EVOLUTION OF THE PLACE ATTACHMENT: AN ECONOMIC APPROACH

Edgar J. Sánchez Carrera
Facultad de Economía, UASLP, Mexico and
Department of Economics and Statistics, University of Siena
P. zza S. Francesco 7, 53 100 Siena, Italy
E-mail: sanchezcarre@unisi.it

Slađana Pavlinović
University of Split, Faculty of Economics
Cvite Fiskovića 5, 21 000 Split, Croatia
E-mail: sladjana.pavlinovic@efst.hr

Abstract

Despite relatively cheap mobility and intensive globalization processes, the place attachment remains an important part the human existence (Lewicka, 2010:226,). Our aim is to understand the evolution of the place attachment. For this purpose we apply evolutionary game theory with the replicator dynamics and we follow the literature on the identity economics.

A novelty which Akerlof i Kranton (2000) introduce is that an individual may choose an activity opposite to her identity in order to maximize her own utility. In other words, the choice of identity and activities is separated.

Pavlinović (2012) develops a basic evolutionary game-theory model of spatial identity where agents can only act in line with their own identity. On the contrary, Akerlof i Kranton (2000) introduce the assumption that an individual may choose an activity opposite to her. Thus, we modify the model in Pavlinović (2012) and consider the choice of identity and action separately. We explore if this modification significantly affects the results.

Key words: *Identity, Place attachment, Evolutionary Game theory, Replicator dynamics*

1. INTRODUCTION

The aim of this paper is to elaborate evolution of the place attachment by applying evolutionary game theory. We extend the basic model in Pavlinović (2012) by considering the choice of identity and action separately.

We suppose that an agent can choose her identity. In this case the identity is related with the place attachment. Identity has been recently introduced into economics, dating back to Akerlof and Kranton (2000). Identity has been studied by economists in order to provide better understanding of socio-economic phenomena, such as segregation, crime or poverty. Already Akerlof and Kranton (2000) proposed the game theory model of identity. The choice of identity implies the choice of accompanying preferences. Furthermore, an agent may punish others who behave contrary to his own identity. Punishment is also present in the model of Wichardt (2011) who uses evolutionary game theory to study identity. Eaton et al (2011) also applies evolutionary game theory, but with a focus on altruism and team production. An application of the identity to the natural resources is done by Almudi and Sanchez Choliz (2011).

The model we present treats the issue of place, which is linked to the environmental and natural resource problems in general. However, unlike Almudi and Sanchez Choliz (2011), we follow the methodological approach of Wichardt (2011) and Eaton et al (2011). We apply the evolutionary game theory to the place attachment (which can be understood as a sort of identity) and we treat the place as a public good, with the possibility of punishment of those agents who do not contribute.

There exists a rich literature on place attachment (one can check Lewicka (2010) for the survey). Despite relatively cheap mobility and intensive globalization processes, the place attachment remains an important part of the human existence (Lewicka, 2010:226). Scannell and Gifford (2010:294) find that the place attachment positively affects the responsible behavior towards the environment. Cocks (2006:187-188) mentions some examples of the local population which places a particular importance to the landscape where they live, and they significantly contribute to its protection.

The important observation of the mentioned literature is that the place attachment implies investment of effort to protect and improve the place to which an agent is attached. Furthermore, the places usually have characteristics of the public goods (Pavlinovic, 2012:6).

Pavlinovic (2012) applies evolutionary game theory to study the place attachment (place identity) and treats the place as a public good. It offers a model where the choice variable is identity. Actions of an agent are exclusively determined by her identity. On the other hand, Akerlof i Kranton (2000) emphasise that an individual may choose an activity opposite to her identity in order to maximize her own utility. That is, choice of activity is detached from the choice of identity.

We extend the basic model in Pavlinović (2012) and consider identity and action choice separately. In this model an agent can choose an action opposite to her identity. We check if the results significantly change when this assumption is introduced.

The place attachment is identified as an important determinant of environmental protection. That is, as the place attachment becomes stronger, the environmental quality improves. Such a relationship between the place attachment and environmental quality is captured in Pavlinovic (2012) in the payoff function. The quality of environment increases as the fraction of the agents attached to the place increases. However, in this paper, due to the possible free-riding, a decrease in environmental quality is possible even if the fraction of the agents who attach to the place increases.

We suppose that an agent chooses her identity by deciding if to attach to a place or not. Furthermore, the agent chooses if to invest efforts to improve environmental quality. Also, the place attached agents who invest the efforts punish those who do not do the same. This punishment is costly for both, the punisher and the punished agent.

In the next section we present the model. We study two variants of the model in order to understand the importance of action choice and punishment for the place attachment evolution.

2. MODEL

We present a model where an agent can choose identity and actions independently. We suppose that there are two possible identities, Citizens and Petty Bourgeois. Citizens are attached to the place, while this is not the case with Petty Bourgeois. The place can be treated as a public good. In many aspects, the place can be reduced to the environment where people live: the gardens, the parks and the squares. Thus, in what follows, instead to the place, we refer to the environment. Function $f(\alpha, \gamma, e)$ stands for the quality of the environment.

Furthermore, independently of their identity agents can choose if to invest efforts to improve the environment. Based on this, we classify four types of agents: Citizens who invest efforts in the environment (CE), Citizens who do not invest the efforts (CN), Petty Bourgeois who invest the efforts in the environment (PE) and Petty Bourgeois who do not invest the efforts (PN). Their fractions in the population are denoted by α, β, γ and δ respectively. The population composition is presented in the next figure. Citizens who do not invest efforts in the environment can be called free-riders.

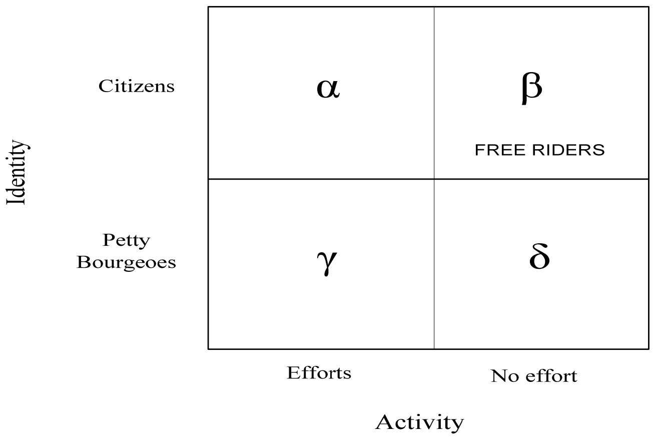


Figure 1: Population structure

We define the expected payoffs:

$$\pi_{CE} = f(\alpha,\gamma,e) - e - k(\alpha,\gamma)$$
$$\pi_{CN} = f(\alpha,\gamma,e) - g(\alpha)$$
$$\pi_{PE} = z - e$$
$$\pi_{PN} = z - g(\alpha)$$

Citizens who invest efforts in the environment enjoy the place they are attached to. The utility from the place attachment is reflected in the environmental quality $f(\alpha,\gamma,e)$ with $\frac{\partial f(\alpha,\gamma,e)}{\partial \alpha} > 0$, $\frac{\partial f(\alpha,\gamma,e)}{\partial \gamma} > 0$, and $\frac{\partial f(\alpha,\gamma,e)}{\partial e} > 0$. Environmental quality is modeled as a public good, so that function $f(\alpha,\gamma,e)$ follows properties like in Bowles (2004:130). We assume that Citizen who invests efforts in the environment also punishes types who do not invest, which is captured by functions $k(\alpha,\gamma)$ and $g(\alpha)$. Punishment represents the cost for the punisher, and this cost increases positively with the fraction of agents who do not collaborate. We assume that probability of being in the situation to punish increases with the fraction of Citizens and Petty Bourgeois who do not invest in the environment, that is, $\frac{\partial k(\alpha,\gamma)}{\partial \alpha} < 0$ and $\frac{\partial k(\alpha,\gamma)}{\partial \gamma} < 0$. In the other words, Citizen who invests in the environment is more likely to meet an agent who has to be punished if β and/or δ increase (that is, if α and γ decrease). On the other hand, probability to be punished increases with fraction α. The cost of being punished is captured by expression $g(\alpha)$. Thus, Citizens who miss making efforts to improve the environment are punished in such a case.

Apart from the place attachment, the difference between the two identity types, Citizens and Petty Bourgeois, is captured by term z. It reflects the fact that the people who are not attached to the place are inclined to move, and thus, are able to exploit some external opportunities.

Therefore, Petty Bourgeois who invest in the environment still do not attach to the place, and thus, they are able to exploit potential external opportunities. Although they are not punished by the responsible Citizens, their payoff is negatively affected by the effort. On the contrary, Betty Bourgeois who avoids investing efforts in the environment may be punished by the responsible Citizens.

We want to obtain some insights about the co-evolution of these four types. In order to make the analysis more tractable, we introduce additional constraints on the payoff functions which, we believe, do not affect the results significantly.

Let suppose that punishment is performed as a conflict which is equally costly for both, the punisher and the punished agent. We denote this cost by coefficient k. As we previously clarified, the probability that Citizen is paired with an agent who does not invest in the environment is equal to $1-\alpha-\gamma$, and the probability that an agent is paired with Citizen who invests in the environment is equal to α. Based on this, we set functions $k(\alpha,\gamma)=k\cdot(1-\alpha-\gamma)$ and $g(\alpha)=k\cdot\alpha$. Also, we set environmental quality $f(\alpha,\gamma)=f\cdot(\alpha+\gamma)\cdot e$ where f is the marginal productivity of individual effort and e is the level of effort. Thus, we can write the payoff functions as follows:

$$\pi_{CE}=f\cdot(\alpha+\gamma)\cdot e-e-k\cdot(1-\alpha-\gamma)$$

$$\pi_{CN}=f\cdot(\alpha+\gamma)\cdot e-k\cdot\alpha$$

$$\pi_{PE}=z-e$$

$$\pi_{PN}=z-k\cdot\alpha$$

where f and k are positive numbers.

We study the evolution of types and we set the following replicator dynamic equations (elaborated in Weibull (1995:69) and Bowles (2004:67)):

$$\frac{d\alpha}{dt}=\alpha(\pi_{CE}-\bar{\pi})$$

$$\frac{d\beta}{dt}=\beta(\pi_{CN}-\bar{\pi})$$

$$\frac{d\gamma}{dt}=\gamma(\pi_{PE}-\bar{\pi})$$

where $\bar{\pi}$= $\alpha\pi_{CE} + \beta\pi_{CN} + \gamma\pi_{CE} + \delta\pi_{CE}$, and $\delta = 1 - \alpha - \beta - \gamma$. Next, we search the stationary points and study their stability. For this purpose we analyse the three-type models: a model without Petty Bourgeois who invest efforts (a model without conformists), and a model without Petty Bourgeois who do not invest the efforts (a model without deviators).

2.1. A model without conformists

We suppose that for cultural or other evolutionary reasons, type Petty Bourgeois who invests the effort in the environment does not exist, and we refer to such types as *conformists*. Those are types who make efforts although those efforts do not result with individual benefits directly. However, the conformists avoid potential conflicts in this way. Thus, we set fraction of conformists to $\gamma = 0$.

The set of expected pay-offs thus reduces to:

$$\pi_{CE} = f \cdot \alpha \cdot e - e - k \cdot (1 - \alpha)$$

$$\pi_{CN} = f \cdot \alpha \cdot e - k \cdot \alpha$$

$$\pi_{PN} = z - k \cdot \alpha$$

An advantage of this variant of the model is that enables us to express the payoffs exclusively as a function of α, which significantly simplifies the analysis. We present the expected payoffs of case where $f = 4$, $k = 1$, $e = 0.5$ and $z = 1$.

The expected payoffs of the two subgroups of Citizens is equal when $\alpha = 0.75$. This is actually a threshold which divides two basins of attraction, that is, an unstable interior stationary point. If $\alpha > 0.75$, then a Citizen who invests retains her type when paired with other types, and the other types convert to Citizens who invest efforts.

Payoffs of Citizens who do not invest efforts and Petty Bourgeois is equal when $\alpha = 0.625$. This point represents a saddle, an interior unstable stationary point, if $\beta = 0$. In such a case, a small perturbation can drive the population to the state composed of Petty Bourgeois only, or on the contrary, to the state composed only of Citizens who invest efforts.

From the expected payoffs in Figure 2, we suspect that there are two evolutionary stable states, $\alpha = 1$ and $\delta = 1$.

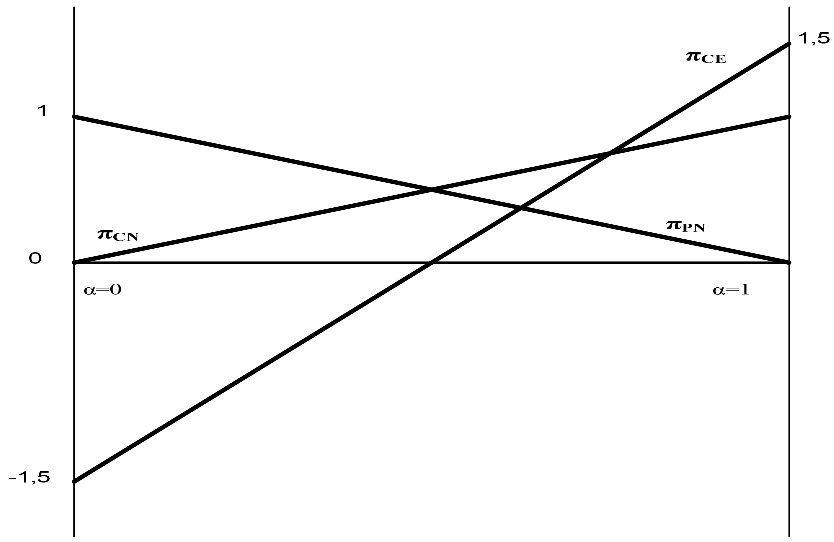


Figure 2: The payoffs of Citizen who invests effort (positively inclined steep line), Citizen who does not invest effort and Petty Borugeois who does not invest effort (negatively inclined line)

Furthermore, we determine the loci along which the populations are stationary which are presented in the next figure.

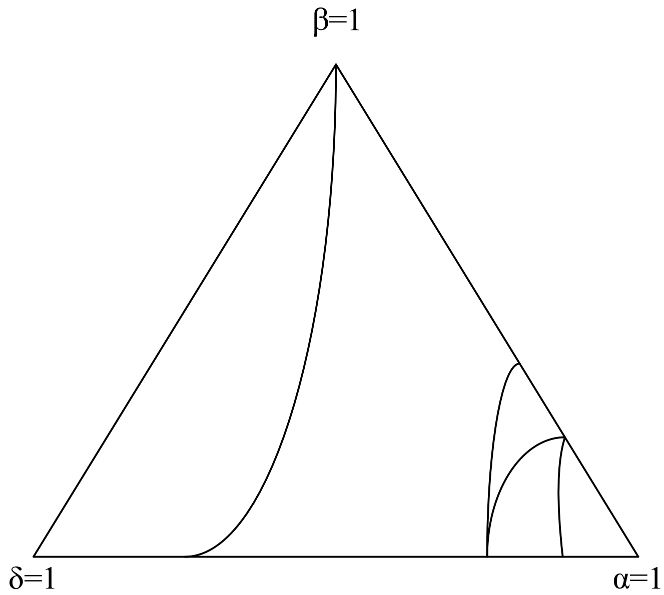


Figure 3: The stationary loci – the case without conformists

Population of Citizens who make efforts, α is stationary along the third curve (from the left). Population of the Citizens who free-ride is stationary along the first and the last curve, and along the horisontal axis. Fianall, the remanining population of Petty Bourgeois is stationary along the second curve (from the left). An insight about the stability of these loci can be obtained by inspecting the next vector field.

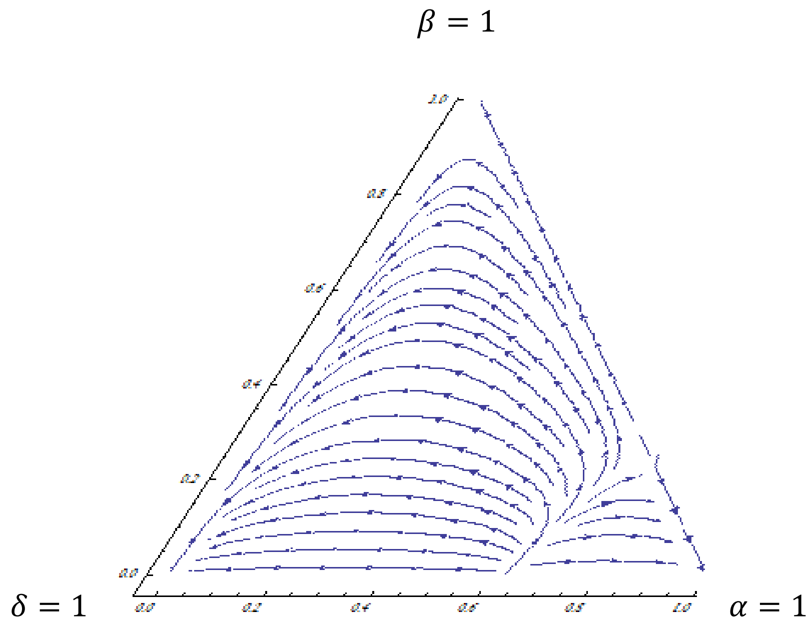


Figure 4: Vector field – the case without conformists

We can conclude from the vector field that the third loci is actually a trajectory which divides two basins of attraction, which indicates that there are two evolutionary stable equilibria. In the first evolutionary stable equilibrium α=1. That is, the population is composed exclusively of Citizens who invest efforts in the environment. However, the basin of attraction of the second evolutionary stable equilibrium, with δ=1, is significantly larger for the given parameter set. In the second evolutionary stable state the population is composed exclusively of Petty Bourgeois who do not invest efforts.

In the basic model of Pavlinovic (2012), only evolution of two types was studied: Citizens who invest in the environment and Petty Bourgeois who do not invest. There were two evolutionary stable states composed of homogeneous population (one or another type). Here we introduce the third type, Citizen who free-rides. Again, the evolutionary stable states remain unchanged: Citizens who invest and Petty Bourgeois who free-ride.

It is interesting that the homogeneous population of Citizens who free-ride (evolutionary unstable stationary state) actually transformed their preferences into Petty Bourgeois. We may speculate that free-riding leads to the preferences deterioration. In the next variant of the model we study the opposite situation where Petty Bourgeois always conforms and invest effort in the public good.

2.2. A model with conformists and without deviators

A model without deviators captures the situation where foreigners come into closed society. In order to avoid conflicts, they conform to the local norms and invest the effort in the environment. However, the conformists are not attached to the place, and they can easily leave the place. On the other hand, the rest of the population is composed of natives who are attached to the place.

The expected payoffs are the following:

$$\pi_{CE} = f \cdot (1 - \beta) \cdot e - e - k \cdot \beta$$

$$\pi_{CN} = f \cdot (1 - \beta) \cdot e - k \cdot \alpha$$

$$\pi_{PE} = z - e$$

We plug in previously mentioned parameter values and explore the stationary loci and the vector field. The loci with stationary fractions of the sub-populations are presented in the following simplex.

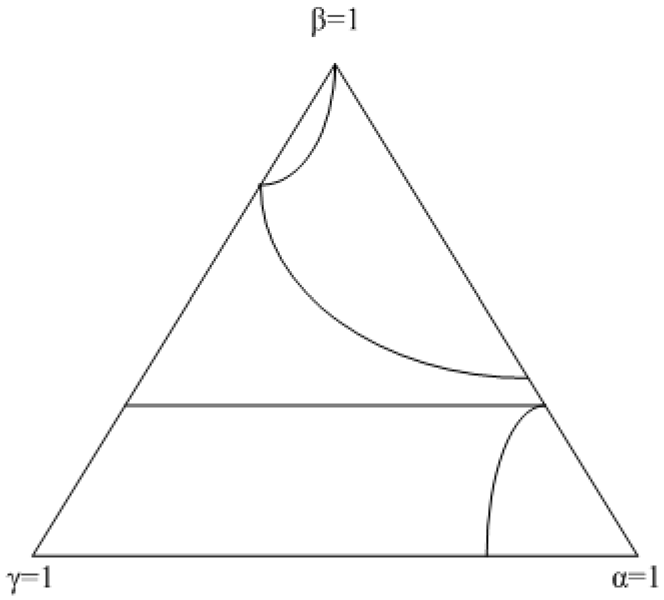
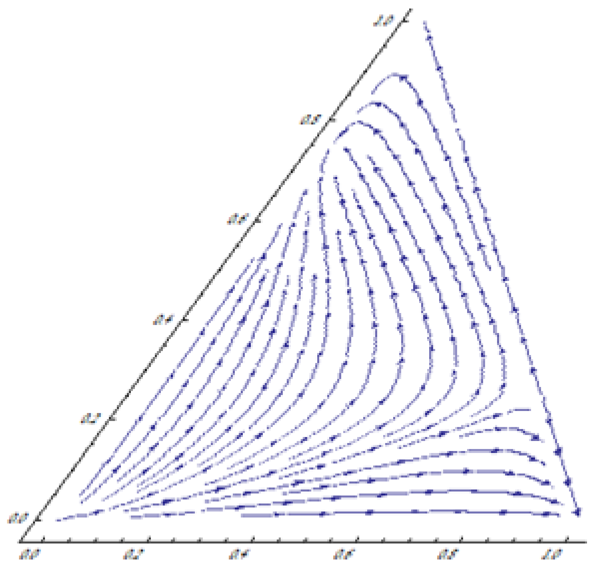


Figure 5: The stationary loci – the case with conformists

The stationary loci are presented in Figure 5. The upper left curve refers to the stationary population of Citizens who free-ride. The population of Petty Bourgeois is stationary along the negatively inclined line. Closer look to the vector field in Figure 6 reveals two stationary stable equilibria, pure and mixed. Pure equilibrium is composed exclusively of Citizens who contribute to the place (invest efforts in the environment). The mixed equilibrium is on the contrary reached when $\beta = 0.75$ and $\gamma = 0.25$.

$\beta = 1$



$\gamma = 1$ $\alpha = 1$

Figure 5: The vector field – the case with conformists

If the fraction of Citizens who contribute to the public good is sufficiently large, this will result with their absolute dominance in the long-term. However, if the fractions of the other types are sufficiently large, the population evolves towards the mixed evolutionary stable state where the payoffs of Citizens who free-ride and Petty Bourgeois who contribute are identical. Small perturbations from this state lead back to this evolutionary stable state. If the fraction of free-riders decreases, then the place (the environment) is improved. Thus, becoming a free-riding Citizen with preferences towards the place becomes more attractive. However, an increase in fraction of such Citizens decreases the quality of the place and decreases Citizens' payoffs.

3. CONCLUSION

We studied evolution of the place attachment. We treated the place attachment as a sort of identity which is captured by the agents' payoff function. The notion of public good and punishment is applied in the models. The choice of identity and activity was partly detached because the agents could choose between two types attached to the place and the third type which is not. We find that Citizen who contributes to the place is an evolutionary stable strategy. The population can never be composed solely of Citizens who free-ride because this would significantly deteriorate the place and decreased the payoffs of Citizens. However, free-riding Citizen may co-exist in the long term together with conforming Petty Bourgeois. However, when mixed with Petty Bourgeois who do not contribute, free-riding Citizens shift and become Petty Bourgeois. This paper provides interesting insights into the evolutionary dynamics of the place attachment. It departs from the existing models by introducing the third type. The suggestion for the future research is to elaborate the replicator dynamics and stability of the population composed of four types. Also, more detailed analysis of the stability is needed.

REFERENCES

Akerlof, G.A. and Kranton, R.E. (2000), "Economics and Identity", *The Quarterly Journal of Economics*, 15 (3), pp. 715-753.

Bowles, S. (2004), *Microeconomics: Behavior, Institutions, and Evolution*, Russell Sage Foundation and Princeton University Press, Princeton.

Cocks, M. (2006): Biocultural Diversity: Moving Beyond the Realm of „Indigenous" and „Local" People, *Human Ecology*, 34 (2), pp. 185-200.

Eaton, B.C., Eswaran, M. and Oxoby, R.J. (2011), "„Us" and „Them": the Origins of Identity and its Economic Implications", *Canadian Journal of Economics,* 44 (3), pp. 719-748.

Horst, U., Kirman, A. and Teschel, M. (2007), "Changing Identity: The Emergence of social Groups", Working paper, <available at: http://www.sss.ias.edu/files/papers/econpaper78.pdf>, [Accessed 29/11/2011].

Hoyos, D., Mariel, P. and Fernandez-Macho, J. (2009), " The influence of cultural identity on the WTP to protect natural resources: Some empirical evidence", *Ecological Economics*, 68 (8-9), pp. 2372-2381.

Infield, M. (2001), "Cultural Values: A Forgotten Strategy for Building Community Support for Protected Areas in Africa", *Conservation Biology,* 63 (3), pp. 224-237.

Lewicka, M. (2011), "Place attachment: How far have we come in the last 40 years?", *Journal of Environmental Psychology,* 31, pp. 207-230.

Pavlinović (2012), "Ekonomika identiteta i prostorni identitet", *Identitet Jadranskog prostora Hrvatske: Retrospekt-Prostpekt*, Sveučilište u Splitu, Ekonomski fakultet, Split, in press

Scannell, L. and Gifford, R. (2010) "The Relations between natural and civic place attachment and pro-environmental behavior", *Journal of Environmental Psychology,* 30, pp. 289-297.

Weibull, J.W. (1995), *Evolutionary Game Theory*, MIT Press, Cambridge MA.

Wichardt, P.C. (2011), "Identity, Utility, and Cooperative Behaviour: An Evolutionary Perspective", *The Scandinavian Journal of Economics,* 113 (2), pp. 418-443.