THE ECONOMY AND THE ENVIRONMENT IN THE DOMINICAN REPUBLIC AND HAITI: WHAT EXPLAINS THE DIFFERENCES?

João R. Faria
University of Texas, El Paso, USA

and

José R. Sánchez-Fung
Kingston University, London, UK, and ISA, University of London, UK

October 2009

Abstract

The Dominican Republic and Haiti share one island but display different economic and environmental paths. Policy decisions in the Dominican Republic aimed at protecting environmental resources help in explaining its better economic and environmental performance as compared to Haiti. The paper advances a model for explaining the differences as a result of environmental preferences and environmental saving efforts. The modelling derives sufficient conditions for better economic and environmental performance in the Dominican Republic in comparison with Haiti.

Key words: environmental degradation; growth and the environment; The Dominican Republic and Haiti.

JEL Classification Numbers: O13; Q2.

Acknowledgements: we are grateful to Paul Auerbach, Joachim Stibora, and three anonymous referees for comments and suggestions on a previous version of the paper. Any shortcomings are our responsibility. Sánchez-Fung thanks the hospitality of VATT in Helsinki, Finland, while working on the project.

Correspondence:

Professor João R. Faria, IPED, University College**,** University of Texas**,** 500 West University Avenue**,** El Paso, Texas, 79968-0703, USA.
E-mail: rfaria2@utep.edu.

Dr José R. Sánchez-Fung, School of Economics, Kingston University, London, Penrhyn Road, Kingston-upon-Thames, Surrey, KT1 2EE, UK.
E-mail: j.sanchez-fung@kingston.ac.uk.

1. Introduction

The Dominican Republic and Haiti share one island, as well as historical and institutional developments. But the Dominican Republic and Haiti have displayed strikingly different economic growth performances. Explaining economic growth and other aspects of economic development in the two economies is a relevant and challenging research topic (e.g., Jaramillo and Sancak, 2009).

In analysing the Dominican Republic in relation to Haiti the natural environment is fundamental[1]. Jared Diamond states:

> To anyone interested in understanding the modern world's problems, it's a dramatic challenge to understand the 120-mile border between the Dominican Republic and Haiti…From an airplane flying high overhead, the border looks like a sharp line with bends…dividing a darker and a greener landscape east of the line (the Dominican side) from a paler and browner landscape west of the line (the Haitian side) (2005, p. 329).

Figure 1 shows maps, obtained from the United Nations Food and Agriculture Organization (FAO), illustrating Diamond's observation about the different states of the natural environment in the two sides of the island[2]. In addition, the environmental performance index produced by Columbia and Yale Universities is an objective, data-based, assessment for informing decision-making on environmental protection and global sustainability. On the basis of the score in the 2008 environmental performance

[1] Lundahl (1992) examines various aspects of Haitian underdevelopment, including population growth and soil erosion.

[2] Hernández-Leal et al (2005) use data from the Advanced Very High Resolution Radiometer and also employ a Lansat-TM to study vegetation dynamics in the Dominican Republic and in Haiti. The study corroborates the distinct vegetation dynamics in the two countries.

index the Dominican Republic ranks 33rd and Haiti 119th in a sample of 149 countries (Esty et al, 2008: Table 1, page 10).

What can explain the different economic and environmental paths in the Dominican Republic and Haiti? The paper aims at answering that question. The research strategy involves developing a theoretical model capturing the dynamics between economic policy and the environment.

Jaramillo and Sancak (2009) develop an index comprising structural measures and stabilisation efforts in examining the comparative economic growth performance in the Dominican Republic and in Haiti. The authors find that the Dominican Republic has outperformed Haiti and other Latin American countries in reforming its institutions. The fact helps in explaining the Dominican Republic's stronger economic performance, but does not illuminate the environment's role in producing the outcome.

The paper relates environmental preferences and environmental saving efforts to specific economic and environmental policies in the Dominican Republic and in Haiti. The modelling explains the differences between the two economies as an outcome of environmental preferences and environmental saving efforts. The analysis also derives sufficient conditions for observing better economic and environmental performances in the Dominican Republic in relation to Haiti.

The paper proceeds as follows. Section 2 recounts environmental policies in the Dominican Republic and in Haiti to substantiate the modelling in the ensuing sections. Section 3 develops a model highlighting the role of preferences for environmental preservation and the efforts towards replenishing natural resources. Section 4 employs the model in comparing the economic and environmental outcomes in the Dominican Republic and in Haiti. Section 5 concludes.

2. Environmental policies in the Dominican Republic and Haiti

Geographical and historical features are relevant for understanding the Dominican Republic and Haiti. The Dominican Republic is less mountainous and occupies the eastern side of the island, so it gets more rain and is better placed for agriculture. But earlier in its development Haiti generated a higher agricultural output in relation to the Dominican Republic. That agricultural output was based on an unsystematic, free peasants scheme. So land tenure to some extent helps in explaining the subsequent soil degradation[3].

Other factors may have played an important role in generating the different outcomes in the Dominican Republic and Haiti. Haiti's population has been using land in an intensive way to produce export crops and food crops. Bayard et al. (2006a) show that factors such as age, education, and participation in local groups play an important role in land management. Furthermore, in Haiti the indiscriminate use of wood as fuel and for housing construction has been at the heart of deforestation [4].

Policy decisions are central in the analysis undertaken in the paper. The modelling aims at showing that they explain the differences in the framework advanced in the sections ahead, and are at the heart of the diverging environmental and economic paths in the Dominican Republic and Haiti.

During the 20th century the dictators in the Dominican Republic and Haiti, Trujillo and Duvalier, had different preferences towards the economy and the environment. Trujillo wanted to develop an industrial economy, and also endorsed

---

[3] On land tenure in Haiti, see Dolisca et al.(2007).

[4] Jameson (1988) finds evidence on the positive role that education can play in environmental issues. McIlvaine-Newsad (2003) studies a range of elements, like gender and food security, playing a role in the potential success of forestry projects in the Dominican Republic.

measures for caring about the environment, even though the ultimate goal was increasing his personal wealth. Duvalier did not pursue environment-friendly policies or any systematic development strategy. The fact may help in explaining the genesis of the modern environmental divergence between the Dominican Republic and Haiti. From the late 1960s the Dominican Republic passed laws banning the cutting of trees, and later on created large inland and coastal conservation areas.

In Haiti there have been efforts towards preserving soil and reforesting. The attempts range from food-for-work schemes to building watersheds during the period 1950-2005 as documented in a United States Agency for International Development Report (USAID) (see Smucker et al, 2005). The USAID report concludes that the limited success of the schemes boils down to not providing the right economic incentives for farmers to work towards the policies' success. So the policies put in place in Haiti have largely been unsuccessful in altering the preferences of economic agents. The result if that people tend to choose behaving in a way that harms the natural environment, i.e. not exerting the necessary environmental saving efforts. More recent efforts at implementing sound environmental policies at the ministerial level in Haiti, like creating the Ministry of the Environment in the mid 1990s, and the 1999 National Environmental Action Plan (NEAP), have met with limited success.

In terms of the analytical modelling, explicit policies reveal the preferences of Dominican policy makers for encouraging a more balanced development. There are particular policies seeking to provide the right incentives for people to care about the environment. For instance, there was a fairly successful social programme in the Dominican Republic for persuading people to use gas burning stoves instead of wood.

Plan Sierra is another significant example of active environmental policy in the Dominican Republic: the plan was launched in 1979 for protecting watersheds in the central part of the country[5]. *Plan Sierra* involved educating people about agriculture's potentially damaging impact on the soil. The environmental education programme aimed at preserving trees and soil[6]. From its inception the plan was seen as a remarkable endeavour, encompassing investment in education, health, and economic development, making it a sustainable option for local farmers and in the process curtailing rural-urban migration. By fostering this project the Dominican Republic was providing an important example in terms of environmental management, at least in a developing economy context (e.g. Shepard and Roth, 1984)[7].

The Dominican Republic has taken further steps towards enhancing the government's ability to regulate the natural environment. The General Law on the Environment and Natural Resources (Law 60 of 2000) created the Ministry of the Environment and Natural Resources (see Lizardo and Guzmán, 2005). The goal of this new ministry is improving environmental policies directed at protecting and improving the environment and natural resources, and safeguarding its sustainability. The Dominican Republic's Ministry of the Environment and Natural Resources has been rather successful and commands substantial credibility in the country.

In terms of the formal model, policy decisions in the Dominican Republic substantiate the assumptions of preferences for the preservation of the natural environment, as well as the development of environmental saving efforts. Both are scarcer in Haiti. According to the analysis that follows, the differences can help in

---

[5] De Janvry et al. (1995) study sustainability aspects of the Plan Sierra.

[6] The plan could improve farmers' awareness of, and attitude toward, environmental problems. On this issue see Bayard et al. (2006b).

[7] An additional, and rather successful, environmental management effort in the Dominican Republic is the 'Plan Quisqueya Verde'. The plan comprises reforestation, the protection of rivers and improving the rules for the private sector's involvement in forestry activities.

explaining a better environmental and economic performance in the Dominican Republic in comparison to Haiti**.**

3. The model

The stylized model highlights the role of preferences for environmental preservation, and actual efforts to replenish the natural resources (assumed to be renewable). The model takes into account the fact that economic activity uses natural resources and, as a consequence, it affects its dynamics. As natural resources are necessary for production, there is a feedback mechanism linking natural resources to the economy, since greater scarcity of natural resources is costly to the economy.

The representative agent problem is the following

$$\underset{c_i}{Max} \int_0^{\infty} U(c,N) e^{-\beta t} dt \ ,$$

$$\dot{k} = f(k,N) - c - nk - S(N) , \quad (1)$$

$$\dot{N} = \Delta(k, N, S(N)) = R(k,N) . \quad (2)$$

In this yeoman-type model, which is a good description for agrarian and not technologically driven economies like as Haiti and the Dominican Republic, people offer their services inelastically as in a basic Ramsey model. The representative agent's preferences, described by the instantaneous utility function $U(c,N)$, assume that she derives utility from per capita consumption *c*, and may or may not derive utility from the stock of per capita natural resources, *N*. It is controversial to assume that natural resources provide direct satisfaction, which makes its appearance as an argument of the utility function problematic. There are, however, a number of possible justifications for including it in the utility function.

One is that consuming natural resources yields direct benefits. Another is assuming that part of the output produced with the natural resource is exported and traded by an imported consumption good that appears in the utility function. A third reason may be the public's education regarding the environment, so as to value the stock of natural resources as something useful and good. Finally, tourists can be attracted by the natural resources and generate an additional source of income, allowing an increase in consumption levels. As a consequence, economic forces such as trade openness, tourism, and ecological education render including natural resources in the utility function a less contentious decision. On the other hand, the less open to trade and tourism an economy is, and the lower the level of ecological education in that economy, may justify excluding *N* from the utility function.

According to the discussion above, assume that the utility function has the following properties: $U_c > 0; U_N \geq 0, U_{cc} < 0, U_{NN} \leq 0, U_{cN} \geq 0$. Output per capita, *y*, is described by a well-behaved production function:

$y = f(k, N)$, $f_k > 0; f_N > 0, f_{kk} < 0, f_{NN} < 0, f_{kN} > 0$. Output depends on the per capita capital stock and natural resources, with constant returns to scale. A well-behaved neoclassical production function is in line with an economic growth approach along Ramsey lines. A criticism of Ramsey-type models is that they are not able to account for divergence. The alternative would be to study an endogenously growing economy with natural resources; e.g. Eliasson and Turnovsky (2004). The trouble of assuming a production function like Romer's (1986) for Haiti and the Dominican Republic is that they are not knowledge-driven economies. That explains why the paper accounts for differences between Haiti and the Dominican Republic as resulting from preferences and natural resources saving efforts.

Per capita capital investment $\dot{k} \equiv dk/dt$ depends on savings, defined as output less per capita consumption less environmental saving efforts. The presence of function *S(N)* in eq. (1) reflects that some natural resources are reserved or saved for replenishing the natural resources used in production. Environmental saving efforts can result from individual forward-looking farmers conscious that their future income depends on the preservation of the natural habitat. That behaviour may also be linked to ecological education, or to government programs to preserving agricultural soil, avoiding land erosion, and maintaining rivers and native vegetation. Likewise, environmental saving efforts are affected by geographic and meteorological natural conditions; for instance, land degradation, for any kind of agricultural activity, may be accelerated by topography and raining seasons.

The dynamics of natural resources described by equation (2) show that the variation of natural resources over time, $\dot{N} \equiv dN/dt$, depends on the stock of natural resources as well as on the economy's per capita capital stock (see Faria, 1998). The assumption that natural resources dynamics depend on per capita capital stock, *k*, captures the human exploitation of natural resources, i.e., the resources extraction rate is related to the use of capital per capita. The function $R(k,N)$ has the following characteristics: $R_k < 0; R_N > 0, R_{kk} \leq 0, R_{NN} \leq 0, R_{kN} \leq 0$.

The Hamiltonian function corresponding to the above problem is

$$H = U(c,N) + \lambda[f(k,N) - c - nk - S(N)] + \mu R(k,N) . \qquad (3)$$

In equation (3), λ and μ are, respectively, the shadow prices of per capita capital, *k*, and per capita natural resources, *N*.

The first order conditions are

$$H_c = 0 \Rightarrow U_c(c,N) - \lambda = 0, \tag{4}$$

$$\dot{\lambda} - \beta\lambda = -H_k = -\{\lambda[f_k(k,N) - n] + \mu R_k(k,N)\}, \tag{5}$$

$$\dot{\mu} - \beta\mu = -H_N = -\{U_N(c,N) + \lambda[f_N(k,N) - S_N(N)] + \mu R_N(k,N)\}. \tag{6}$$

The transversality conditions are $\lim_{t\to\infty} k\lambda e^{-\beta t} = 0 = \lim_{t\to\infty} N\mu e^{-\beta t}$.

Given eqs. (1), (2), and (4)-(6), the steady state equilibrium is given by the following equations

$$\dot{k} = 0 \Rightarrow f(k,N) = c + nk + S(N), \tag{7}$$

$$\dot{N} = 0 \Rightarrow R(k,N) = 0, \tag{8}$$

$$U_c(c,N) = \lambda, \tag{9}$$

$$\dot{\lambda} = 0 \Rightarrow [\beta - f_k(k,N) + n]\lambda = \mu R_k(k,N), \tag{10}$$

$$\dot{\mu} = 0 \Rightarrow U_N(c,N) + [f_N(k,N) - S_N(N)]\lambda = \mu[\beta - R_N(k,N)]. \tag{11}$$

Equation (7) says that in equilibrium output will be consumed and used in replenishing natural resources. Eq. (8) is the steady state condition for natural resources dynamics. Eq. (9) shows that the shadow price of capital , λ , corresponds to the marginal utility of consumption. Eqs. (10) and (11) are the Euler equations in the steady state.

The system of equations (7) to (11) allows studying Haiti and the Dominican Republic. We need, however, to establish the differences distinguishing these economies. For Haiti the analysis proceeds by assuming that the representative agent does not derive utility from the environment, thus the function $U(c,N)$ should be replaced by $U(c)$. Therefore, in the above system, $U_N(c,N)=0$.

The modelling assumes that the Haitian representative agent makes no effort to save natural resources, i.e., *S(N)*=0. It is also useful to distinguish the dynamics of natural resources as well as the production function between Haiti and the Dominican Republic. So we use a superscript on functions *R* and *f* to denote whether it corresponds to Haiti, *h*, or the Dominican Republic, *d*.

The analysis proceeds to solve the model for the Haitian case. Eliminating the shadow prices λ and μ from eqs. (10) and (11) yields

$$[\beta - R_N^h(k,N)][\beta - f_k^h(k,N) + n] = R_k^h(k,N) f_N^h(k,N)\,. \qquad (12)$$

Equations (7), (8), and (12) form a system of three equations that determine the per capita steady state (equilibrium) values [denoted by a superscript *h*] of three unknowns, consumption, capital and natural resources: $c^h, k^h, and\ N^h$. The system is block recursive, so that eqs. (8) and (12) determine k^h and N^h, and then eq. (7) determines c^h.

Obtaining explicit solutions involves assuming the following production function and natural resources dynamics for Haiti

$$f^{h}(k,N) = Ak^{\alpha}N^{1-\alpha}, \tag{13}$$

$$R^{h}(k,N) = rN - akN. \tag{14}$$

In eq. (13) α is the share of capital in output and (1−α) is the share of natural resources [all in per capita terms]; in eq. (14) *r* stands for the rate of growth of natural resources and *a* is the extraction rate of natural resources.

Equation (14) is a homogeneous first-order linear differential equation with a variable coefficient

$$\dot{N} = rN - akN \Rightarrow \frac{\dot{N}}{N} = r - ak(t)$$

And it has a general solution of the form

$$N(t) = Ae^{r-a\int k(t)dt}$$

The implication is that without human intervention [*k(t)=0*] the renewable natural resource grows to an exponential rate. The exponential growth rate may hold true in the short run in a tropical environment where an almost destroyed rainforest typically grows very fast in the absence of human intervention. A more realistic setup involves assuming that in the long run renewable natural resources may converge to a maximum sustainable stock, $\overline{N}$, called the carrying capacity of the environment. In such a case the appropriate assumption for the growth of the renewable resource is a logistic function[8]: $L(N) = rN(1-\vartheta N/\overline{N})$, rather than *r*, as in (14).

Although a logistic function makes sense in environmental terms, we choose to make $\vartheta = 0$, rather than assuming $\vartheta = 1$, emphasising a much simpler economic reality for very poor countries depending on their agricultural output so that their capital stock is directly related to the ratio between natural resources growth and exploitation. This is the result, derived in equations (15) and (24), below.

Given eqs. (13) and (14), from eq. (8) we determine the equilibrium value of capital per capita for Haiti

$$R(k,N) = rN - akN = 0 \Rightarrow k^h = r/a\,. \qquad (15)$$

Using eqs. (15), (13) and (14) into (12) generates the equilibrium value of natural resources

$$N^h = r\left(\frac{\beta(\beta+n)a^{\alpha}}{aA(\alpha\beta+(1-\alpha)r)}\right)^{1/(1-\alpha)}. \qquad (16)$$

Consumption for Haiti is

$$\dot{k} = 0 \Rightarrow c^h = A(r/a)^{\alpha}\, r^{1-\alpha}\left(\frac{\beta(\beta+n)a^{\alpha}}{aA(\alpha\beta+(1-\alpha)r)}\right) - nr/a\,. \qquad (17)$$

[8] See Brown (2000) and Conrad (1999).

The Dominican Republic is more complex and the analysis cannot proceed in the same way as in solving the model for Haiti. In the Dominican Republic case the assumption is that the representative agent has preferences for environmental preservation, implying a utility function of the form $U(c, N)$. The analysis also assumes that the agent makes an effort to save natural resources used in production, *S(N)*>0.

In solving the model for the Dominican Republic the analysis proceeds by isolating μ in eq. (10)

$$\mu = \frac{[\beta - f_k(k, N) + n]\lambda}{R_k(k, N)}. \qquad (18)$$

Plugging eq. (18) into eq. (11) and using eq. (9) yields

$$U_N(c, N) = U_c(c, N)\left\{\frac{[\beta - f_k(k, N) + n]}{R_k(k, N)}[\beta - R_N(k, N)] - [f_N(k, N) - S_N(N)]\right\}. \qquad (19)$$

The system formed by equations (19), (7) and (8) determine simultaneously the per capita steady state values of consumption, capital, and natural resources for the Dominican Republic, $c^d, k^d, and\ N^d$.

In order to obtain explicit solutions the modelling assumes the following utility and production functions, natural resources dynamics, and savings of natural resources (the superscript for the Dominican Republic is *d*)

$$U^d(c, N) = c^b N^{1-b}, \qquad (20)$$

$$f^d(k, N) = Bk^{\varepsilon} N^{1-\varepsilon}, \qquad (21)$$

$$R^d(k,N)=\rho N-\psi kN, \tag{22}$$

$$S(N)=\frac{\xi}{(1-\varepsilon)}N^{1-\varepsilon}. \tag{23}$$

Eqs. (20) and (21) are Cobb-Douglas utility and production functions. Eq. (22) has an analogous interpretation to the one given for eq. (14). Eq. (23) describes environmental saving efforts, and parameter ξ captures the marginal environmental saving effort.

From eqs. (8) and (22) the modelling calculates the equilibrium value of capital per capita for the Dominican Republic

$$\dot{N}=0 \Rightarrow R(k,N)=\rho N-\psi kN=0 \Rightarrow k^d=\rho/\psi. \tag{24}$$

Using eqs. (7), (19) and (20)-(24) and solving for natural resources yields

$$N^d=\left(\frac{\beta(\beta+n)+b^{-1}(1-b)n\rho}{\psi\xi[b(1-\varepsilon)]^{-1}[1-\varepsilon b]+B\rho^{\varepsilon}\psi^{\varepsilon-1}[(\beta\rho^{-1}+1)\varepsilon-b^{-1}]}\right)^{1/(1-\varepsilon)}. \tag{25}$$

The non-negativity condition for N^d is

$$\psi\xi[b(1-\varepsilon)]^{-1}[1-\varepsilon b]+B\rho^{\varepsilon}\psi^{\varepsilon-1}[(\beta\rho^{-1}+1)\varepsilon-b^{-1}]>0. \tag{26}$$

Merging equations (24) and (25) into (7) yields the equilibrium value of consumption per capita for the Dominican Republic

$$c^d = \left[B(\rho/\psi)^{\varepsilon} - \frac{\xi}{(1-\varepsilon)} \right] \left(\frac{\beta(\beta+n) + b^{-1}(1-b)n\rho}{\psi\xi[b(1-\varepsilon)]^{-1}[1-\varepsilon b] + B\rho^{\varepsilon}\psi^{\varepsilon-1}[(\beta\rho^{-1}+1)\varepsilon - b^{-1}]} \right) - n(\rho/\psi) \tag{27}$$

The next section compares Haiti with Dominican Republic using the steady state equilibrium for each economy.

4. Comparing the Dominican Republic and Haiti

Comparing the steady state equilibriums allows deriving the conditions for the Dominican Republic to display a better environmental and economic performance in relation to Haiti. The assumptions of environmental preferences and saving efforts do not guarantee a priori that the Dominican Republic will have a better economic and environmental performance. The section highlights the sufficient conditions for observing the result, and serves to underscore the limitations of the modelling strategy.

What follows shows the conditions that make the Dominican Republic's equilibrium natural resources greater than Haiti's by comparing equations (16) and (25). The strategy involves establishing the conditions for a greater numerator and a smaller denominator for the Dominican Republic in relation to Haiti. The conditions will allow identifying the reasons for observing a better environmental performance in the Dominican Republic.

Making the exercise more tractable involves assuming that the output share of capital and the rate of growth of natural resources is the same for both countries, i.e., $\alpha=\varepsilon$, $\rho=r$. Beginning with the numerator, the rate of growth of natural resources is smaller than the equilibrium capital in Haiti powered by α

$$r < \left(k^h\right)^{\alpha} \tag{28}$$

the numerator in expression (25) is greater than the numerator in (16).

In comparing the denominators notice that if in (16)

$$\beta < \rho[(\varepsilon b)^{-1} - 1] \tag{29}$$

it follows that

$$\psi\xi[b(1-\varepsilon)]^{-1}[1-\varepsilon b] > \psi\xi[b(1-\varepsilon)]^{-1}[1-\varepsilon b] + B\rho^{\varepsilon}\psi^{\varepsilon-1}[(\beta\rho^{-1}+1)\varepsilon - b^{-1}]\ . \tag{30}$$

Therefore the conditions that warrant

$$\psi\xi[b(1-\varepsilon)]^{-1}[1-\varepsilon b] < aA(\alpha\beta + (1-\alpha)r)\ . \tag{31}$$

are sufficient for observing a greater denominator in (16) than in (25).

Recalling that we are assuming $\alpha=\varepsilon$, it follows that

$$\psi\xi < (1-\alpha)abA(\alpha\beta + (1-\alpha)r)\ . \tag{32}$$

Assuming that the rate of extraction of natural resources is higher in Haiti than in the Dominican Republic, $\psi < a$, produces

$$\frac{\xi}{b} < (1-\alpha)A(\alpha\beta + (1-\alpha)r) . \quad (33)$$

Conditions (28) and (33) provide a sufficient condition for the per capita stock of natural resources in the Dominican Republic to be greater than in Haiti, $N^d > N^h$. So conditions (28) and (33) are important to identify the factors and relations leading to observing a better performance in the Dominican Republic in comparison with Haiti.

Condition (28) states that the rate of growth of natural resources is smaller than the equilibrium capital in Haiti powered by α. Condition (33) says that in Dominican Republic the rate between the marginal environmental saving effort ξ and the share of consumption in the preferences, *b*, must be smaller than a linear combination between the discount rate and the growth rate of natural resources, weighted by the product of technology and the share of natural resources in Haiti's output.

The analysis proceeds by showing the conditions for economic performance in the Dominican Republic to be superior to that in Haiti. Given the assumption that the rate of extraction of natural resources is higher in Haiti than in the Dominican Republic, $\psi < a$, and the same rate of growth of natural resources for both countries, ρ=r, it is easy to see from eqs. (15) and (24) that the equilibrium capital per capita in the Dominican Republic is greater than in Haiti, $k^d > k^h$.

Provided that $k^d > k^h$, and that $N^d > N^h$, it follows from eqs. (13) and (21) that output per capita in the Dominican Republic is greater than in Haiti, $y^d > y^h$; and, as a consequence, from eqs. (17) and (27) it follows that the consumption per capita in the Dominican Republic is greater than in Haiti, $c^d > c^h$.

5. Concluding Remarks

The paper advances a framework for understanding the different economic and environmental paths in the Dominican Republic in comparison with Haiti. Policy decisions in the Dominican Republic aimed at protecting environmental resources help in explaining its better economic and environmental performance as compared to Haiti, where the implementation of similar policies has been rather unsuccessful. The formal modelling explains the differences as a result of environmental preferences and environmental saving efforts.

References

Bayard, Budry, Curtis Jolly, and Dennis Shannon (2006a) The adoption of soil conservation practices in Haiti: The case of Rock Walls, *Agricultural Economics Review* **7**, 28-39.

Bayard, Budry, Curtis Jolly, Dennis Shannon, and Alejandro Lazarte (2006b) Low-income farmers' behaviour toward land degradation: The effects of perceptions, awareness, attitude, and land use, *International Journal of Ecological Economics and Statistics* **6**, 64-89.

Brown, G.M. (2000) Renewable natural resource management and use without markets, *Journal of Economic Literature* 38, 875-914.

Conrad, John (1995) *Resource economics*, Cambridge University Press: Cambridge.

De Janvry, Alain, Elisabeth Sadoulet, and Blas Santos (1995) Project evaluation for sustainable rural development: Plan Sierra in the Dominican Republic, *Journal of Environmental Economics and Management* **28**, 135-154.

Diamond, Jared (2005) *Collapse: How societies choose to fail or survive*, Penguin Books: London.

Dolisca, Frito, Joshua McDaniel, Lawrence Teeter, and Curtis Jolly (2007) Land tenure, population pressure, and deforestation in Haiti: The case of Foret des Pins Reserve, *Journal of Forest Economics* **13**, 277-289.

Elíasson, Lúdvík, and Stephen J. Turnovsky (2004) Renewable resources in an endogenously growing economy: Balance growth and transitional dynamics, *Journal of Environmental Economics and Management* 48, 1018-1049.

Esty, Daniel C., M.A. Levy, C.H. Kim, A. de Sherbinin, T. Srebotnjak, and V. Mara (2008) *2008 Environmental Performance Index*, New Haven: Yale Center for Environmental Law and Policy

Faria, João R. (1998) Environment, growth and fiscal and monetary policies, *Economic Modelling* **15**, 113-123.

Hernández-Leal, P. A., A. González-Calvo, L. Arvelo-Valencia, and M. Arbelo (2005) Assessing the impact of deforestation using satellite data, *Geophysical Research Abstracts*, **7**.

Jameson, Kenneth P. (1988) Education's role in rural areas of Latin America**,** *Economics of Education Review* **7**, 333-343.

Jaramillo, Laura, and Cemile Sancak (2009) Why has the grass been greener on one side of Hispaniola? A comparative analysis of the Dominican Republic and Haiti, *IMF Staff papers*, **56**, 323-349.

Lizardo, Magdalena, and Rolando M. Guzmán (2005) *Coordinación de las políticas fiscales y ambientales en la República Dominicana*, United Nations Economic Comission for Latin America and the Caribbean (ECLAC), Serie Medio Ambiente y Desarrollo no. 100, Santiago, Chile.

Lundahl, Mats (1992) Politics or markets? Essays on Haitian underdevelopment, Routledge, London and New York.

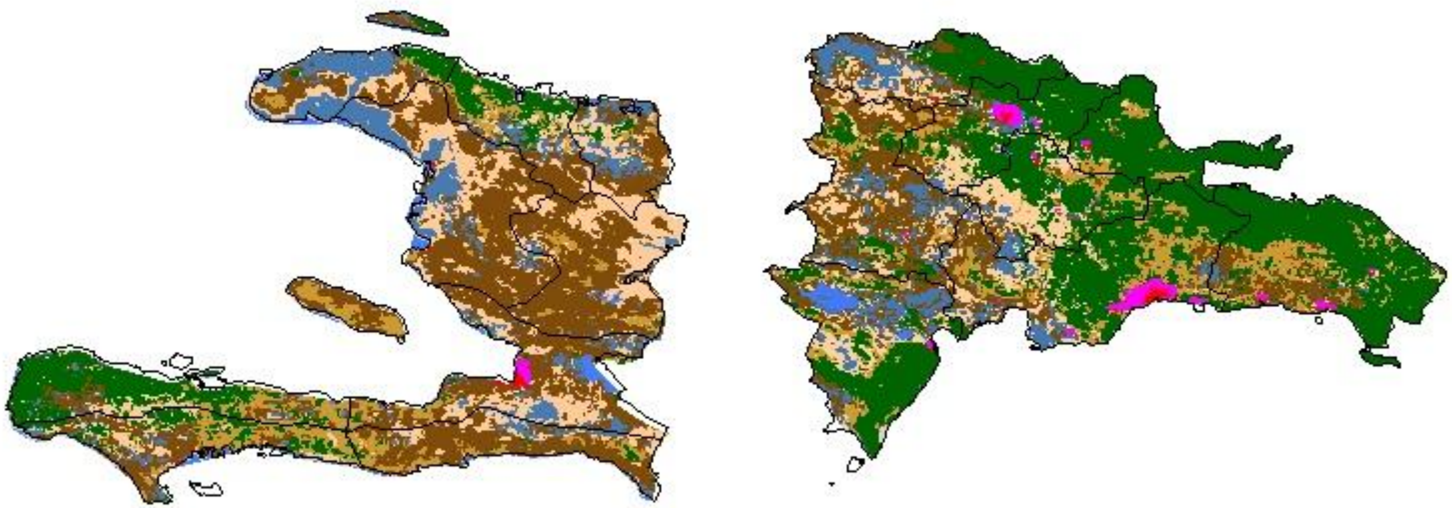
McIlvaine-Newsad, Heather (2003) Ojalá que llueva algo en el campo: unanticipated influences and development, *International Journal of Agricultural Resources, Governance and Ecology* **2**, 153-166.

Romer, Paul M. (1986) Increasing returns and long-run growth, *Journal of Political Economy* **94**, 1002-1037.

Shepard, Clinton L., and Robert E. Roth (1984) Stockholm recommendation 96: Viable in the Dominican Republic, *The Environmentalist* **4**, 301-304.

Smucker, Glenn R., Gardy Fleurantin, Mike McGahuey, and Ben Swartley (2005) Agriculture in a fragile environment: Market incentives for natural resource management in Haiti, order no. 521-O-00-05-00066-0, USAID/Haiti Mission/EG, Port-au-Prince, Haiti.

Figure 1
Individual maps showing land cover in Haiti (left)
and the Dominican Republic (right)



Notes on Figure 1: Haiti and the Dominican Republic share **one island** but the map for each country is shown individually. The maps are arranged in the true geographical orientation: the Dominican Republic is in the east of the island and Haiti in the west. The areas in green are forests; the areas in brown are dry croplands and pastures. Sources: maps downloaded in 2009 from the United Nations Food and Agriculture Organisation (FAO) website www.fao.org. Landcover datasets from the University of Maryland and the World Land Cover dataset from the USGS EROS Data Centres Global Land Characteristics Database. For further details see http://www.geog.umd.edu/landcover/global-cover.html.