t, \ \alpha_0, \alpha_1 > 0, [15] \tag{17}$$

and

$$\frac{\dot{A}_t}{A_t} = kh\left(\beta\,(1-R_t)+\beta^A\,R_t\right)- g_N = kh\beta - g_N + \left(\beta^A - \beta\right)khR_t. \tag{18}$$

The stationary equilibrium is given by

$$A^* = \frac{\alpha_0}{\alpha_1} \tag{19}$$

and

$$R^* = \frac{g_N - kh\beta}{(\beta^A - \beta)\,kh}. \tag{20}$$

For the index of inequality of regional incomes, the following must hold: $0 \le R_t \le 1$. From Eq. (20), it can be seen that the regional income distribution depends on labour productivity, since $R=0$, if $k = \frac{g_N}{h\beta}$; respectively, $R=1$, if $k = \frac{g_N}{h\beta^A}$. As $\beta > \beta^A$ holds, the nonnegativity of $R^*$ is only assured if $g_N < kh\beta$.

In order to analyse the stability properties of the equilibrium solution, we look at the Jacobian matrix

$$J\left(R^*, A^*\right)= \begin{bmatrix} 0 & \alpha_1 \dfrac{g_N - kh\beta}{kh(\beta^A - \beta)} \\ (\beta^A - \beta)kh\dfrac{\alpha_0}{\alpha_1} & 0 \end{bmatrix}, \tag{21}$$

---

[15] Eq. (17) is based upon the realistic premise that regional income disparities decrease when there is no agglomeration, i.e. when production is equally distributed among the two regions.

whose eigenvalues can be calculated from the equation

$$\lambda^2 = \sqrt{\alpha_0\left(g_N - kh\beta\right)}. \tag{22}$$

From Eq. (17), the stability properties of the model are immediately apparent: Since, due to the condition $R \geq 0$, the relation $g_N < kh\beta$ holds, the discriminant is negative, i.e. Eq. (17) has two conjugated complex solutions; the real parts of $\lambda_1$ und $\lambda_2$ are 0. Hence, the stationary soluation is instable.[16]

Hence, if labour productivity is sufficiently high, agglomeration and regional disparities evolve along regular though phase-delayed cycles (Figure 5a), whose periods' length then – provided that firm creation is decreasing or stagnating in the whole integrated area - takes the values of $\dfrac{2\pi}{\alpha_0 kh\beta}$ and, respectively, $\dfrac{2\pi}{\alpha_0\left(g_N - kh\beta\right)}$ (Hirsch and Smale, 1974, p. 95).

Hence, the length of the periods depends on

- average labour productivity,
- the flexibility of firm creation or firm closure with changing demand,
- the demand of the lagging region for goods that are produced in the richer region, and
- the (falling) growth rate of income disparities between both regions.

Clearly, the opposite evolution of the parameters just examined would lead to a shortening of the periods.

The relationships derived lead us to the conclusion that the exclusive stimulation of the creation of new firms[17] is not a guarantee for a stable development in the regions. The decisive variable is the degree of labour productivity that is reached (or can be reached) in the richer region. Yet, even then there can be at best a phase-delayed, cyclical evolution of the examined variables.

---

[16] If this condition is fulfilled, the model is a Lotka-Volterra model (cf e.g. Assenmacher, 1990).
[17] Regarding the transition process in the CEECs, we could also say: the disintegration of the former big public monopoly firms and their transformation into smaller units.

**Figure 5a: The evolution of agglomeration and regional disparities over time**
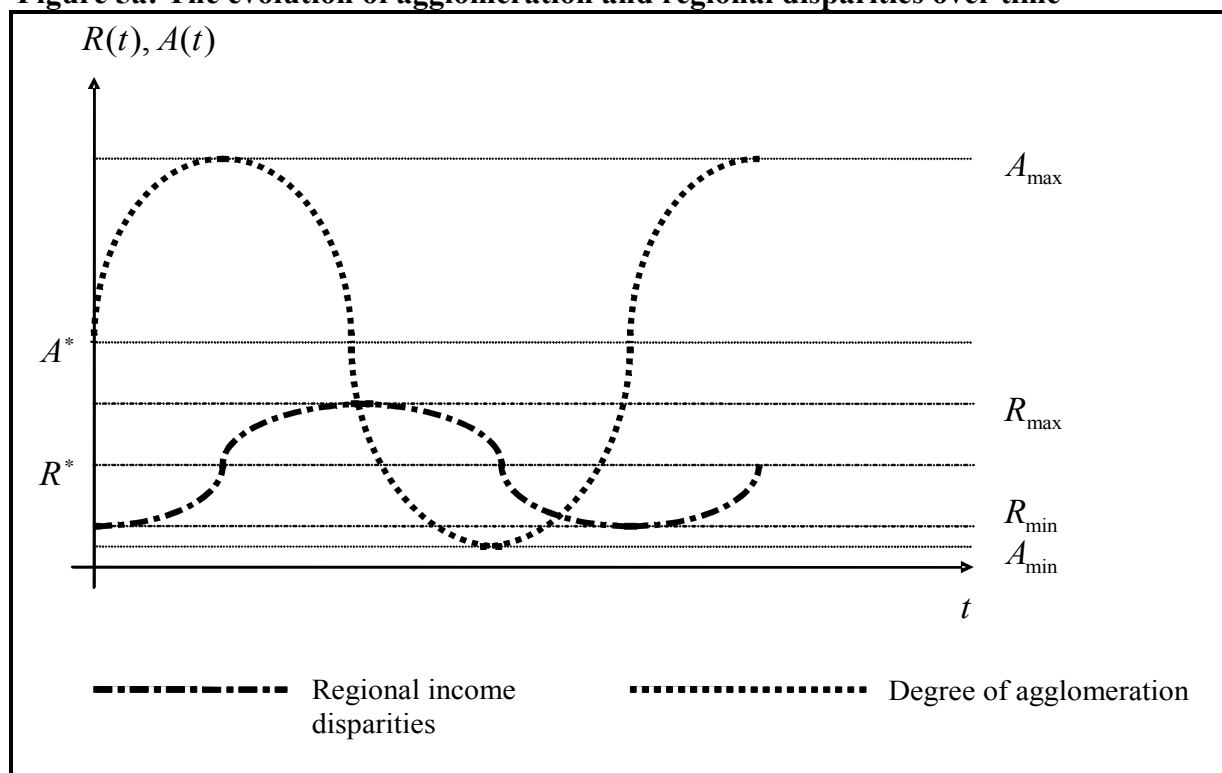


*4.2. The effects of EU cohesion policy income transfers in a dynamic context*

In his study, Martin (1999a) examines – inter alia – the implications of monetary transfers for regional development. In his line of reasoning, simple monetary transfers from the richer to the poorer regions lead to a decrease of regional income disparities (Martin, 1999a, pp. 16-17). In contrast to Martin's line of reasoning, we do not assume a transfer from the richer to the poorer region, but an "exogenous" transfer from a third party – in practice, this would be the European Union/European Commission, who spends billions of euros annually for its cohesion policy interventions in the EU's poorest regions.[18] Also in contrast to Martin's line of reasoning, these transfers shall not lead directly to a decrease of regional income disparities, but shall be placed at the disposal of the economic agents of the poorer regions, who can buy (mainly manufactured) goods with them.[19]

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[18] One could e.g. assume a transfer from Brussels to Eastern Hungary (Hungary's poor region), which has significant effects on Hungary's rich region, Budapest, too.
[19] In the present dynamic version of the model, it would not make much sense to assume a policy directly influencing regional income disparities, since we presumed that regional income disparities vanish nearly automatically if there is no agglomeration. Consequently, the more adequate policy approach is one targeted at a decrease of the degree of agglomeration.

Let us assume that $m$ denotes the monetary transfer. Consequently, the disposable income in the poorer region increases to $Y_t + m - y_t^A N_t^A$. If we further assume that the monetary transfers depend on the aggregate income of the whole integrated area, i.e. that $m = \gamma\, Y_t$ (with $0 < \gamma < 1$), then the poorer region's demand for goods produced in the richer region changes to $\beta\left(1 + \gamma - R_t\right)$. This makes the dynamics of the degree of agglomeration change. Instead of Eq. (18), we now have

$$\frac{\dot{A}_t}{A_t} = kh\left(\beta\left(1 + \gamma - R_t\right) + \beta^A R_t\right) - g_N = kh\beta(1 + \gamma) - g_N + \left(\beta^A - \beta\right)khR_t \tag{23}$$

.

The determinants of the growth rate of regional income disparities remain unchanged. The new model is thus given by Eq. (17) and (23). The respective stationary solutions are

$$A^* = \frac{\alpha_0}{\alpha_1} \tag{24}$$

and

$$R_1^* = \frac{g_N - kh\beta(1 + \gamma)}{(\beta^A - \beta)\, kh} \tag{25}$$

.

Since however $\beta > \beta^A$, in order to assure the positivity of $R^*$, the condition $kh\beta(1 + \gamma) > g_N$ has to be fulfilled, and this is easily the case. Yet, then $R_1^* > R^*$, because $kh\beta(1 + \gamma) > kh\beta$. Hence, the intervention via transfer payments aiming at reducing regional income disparities leads to the contrary: regional inequality and the growth rate of agglomeration increase. The latter does so since $kh\left(\beta\left(1 + \gamma - R_t\right) + \beta^A R_t\right) - g_N > kh\left(\beta\left(1 - R_t\right) + \beta^A R_t\right) - g_N$ (cf. Eq. (18) and (23)). Thus, the opposite policy approach would seem to be promising if interregional cohesion is the main goal. Even if it is an idle question if the lagging region should be extra-taxed, the basic conclusion remains: an income support to the lagging region doesn't yield the desired outcome.

The reason for this seemingly counter-intuitive result is the way demand is "steered": the increased disposable income in the lagging region leads to increased demand, which is satisfied by enhanced production in the richer region. The result is a higher income in the latter, which ultimately leads to an increase of regional income disparities. This confirms the occurrence of an equity-efficiency trade-off that is also prevalent in the original Martin model, according to which transfers from the rich to the poor region lead to reduced income disparities and to a reduced degree of agglomeration and thus to less innovation and growth. Hence, in both versions of Martin's model (static and dynamic), a simple monetary transfer to the poorer region (no matter if it comes from the richer region or from the EU) involves an equity-efficiency trade-off. However, this trade-off has a different sign in the two cases: while in Martin's static context, the outcome is compatible with the equity goals, but fails to pass the efficiency test, the result in the dynamic context (and with an EU transfer) is an efficient policy enhancing overall growth, but at the expense of equity (both in terms of income and location).

If we examine the stability properties of the stationary solution, we find that the monetary transfer doesn't entail any qualitative changes. The Jacobian matrix now has the form

$$J\left(R^*, A^*\right) = \begin{bmatrix} 0 & \alpha_1 \dfrac{g_N - kh\beta(1+\gamma)}{kh(\beta^A - \beta)} \\ (\beta^A - \beta)kh\dfrac{\alpha_0}{\alpha_1} & 0 \end{bmatrix}, \tag{26}$$

with the eigenvalues

$$\lambda^2 = \sqrt{\alpha_0\left[g_N - kh\beta(1+\gamma)\right]}. \tag{27}$$

The solutions are again conjugated complex, thus our earlier statements regarding the evolution of the degree of agglomeration and the regional income disparities in the neighbourhood of the equilibrium remain valid.

However, there is a difference with regard to the length of the period, which now takes the value $\dfrac{2\pi}{\alpha_0\left[g_N - kh\beta(1+\gamma)\right]}$. The expression in (square) brackets has increased compared to

the situation without transfer payments, i.e. the regular cycles are shortened due to the transfer payments.

**5. Policy implications and conclusion**

As we have shown in Chapter 4.2, the effect of an EU transfer (e.g. in the context of the Union's cohesion policy) to the poorer region interestingly is to particularly increase income in the richer region, since the poorer region's transfer-induced additional demand for manufactured goods can only be satisfied in the richer region. This additional demand increases firm creation and agglomeration in the richer region, and thus the rich region's income (in line with Eq. (14), (15), and (23)). Ultimately (and absolutely), both regions gain: the richer region because of increasing incomes, and the poorer region because it can satisfy its demand for manufactured goods from the richer region better than in the situation before the transfer. Yet, in terms of the location/creation of firms as well as in terms of income, the richer region stands to gain much more from this EU regional policy intervention than the poor region. Hence, relatively speaking, the poorer region falls behind even further. Though the policy is efficient (for it increases aggregate growth in the integrated area), it is counterproductive if interregional cohesion is the main objective, given that the interregional differences with regard to firm location and income increase even more. What may be the policy response to tackle this equity-efficiency trade-off?

In this paper, we suggest a "two-step regional policy approach": Figure 5b illustrates once more the cyclical evolution of regional disparities and agglomeration. EU cohesion policy should not try to counteract or reverse these cycles, but try to use them and benefit from them in order to stimulate overall efficiency in a first step and interregional equity in a second step. The first step that ought to be recommended to EU cohesion policymakers is to promote overall growth in the integrated area and in the richer region, which should act as the dynamo of growth – last but not least via transfers to the poor region, which stimulate demand for manufactured goods to be satisfied in the rich region, increasing firm creation and income there, while the poorer regions' consumers better can satisfy their needs thanks to the transfers. In terms of Figure 5b, this first step should be pursued up until Points 1a and 1b are reached, i.e. as long as agglomeration and the growth rate of regional disparities increase anyway. Before turning to an equity-oriented policy, the main objective of this efficiency-oriented first step is to "make the pie as big as possible, before cutting it into slices".

**Figure 5b: The evolution of agglomeration and regional disparities over time: the policy implications**
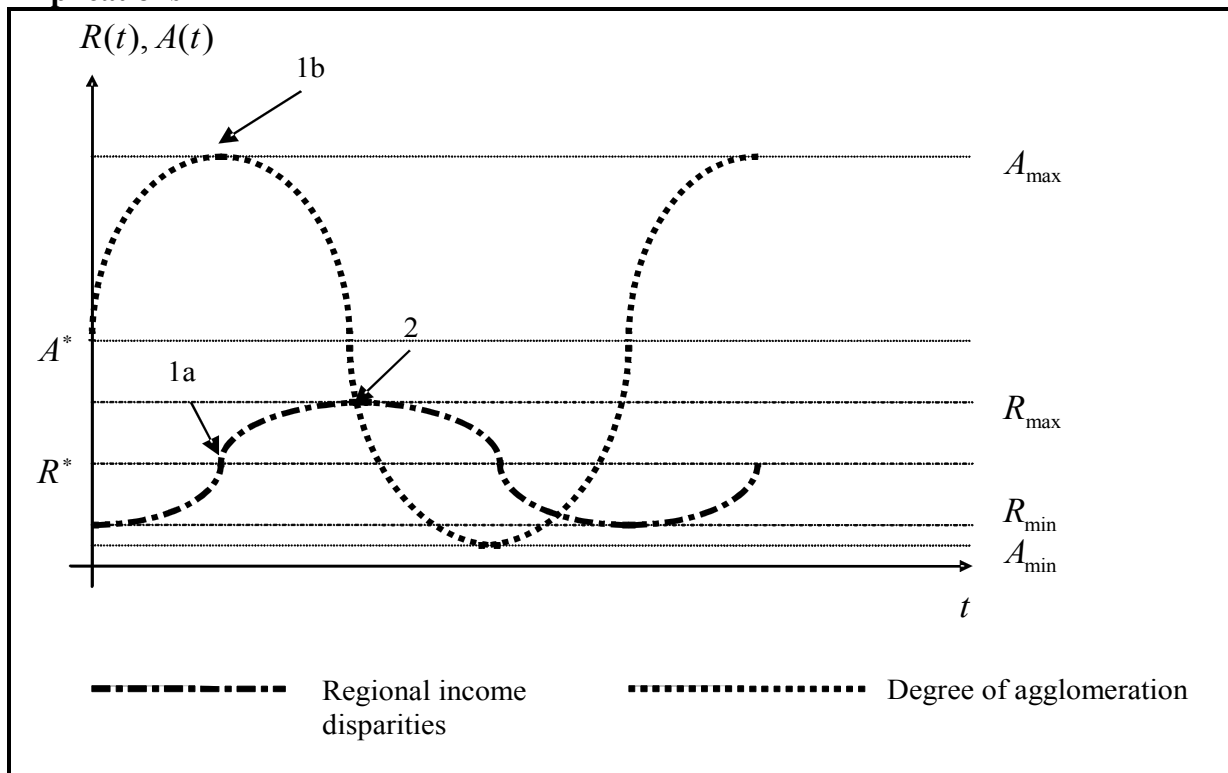


Point 1a is an inflexion point of the regional disparities curve: from there onwards, the growth rate of regional disparities decreases, before turning negative in Point 2. Moreover, from Point 1b onwards, the degree of agglomeration decreases. Hence, from Points 1a and 1b onwards, regional policymakers ought to give way to an equity-oriented policy, in order to enhance cohesion between the richer and the poorer region. This could be done by fostering the creation of innovative companies in the poorer region, so that $N_t - N_t^A$ increases. Thereby, $Y_t - y_t^A N_t^A = Y_t(1 - R_t)$, i.e. the income of the poorer region, increases, too. While agglomeration and regional disparities are reduced, the poorer region now gets an increasing share of the pie – a pie whose size has been increased by the first step of the policy approach.

The more these newly created companies in the poor region are able to benefit from spillovers and knowledge/technology transfer (particularly from companies in the richer region), the more productive they will be, and the more efficient the overall policy will be – apart from being equity-oriented, which is the main objective in this second phase. Ideally, this second step policy even entails efficiency gains (which is the case if the firms newly founded in the poorer region are more productive than those in the rich region (cf Footnote 5)). Hence, there clearly seems to be a case for a regional policy targeted at the transfer of innovation, technology and knowledge to the poorer region in this second step of a two-step regional

policy – instead of the monetary transfer that dominated the first step. This innovation-oriented policy clearly resembles the policy advocated by Martin (1999a, pp. 20-21), who argues for policies that "would have the objective of increasing the capacity of poor regions to absorb new technologies and to increase spatial diffusion of innovation."

Clearly, our "two step regional policy approach" combines what growth pole concepts (cf Chapter 2.3) aspire to achieve: first enhance growth in a favoured centre, and then build on spread effects starting from this centre, favouring the periphery and thus leading to interregional cohesion. The problem of most growth pole concepts is that they do not deliver a policy recipe for this second part of the story: typically, spread effects are assumed (to fall like "manna from heaven"), but there is no concrete strategy in case they don't materialise – an example are the new German Bundesländer, where the existing growth poles are still too weak to make up for spread effects: consequently, the periphery does not grow, and development remains concentrated in a very limited number of growth poles.

Another advantage of the "two step regional policy approach" is that it solves one of the main problems due to the political economy of regional policy: governments always feel a strong pressure "to be seen to be doing something for the less-favoured regions" (Parr, 1999, p. 1206). Hirschman (1958, p. 190) already argues that the most pervasive tendency of governments is "the dispersal of funds among a large number of small projects scattered widely over the national territory". Governments thus often ignore the more efficient part of regional policy – to support the dynamos of growth. In the "two step regional policy approach", this important aspect is duly taken into account: first the growth poles are favoured (something that may be politically difficult to push through), and only then – when the basis for an equity-oriented policy is created – a clearly equity-oriented regional policy is pursued, fostering firm creation based on innovation spillovers and knowledge transfer.

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