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Maria Carmela Aprile, Bruno Chiarini, Elisabetta Marzano

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Telephone +49 (0)89 2180-2740, Telefax +49 (0)89 2180-17845, email office@cesifo.de
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Abstract

This paper presents a simple strategic model (defined as a shortsighted game) to highlight the incentives for local governments to allow the exploitation of land in areas not suitable for such exploitation due to environmental or other risks. Municipal discretionary policy inevitably produces strategic complementarities and guides individuals to use the land (to choose the most beneficial "shortsighted" Nash equilibrium). In light of these results, it seems possible to state that the definition of non-exploitable territory and the decisions concerning it should not be left to local governments.

JEL-Codes: C720, H310, H770, Q240.

Keywords: land exploitation, municipal policy, strategic complementarities, myopic equilibrium.

Maria Carmela Aprile
University of Naples, Parthenope
Via Generale Parisi 13
Italy - 80132 Naples
aprile@uniparthenope.it

*Bruno Chiarini**
University of Naples, Parthenope
Via Generale Parisi 13
Italy - 80132 Naples
bruno.chiarini@uniparthenope.it

Elisabetta Marzano
University of Naples, Parthenope
Via Generale Parisi 13
Italy - 80132 Naples
elisabetta.marzano@uniparthenope.it

*corresponding author

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1 Introduction

The areas that form many municipalities often include particular territories where the possibility of pollution of the aquifers, the danger of flooding, or the protection and preservation of the environment and landscape impose limits on their exploitation. Exploitation activities could result in significant risk and, as such, its prevention should be paramount through improved understanding of geohazards, their causes and their implications. For example, in Italy, there is a large "building speculation" industry that has led to the building of homes on vast coastal and mountainous areas, degrading them noticeably and, in some cases, leading many people to live near rivers that, once flooded, caused destruction and death. In other cases, the exploitation of the land puts hundreds of thousands of people at risk, leaving houses built up on the slopes of an active volcano, as in the municipalities of the Vesuvian area. However, the pervasive use of some areas for waste storage, pasture and productive activities capable of generating significant externalities for neighboring territories and the citizens who live there, constitute only a few examples of the exploitation of a territory that should be prevented.

The possibility that land can be exploited in some way by the private sector of the economy often creates a failure of coordination between the local government and the private sector in a context characterized by multiple equilibria. This failure, however, is based on two crucial assumptions: First, that agents know how to internalize costs and any long-term risks and modify their decisions accordingly and, second, that local governments maximize the well-being of citizens who exploit soil that would otherwise be protected (see, for instance, King 2006).

In such cases, it would be desirable for the central government to pass a clear and transparent law to restrict individual exploitation of the soil. If no one was allowed to use, produce on or live on the soil, then it would not matter whether any infrastructure was built there by a discretionary government, since people do not use the land. Hundreds of thousands of empirical cases of the devastation of territory indicate that this is not possible in decentralized decision-making schemes. Regulatory regimes that assign a marked decentralization in public management, assigning to the local authorities a greater autonomy in the collection of taxes and the administration of their revenue and expenses, as well as in the management of the territory and its environment, lead citizens to a worse outcome. A national policy that announces a clear rule (commitment) on soil exploitation can be credible and may limit this phenomenon.

Our paper is motivated by the observation of this exploitation of the soil and by the fact that millions of citizens in various municipalities are victims of a failure of coordination.

In this paper, we present a simple strategic model (defined as a shortsighted game) to highlight the incentives of local governments to allow the exploitation of the land in areas not suitable for it due to environmental or other risks.

The framework in which problems related to discretionary policy are placed is determined by the possibility of coordination failure due to the presence of multiple Pareto-ranked Nash equilibria (see, for instance, Cooper 1999). This strategic framework (coordination games) exhibits strategic complementarity: increasing effort by some agents leads the remaining agents to follow suit. The best response of one agent to an increase in the activity of all the others is to increase his activity.

Municipal discretionary policy inevitably produces strategic complementarities and guides individuals to use the soil (to choose the most beneficial "short-sighted" Nash equilibrium). The discretionary policy leads to the selection of the short-sighted Pareto-optimal solution, although this equilibrium does not consider the long-term externalities of the choice (i.e., it is shortsighted). This strategic context may produce a "coordination failure" between the local government and individuals, choosing the less attractive outcome but providing the Pareto short-sighted optimal outcome for the simultaneous game with many agents, which characterizes many real contexts. In this case, an agent who exploits the land achieves a high return when other agents exploit the same land. This strategic complementarity is possible in the scheme only when the municipal policy is discretionary.

The problems of land use and its effects on the utilities and profits of agents should characterize the game. In reality, a process of learning, due to the many experiences accumulated in the past in different urban and nonurban contexts, should define a different game based on what we see in the territorial realities. Nonetheless, people converge on the short-sighted social optimum outcome of the game. In fact, more than the "failure of coordination" due to the discretion of governments, one should speak of the "far-sighted failure of coordination". The strategic complementarity due to policy discretion leads to a failure of coordination once the feedback on individuals' payoffs due to environmental degradation is considered; this does not apply to short-sighted people, who do not include risks and externalities that are more distant in time. Therefore, floods in lands at risk of flooding; the risk of volcanic eruption; the bradyseism phenomena, which has been repeated several times in the last decades in the Neapolitan area (Campi Flegrei);[1] the pollution of groundwater and

[1] Bradyseism is a phenomenon linked to the volcanism consisting in a periodical lowering (positive bradyseism) or raising (negative bradyseism) of the ground level.

other aspects of degradation (negative externalities) due to the exploitation of the soil should be internalized in the payoffs of individuals for a correct choice. It is, in fact, the ineluctable short-sightedness of governments, anchored to their life span, which produces this failure, coordinating with individuals on the short-sighted equilibrium.[2]

The paper is organized as follows. Section 2 reports the stylized facts for Italy, showing some numbers regarding the disfigurement of municipal territories. Section 3 presents the strategic interaction between the individual and the local government. Sections 4 and 5 emphasized the discretional determinant of the local government on the agents' strategic behavior, showing the sequential version of the game and the Nash equilibrium in mixed strategies. Section 6 reproduces the game with a multiplicity of agents and highlights the role of strategic complementarity and the incentives of spillovers. Section 7 questions why the agents chose a short-sighted equilibrium, neglecting the feedback on their payoffs from the externalities that they themselves caused. Section 8 concludes.

2 Stylized facts on the exploitation of the soil in Italy

It is possible to report a huge series of data on the indiscriminate use of the soil by municipalities in Italy, including its waterproofing, which is the main cause of soil degradation, as it entails an increased risk of flooding, contributes to climate change, threatens biodiversity, causes the loss of fertile agricultural land and natural and seminatural areas and together with urban diffusion contributes to the progressive and systematic destruction of the landscape, especially rural areas (ISPRA 2017). For a detailed analysis, we refer to the reports that the Italian Higher Institute for Environmental Protection and Research (ISPRA) produces annually. Below, we briefly mention some data concerning the use of the soil in dangerous or protected areas and the problem of volcanic risk in some areas of the country, which lead back to the drama of the problem and naturally give rise to the questions for which this work was created.

Soil consumption is a phenomenon associated with the loss of a fundamental environmental resource due to the occupation of an originally agricultural, natural or seminatural surface. The phenomenon, therefore, refers to an increase in artificial land cover, linked to settlement and

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[2] In governments, myopia generally arises because incumbent governments may not have access to the future benefits from decisions taken now, which only have an impact with a lag on consumer utility (see, for instance, Persson and Tabellini 2000).

infrastructural dynamics. This is a process mainly due to the construction of new buildings and settlements, the expansion of cities, the densification or conversion of land within an urban area, or the infrastructure of the territory. Soil consumption is therefore defined as a variation from a non-artificial cover (unused land) to an artificial cover of the ground (soil-consumed).

The consumption of soil within areas classified as landslide hazard is about 11.8% (almost 273,000 hectares) of the total artificial soil in Italy. The comparison between 2015 and 2016 data showed that approximately 11.5% of the land consumed during this period is in landslide areas, with an average percentage increase of 0.2%. Approximately 51 hectares have been consumed in this period in very high-risk areas, 69 in high-hazard areas. Similarly, ISPRA has calculated the variation of the soil consumed in areas with hydraulic danger. For the entire national territory, over 257,000 hectares of land consumed are in areas of average danger with a return time between 100 and 200 years, or 11.2% of the total artificial surface.

In Italy, 32,800 hectares of land consumption fall within protected areas today, and between 2015 and 2016, another 48 hectares were consumed (+ 0.15%). At the national level, the percentage of land consumption within protected areas is limited to 2.3%.

Over 7% and almost 5% of the soil in areas with high and very high seismic hazards, respectively, has been consumed, which equals over 860,000 hectares of worn surface. At the regional level, Lombardy, Veneto and Campania are home to the highest values of soil consumed in areas with high seismic hazards (14.4%, 12.6% and 10.4%, respectively).

Land consumption in the coastal strip is estimated at different distances from the coastline: 0-300 meters, 300-1,000 meters, 1-10 kilometers, and over 10 kilometers. Percentage values of the soil consumed grow closer to the coast. At the national level, almost a quarter of the band included within 300 meters from the sea is now consumed.

Another question that naturally arises in the analysis of the exploitation of the soil is, how is it possible that local governments allow the exploitation of the land in areas not suitable for exploitation for various risks, such as the volcanic areas of the Vesuvian municipalities? After the last eruption in 1944, the perception of the risk seems to have been lost. Therefore, the building boom of the fifties and sixties produced a huge expansion of the ancient population centers that did not spare, in its aggression, the upper part of the volcano. Moreover, the area, in addition to being one of the most highly anthropized in the world, is also characterized by profound environmental deterioration, so much so that it has been declared, according to the law n. 349/86 in 1990, an "area with a high risk of environmental crisis". The phenomena of wild urbanization, nefarious building abuse and a radical and rapid process of deruralization have exponentially increased exposure to various types of risk, not only those of a physical-natural type (particularly those of a hydrogeological nature) but also those of a pollution and social nature (e.g., Sibilio 2001).

The urban area of the Vesuvian municipalities has been constantly developed since the sixties, including the upper part of the volcano, which is characterized by the greatest potential impact on the population and housing structures of Europe and, consequently, with the greatest capacity to generate economic damage, which specifically acquires connotations of singular tragedy. Despite this risk, it was developed in a completely irresponsible way, leading to a "building confusion from which it is difficult to unravel the settlement plot" due to the "distracted" behavior of the inhabitants and to a "politics that is" inattentive "to the proper governance of the territory "(D'Aponte, 2005; Pesaresi and Scandone 2013). As of December 31, 2010, the 18 municipalities in the "red zone" (i.e., the one most exposed to catastrophic consequences in the case of a resurgence of Vesuvio's activity) contain 541,863 inhabitants for a total of 182,345 families.

In the following sections, we will try to define some strategic aspects of exploitation for the productive or residential use of land that would otherwise not be exploitable, a widespread phenomenon in the territories of Italian municipalities

3 The agent-municipality game

We start with a context where a single agent and the local government interact strategically. King (2006), following the seminal paper of Kydland and Prescott (1977), sets up a simple strategic model to stress that an individual’s rewards for locating on the plain are higher when other individuals choose to locate there. This strategic complementarity is present only when policymaking is discretionary. The solution, however, was based on a peculiar assumption that the government seeks to maximize the welfare of individuals, while the latter neglect to calculate the long run effects of their short run payoffs. In contexts of land exploitation (which would endanger the environment and the citizens themselves), the hypothesis that the local government can "adapt" to the conveniences of agents, thereby maximizing their well-being (as in King 2006), does not seem very realistic. On the contrary, the municipality, in its simplest formulation, acts to maximize its possible revenue (or the chance to be re-elected and, therefore, the votes it receives).[3] In other words, local governments are aiming to maintain a budgetary balance and thus obtain more revenue

[3] It should noted that there is no environmental or resources exploitation purpose of this taxation. Moreover, we could retrace our analysis thinking that the discretion of the local government is linked to the possibility of being re-elected and therefore to the exchange of votes.

to make more municipal expenditures.[4] In this more realistic context, the role of municipal discretional policy is generalized and, therefore, even more dangerous. The assumption that King adopts for the welfare of citizens is misleading because the citizens who decide to use territory that is not exploitable are often only a part of the community. Moreover, the exploitation of these territories can be harmful and/or risky for the citizens themselves. This assumption radically changes the characteristic of strategic interaction, since it no longer produces a failure of coordination and a less attractive equilibrium.

In our model, the municipality decides whether to intervene with appropriate infrastructure on land considered "unprofitable". These interventions could include sewage infrastructure, industrial and urban waste recovery, the construction of floodplains or simply the construction or improvement of roads and lighting. Municipal actions are denoted as E (exploitable, building infrastructure) and NE (non-exploitable). Certainly, municipal intervention through the construction of infrastructure must resort to general taxation to cover its costs. The private agent's choice problem is whether to conduct his activity (building a dwelling, a factory, or even developing agricultural or pastoral activities) on land defined as unprofitable, selecting E, or not exploit the land (NE).

Figure 1: The strategic interaction between agent and municipality

	NE	E
NE	$y, \ 0$	$y-\mu, \ -t$
E	$k+x, \ \varphi$	$y-\mu+x, \ t$

We hypothesize that the payoff for agent i is given by the following function, where income $y, k \in R$ is additionally increased by an allocation value:

[4] The Italian system of municipal government counts more than 8,000 authorities, a high degree of fiscal decentralization, and a notable variety of local revenue sources, including property taxes, personal income surcharges, and user fees. The municipal tax mix choice has non-negligible allocative, distributive and political consequences. Over the past two decades, a complex process of fiscal decentralization occurred in Italy, starting from the introduction of a local property tax in the early 1990s and followed by the introduction of a municipal (and regional) surcharge on the national personal income tax, culminating in the 2001 constitutional reform that further enlarged (in principle) the fiscal autonomy of the municipalities. Italian municipalities derive their main source of tax revenue from a property tax. This tax accounts for about 33% of municipalities' own fiscal revenue. The presupposition of the tax is the possession of any type of property and any use for which it is intended. Other salient sources of revenue in Italian municipalities are related to waste disposal and to the taxation of personal income, which account for 16% and 13% of municipalities' own fiscal revenue, respectively. Additional revenue can be raised by Italian municipalities through much smaller fees, such as the issuance of parking permits and certificates or certificates related to the occupation of public spaces, which account for around 38% of municipalities' fiscal revenue. See, for instance, Bracco et al. (2013).

$$U(R_i + x(E=1)) \quad (1)$$

The payoff U is assumed to be twice continuously differentiable and strictly concave in the first argument, with E=1 for exploitable and E=0 for non-exploitable (NE). That is, an agent who chooses an action for which E=1 has a positive effect, $x>0$, on his payoff in exploiting the soil. Thus, there is additional income (and utility) that a firm or an agent receives if it invests in the non-exploitable land. The other hypotheses are the following.

Individual: Income: y is the reference income (or profit), and k is the income that the agent achieves on the unprofitable land when the local government does not build infrastructure. The restriction $y>k$ is appropriate because if the agent allocates his assets to land with geohazard problems that is therefore risky and/or less efficient due to the lack of intervention of the local government, he necessarily derives a lower income (or, for instance, an apartment with a lower value in the case of a resident). With regard to costs and benefits, we assume that the cost of building infrastructure, via lump-sum taxation μ, is higher than the allocation benefit $\mu > x$ and, therefore, $y > y - \mu + x$. Thus, the cost to build the infrastructure and paid by the agents is higher than the additional value of income they receive for living in the land. [5]

Municipality: When government investment is undertaken, the agent obtains an after-tax income $(y-\mu)$. To build infrastructure, the municipality has to finance it via lump-sum taxation μ. However, even if the municipality does not invest in the land, it earns revenue $\varphi > 0$ due to the productive or allocation activities on the land itself. Lastly, when the municipality intervenes and exploits the land, it gets an additional revenue $t - \varphi > 0$ if the agent allocates his assets to the land; otherwise, if the agent does not exploit the land, it will suffer a loss equal to the potential revenue.

The result of this interaction with complete information is trivial. The optimal choice of the individual is to act on NE land when the government is not building and to exploit (E) when a government acts on E land. This discretionary policy under full information leads to two Nash equilibria: (NE,NE) and (E,E).

It should be noted the difference between a municipality which tries to maximize the well-being of the individual (as in King 2006) and a municipality which maximizes its revenue. In the first case, we would always have two Nash equilibria but with the social optimum occurring when both the agent and the municipality choose NE (non-exploitable). In the second case, as described in Figure

[5] The share of resources that is associated with fraud in the public procurement of goods and services, the diversion of funds, and the over-invoicing of goods and services are not considered in this analysis.

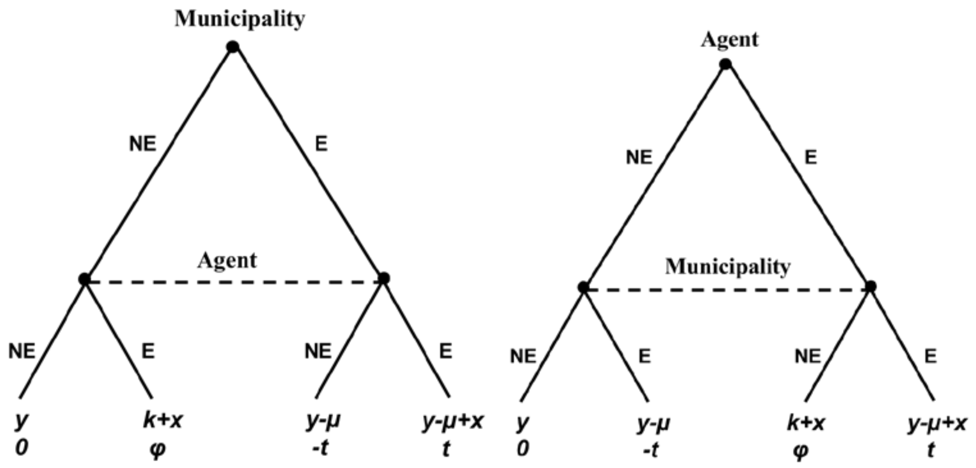
1, this equilibrium is no longer the social optimal situation; the government's preferred equilibrium strategy is to exploit.[6]

4. Indications coming from the timing.

Consider a sequential version of the game reported in Figure 1, where a player (first mover) moves first, deciding whether to exploit or not to exploit, and then, the follower player responds.

Suppose the local government is the first mover. Its first move is to exploit. As shown in Figure 2, since $t - \varphi > 0$, the forward induction brings to the unique subgame perfect equilibrium (E,E), eliminating the agent's uncertainty about the information set by means of past rationality. These equilibrium strategies are sequentially rational, and given the players' beliefs, they constitute a perfect Bayesian equilibrium: the discretion of the municipality indicates the possibility of exploitation. The fact that the government cannot commit rules out multiple equilibria and pushes individuals to their correct choices. Municipal discretion eliminates any coordination problem and, therefore, multiple equilibria. The important point to highlight with this simple strategic model is that if the leader or the holder of the first move is the agent, then applying the principle of "past rationality" makes the equilibrium coordinate be (NE,NE), also forming a perfect Bayesian equilibrium in this case.

Figure 2. First mover advantage



[6] To observe this, just delete the payoffs of the municipality in Figure 1 and assume that the payoffs of the individual are exactly those of the municipality.

The timing is, of course, important. In these cases, building or locating after infrastructure implementation would bring all the interested agents to locate or allocate their assets on the land. By contrast, Pareto ranking would lead people to choose not to exploit. The game we are describing is, however, a simultaneous game. The sequential version of the game reveals that the failure of the agents to internalize the costs of choices is only possible if there is the possibility of a discretionary policy, an eventuality also confirmed by the Nash equilibrium in mixed strategies presented in the next section.

5. A mixed strategy coordination

As we know, there is a third Nash equilibrium in mixed strategies, which makes the two players indifferent (the individuals are indifferent about locating or allocating assets in the land, and the municipality is indifferent about whether to intervene):

$$p = \frac{t-\varphi}{2t-\varphi}; \quad (1-p) = \frac{t}{2t-\varphi}; \qquad q = \frac{k+x}{y}; \quad (1-q) = \frac{y-(k+x)}{y} \qquad (2)$$

where p and q are the probability of the individual or the local government playing NE, respectively. This equilibrium appears indicative, as it shows that the local government is more likely (with a higher probability) to exploit the land by undertaking infrastructural investments when the level of income that the agents obtain in the land without infrastructure is relatively lower than the reference level (and vice versa). It is interesting to note that if we relate the choice not to exploit (NE) to the awareness that, ex-post, negative externalities will need to be paid, then we can interpret (2) as follows: the higher y (the long-term outcome that internalizes the externalities of land exploitation) compared to the short-term payoff $k+x$, the more incentive the local government has to decide for exploitation. On the other hand, individuals are more likely (more willing) to allocate their resources in the "non-exploitable" land, the lower is the taxation gap $(t-\varphi)$. Moreover, the higher are the total revenues that the municipality obtains from building the infrastructure, the higher will be the individuals' likelihood of exploiting the land. The problems of interpretation and stability of this mixed-strategies equilibrium are well known, but it seems interesting to us, as it defines the useful parameters for coordinating rational agents toward one of the equilibria of the game.

6. What happens with a multitude of agents?

In this (more realistic) case, we can assume that the local government will choose to exploit land only if a certain number of agents are available to use this land, while it may decide not to exploit it if the number of people who intend to use the land is lower than this threshold.

Knowing this threshold, it is important to analyze the behavior of the individual agent. The individual must, in fact, decide whether or not to opt for land use based on the function of the other agents. Taking into account that the local government bases its decision on the actions taken by the aggregate private sector, there are two symmetric equilibria. In one, all individuals will choose not to locate or use the soil in question, while in the other, all individuals will choose to exploit the soil. We assume that all the agents are identical in their preferences.

The situation could be simplified if we think in terms of the average agent. The individual chooses NE if the average agent chooses NE due to the choice of NE by the municipality and vice versa, the individual chooses E because the average agent chooses E, while the municipality chooses E. How do they coordinate in this case? The discretionary policy of the local government leads people to choose the equilibrium and, therefore, to coordinate their strategies: the agents optimize following their neighbors interested in exploitation.

Suppose now that each agent must decide whether to invest (or allocate his assets) or not invest in the same local area. The agents know that this area is non-exploitable, but they gain x from going there. Suppose, further, that each agent receives an increasing spillover x on his investment only if other agents invest; that is, $x(E_{-i})$, with $x'(E_{-i}) > 0$ and $x \to \varepsilon > \mu$ as $i = 1,2,........I \to \hat{E}$

Now the utility function is:

$$U(R_i + x(E_{-i})) \quad E = 1 \quad x'(E_{-i}) > 0; x''(E_{-i}) \geq 0 \tag{3}$$

where x is a positive spillover, E_{-i} denotes the vector of actions by all players other than i and $x(E_{-i})$ is an aggregate statistic. We assume that $x(E_{-i})$ is twice continuously differentiable and that $x'(E_{-i}) > 0$ for all $E_i \in [0,1]$. Referring to real situations in which entire urban areas or industrial poles have developed on land considered, for various reasons, not exploitable, it is not difficult to justify the existence of positive spillover effects. The spillover can be justified by thinking of a company that increases its performance or an agent that increases its income if they located in the area for the positive externalities that will surely be created in this area. For example, for a resident, the value of his real estate investment in the area goes up if, in addition to other residents, he also finds shops and private services. Once a territory develops, the sunk costs (material and political costs) that must be faced for changing direction are huge, and alternative solutions may never be achieved. Now, following Cooper and John (1988), the spillovers increase because the choice of exploiting in one player's strategy affects the payoff of the other players. Moreover, this provides a strategic complementarity because this strategy carried out by one player increases the optimal strategy of the other players. Thus, denoting $x(E_{-i})$ as $x(E)$ and *X=x(E)*, a necessary condition for this game is $\partial(\partial U / \partial X)/\partial E > 0$.

Assuming that the agent payoff function is continuously differentiable and that $\partial^2 U / \partial R_i^2 < 0$ (as in (1)), the payoff of agent *i* with action *E*, when all the E_{-i} take action, is $U(E_i, \hat{E})$. The Nash equilibrium is characterized by $E_i^*(E) = E$. If all the other agents are selecting *E*, then agent *i* must also select *E* (it is in his interest). Along the lines of Cooper and John (1988), we have the following results for the payoff of agent *i* (the subscript denotes a partial derivative):

i) $U_2(E_i, \hat{E}) > 0$ a game with positive spillovers. An increase in the strategy of all but one agent yields an external benefit upon the remaining agent (increases his payoff).

ii) $U_{12}(E_i, \hat{E}) > 0$ a game with strategic complementarity. An increase in the action of all but one agent increases the marginal return on this latter agent's action (optimal strategy), with *E* being an increasing function of $\hat{E}$.

Now the game of Figure 1 has two Nash equilibria where (E,E) is the social optimum outcome and the simultaneous game will bring about this outcome. The strategic complementarity leads to the selection of the short-sighted Pareto-optimal solution, but this equilibrium does not consider the long-term externalities of the choice.

How do they coordinate the short-sighted equilibrium?

To analyze the reasoning of the single agent to conform to the multitude of agents who opt for land use, we report in Figure 3 the payoffs related to the choices of the single agent and the multitude of agents. We know that $x'(E_{-i}) > 0$ and that this leads to $x \to \varepsilon > \mu$. As people bring their resources to the "forbidden" land, their income becomes higher than the reference one: $y < y - \mu + x(E_{-i})$.

Although it would be desirable for individuals to coordinate their location actions with E=0 (NE, NE), the strategic complementarity leads to E=1 as each individual chooses E=1.

Figure 3. The strategic interaction between an individual agent and all other agents

	E_{-i} NE	E_{-i} E
NE	$y, \ y$	$y, \ y+\varepsilon$
E	$k+x, \ y$	$y+\varepsilon, \ y+\varepsilon$

Note that NE is a dominant strategy if we rule out the existence of positive and increasing spillover effects. This strategy becomes dominated by E once we consider the effect of spillovers and strategic complementarity. There is a unique equilibrium, (EE). The discretion of municipalities in matters of the environment and territory necessarily leads, as seen in Section 2, to overexploitation and the abandonment of safeguards and rules. The problem is worsened in countries such as Italy, where a federal reform leaves extensive powers to local governments (municipal, provincial and regional) in the area of land management. In addition to the problem of malfeasance and corruption that this reform has generated and which we do not consider here, fiscal federalism has triggered a series of incentives for the depletion of the territories, putting the citizens themselves at risk.

7. *Why should rational agents choose the myopic equilibrium?*

A natural question is, therefore, why do agents choose a short-sighted equilibrium neglecting the feedback on their payoffs of the externalities that they themselves cause? An explanation of why people conform and why the convergence of behavior can be Pareto short-sighted efficient can be based on informational cascade models (social learning) or incomplete insurance markets.

Herding interpretation

Suppose agents (in a population of N peoples) must decide to exploit or not exploit land. As prior probability, they know, say, that it is better to exploit the soil for 60% of the population, whereas the rest of the population says that it is better not to exploit. People living in this municipality make decisions in sequence, observe the actions made by others before them and then decide whether to exploit. Each of these people received a signal, but this signal could be wrong. The signal says either that exploiting is better or that not exploiting is better, and all the signals are of the same quality. Suppose that N-1 of N people interested in some activity on the land in question have received a signal that the better decision is not exploiting. However, the first person makes the decision to exploit. Now, suppose that the second agent knows that the first one had a signal that favored exploiting, while her own signal favors not exploiting. The signals are of equal quality, and at this point, the problem of the second agent vanishes since the signals are opposed and cancel out. Therefore, the rational choice is to go by the prior probability and decide to exploit. Thus, the second agent exploits the soil regardless of her signal (herd externality on the rest of population). The third person faces the same situation as the second person and will make the same choice and so on. All the agents end up making the exploiting choice, even if not exploiting may be better. The equilibrium pattern of choices may be inefficient in the ex ante welfare sense. As a result, the whole sequence of agents may "herd" and choose a "wrong" action (Banerjee, 1992, among others).

The problem is that the local government is not able to commit to the E=0 action. People will not want to live on the floodplain if there is no dam, just as people would not want to live in an area without sewers and asphalt roads or even exploit land for industrial purposes without the energy needed for production and a road to connect the industrial site to a road artery. It is this strategic complementarity that leads to the failure to coordinate on (NE NE) in Figure 3, making it optimal for any single individual to align his location action with those of his fellow citizens. However, it is discretionary policy that leads to this strategic complementarity. It generates the prior probability, which is crucial in determining the wrong action.

This very simple herding model is followed by a vast literature based on rational social learning and fictitious play models, involving players who act myopically while facing each other repeatedly. Learning from personal experience or from the experiences of others, as well as from word-of-mouth learning or learning through reinforcement and replicator dynamics, results in play models that can be adapted to our situation to justify myopic and short-term behavior. (Fudenberg and Levine 1998). Therefore, a model of social learning can be used to justify the (E,E) equilibrium in a Bayesian context. Thus, rational (Bayesian) agents may neglect their own private information and take action based only on public information (Banerjee 1992; Vives 1997). However, although the model exalts herd externality, it lacks in this interpretation the understanding of the externality that can be generated with one's choice of one's own payoff.

Transaction failure between generations

Myopic behavior may be justified rationally in a game between generations. After all, geohazards are geological and environmental conditions and involve both short-term and long-term geological processes. They can be relatively small features when the land is exploited, but they can also produce huge dimensions affecting the local economy to a large extent. These phenomena may produce myopic behavior and generate negative externalities (soil exploitation, pollution, reduction of nonrenewable resources, etc.) on future generations (see, among others, von Amsberg 1995). It is easy to imagine that this behavior is increasingly applied with decision, the negative effects it generates on the generations that are yet to be born are far away.

In theory, this growth could be avoided if there was a market that would safeguard future generations from possible environmental disasters caused by current generations. It is a question of reducing the risk of those who have yet to be born through market transactions that include insurance investments against possible future disasters linked to the externality – that is, through the correct decision not to exploit. However, it is well known that these intergenerational insurance markets are incomplete because future generations cannot make any transactions with the current ones. Therefore, future generations cannot affect current decisions and may wish to carry out wealth transactions on the market depending on the state that could be generated by the externality (for example, the occurrence of a catastrophic event or not) affecting the actual decision of the current generation. As a result, the current generation does not take into account these possible decisions by future generations and opts for exploitation.

8. Concluding remarks

In this paper, we have defined, in strategic terms, a very widespread phenomenon in the territories of Italian municipalities: the exploitation for productive or residential use of land that would otherwise not be exploitable. The strategic analysis leads to a definition of the determinants of this phenomenon, found in the discretion of local governments and in the generation of the strategic complementarities based on that discretion. In strategic terms, individuals, in exploiting the soil, choose the optima Pareto equilibrium, but it has a short-sighted outcome in the sense that they choose the strategic equilibrium that neglects the payoff feedback that their decision produces in terms of negative externalities. We conclude by proposing two possible interpretations to justify this myopic behavior: the models of social learning and incomplete insurance markets. In light of these results, it seems possible to state that the definition of non-exploitable territory and the decisions concerning it should not be left to local governments. Finally, regarding the policy analysis of local administrations, the problem of land exploitation not for building use or productive activities is worsened in countries such as Italy, where a federal reform leaves extensive powers to local governments (municipal, provincial and regional) in the area of land management.

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