HALTING THE RURAL RACE TO THE BOTTOM:
AN EVOLUTIONARY MODEL OF RURAL DEVELOPMENT TO
ANALYSE NEO-ENDOGENOUS POLICIES IN THE EU

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AN EVOLUTIONARY MODEL OF RURAL DEVELOPMENT TO ANALYSE NEO-ENDOGENOUS POLICIES IN THE EU

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Abstract
The article contributes to the understanding of neo-endogenous rural development policies from the perspective of evolutionary game theory. Rural development is modelled as the increasing realisation over time of gains from interaction by rural stakeholders. The model exhibits two dynamically stable equilibria, which depict declining and prospering regions. Neo-endogenous policies are interpreted as stimuli emerging from an external government authority which help decentralised actors to coordinate on the superior of the two equilibria. External intervention may thus be possible and desirable without giving up the autonomy of local decision makers. However, because initial conditions matter, outcomes cannot be planned or engineered from the outside.

Keywords: Rural governance, neo-endogenous policies, evolutionary game theory, collective action.
JEL-codes: C73, R23, R58.

1 Introduction
In its widely acknowledged publication “The New Rural Paradigm” (2006), the OECD identified a vicious circle characterising the economic situation in many rural regions of its member countries. The mutually reinforcing elements of this circle include a low population density, which leads to a lack of critical mass for services and infrastructure, which in turn implies lower rates of business creation. Fewer businesses result in fewer jobs, which induces out-migration and ageing, which again lowers the population density of a rural area, so that the circle is closed (see OECD, 2006, 24-37, for supporting evidence). A natural question that arises from this diagnosis is how the circle can be broken. The strategy advocated by the OECD is to enter a “New Rural Paradigm”, in which traditional agricultural sector policies are replaced by territorially-oriented rural policies. The programme LEADER of the European Union (EU) is one of the leading policy examples of the “New Paradigm”. It provides funding for area-based local strategies to induce rural development by innovative projects of resource valorisation, enhancing competitiveness, and networking. Strategies are supposed to emerge from bottom-up initiatives developed by local stakeholders.

The aim of this article is to contribute to the understanding and interpretation of LEADER-type policies from the perspective of evolutionary game theory. So far, the emerging debate on what LEADER-type policies are, how they affect economic and social development processes, and where they are to be located in the social science of rural development has largely been dominated by sociologists, geographers, and rural planners. Ray (2006) aptly called these policies “neo-endogenous”, as they advocate development along a bottom-up trajectory. Localities can effect change in their favour, and need not become victims of broad, exogenous, political and economic forces. At the same time, there is some type of intervention in the form of rural policies, “neo” thus stressing the influence of the extralocal. Ray (2000) labelled LEADER both a modern and a post-modern form of intervention, stressing that the commitments made by the public were small in terms of financial volume, but that they allowed a surprising element of “anarchy” in terms of latitude localities have in decision making. Böcher (2008) established the link between LEADER and the concept of regional governance, highlighting the self-governing responsibilities of regions, the co-operation of different types of actors, and the role of competition among regions.

Economists have been mostly silent on how to theorise such policies and how to analyse their role in the dynamics of rural development. My contribution is to outline a formal model of rural development based on evolutionary game theory that fills this lacuna. The evolutionary game depicts

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what I call a rural race to the bottom, i.e. the simultaneous outmigration and investment inactivity observed in many rural regions. It is based on a one-shot asymmetric coordination game and models the interaction of two subpopulations (the Mobile and the Immobile), each with two strategies (stay/move and invest/abstain), which are paired once per period. Strategies are periodically updated based on successful outcomes of the previous period. Idiosyncratic deviations from best-response are possible, thus introducing the possibility of innovation. Equilibria of this game are reached via the concept of Evolutionary Stable Strategies (ESS). There are two equilibria: “Decline” resulting from move/abstain, and “prosperity” resulting from stay/invest, that is the successful realisation of an endogenous project. The former equilibrium is Pareto-inferior to the latter.

In this evolutionary game I nest a collective action game which can be stimulated by external finance, for example as in the form of LEADER funding. Collective action is modelled as a self-reinforcing process once a critical participation rate is reached. The determining factors of a successful change of regime from decline to prosperity are the individual propensity to participate, the level of financial support through policy, and the pay-off to the endogenous project vs. the agents’ reservation wage. The conditions are hence outlined under which such “governmentally-induced spontaneous order” can move a rural region from an inefficient downward spiral to a growth trajectory. Finally, implications for policy making and further empirical analysis are spelled out.

2 Neo-endogenous rural development policies in the EU

LEADER is relatively well-known and has been implemented in all EU member states, I therefore take it as a prime example of a neo-endogenous policy. However, note that there are other programmes at the national level which follow similar design principles, such as “Regionen Aktiv” in Germany and “Proder” in Spain (OECD 2006, 91). LEADER abbreviates “ Liaison Entre Actions de Développement de l’Économie Rurale”, meaning “Links between the rural economy and development actions”. According to European Commission (2006), there are seven principles governing this policy approach: (1) It focuses on local development strategies that are area-based and not primarily of a sectoral nature, (2) it follows a bottom-up approach, thus giving local stakeholders a voice and power of decision making, (3) it supports and requires the establishment of local public-private partnership, the so-called local action groups (LAGs), (4) it puts much emphasis on facilitating innovation, (5) activities need to be integrated in that they include different economic, social and environmental players, (6) there should be networking among different LAGs, and (7) this networking may be intensified to establish comprehensive cooperation among regions.

Moving away from the traditional production focus of the Common Agricultural Policy (CAP), LEADER is thus multi-sectoral, decentralised, participatory, and community-driven. Its LAG’s are based on regional partnerships between governmental and private actors with the intent of creating local development strategies based on local capabilities. Established in 1991, LEADER went to three generations called LEADER I (1991-93), LEADER II (1994-1999), and LEADER+ (2000-06). After 2007, LEADER became “mainstreamed” and currently represents the horizontal axis in the rural development pillar of the CAP. The European-wide number of LAGs increased from 217 in LEADER I to 893 in LEADER+ in 2007, while funding was raised from 442 million EUR in LEADER I to 2105 million EUR in LEADER+ (European Commission, 2006, 7). However, the relative share in total rural development funding remained relatively small, representing six percent of EU funding for rural development in 2007-2013.

LEADER is available for funding two types of activities: on the one hand, it financially supports regions to run a LAG and to engage in regional management. On the other, it provides funding for specific projects implemented by the LAG, which under LEADER+ typically have focused on the valorisation of natural and cultural resources, the improvement of the quality of life, enhancing local value added, on knowledge and new technologies to improve rural competitiveness, and on networking activities (European Commission, 2009). In order to qualify for funding, private and social stakeholders (associations) need to contribute at least 50 percent of the partners to the LAG.
3 Modelling rural development as a dynamic coordination game

3.1 Preliminary considerations
A decentralised and diversified programme like LEADER poses a considerable challenge for theoretical analysis. At the outset, it therefore seems useful to formulate the desiderata for such an analysis. One aspect that deserves highlighting is recognised by the policymakers themselves: LEADER is a policy that suggests how to proceed, not what needs to be done (European Commission, 2006, 8). It therefore differs substantially from established agricultural or regional policy measures which focus on funding specific activities, such as investment in farm assets or infrastructure, or environmental services. The focus of LEADER-type policies is rather on organisational principles and governance. Required is thus a theory of organisation and interaction, not allocation, as is traditionally used in agricultural sector analysis.

Furthermore, the process of “rural development” needs to be interpreted and specified. As I put emphasis on endogenous rural development, the interpretation should be in a way that stresses the action and interaction of local stakeholders. In addition, I request that the model is dynamic so that it allows the analysis of rural development over time. It should be consistent with the vicious circle outlined above, that is a self-reinforcing process of decline. If we assume that this process can potentially be overcome, an implication is that multiple equilibria are possible and declining and developing regions co-exist. Finally, a pathway is needed how external stimulus or animation, that is the presence of LEADER-type policies, can affect the development dynamics of the model. This also requires a specification of how these policies work and how they affect the actions of stakeholders in the model.

In the following, I try to show how evolutionary game theory can be used to formulate a model of rural development that principally meets these requirements. In the model, “rural development” is interpreted as the increasing realisation over time of gains from interaction by rural stakeholders. In a highly stylised coordination model, some basic features of migration behaviour, business creation, and (lacking) entrepreneurship of the rural population are captured. This model has two equilibria, of which one is Pareto-superior to the other. Evolutionary game theory allows to study the properties of the model by assuming it is played repeatedly over time. I suppose that learning and innovation by adopting successful strategies of peers are possible. The process accommodates two dynamically stable equilibria, which depict declining and prospering regions. Which equilibrium is reached depends on the initial situation of a region and thus exhibits a path dependency. LEADER-type policies are interpreted as financial programmes that induce collective action on the side of the local stakeholders to overcome Pareto-inferior interaction outcomes in a given region and period. These policies are assumed to potentially break the path dependency. Given these policies and the characteristics of a region, there is a likelihood that the rural race to the bottom can be turned into an upward growth trajectory for that region.

3.2 Migration and rural business creation: a simple coordination game
In order to sketch a very simple model of the rural development process, I assume the rural population can be separated into two groups, the Mobile and the Immobile rural residents. Representatives of these two groups are assumed to interact following the payoff schedule shown in Table 1. The basic idea of the game is that there exists a potential development project such as a business idea that requires the presence of both Mobile and Immobile. If they coordinate on the realisation of this project, the Pareto-superior growth equilibrium is reached. If they fail to coordinate and Mobile leaves the rural area, the inferior decline equilibrium results. In a later step, an external policy is introduced that aims to support coordination on the superior equilibrium. I now explain the details of the model.
Table 1. The rural coordination game

<table>
<thead>
<tr>
<th>Mobile stays in rural area</th>
<th>Immobile invests locally</th>
<th>Immobile abstains to invest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile moves to urban area</td>
<td>$y, y$</td>
<td>$w_y, w_y$</td>
</tr>
<tr>
<td></td>
<td>$w_u, 0$</td>
<td>$w_u, w_r$</td>
</tr>
</tbody>
</table>

Note: It is assumed that $y > w_u > w_r > 0$. $y$ is the (equal) net payoff of an endogenous rural project carried out jointly by Immobile and Mobile, and $w_u, w_r$ are the urban and rural net wage rates, respectively.

Nash-equilibria are marked by underbar.

Source: Author.

Mobile has the option of leaving the rural for an urban area outside the model or stay in the rural area. Mobile may belong to the younger or more educated group of residents. Moving involves additional benefits (higher income) but also costs (such as higher housing costs or commuting to family members). The moving option yields a net income of $w_u$, the urban wage, as shown in the bottom row of Table 1 (left entries in the payoff cells). Alternatively, Mobile may stay, in which case the payoff depends on the behaviour of Immobile.

Immobile residents cannot move, for example because they have little chances on the urban job market due to a lack of suitable qualifications, they made irreversible investments in the past, or because their demographic situation does not permit this (because of old age or dependent family members). As a default, Immobile are assumed to pursue a low-paying activity with a payoff of $w_r$, the rural reservation wage (right entries in right column of Table 1). Immobile can nevertheless invest in a local project. This project may be a business idea, such as touristic development, or new ways of marketing agricultural products. Investment by Immobile may be financial, but may also be based on ideational commitment or the contribution of working time to the realisation of the project. If successful, this investment implies the move from a low to a high payoff activity for Immobile.

A key feature of the model is that the high payoff requires the presence of Mobile in the rural area. For example, the skills and knowledge of Mobile may be indispensable for the success of the project, or the available labour force may simply be insufficient if Mobile moves. If Immobile invests and Mobile stays, both earn $y$, the payoff of the project which, for the sake of simplicity, is assumed to be of equal size for both (top left entry in Table 1). Furthermore, it is assumed that $y > w_u > w_r > 0$. If Immobile does not invest and Mobile stays nevertheless, both earn $w_r$ (top right entry). If Mobile moves although Immobile invests, Immobile gets nothing (bottom left entry) and the project fails. Mobile’s and Immobile’s actions are thus strategic complements. If Mobile stays, Immobile’s potential investment return rise. If Immobile invests, Mobile’s potential payoff from not moving rises also.

Using traditional solution concepts of non-cooperative game theory (Dixit and Skeath, 2004, 86-90), this game has two Nash-equilibria in pure strategies, as indicated by underbars: (decline, move) and (invest, stay). However, (invest, stay) or what could be called the “prosperity” equilibrium is Pareto superior to (abstain, move), an equilibrium of “decline”, and also to the two non-equilibrium outcomes. It may thus be taken as depicting in a metaphorical way the up- or downward spiral experienced in many rural regions of OECD countries (OECD, 2006, 32).

3.3 An evolutionary game of endogenous rural development

The skeleton interaction problem outlined in the previous section shall now be used as a basis for a dynamic model of endogenous rural development. To do so I interpret the rural coordination game in the framework of evolutionary game theory. A hallmark of the latter approach is that it applies insights taken from evolutionary biology to the analysis of dynamic economic systems. The key biological mechanism adapted in evolutionary game theory is the dynamic selection process which changes the mix of phenotypes with different degrees of fitness in heterogeneous populations (see Dixit and Skeath, 2004, 425-463, and Bowles, 2004, 56-92, for introductions, and Weibull, 1995 for a formal treatment of the subject). In the evolutionary game, the decision makers of the classical game are modelled as populations which interact in real time and which each include as many phenotypes as
there are available strategies. The strong rationality assumptions used in classical game theory are replaced by simple adaptive behaviour. Individual strategies are interpreted as given phenotypes within a population. Their reproductive fitness is measured by the payoffs generated in the interaction with phenotypes present in other populations. The selection process is based on a rule that governs the periodically updated replication of strategies (the replicator dynamic). The structure of the population thus changes constantly over time unless it reaches an evolutionary stable equilibrium. Chance events or external stimuli may lead to mutations of the phenotypes, which may be more or less successful in invading the overall population. As fitter phenotypes dominate those which are less suited to the given environment, the latter die out. In economic games, mutations have the interpretation of innovative behaviour, while the replicator dynamic describing the selection mechanism formalises a process of imitation or social learning among peers in a given population.

The necessary ingredients of an evolutionary game are thus: (a) the definition of the interacting subpopulations, (b) the collection of phenotypes (strategies) in each subpopulation, (c) a matrix which defines the payoffs generated from interactions between phenotypes of different subpopulations, and (d) the selection rule defining the evolution of the relative shares of phenotypes in relation to their fitness (Dixit and Skeath, 2004, 430). Given the dynamic proliferation, mutation, and decay of the phenotypes, the interesting question addressed by such a model is which are its evolutionary stable equilibria (if there are any) and which processes determine how and why they are reached.

The following evolutionary model takes ingredients (a) to (c) from the game described in Table 1: the Mobile and the Immobile are the two populations of equal size with the phenotypes defined by the strategies move/stay and invest/abstain. The payoffs generated from interactions are given in the table. I thus work with a simple two-groups two-phenotypes evolutionary game. Note that the individual phenotypes have no freedom to choose their strategy at all, they are rather “born” to play one strategy. In each period, they are randomly paired with a phenotype from the other subpopulation. Such a two-population coordination game has been a workhorse in the literature on evolutionary game theory. In the following, I present some intuition on its properties coupled with the specific application to rural development. A more technical analysis of the general model can be found in Weibull (1995, 163-228).

Given the payoff matrix in Table 1, the expected payoffs to the interactions depend on the relative frequency of the two phenotypes of the other population. They are shown for each population of the rural coordination game in Figure 1 and Figure 2.

**Figure 1. Expected payoffs for Mobile**

![Figure 1. Expected payoffs for Mobile](image-url)
If we denote $\beta$ as the fraction of investing Immobile on the horizontal axis, Figure 1 shows the expected payoffs for Mobile from each of the two available strategies (move/stay) on the vertical axis. The lines are drawn for arbitrary values of the exogenous variables that satisfy $y > w_u > w_r > 0$. The expected benefit for the staying Mobile, $B_{ms}$, is defined as $B_{ms} = w_r + \beta y$, and thus increases in the fraction of investing Immobiles. The expected benefit for the moving Mobile is the constant urban reservation wage, $B_{mm} = w_u$. It is hence possible to calculate a critical fraction of investing Immobile, $\beta^*$, that is necessary to make “stay” the best response for Mobile. This fraction is defined by $B_{ms} = B_{mm}$, which can be solved for $\beta^* = \frac{w_u - w_r}{y}$.

**Figure 2. Expected payoffs for Immobile**

![Diagram showing payoffs for Immobile](source)

Similarly, Figure 2 shows the payoffs for each of Immobile’s strategies depending on the fraction of staying Mobile, $\alpha$. The expected benefit for the investing Immobile, $B_{ii}$, is $B_{ii} = \alpha y$. The benefit for the abstaining Immobile is $B_{ia} = w_r$. The critical fraction of staying Mobile that makes “invest” the preferred option for Immobile is given by $\alpha^* = \frac{w_r}{y}$.

The selection dynamic of the model is based on the assumption that each period, a fraction $\omega$ of each subpopulation updates their actions. Updating means that the phenotypes, which are simply the bearers of one of the two strategies, can switch to the other strategy. Whether they do so is determined by the expected success of the two strategies in the previous period and hence the relative fractions of phenotypes in the other subpopulation. If the strategy not borne by the phenotype has on average been more successful in the previous period, it is adopted. Otherwise, no switch occurs. For example, a moving Mobile may switch to “stay” if $B_{ms} > B_{mm}$ in the previous period. As a consequence, $\Delta \alpha$ and $\Delta \beta$ have the signs of $B_{ms} - B_{mm}$ and $B_{ii} - B_{ia}$, respectively. While this updating or learning process is not very sophisticated, making it less naïve, for example by extending the memory or limiting the knowledge about the distribution of types in the other subpopulation, does not fundamentally alter the outcomes of the model (Bowles, 2004, 408). The assumption that $\omega < 1$...
ensures that external shocks have a persistent impact as they are transmitted over many generations (Young, 1998).

Figure 3. State space in the evolutionary game

The state of the population at any time \( t \) is described by a distinct pair of \( \{\alpha, \beta\} \). Given the replicator dynamic explained before, the dynamics of the population may be depicted as in Figure 3. The critical fractions determining the switch between strategies define what could be called “tipping frequencies” (Bowles, 2004, 409), which in our case separate the state space into four regions as shown in the figure. In the southwest region of Figure 3, \( \Delta \alpha \) and \( \Delta \beta \) are negative, so that (move, abstain) are the most successful pairings of strategies. The population will thus move to \( \{0,0\} \), as denoted by arrows. Analogously, in the northeast region, the population will evolve towards \( \{1,1\} \). In the northwest and southeast regions, there is a set of \( \{\alpha, \beta\} \) combinations where the selection forces toward the northeast and the southwest equilibrium just offset each other. These are denoted by the dashed line running from the northwest to the southeast angle. States on this line move towards the \( \{\alpha^*, \beta^*\} \) combination (Weibull, 1995, 183). The latter is a polymorphic saddle equilibrium that is unstable, as it can easily be left by perturbations to the northeast and southwest. However, \( \{0,0\} \) and \( \{1,1\} \) are stable equilibria in the sense of absorbing states, which means that they are never left once the population has reached either of these states. As only one phenotype of each subpopulation survives, the outcome is called monomorph. The dashed line thus separates the state space into two basins of attraction for the \( \{0,0\} \) and \( \{1,1\} \) equilibria. The sizes of these basins are determined by \( \alpha^* \) and \( \beta^* \). The dynamic process hence has two stable equilibria, a property that is called non-ergodic. Both equilibria, once established, cannot be successfully invaded by another phenotype. The prevailing phenotypes in the equilibria are both an evolutionary stable strategy (ESS). Which of the equilibria is reached depends on the initial \( \{\alpha, \beta\} \), and thereby on the initial conditions of the system.
How does this model help to understand rural development processes? First, recall that the model interprets rural development as the successful coordination of two types of rural actors. The model supposes that the population of any given rural region can be divided into two subpopulations, the Mobile and the Immobile. It further assumes that there are gains to be had from productive interaction of staying Mobile and investing Immobile, but this equilibrium may or may not be reached. A fraction of both types of actors revises their behaviour on a regular basis, for example annually. In that year, the success of last year’s interaction is studied and consequences for the own future behaviour are considered. Over time, either a productive equilibrium, denoted “prosperity” in Figure 3, is reached, in which all Immobile invest and all Mobile stay. As a result, many “projects” can be realised or businesses be run. Moving Mobile and abstaining Immobile die out. However, it is also possible that the inferior equilibrium is reached, denoted “decline” in Figure 3, in which only moving Mobile and abstaining Immobile survive and everyone is worse off. Note how the evolutionary process gives meaning to the idea of endogenous development. As noted in the introduction, Ray (2006) stressed the bottom-up trajectory of this process, which characterises the decentralised, self-organised interaction of local stakeholders independent of external steering or planning. In the evolutionary model, this is interpreted as a process of “spontaneous order” that is determined by countless interactions of individuals. Adaptive agents carrying simple behavioural rules reach, by trial and error, an outcome whose aggregate properties are not known to them beforehand and are thus not pursued intentionally.

Figure 4. The basin of attraction for prosperity shrinks in disadvantaged regions

It is instructive to show how the exogenous variables of the model affect the likelihood that a randomly chosen region ends up in one of the two opposing equilibria. To increase the likelihood of reaching the prosperity equilibrium, \(\alpha^*\) and \(\beta^*\) as measures of persistence of “decline” must be small and the (invest, stay) equilibrium must be easy to reach. This is the case the lower the urban reservation wage \(w_u\) and the higher the payoff to the joint project \(y\). The role of the rural reservation wage is ambiguous. A large \(w_r\) makes abstaining more attractive for the Immobile and thus increases \(\alpha^*\). At the same time it makes staying more attractive for the Mobile, hence decreasing \(\beta^*\). In other
words, while a low rural wage tends to drive away the Mobile, it also increases incentives for the Immobile to help themselves. Regions that are disadvantaged in facing high urban wages in the target destinations of their Mobile and little potential for productive endogenous projects or businesses display a considerably smaller basin of attraction for \[\{1,1\}\] and a reduced likelihood of reaching the “prosperity” equilibrium (Figure 4).

Note how this simple model highlights a number of characteristics typical of the approach of evolutionary game theory (Bowles, 2004, 66): the model exhibits multiple equilibria, there is a historical contingency of outcomes or path dependency, local homogeneity (within regions) potentially coexists with global heterogeneity (across regions), and Pareto-inferior outcomes may be persistent. With regard to the basic analytical model, the evolutionary approach differs considerably from the traditional microeconomic market model. The latter emphasises the existence of a unique, Pareto-optimal equilibrium that is achieved by hyper-rational agents interacting in a perfect market environment, and is largely inspired by Newtonian mechanics (Petrick, 2008a).

3.4 Collective action in the evolutionary game
The evolutionary model presented here is consistent with a tradition in political philosophy descending from David Hume and Adam Smith to Friedrich von Hayek which stresses the self-organisation ability of society. Proponents of this view argue that no central authority can have the relevant knowledge to successfully solve the coordination problems of society, only strongly decentralised systems can achieve this. Such systems, it is argued, also have advantages in terms of local experimentation with making the best out of a given, ongoing order of social institutions (see Sugden, 1993, for a general discussion). With regard to normative questions of institutional change, this “spontaneous order” tradition is contrasting with a tradition of “institutions by design”, according to which social rules are best engineered centrally, for example by the state (Bowles, 2004, 58, 475; Hargreaves Heap and Varoufakis, 2004, 207). This external authority may be able to imagine better rules as an outcome of deliberate reasoning and impose them on actors. Adherents to this view like Thomas Hobbes in his classical work “Leviathan” argued that coordination should be achieved by constraining the choices of individuals. They saw the strong state in a favourable position to enforce the relevant rules.

With regard to rural development, this fundamental debate raises an interesting question that I will address in the remainder of the article. If a “laisser-faire” approach of decentralised and autonomous interaction in rural regions leads to undesired outcomes, such as the decline equilibrium denoted above, what can be done to avert this rural race to the bottom? In particular, what are the implications for public policy? Programmes like LEADER also emerged because there was a perceived dissatisfaction with highly centralised agricultural policy programmes whose main objective was to channel subsidies into the farming sector. LEADER was thus a key element in the paradigm change towards a European policy that considers rural rather than agricultural interests (Ray, 2000; Petrick, 2008b). Bearing in mind the calls for a more democratic and participatory policy that takes into account local resources and capabilities, a top-down policy package administered by a central authority cannot be the answer for declining rural regions. The problem is thus how the race to the bottom can be overcome under the condition that rural people are the best engineers and judges of their own fate. The answer our model gives is that this is possible only if both groups of actors play the rural coordination game in a different way. Given a “decline”-equilibrium, nonbest responses by both groups are necessary to navigate into the basin of attraction of the “prosperity” equilibrium. Under which conditions might such a change occur? Following Bowles (2004, 402-436), two broad pathways may be distinguished:

1. Change may occur as a result of chance events, or stochastic idiosyncratic play. The idea is that in the process of updating, there may be a positive probability that each individual may switch for idiosyncratic reasons. This may be due to experimentation, error, or another reason not captured by the model. For example, in the present game, the decline equilibrium will be left if, in a given period, more than \[\alpha^*\] moving Mobile decide to stay. As a result, “invest” becomes the best response for the Immobile in the next period. If more than \[\beta^*\] switch, the best response for the updating Mobile will in turn be “stay”. This pathway hence transforms the dynamic system into an ergodic one, with no absorbing states in the long run. The study of such processes is the domain of stochastic evolutionary game theory (Young, 1998). The major problem is that, similar to
biological evolution, the probability of change is very low and is thus likely only in the very long run. Furthermore, it is governed by chance events and thus completely arbitrary, unless the emergence of idiosyncratic mutations is specified in more detail. We will therefore not consider this pathway further here.

2. Alternatively, change may be induced by *intentional collective action* of players who have something to gain from an alternative equilibrium (Naidu and Bowles, 2005). This pathway may be viewed as introducing politics into the coordination game considered so far (Hargreaves Heap and Varoufakis 2004, 245). It will be used in the following to model the impact of LEADER-type policies. Given a prevailing state of play, this pathway assumes that players do not switch to nonbest responses accidentally, but as a result of intentional action. In addition, this intention may be due to an external policy stimulus. Neo-endogenous policy programmes as considered by Ray (2006) may thus be interpreted as something like “governmentally-induced spontaneous order” in the evolutionary model presented here.

In the following, I nest a collective action game in the evolutionary model, in the spirit of Bowles (2004, 426-431). The collective action game is augmented by an external policy stimulus. I allow that individuals have the capacity to look forward and can imagine the benefits they may have from an alternative state of play, thus relaxing the extremely limited cognitive capacities assumed in the model so far. Furthermore, I assume that the propensity to engage in intentional action may vary among individuals and depends on the size of the gain to be had as well as on the availability of an external financial incentive to collective action. This is how the influence of LEADER-type policies is formalised: it provides an extra reward for engaging in collective action that produces innovative behaviour in order to leave the “decline”-equilibrium. A plausible model of collective action should also include the opportunity to free-ride. This is modelled in the following by assuming that individuals engage in collective action only if a sufficient number of peers do as well, so that conformism is assumed to be present.

Suppose a rural region is characterised by a “decline”-equilibrium as explained in the previous section. To leave this equilibrium, the moving Mobile need to switch to “stay” and the abstaining Immobile have to invest. Successful collective action means that a fraction of actors above the critical values for “tipping” ($\alpha^*$ or $\beta^*$) in at least one of both groups engage in nonbest play in a given period. I presume that the individual willingness to participate in such collective action is determined by a group-specific “social engagement” parameter $\delta$ and the size of gains to be had, $y - w_x$. The gains differ for both groups, so that $x \in \{u, r\}$. The latter implies that people are more inclined to engage in a joint undertaking with uncertain outcome if the potential benefit in terms of future revenue is bigger. Bowles (2004, 427) assumes that the individual benefit from collective action can simply be represented by $\delta(y - w_x)$, where $\delta$ is a constant. I follow this assumption here, but in addition to Bowles I introduce a financial transfer payment $T$ which provides an additional incentive for social engagement, so that $\delta = \delta(T)$ and $\delta > 0$. $T$ measures the injected funding from LEADER-type measures.

In addition to the benefits I also assume there are costs from collective action which are supposed to be particularly high if few others in the group engage in collective action. These costs of non-conformism depend on the fraction of participants in collective action, $\theta \in [0..1]$, and the costs of being a sole non-conformist, $c$, such that $(1-\theta)c$ are the costs for participants and $\theta c$ the costs for non-participants. This model implies there is a critical mass phenomenon in the sense that, because it is less costly to do what most peers do, either all will participate or nobody will. The collective action problem is thus modelled as a multiperson coordination game.

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1 It seems reasonable to assume that $\delta$ differs by individual, not only by group. For simplicity, I stick to the group interpretation in the following.

2 Even regions with successful LEADER projects suffer from a lack of engagement by the broad public. The collective action model may therefore be more realistically be limited to apply to a fraction of the total population only, namely those who are “asked” or “called” to participate by a regional authority (Bowles, 2004, 421).
Whether or not collective action is carried out hence depends on the single-period net benefits from participation to the moving Mobile and the abstaining Immobile, $B_{px}$, and non-participation, $B_{nx}$, where

$$B_{px} = \delta(T)(y - w) - (1 - \theta)c$$ and

$$B_{nx} = w - \theta c,$$

with $x \in \{u, r\}$. These benefit functions are drawn in Figure 5 for a general $w$.

**Figure 5. Payoffs in the collective action game for each subpopulation**

![Payoffs diagram](image)

It can be seen that there exists a critical value $\theta^*$ which equals the benefits from participation and non-participation. It indicates the participation rate above which participation becomes self-reinforcing. Successful collective action in each subpopulation will occur if more than $\theta^*$ individuals choose to participate:

$$\frac{1}{2} \delta(T)(y - w) - w.$$

If the second term on the right-hand side is positive, $\theta^*$ is smaller than one half and overall success is more likely than failure. Note that it suffices to induce full participation in one of the two subpopulations in order to propel the population to the “prosperity”-equilibrium, as this will also change the best response of the other group.

According to this model, collective action in a given region is more likely to succeed ($\theta^*$ is likely to be small) if (a) the individual propensity to participate is high, (b) the volume of available financial transfers is high, (c) the difference between $y$ and $w$ is high, and (d) the level of $w$ is low. However, the success of collective action is independent from the level of individual costs of non-conformity, as $c$ does not influence the sign of the second term in (3). From (3), it can be seen that $\frac{\partial \theta^*}{\partial T} < 0$. The
presence of LEADER funding increases $\delta$ and thus induces a parallel upward shift of the “participate”-line, making successful collective action more likely.

A further point to examine is how heterogeneous group size affects outcomes. Without giving up the logic of the interaction model in Table 1, it is conceivable that there are fewer Immobile than Mobile in the population (cf. Bowles, 2004, 426). Under such circumstances, one Immobile may interact with several Mobile per round, for example because the businesses or projects allow the presence of several dependent employees. In such a case, the Immobile get into a more favourable position to induce successful collective action. As each of them is paired with several Mobile, a smaller fraction of individual Immobiles playing “invest” is required to induce the Mobile to switch to “stay”. If this case applies, the Immobile, as rural would-be entrepreneurs, are a particularly interesting target for LEADER-type policies. On the other hand, if there are more Immobile than Mobile, a case would emerge where certain Immobile have no interaction partner at all. While, in terms of payoffs, it is reasonable to assume that this will be identical to the case where Mobile move to the urban area, it does no longer allow to induce a regime change via nonbest play of the Mobile. One interpretation of this case is that the prospects for successful collective action in declining regions are even worse if the Mobile have left the region altogether so that no further interaction with the Immobile takes place. While it seems to be a plausible case, it is not included as a formal option in the model so far.

Note how the LEADER principles given in section 2 are reflected in the model. The importance of local strategies and the bottom-up approach (principles 1 and 2) are taken into account by the general structure of the model, which stresses that outcomes are the result of decentralised interaction of individuals. Innovation (principle 4) is carried by the notion of nonbest play in the process of updating individual strategies. The local partnership and the integrated nature of actions (principles 3 and 5) are captured by the parameter $\delta$, which directly influences the likelihood of success in the collective action game. Of course, the two highly stylised actors in the game-theoretic model present no full account of the stakeholders relevant in real-world LAGs, and also cannot be clearly identified with the three groups present in LEADER projects (private, social, and public). However, the model does provide the nucleus of a formal structure reflecting the multiple stages of individual and collective decision making that are relevant for LEADER-type policies. LEADER transfers coming from a government agency external to the model induce innovative nonbest play by the individual actors, so that the activities of the LAG may be interpreted as producing the public good of superior coordination. Explicit consideration of the networking principles of LEADER (6 and 7) is left for a future extension of the model.

With regard to the fundamental policy debate outlined in the beginning of this section, an interesting question is whether policy “intervention” by instruments like LEADER is sufficiently modest to avoid the destruction of otherwise beneficial properties of decentralised coordination. If my interpretation of LEADER is correct, this policy could be regarded as a means to further the inherent coordination abilities of the relevant actors, by inducing them to engage in bottom-up collective action. This seems consistent with what Hayek (1976, 24) calls “immanent criticism” (cf. Sugden, 1993), a process which attempts to reconcile the knowledge-processing capacity of spontaneous orders with external interventions that “gradually correct institutional ‘development traps’” (Schubert, 2005, 121).

4 Conclusions and outlook
In this article, I have outlined the ingredients of a model that sees rural development as the increasing realisation over time of gains from interaction by rural stakeholders. The model exhibits two dynamically stable equilibria, which depict declining and prospering regions. Neo-endogenous policies are interpreted as stimuli emerging from an external government authority which help decentralised actors to coordinate on the superior of the two equilibria.

The model makes predictions that are amenable to empirical testing. It seems useful to see these predictions in the light of the regional convergence debate (Magrini, 2004). In contrast to neoclassical growth theory, which implies general convergence of regions, the present model implies that regions will diverge into prosperous and declining rural regions. A region will more likely converge to the prosperity equilibrium in the presence of low urban reservation wages, high pay-offs to joint projects, high rural wages for the Mobile and low rural wages for the Immobile. Furthermore, a success of neo-endogenous policies will be more likely in the presence of individuals who are willing to participate in
collective action, higher financial incentives to participate, higher gains to be had from collective action, and lower reservation wages. These propositions shall be tested in future work.

To the extent that it is taken as a plausible account of reality, there are two main political implications of the model. First, small financial commitments by the government may result in a shift of equilibrium and thus have far-reaching consequences for economic outcomes. In this sense, neo-endogenous policies may be called “modern” because they endorse an image of the slim state that reaches its goals with minimal outlays. Perhaps even more importantly, the model also shows that external intervention may be possible and desirable without giving up the autonomy of local decision makers. However, the second message is that a successful shift depends on the specific rural context. In regions which are initially disadvantaged, for example because their potential for endogenous projects is low or they are exposed to migration into highly attractive urban centres, it is much less likely that a policy stimulus can mobilise the fraction of actors required for an equilibrium shift. The same applies if local residents have little inclination to engage in collective action. In this regard, rural outcomes cannot be planned or engineered from the outside, because initial conditions matter.

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References
Naidu S., Bowles S. (2005): Equilibrium Selection by Intentional Idiosyncratic Play, Santa Fe Institute Working Paper, Santa Fe, NM.