

Cluster Policy: A Strategy for Boosting Competitiveness and Wasting Money?

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Abstract

In this paper we take a critical view of cluster policy from a theoretical perspective. We argue that the concept of clusters is correctly based on agglomeration economies which imply externalities and complex non-linear dynamics of the respective economic system. This has fundamental implications for the dynamics of the system. Cluster policy can work because of agglomeration economies. However, agglomeration economies also imply major dilemmas for cluster policy which are in the areas of sectoral and temporal targeting and are discussed in this paper

Key words: cluster policy, agglomeration economies, externalities

1 Introduction

Since the publication of Michael Porter's book "The Competitive Advantage of Nations" [1] the popularity of term "cluster" has soared. In the academic world, on the one hand, it served as a new label and as a new rationale for older concepts of externalities and economies of agglomeration. In policy, on the other hand, it was welcomed as a flexible instrument for supporting industrial sectors and regions. A number of consultancy firms developed blue prints of cluster policies and began aggressively marketing the concept [2].

When we look around today, cluster policy seems to be the regional policy instrument of the early 21st century. Clusterland Oberösterreich GmbH [3] lists no less than 41 cluster and network initiatives for the small country of Austria, all of them implemented at a regional level. They display a substantial amount of overlap. Eight of the clusters are focussed on wood, furniture and construction, another eight on health, wellness and life sciences. Five initiatives respectively concentrate on various aspects of transportation, and on energy and environment. The Austrian country of Oberösterreich (Upper Austria) alone hosts 11 clusters and networks, which are coordinated by a privately organized company that is indirectly owned by the country of Upper Austria and other semi-public institutions. Being named "Clusterland Oberösterreich GmbH" ("Cluster Country Upper Austria Ltd.") the company carries the cluster inflation already in its name.

At a European level, cluster initiatives can be found in a broad range of countries (see [4], p. 24f). “Some of them have started clusters policies long ago—Catalonia and the Basque Country in Spain, Veneto in Italy, Scotland in the UK, Denmark, the Netherlands—while others have started within the last few years—a number of Austrian regions, the Czech Republic, the UK, Sweden—or have further developed them through national initiatives—France, Germany” ([5], p.4). The European Union supports various cluster initiatives, among them initiatives to improve the communication between cluster initiatives (see [6]). In their draft of “A European Cluster Memorandum” a “European Cluster Alliance” calls for the European Commission among other points to “Streamline the support it provides to cluster efforts through different programmes to enable a more effective use of the available instruments” ([5], p.6).

In this paper we want to investigate cluster policy from a theoretical point of view. We will distinguish strictly between clusters as a theoretical economic concept, which describes the spatial agglomeration of specific economic activities, and cluster policy as a policy instrument, which intends to encourage and support this agglomeration in order to generate a self sustained regional growth process. The main argument is that exactly the same agglomeration factors that lead to the formation of clusters work against cluster policy. The agglomeration factors yield a non-linear dynamic process which is path dependent, may yield multiple long term equilibria, and is therefore very difficult to predict. This makes cluster policy particularly difficult and implies very high risk of failure and wasting money.

The paper is organized in 4 sections. In the next section we briefly review the theoretical basis of the cluster concept. In section 3 we will illustrate the consequences of this theoretical basis for the behavior of the economy. We will specifically focus on the implications for cluster policy and demonstrate the main dilemma of this policy. The paper will close with a summarizing section.

2 The Theoretical Basis of Clusters – Agglomeration Economies

As has been pointed out by a number of authors ([2] [7] [8] [9] [10] [11]), clusters are a rather vaguely defined concept. Martin and Sunley [12] even suspect that the success of the cluster concept derives in large parts from its vagueness. This view is shared by Torre [8]. Kiese [2] goes even a step further: “In any case, fuzziness is most welcome with consultants, allowing them to sell the concept widely and to truncate, rewrap, adapt or amend it at their pleasure” (p. 270). Fortunately, for the argument of this paper we do not require a precise definition of clusters. The only element we need is one that is common in all cluster definitions we know: the existence of agglomeration economies. They are the factors that make the existence of a concentration of companies of a certain type attractive for the location of additional companies.

Marshall [13], who is considered the founding father of the concept of agglomeration economies, distinguishes three mechanisms that contribute to the advantage of agglomeration of economic activities: First, the linkages between firms in the value chain. Spatial proximity between firms that are in a buyer-supplier-relation allows them to save on transport costs and enjoy economies of scale. Second, Marshall argues that there is a thick labour market in agglomerated areas. For employers the agglomeration offers the advantage of a good choice of workers with the required skills. For workers a concentration of potential employers allows them to specialize and to develop and utilize sector specific knowledge. The third argument of

Marshall is that of technological externalities. “Good work is rightly appreciated, inventions and improvements in machinery, in processes and the general organization of the business have their merits promptly discussed; if one man starts a new idea, it is taken up by others and combined with suggestions of their own; and this it becomes the source of further new ideas” ([13] p. 225). The third one of Marshall’s mechanisms is particularly important from a cluster policy point of view as these knowledge spillovers are typically intended to be stimulated by cluster policy.

Agglomeration economies are “at the heart of modern cluster theories” [14]. Without the existence of agglomeration economies of any kind, economic activities would not cluster at all as they would be driven apart by increases in the prices of land and other inputs. But, agglomeration economies are not merely a factor that economists may or may not use in their lines of reasoning. As has been shown for example by Starrett [15] and Mills [16], as soon as we allow for transport costs, an economy without agglomeration economies collapses into a structure that is adequately named “backyard capitalism” [17]: . “Each consumer becomes a Robinson Crusoe producing for his own consumption” ([18], p. 3).

Cluster theory is not the only economic concept that rests solidly on agglomeration economies. The innovation systems approach (see [19] [20]) is another example. An even more prominent case is the new economic geography ([17] [18] [21] [22]), which utilizes the fixed cost digression of the Dixit-Stiglitz model to implement agglomeration economies. Venables [23] argues that despite different structures, arguments and spatial scope, all new economic geography models “require two building blocks. One is an understanding of the costs of distance, and the other is a description of the mechanisms that cause activity to cluster.” (p. 740)

In a technical sense, agglomeration economies are positive externalities interacting between the economic actors. A firm that decides to locate in a specific region takes into account its own costs and revenues, but not the agglomeration economies it may generate with this decision. Neither its potential contribution to the locational advantages of related production or to the thickness of the labour market nor the knowledge spillovers it may generate are decisive for the locating firm. For the regional economy as a whole they may be quite important. This has consequences for the path of development of the regional economy, for its sectoral composition, its competitive position vis-à-vis other regions, and for the social value of the development.

3 Dynamic Consequences of Agglomeration Economies – The Dilemma of Cluster Policy

Many regional scientists employ the assumption of agglomeration economies in the various theoretical contexts and argue in terms of technological and knowledge spillovers, thick labour markets, and the advantages of spatial proximity. Very few, however, spend any thoughts on the longer term consequences of these assumptions. And these consequences can be quite dramatic.

To illustrate the implications of agglomeration economies, let us borrow a very simple but quite illustrative model from [25]. They compare two versions of the model. In every period one unit is added to one of two containers by a random process. We can think of the containers as regions and of the units as firms. In the first version of the model the probability

that the firm is assigned to one of the regions, say region *A*, is fixed and constant over time. Because of the law of large numbers, in the long run the region's share of firms will approach the respective probability. There is one long run equilibrium that we can predict with certainty. If the process is disturbed by some exogenous event, once it has ended, its impact will be eliminated over time by the growth process.

In the second version, an externality is introduced into the model. Instead of constant and exogenously given, the probability that the next firm is assigned to region *A* is assumed to be equal to this region's current share of firms. The outcome of the assignment process at one time period not only changes the distribution of firms at that period, but also the chance of the future assignment processes. This adds an externality. The result is a so called Polya-process. Polya [26] showed that in the long run the relative frequencies resulting from this process tend toward a limit *X* with probability one, where "X is a random variable uniformly distributed between 0 and 1" ([27], p. 36). In other words, the distribution of economic activities will converge toward equilibrium, but, there are infinitely many equilibria possible and at the beginning of the process all are equally likely.

Note that the convergence toward an equilibrium value implies that the equilibria are equally likely only at the beginning of the process. When the process runs with every time period it adds to the stock of firms in the two regions which slightly narrows the range of reachable long term equilibria: equilibria similar to the current shares of firms between the two regions become more likely, those further away from the current share become less likely. This mechanism is referred to as path dependence. When viewed from a certain point in the process, the long term outcome of the process depends upon the path the process has taken up to this point. The expected long term result depends upon the previous path.

So, the model dynamics display multiple equilibria, path dependence and lock-in. Since there are an infinite number of equally likely equilibria, the long term outcome of the process is completely unpredictable at its beginning. Although the two versions of the model differ only by the added externality, their dynamics and long term results differ considerably.

What does this imply for cluster policy? First, when we compare the two versions, we see that the introduction of the agglomeration economies creates a case for cluster policy. In the first version, any policy intervention is fruitless, since the development eliminates its temporary effects over time. In the long run the share of region *A* always tends toward the given probability. In the second version, however, policy can move the system into a certain area where it will remain because of path dependence. Obviously, cluster policy makes sense only for those sectors of the economy which are characterized by agglomeration economies. Targeting the policy in terms of the sector is important. For sectors that lack agglomeration economies that policy will not work and simply be a waste of money.

It is difficult, however, for policy to identify those sectors that are characterized by agglomeration economies. The mechanisms are difficult to identify and observe directly, and the observable tendency for spatial agglomeration of a sector is not necessarily the result of agglomeration economies affecting this sector. It may as well result from spatially concentrated inputs or markets or the close linkage to another sector that agglomerates.

Second, the effect of the policy crucially depends upon intensity and timing of the policy. To demonstrate this, we run our model on the basis of different policy assumptions for 10,000

time periods, record the final share of firms for one of the regions, and repeat this process 10,000 times.

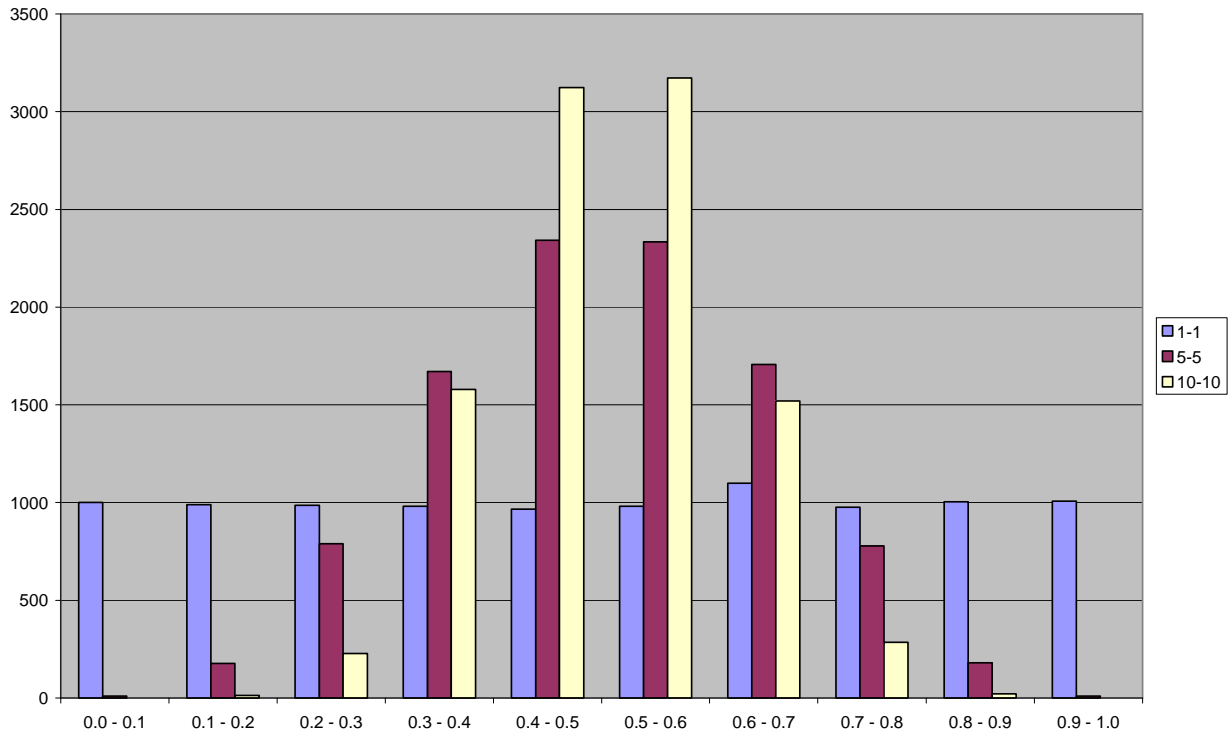


Figure 1: Distribution of long term shares at different start values

Figure 1 shows the distributions of the long term share of region A when we start with one firm in each region (1-1) or exogenously distribute the first 10 (5-5) and the first 20 (10-10) firms evenly between the two regions. The second and third alternative can be viewed as a policy that attempts to create a more even firm distribution between the two regions. As we see from the figure, this policy does increase the chance that the long term outcome will be close to an equal distribution between the regions. We also see that this effect is stronger the stronger our policy intervention is. Note that the policy is applied only to the first ten or twenty of 10,000 firms that are allocated in the whole process. So, because of the path dependence of the process the policy is highly effective.

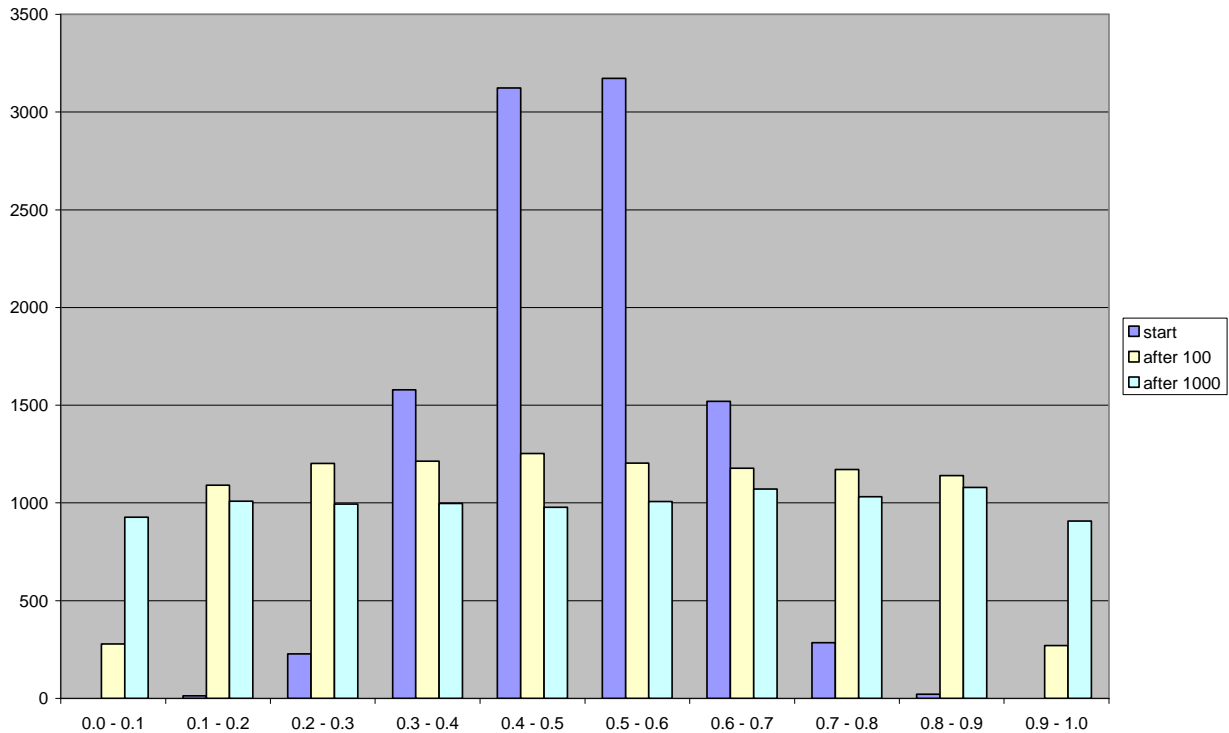


Figure 2: Distribution of long term shares with 10-10 policy applied at different times

However, path dependence also works against cluster policy. Because of path dependence the policy works best when it is implemented at the beginning of the process. When we let the process run for a number of iterations and add the policy then, it is much less effective, since the process has already reached a certain stage of path dependence. Figure 2 shows the distribution of the long term result with the same policy applied at different period of the process. As a policy we exogenously set 20 firms, 10 to region A and 10 to region B. In the three versions shown in Figure 2 this policy is applied right at the start of the process (identical to the 10-10 option of figure 1), after 100, and after 1000 time periods respectively. When it is applied at the beginning, the policy strongly increases the chance for an approximately equal distribution of firms in the long run. In the other two cases, the effect of the policy is much smaller and mainly confined to the reduction of the chance of extreme outcomes. For cluster policy we can conclude that its effectiveness may differ depending upon the maturity of the process. The results of the previous model indicate that a young process will be much easier to influence by cluster policy than one where the allocation of firms in space has already been going on for a while. However, the mature processes are much easier to identify than the young ones. They have accumulated a noticeable number of firms and have demonstrated their growth potential in other regions. Really young processes consist of only a few small firms and are therefore easily overlooked by policy. The dilemma this implies for cluster policy is obvious: when it concentrates on those sectors that are easy to identify its policy is likely to fail because of the path dependence implied by the already well developed structure of the sector. When it tries to focus on the really young sectors, which are easy to influence, it runs the risk of missing the “right” sector and investing in the wrong ones, since these sectors neither have reached a critical mass of firms nor have accumulated a record of success. As it seems, most cluster initiatives prefer the first evil over the second one.

The results mentioned so far imply that the earlier a cluster policy is applied to the growth process of a sector the bigger is its chance for success. However, this is an artefact of the

model and not generally the case. To illustrate this, let us look at a slightly more realistic model [28]. This model combines a standard neoclassical growth model with a simple version of Marshall’s technology spillover argument. The latter is implemented in such a way that innovations are assumed to accumulate over time in each of two regions just like the firms accumulated in the previous model. The chance that an innovation is assigned to region A at a certain time is assumed to be equal to that region’s share in overall production. In a simple way this implements the argument that an agglomeration of economic activity is likely to generate more innovation.

The model considers two production factors; one which is mobile between the two regions (capital) and an immobile¹ one (we call it “labor”, but one can also think of it as land). Capital is accumulated over time according to a standard capital accumulation process and moves freely between the regions in reaction to differences in capital rents. Although labor is immobile, wages are equal to the marginal product of labor in the region and thus react accordingly. The regional level of production results from a Cobb-Douglas production function being applied to the amount of capital and labor and the accumulated level of innovations available in the region.

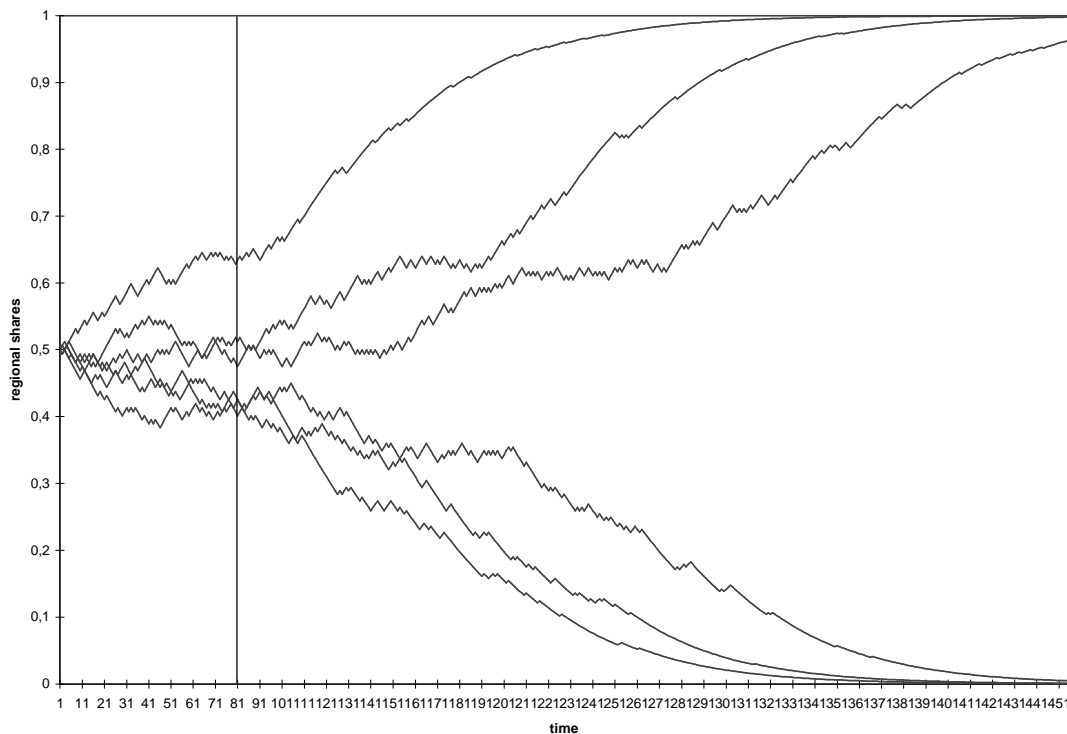


Figure 3: Six typical model runs

Figure 3 shows six typical runs of this model. The horizontal axis shows time, the vertical axis the production share of one of the regions. In all six runs the production share converges toward either a value of 1 or 0, meaning that production ends up strongly concentrated in one of the regions. This long term behaviour differs dramatically from that of the standard neoclassical growth model which always yields production to be equally distributed between the two regions. Again, the only difference between the two models is the agglomeration

¹ One of the factors has to be fixed. Otherwise all production would immediately move to the one region that has a temporary advantage and crash the model.

economies that we introduced by assuming that innovation will be more likely to occur in a region with a higher share of production.

From the equations of the model we can derive a relationship between the region's share of innovation and the probability that it will receive the next unit of innovation (for details see [28]). From this we can derive information about the dynamic behaviour of the model. As it turns out, the model has a fixed point at 0.5, when innovation and production are equally distributed between the two regions. The stability of this fixed point, however, changes over time. The condition for stability is $N \leq \frac{2(1-\alpha)}{\tau}$, where α is the production elasticity of capital, τ is the growth rate generated by one timeunit of innovation, and N is the number of time periods the process has been running. Since the two parameters are given and N increases over time, whatever the parameter values, the model first runs through a phase where equal distribution of production is a stable solution and then enters a phase where this solution becomes unstable and more so with every iteration. In Figure 3 the border between the two phases is marked by the vertical line. In the first phase the model behaves similar to a neoclassical growth model tending toward equal distribution and with disturbances being washed away over time. In the second phase path dependence takes over and forces the production share in one or the other direction making the region either the winner or the loser of the process.

When cluster policy wants to ensure that the region is the winner, it faces an even severer timing problem than before. While in the model above cluster policy should be applied as early as possible, in this model it needs to come at just the right time, not too early and not too late. The right time, obviously, is when the model switches from one phase to the other. When the policy is applied very early in the first phase of the process, by the time of the transition to the second phase, its effect will mostly be washed away by the process's tendency toward the equal-shares equilibrium. When the policy is applied too late, path dependence may have pulled the region already too far toward the losing end such that the policy will not change the long term result. In both cases the money spent on cluster policy will be wasted.

To be effective, cluster policy will have to be timed around the period of the transition between the first and the second phase. However, this period is difficult to identify for policy makers. In the first phase, the model behaves like a neoclassical model and does not even show any clear evidence of agglomeration economies. So, the respective sector does not even show clustering tendencies and may not be considered a target for cluster policy at all. The effects of the agglomeration economies may become apparent only after the model has entered the second phase. At this stage, cluster policy will have to react quickly and with sufficient funds in order to overcome the inertia of path dependence that has already set in.

We do not claim that the two models that we have discussed in this paper perfectly describe the economy. In reality the economy is much more complex than these simple models. The models show, however, that the introduction of agglomeration economies into the model, that is suggested by convincing theoretical arguments and an abundance of empirical evidence dramatically changes the long term dynamics of the models. In both our examples the version with agglomeration economies behaved completely different than the model without agglomeration economies.

While the introduction of agglomeration economies provides the conceptual basis for clustering of economic activities and cluster policy, even in our simple models it also generates serious dilemmas for the targeting of cluster policy:

1. sectoral targeting: the instruments of cluster policy can only work for sectors whose operation is characterized by agglomeration economies. However, agglomeration economies per se are difficult to identify and are typically only inferred from the observation of clustered spatial location patterns. These patterns are not necessarily the result of agglomeration economies in this sector but can result from spatially concentrated inputs or agglomeration economies in other sectors in the value chain. Moreover, sectors need to develop to a certain stage before their agglomerated location pattern can be observed.
2. temporal targeting: our models indicate that the effectiveness of cluster policy will depend upon the time when it is applied. The argument of path dependence that results from agglomeration economies suggests that cluster policy is more effective the earlier it is applied. Our second model, however, shows an example where early application of the policy will also be ineffective because of the equilibrating mechanisms of capital accumulation and capital mobility.

In order to apply the cluster policy effectively, cluster policy makers need to know much more than they typically do and realistically can. It is quite likely that most of the funds for cluster policy are applied to sectors and/or at times when their effect on long term growth and performance is negligible. These funds, of course, would be better used in other policy areas or on other sectors. Particularly the strategy of targeting those clusters that have been successful in other regions in the past appears dubious from this point of view.

4 Summary and Conclusions

In this paper we have discussed cluster policy from a theoretical point of view and raised the question, whether with reasonable probability cluster policy can lead to a self-sustained regional growth process. After a brief introduction which sketched some of the cluster policy initiatives in Austria and in the EU, we demonstrate that the concept of clusters is based upon agglomeration economies, a set of externalities which make it advantageous for economic activities to agglomerate in space. Cluster policy typically attempts to strengthen these mechanisms.

While agglomeration economies are a necessary prerequisite for the existence of clusters and for the applicability of cluster policy, they also make cluster policy conceptually difficult and very risky. As we show in this paper, agglomeration economies lead to path dependence of the respective growth process. This implies some serious dilemmas for cluster policy makers in terms of where and when to apply the policy. Sectors with agglomeration economies are difficult to identify for various reasons. Most of the time they are identified only indirectly by the identification of clusters when they have already formed in some regions. At this stage of development path dependence has already developed to such a state that it will be difficult and costly to overcome. As far as the timing of cluster policy is concerned, we show with two simple models that timing is crucial for the long term success of the policy and that the policy can be applied too late, but also too early, depending upon the form and parameters of the underlying development process.

We conclude from the discussion of this paper that because of agglomeration economies it is extremely difficult to identify the best target and the best timing for the application of cluster policy. Since cluster policy makers typically lack the detailed knowledge of the nonlinear dynamic process that generates clustered locational patterns, it is very likely, we conclude that in most cases funds invested in cluster policy have a negligible effect on the long term distribution of growth and cannot generate a self-sustained regional growth process. In most cases those funds are largely wasted and would probably be better used in alternative policies.

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References

- [1] Porter, M. (1990). *The Competitive Advantage of Nations*, New York: The Free Press.
- [2] Kiese, M. (2008). Cluster Approaches to Local Economic Development: Conceptual Remarks and Case Studies from Lower Saxony, Germany, in Blien, U., Maier, G., *The Economics of Regional Clusters: Networks, Technology and Policy*, Edward Elgar.
- [3] Clusterland Oberösterreich Homepage, <http://www.clusterland.at/> (Oct 3, 2007)
- [4] Observatory of European SME's (2002). Regional Clusters in Europe, Enterprise publications, Observatory of European SME's, 2002 / Nr. 3, http://www.competitiveness.org/filemanager/download/556/smes_observatory_2002_report3_en.pdf (Oct. 3, 2007).
- [5] Centre for Strategy and Competitiveness, CSC, Europe Cluster Observatory (2007). The European Cluster Memorandum, Promoting European Innovation through Clusters, Draft 12 July 2007, http://www.proinno-europe.eu/NWEV/uploaded_documents/Cluster_Memorandum.pdf (Oct. 3, 2007).
- [6] CLOE: Clusters Linked Over Europe homepage, <http://www.clusterforum.org/index.php> (Oct. 3, 2007)
- [7] Feser, E.J. (1998), 'Old and New Theories of Industry Clusters', in Steiner, M. (ed.), *Clusters and Regional Specialisation*, London: Pion Ltd.
- [8] Torre, A. (forthcoming) First Steps toward a Critical Appraisal of Clusters, in Blien, U., Maier, G. (eds.) *The Economics of Regional Clusters: Networks, Technology and Policy*, Edward Elgar, p. 31-42.
- [9] Wrobel, M. (forthcoming) Clusters and Networks: Their Spell Has By No Means Been Broken!, in Blien, U., Maier, G. (eds.) *The Economics of Regional Clusters: Networks, Technology and Policy*, Edward Elgar, p. 239-268.

- [10] Möller, J., Litzel, N. (forthcoming) Measuring Specialisation and Concentration in Regional Clusters – An Empirical Analysis for Eastern Bavaria, in Blien, U., Maier, G. (eds.) *The Economics of Regional Clusters: Networks, Technology and Policy*, Edward Elgar, p. 121-148.
- [11] Steiner, M. (1998), The Discreet Charm of Clusters: An Introduction, in Steiner, M. (ed.), *Clusters and Regional Specialisation On Geography, Technology and Networks*. London: Pion Ltd., pp. 1-17.
- [12] Martin, R., Sunley, P. (2003), Deconstructing Clusters: Chaotic Concept or Political Panacea?, *Journal of Economic Geography*, 3 (1), 5-35.
- [13] Marshall, A. (1920), *Principles of Economics*, 8th edition, London: Macmillan.
- [14] Maier, G., Trippel, M. (forthcoming) Location/Allocation of Regional Growth, in Capello, Nijkamp
- [15] Starrett, D. (1978). Market Allocations of Location Choice in a Model with Free Mobility, *Journal of Economic Theory*, 17: 21-37.
- [16] Mills, E.S. (1972). An Aggregative Model of Resource Allocation in a Metropolitan Area, in: M. Edel, J. Rothenburg (eds.), *Readings in Urban Economics*, New York: Macmillan, 112-123.
- [17] Fujita, M, P.R. Krugman, A.J. Venables. (1999). *The Spatial Economy: Cities, Regions and International Trade*, Cambridge, Mass: MIT Press.
- [18] Ottaviano, G.I.P, Puga, D. (1997) Agglomeration in the global economy: A survey of the 'new economic geography', *Centre for Economic Performance*, Discussion Paper No. 356.
- [19] Acs, Z. (Ed.) (2000) *Regional Innovation, Knowledge and Global Change*. Pinter, London.
- [20] Asheim, B. and Gertler, M. (2005) The Geography of Innovation, in: Fagerberg, J. Mowery, D. and Nelson, R. (Eds.), *The Oxford Handbook of Innovation*. Oxford University Press, Oxford, pp. 291-317.
- [21] Krugman, P.R., (1991a) *Geography and Trade*, Cambridge, Mass.: MIT Press.
- [22] Krugman, P.R., (1991b) Increasing Returns and Economic Geography, *Journal of Political Economy*, 99: 483-499.
- [23] Venables, A.J. (2006). Economic Geography, in B.R. Weingast, D. Wittman, *The Oxford Handbook of Political Economy*, Oxford University Press, 739-754.
- [24] Alecke B, Alsleben, C., Scharr, F., Untiedt, G. (forthcoming) Geographic concentration of sectors in the German economy: Some unpleasant macroeconomic evidence for regional cluster policy, in Blien, U., Maier, G. (eds.) *The Economics of Regional Clusters: Networks, Technology and Policy*, Edward Elgar, p. 215-238.

[25] Arthur, W.B., Ermoliev, Y.M., Kaniovski, Y.M. (1987) Path-Dependent Processes and the Emergence of Macrostructure, *European Journal of Operational Research* 30: 294-303.

[26] Polya, G. (1931) Sur quelques Points de la Théorie de Probabilités, *Annales Institute H. Poincaré*, 1: 117-161.

[27] Arthur, W.B. (1994) *Increasing Returns and Path Dependence in the Economy*, The University of Michigan Press, Ann Arbor.

[28] Maier, G. (2001) History, Spatial Structure, and Regional Growth: Lessons for Policy Making. In: Johansson, B., Karlsson, Ch. and Stough, R.R. (eds.) *Theories of Endogenous Regional Growth: Lessons for Regional Policy*, Springer, Berlin: 111-134.

[29] Blien, U., Maier, G. (eds.) (forthcoming) *The Economics of Regional Clusters: Networks, Technology and Policy*, Edward Elgar.