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PUBLIC INFRASTRUCTURE POLICIES AND ECONOMIC GEOGRAPHY

Abstract: This work proposes a simple way to analyze some of the effects of regional policies on industrial (economic) geography, regional income disparities and growth. For this purpose, it is used the "localized spillover" model, in which both the location and the endogenous growth rate are simultaneously determined. The model is extended to allow explicit consideration of different public policies such as infrastructure policies, transfers and subsidies to technology transfers, etc. An important message of this work is that the presence of localized technology spillovers implies that a trade-off exists between spatial efficiency and equity when infrastructure policies reduce the transport costs either between or inside regions. Public policies that facilitate the interregional diffusion of technology spillovers have very different implications and do not have this trade-off. European policy makers believe that regional policies are not only necessary to improve equity but also efficiency. To give a change to this argument, this work presents an analysis of regional policies in the presence of congestion effects. Multiple equilibria may appear even with capital mobility: a "good" equilibrium with high growth and low spatial concentration and a "bad" equilibrium with low growth and high spatial concentration. In the presence of congestion costs, policies that improve infrastructure in the poor region can improve growth and reduce inequality. Again, however, policies that facilitate the interregional diffusion of technology spillovers are better.

Key words: "localized spillover" model, public policies, economic geography

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Introduction

The economic-geographical categories "regional development", "local development" etc. have gained significant importance and popularity in the democratic present of Bulgaria. In the context of our Euro-Atlantic and pro-European orientation, various governing bodies of state and municipal governments have begun to deal with these concepts and impose, in a template manner, the policies and values that they carry.

It is appropriate to acknowledge and take into account what has been done over the last 25 years of transfer from a centrally planned system towards a capitalistic restart of the Bulgarian economy. A legislative framework has been created in the field of regional development, after a few unsuccessful tries, which has identified the main priorities of development and the toolkit required for achieving the goals set. The efforts of the Bulgarian administration continued "top-down" as a result of which, a dense network of strategic and forecasting documents was created, which defined and navigated through the measures for addressing specific territorial, socio-economical etc. problems of the people.

However, 8 years after adopting the last date law for regional development and almost a decade of joining the EU, is that the Bulgarian regions fail to achieve the appropriate "programmed", balanced and sustainable growth, on the contrary, worsening processes of impoverishment, marginalization of large social groups and depopulation can be observed. Our country is stalling and is failing to materialize its potential despite of "attractive factors": low taxes, low-paid labor, and cheap industrial land and so on. It is paradoxical that Bulgaria is at the top of various rankings in the EU-28, both with positive and with negative signs in the same area. The question then arises how, provided that: a full synchronization with the European policies, highly effective utilization of funds, and constant economic growth for the past 4 years, despite of the crisis, are all present, we fail to get back on "the right path". The meaningless and chaotic application of some "good practices" or the literal translation and application of the legislation of Western partner countries in this area, without taking into account the empirical resources in Bulgaria, leads to strong formalization and downright regional political impotency.

The reasons for that can be sought in different directions. This work does not intend to criticize the status quo or to illustrate only the negative aspects of the processes of regional and economic development in Bulgaria, but to support the statement and good practice of an array of developed countries that there exists a strong link between the economic geographical science and the programming and management of public policies. It is necessary to trust and enable the intellectual and science thought to demonstrate its qualities which, undoubtedly, and proven, assist in the practical-applied modeling of economic processes in a given country or region.

This article does not claim to be a panacea or a benchmark for a change in the thinking of the administration that applies and implements the policies of regional and economic development of the country. It aims to demonstrate, that through the theoretical plots of different spatial models, assistance can be provided for improving the decision-making process, in terms of managing the territory, in terms of the necessity and justification for development of a transport and technical infrastructure, in terms of the localization of economic capacity etc.

This article offers a very simple way of analyzing some of the effects of regional policies on the industrial geography, the difference in regional income and growth. For this purpose, it is used the model of localized spillovers (Martin & Ottaviano, 1999) in which both the location and the speed of the industrial growth are defined. The model is extended to allow detailed examination of various governmental policies on infrastructure, transactions and subsidies, as well as transfer of technology. European politicians believe that regional policies are not only necessary for improving the capital cost, but also efficiency.

The localized spillovers introduced by Martin & Ottaviano (1999) is a model of endogenous growth, which shows that by adding such growth to economic geography models expands the range of features well beyond those of the Core-periphery model, presented by Krugman (1991).

The localized spillovers model moves one step further by showing that endogenous growth per se provides and additional agglomeration force while the strength of spatial spillovers acts as an additional dispersion force.

This model also shows that trade integration can help an economy to take off at the price of regional imbalances. This creates a trade-off for peripheral regions between the static loss due to lower real income and the dynamic gain due to faster growth.

State Goals: Growth and Geographical Effects

An extended model of localized spillovers

The main structure of the model has two regions (north and south), two factors (labor and capital) and two sectors for consumer goods (manufactured goods, M, and homogenous goods, A). The manufactured goods sector is marked with a Dixit-Stiglitz monopolistic competition (Dixit & Stiglitz, 1977), and its production is subject to trade expenses of an iceberg type. The 'A' sector is a "Walrasian" type and its production is traded freely both within and between regions. The capital is used only in the manufacturing sector and in a very specific manner. Each variation of the manufactured good requires one unit of capital as a fixed cost, while all variable costs equal the labor resources. Good A is manufactured by the method of constant returns, using labor as the only resource. The labor owners, as well as the capital ones, are not mobile between regions, but since capital is an "ethereal" factor, it can be put to use in the adjacent region. Let us assume, for ease, that capital is perfectly mobile, in the sense that, it can move between regions with no costs. The whole capital income is redirected back to the region, where its owner is. To allow for growth, the model has an innovation sector (sector I), which produces new units of capital. This sector uses only labor and, to allow for constant growth, it is assumed that the sector is subject to a learning curve, in the sense that, the quantity of labor required for the production of a new unit of capital decreases with the increase of the total number of units produced. The idea is that the accumulated experience from previous production improves the productivity of the current production. It is important that the model assumes this manner of knowledge distribution to be partially localized. This means, that the workers from the northern I sector learn more from northern innovations than from southern.

The extension of the model includes the addition of a new type of transport cost, and therefore, a new dimension for political interference. Specifically, we introduce transaction costs inside the regions (as usual, these costs include all costs to sell from a distance), so that trade costs exist both between regions (inter-regional trade costs), as well as within regions (intra-regional trade costs). We assume that public infrastructure can affect independently both types of costs.

Since state policies alter trade costs, they affect economic geography and, due to localized knowledge spillovers, this affects the growth rate on its end. The model displays, from theoretic point of view, a political compromise between collective growth and regional value of capital. This implies, that regional policies, which increase the regional value of capital, improving, for example, the infrastructure in poor regions with the goal to attract firms, might not generate the most favorable location for growth. This type of compromise should be found in many geographic models. Agglomeration truly creates advantages, because of increasing returns on firm's level, or because of spillovers, which generate the advantages of agglomeration as an external effect.

Inter-regional and intra-regional trade costs

For analytical convenience, we limit the territorial extent within the confines of each region, so that the cost of selling the variety of goods, produced from each local industry, to each local citizen, includes the intra-regional cost, iceberg type, labeled τD, while inter-regional costs are labeled τI (D and I are, respectively, abbreviations for domestic and international). Similar to Martin & Rogers (1995), we interpret these costs as directly linked to the quality of infrastructures. We will regard each decrease of τD as an improvement of intra-regional infrastructure, and each decrease of τI as an improvement of inter-regional infrastructure. For example, the construction of a highway between Rousse and Veliko Tarnovo is an improvement of the intra-regional infrastructure of Northern Bulgaria. The differences between intra-regional trade costs can also be interpreted as differences between the physical location of the regions.

Inequalities of nominal and real income

One of our main concerns is the impact of the various public policies on the economic geography, sn, on the geography of income and expenditure, sE, and on the growth rate of the world capital availability, g. The location of the firms has a significance for the stationary participants in our situation, because a region with more firms, also has the advantage of a lower price index. This is due to the fact, that for locally produced goods, the trade costs (intra-regional) are lower than those for goods imported from other regions. The perfect price index, which corresponds to our underlying CES function is:

$$P \equiv \Delta^{-a}, \quad P^* \equiv (\Delta^*)^{-a}; \quad a \equiv \frac{\mu}{\sigma - 1} > 0 \tag{1.1}$$

so, as usual, an increase in the share of firms in the North favors the people in the North and harms the people in the South.

1. *Continuous Transfer of Income towards the South*

We first look towards the direct monetary transfer to the South, which continues indefinitely. A convenient way for its modeling is for it to be viewed as a transfer of part of the capital wealth of the North to the capital wealth of the South, i.e. a decrease of *sK*. This and other policies can easily be analyzed, using the four quadrant diagram like the one in Fig. 1. The three expressions of equilibrium, (2), (3) and (4) are mapped, respectively, in the north-eastern (NE), south-eastern (SE) and north-western (NW) quadrant of the diagram. The points A express the initial equilibrium.

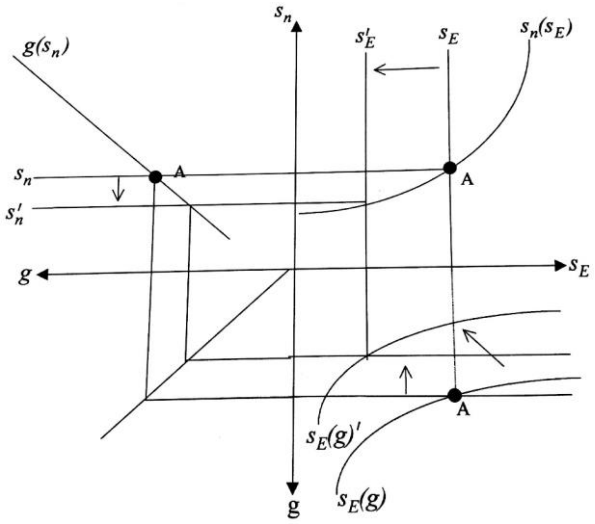


Fig. 1. Impact of the transfer of wealth

The initial impact of the transfer is to lower sE, for any given growth rate just like (3). This change is shown in the SE quadrant in Fig. 1. In turn, the transfer of purchasing power (sE decreases) increases the market share of the South, attracting firms there (sn decreases as shown in the NE quadrant). Due to the localized spillovers, the geography becomes more favorable towards innovation, so that the growth rate decreases (see HB quadrant). This economic geography from the point of view, both of the industrial location, as well as the nominal income, becomes less unequal, so that the inequality in real income decreases, but at the price of the growth rate. To summarize this, we present the following result.

> **Result 1. (transfer of incomes)**. *Transfer of incomes to the poor region lowers the inequality of income and the spatial concentration, but this lowers the growth rate of the entire economy.*

2. *A decrease in the Intra-Regional trade costs in the South*

Let us examine now a policy, which improves the local infrastructures in the South and, therefore, increases the freedom of trade between the various subjects there i.e. φ^*_D increases. The effect of such a policy is expressed with the help of Fig. 2.

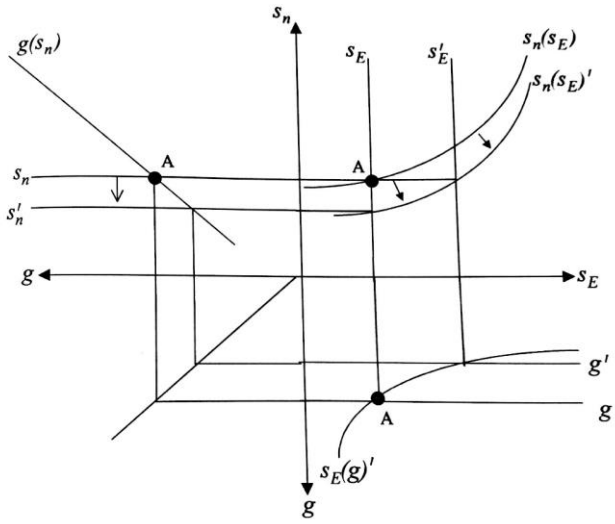


Fig. 2. Improved local infrastructure in the South

In this case, sn decreases for any level of sE (see NE quadrant in the diagram). The assumption is, that while public infrastructure improves, the expenditures for the distribution of goods, produced and consumed in the South decrease, increasing the effective demand. In the presence of increasing economies of scale, the firms in the differentiated goods sector move towards the South and sn decreases. Moving from the North, where the innovative sector is located, towards the South brings in its wake an increase in the innovation costs, lowering the growth rate of innovations. In this sense, an improvement in the infrastructure of the South generates a geography, less favorable for growth, and through decrease in the growth rate of innovations, lowers competition, increasing the monopolistic revenues in favor of the capital owners in both regions. Since the capital owners in the North are more, the inter-regional inequality of costs, calculated by sE, increases (see quadrant SE). Despite of that, the net effect on the real income inequality is unclear. The nominal income inequality has increased, but the price index has decreased in the South compared to the North. This is due to the fact that more firms produce in the South and the transportation cost for distributing locally produced goods to the consumers in the South has decreased.

> **Result 2. (local infrastructure).** *Infrastructure, which favors intra-regional trade in the South, lowers the spatial concentration, decreases growth in the entire economy and increases the nominal income inequality between the North and the South, and between labor and capital owners.*

3. *A decrease in the Inter-Regional Trade Costs*

The effect of improving inter-regional infrastructure in a way, which makes trading between regions more freely, can also be seen in Fig. 2. In this case, while the North has a bigger market share than the South, or while its own infrastructure is better than the one in the South (i.e. $sE > 1/2$ or $\varphi_D > \varphi^*_D$), this improvement in inter-regional infrastructure

will increase the attractiveness of the North, because, as we know from (2), $\partial s_n / \partial \varphi_1 > 0$ when these conditions apply. Therefore, the curve labeled *sn(sE)* shifts as shown in the NE quadrant and the effect of such policy is exactly the opposite, in qualitative sense, to the effect of lowering the intra-regional trade costs in the South. The result, that improved transport infrastructure between regions with different size increases regional agglomeration, in the sense that it improves the attractiveness of the biggest or wealthiest regions, would be valid in many "new models of economic geography", with or without growth.

The effect on regional real income discrepancies is unclear. The discrepancy in nominal income (as measured by sE) decreases, but the impact on the price indices in the two regions is more complicated. In the South, the increased freedom of inter-regional trade decreases the prices of imports from the North. Despite of that, since some firms move to the North (sn increases), more goods must be imported, having a higher distribution cost (inter-regional) than the one from locally produced goods. It may be shown, that the first effect is greater than the second, so that immediately after a decline in the inter-regional transaction costs, the price index in the South decreases. In the North, both effects point in the same direction. The price of imports of goods from the South decreases and more firms decide to produce in the North. It can be pointed out that the price index in the South decreases more than in the North. Therefore, the net result of the real income inequality is unclear. As it is shown from Martin & Ottaviano (1999), if prices per transaction between the two regions are low enough, the impact on price indices will not have a significant importance. Thus, an improvement in the infrastructure, which additionally assists in the decrease of inter-regional transaction costs, will decrease the real income inequality.

A decrease in the intra-regional transaction costs in the North would have the same effect in qualitative aspect as those described here for improvement of inter-regional infrastructures. To summarize this, we present the following result.

> **Result 3. (inter-regional infrastructure).** *An infrastructure, which stimulates the inter-regional trade between the North and the South, increases the spatial concentration, increases the growth in the entire economy and decreases the nominal income inequality between the North and the South, and between labor and capital owners.*

4. Policy aimed at Technology Distribution and Technological Knowledge

In the case of the policies described above, all regional in their nature, a compromise exists, because all of them possess an unwanted side effect. They lead to a lower growth, to a higher nominal income inequality or to more industrial agglomeration. The public policy, which makes technology distribution less localized does not face such a compromise, since making technology distribution more global is both in favor of growth, as well as in favor of technology spillovers. For example, a policy, which improves the telecommunication infrastructures, improves the internet access or focuses on human capital, might be interpreted as a policy which increases the parameter λ, by helping technology spillovers from one region to another. Someone might consider this type of policy as one that stimulates the trade of ideas, not goods. It might be argued that transport infrastructures, which stimulate the movement of human capital, would have

such an effect, because they stimulate "the transportation of ideas", which often requires face to face communication.

In this case, line g(sn) shifts to the left and the equilibrium growth rate increases while innovation costs decrease (NW quadrant in Fig. 3). More firms enter the market lowering the monopolistic power of existing companies and, therefore, the income of capital owners. This lowers the income differential between the North and the South, between labor and capital owners within each region, and leads to companies relocating to the South.

It can be shown how an external in its nature decrease in innovation costs compensates more than enough the external in its nature decrease in spatial concentration in such a manner, that the net result is an increase in the growth rate. It should be noted, that any policy, which reduces innovation costs, may achieve its goals of higher growth and more capital. If given subsidies for research and development, increased market competition on the commodity and labor markets, improved educational infrastructure etc. decrease innovation costs for firms, then this type of policy may carry more desirable results from traditional transfers or regional policies.

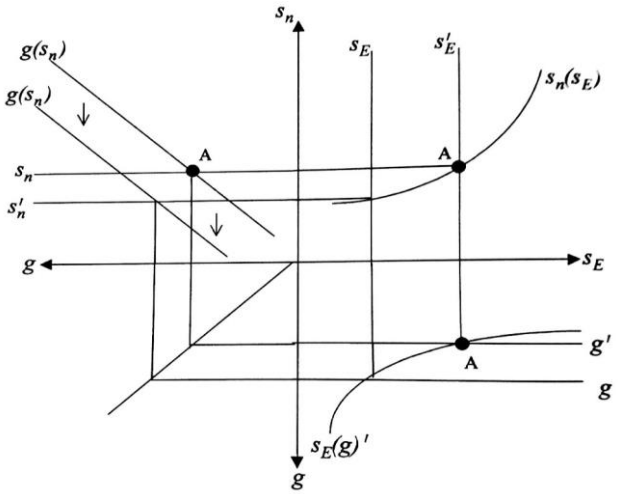


Fig. 3. Improved knowledge spillovers

Note that such a policy, which leads to economic activity transferring to the South, assists in the creation of new economic activities and firms without the presence of any local bias which is typical for regional policies.

Our analysis makes a strict distinction between policies, which decrease transaction costs of commodities and those, which lower the transaction costs of ideas and technology. This is useful, because in the case of the European Union, until recently, the attention was focused to the first type of policy. It should be clear, that our framework gives a strong justification in favor of the second type of policy, which does not face the compromise between capital value and efficiency, as well as the compromise between capital value, determined by space and capital value between individuals. Despite of that,

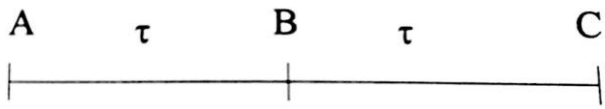
this result comes from the sharp analytical distinction, which we can make in our model, between transaction costs for the movement of commodities and ideas. Apparently, the reality is more complicated: facilitating the trade of commodities also facilitates the trade of ideas, simply because the trade of commodities often assumes, that the individual participants familiarize themselves with new technologies. To summaries this, we present the following result.

> **Result 4 (technology spillovers).** *Public policy, which facilitate inter-regional technology spillovers increases the growth in the entire economy, lowers nominal income inequality between the North and the South and between labor and capital owners, and lowers spatial concentration.*

5. *Transport Infrastructures in a Three Region Framework*

A drawback of the framework, developed in previous sections is, that it is a model with two regions (North and South) which, in their nature, are dots. This is important, in particular, for the result, which states, that a given poor region always loses industries, when transaction costs with a given rich region decrease. This may not be true in a three region model, if the poor region is at a crossroad between two rich regions. In this case the decrease in transaction costs between the poor region and the rich regions may in fact cause firms to relocate in the poor region. Therefore, the effect on public infrastructure depends entirely on physical geography. While the construction of a highway between Western and Eastern Bulgaria did not help the East, and might have even increased the industrial relocation towards the West, the same policy applied to a poor region such as Pernik in Western Bulgaria seem to have been much more favorable for the industrial relocation towards that region. Pernik province is a region in an industrial decline (specialized in the past in mining and metallurgy), which has benefited from important transportation infrastructure projects (highways, Bulgarian railway network, Sofia metropolitan area etc.). In this case, the decrease of transaction costs with rich regions – such as Sofia-city, Blagoevgrad – seems to have generated relocation towards Pernik. The fact, that this region, despite of it being poor, from the point of view of income per capita, is located on a crossroad between several rich and big regions, is key in explaining the effect of infrastructure policy. This effect is similar to the effect of centralized localization, analyzed by Krugman (1993).

In order to observe this position, we may extend our analysis to a simple model with three regions: the three regions are called A, B and C and we will assume that B is located between A and C. More specifically, firms, which export from A to C transport the goods through B and vice versa, so that the transportation costs structure is the following:



Therefore, transportation costs between A and C are τ^2 and τ between A and B, as well as between B and C. To ease the analysis, we assume that A and C are perfectly symmetrical (in terms of capital wealth) and that no intra-regional transaction costs exist.

We note that snB is the share of firms, located in region B, and sEB is the share of total costs in B. We assume that sEB < 1/3, so that region B is truly a poor region, because its share of capital wealth is, in its nature, less than a third. In this case it is easy to extract the equilibrium ration between the regional income inequality and the industrial location:

$$s_{EB} = 1/3 + \frac{(3s_{EB}-1)(1+\varphi)}{3(1-\varphi)^2} + \frac{2}{3}\left(\frac{\varphi}{1-\varphi}\right)^2 \quad (1.2.)$$

Two effects exist, which affect the choice of location of the firms. The first one, represented by the second term on the right side of equation (1.2), is the typical effect of the home market. If, as we assume, region B is poor i.e. sEB < 1/3, then this second term is negative and every policy, which decreases transaction costs (an increase in φ) will cause a decrease in the share of firms in the poor regions. This is the typical effect that we have already analyzed. Despite of that, a second effect appears with the defined geographical structure, which we have assumed, making region B 'a central region' despite of it being poor.

It is positive, because being 'central' is an attractive characteristic for firms. Positioning in B, despite of B not being, in its nature, a big market, assists in providing an easy access to the big markets A and C. We can see here, that a policy decreasing transaction costs between regions (an increase in φ) strengthens this effect and, due to this, prompts firms to relocate in the poor 'central' region. The two effects, of the 'home market' and the 'central position', move in opposing directions, so that an infrastructure policy, which leads to a decrease in transaction costs between regions, has an ambiguous effect on relocating to the poorer region. There will be a relocation towards the poor region, which is $\partial s_n/\partial\varphi_l>0$ if

$$s_{EB} > \frac{1-\varphi}{3+\varphi} \quad (1.3.)$$

Therefore, an infrastructure policy, which decreases transaction costs between a 'central' poor region and two rich regions will be successful in attracting firms towards the poor regions only if the size of the 'poor' regions market is not too small and/or if the existing transaction costs between the poor and rich regions are not too small. Another way to express that is to say that an 'empty' space, even on a crossroad between rich regions, cannot become an industrial base; a large enough market is required. Also, in order to be attractive as a location, saving transaction costs, these costs need to be large enough. This example shows, that the impact of the transportation infrastructural policy depends exceptionally on physical geography, the existing size of the market and on the existing infrastructure. To summarize:

> **Result 5. (three regions).** *A policy, which eases the trade between a centrally located poor region and two rich regions leads to a relocation towards the poor region, if the share of costs is high enough.*

Conclusion

This chapter showed how the models of economic geography can be utilized to analyze some specific questions of regional policy, such as the impact of public infrastructure on spatial agglomeration, the income inequality, and growth. When positive localized knowledge and technology spillovers exist, the spatial concentration of economic activity has a favorable effect on innovation and growth. This assumes, that public infrastructure policies should deal with a fundamental compromise between the regional capital value and productivity. Therefore, a policy investing in public infrastructure in the poor regions (i.e. one that facilitates intra-regional trade in the poor region) will attract firms toward the respective region. Despite of that, this makes geographical location a little less ineffective and less favorable to growth. Increasing capital returns, this policy also increases the income differential between the poor and the rich region. An infrastructural policy, which facilitates the trade between regions of different size would intensify regional inequalities, a result coming directly from the 'home market' effect. In this case, since geographical location would become more favorable for knowledge and technology spillovers, the growth would increase.

The Economy-Geographical science also consists of many other interesting aspects of regional policies which, when properly and knowledgeably read, would be of serious help on local and national politicians in power. Such are policies aimed towards state procurement, which are of potential importance, due to the effect they can have on regional demand and respectively on the industry location in models with effectiveness evaluation. This case has been studied by Trionfeti (2000, 2001) and Brulhart & Trionfeti (2000) who show that, from theoretical and empirical point of view, state procurement policies might counteract the forces of agglomeration. Financing of public infrastructures, on local, national or European level, is also an important problem. It has been studied by Martin & Rogers (1995) and analyzed in detail by Justman et al. (2001) who show, that it can lead to a process of financial agglomeration when the regions compete for quality of their infrastructure with the aim of attracting firms.

If infrastructural policies can attract other policies, then such policies might turn into strategical instruments in the hands of local and especially national governments, according to Maurer & Walz (2000). They show that strategical interaction can lead to an almost optimal provision of local infrastructure.

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ПОЛИТИКЕ ЈАВНЕ ИНФРАСТРУКТУРЕ И ЕКОНОМСКА ГЕОГРАФИЈА

Резиме: Економско – географске категорије "регионални развој", "локални развој" итд. су добиле значајну популарност у демократској садашњости Бугарске. У контексту Евро-атлантске и про-Европске оријентације, различита национална и општинска управљачка тела су почела да се баве овим концептима. Тужан закључак је да, након осам година од усвајања последњег закона за регионални развој и готово деценије од прикључења ЕУ, бугарски региони нису постигли одговарајући "програмиран", уравнотежен и одржив развој, већ се напротив, могу уочити процеси сиромаштва, маргинализације великих друштвених група и депопулације. Овим радом се показује да кроз теоријске оквире различитих просторних модела може бити обезбеђена помоћ за побољшање процеса доношења одлука, у смислу управљања територијом, неопходности развоја саобраћаја и техничке инфраструктуре, локализације економског капацитета итд. Овај рад нуди веома једноставан начин анализе неких ефеката регионалних политика на економску географију. За ту сврху коришћен је модел локализацијског преливања ("spillovers") који дефинише и локацију и брзину индустријског раста.

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