Multi-Product Crops for Agricultural and Energy Production – an AGE Analysis for Poland

Adriana M. Ignaciuk and Rob B. Dellink

NOTA DI LAVORO 133.2005

NOVEMBER 2005

IEM – International Energy Markets

Adriana M. Ignaciuk and Rob B. Dellink, *Environmental Economics and Natural Resources Group, Wageningen University*

Multi-Product Crops for Agricultural and Energy Production – an AGE Analysis for Poland

Summary

By-products from agriculture and forestry can contribute to production of clean and cheap (bio)electricity. To assess the role of such multi-product crops in the response to climate policies, we present an applied general equilibrium model with special attention to biomass and multi-product crops for Poland. The potential to boost production of bioelectricity through the use of multi-product crops turns out to be limited to only 2-3% of total electricity production. Further expansion of the bioelectricity sector will have to be based on biomass crops explicitly grown for energy purposes. The competition between agriculture and biomass for scarce land remains limited, given the availability of relatively poor land types and substitution possibilities. The importance of indirect effects illustrates that the AGE framework is appropriate.

Keywords: Applied general equilibrium (AGE), Biomass, Energy policy, Renewable energy

JEL Classification: D58, H23, Q28, Q42

Address for correspondence:

Adriana Ignaciuk
Environmental Economics and Natural Resources Group
Wageningen University
P.O. Box 8130
6700EW Wageningen
The Netherlands
E-mail: Adriana.Ignaciuk@wur.nl

1. Introduction

Growing demand for clean energy is one of the responses to (i) stringent environmental policies aimed at reducing greenhouse gas emissions and (ii) declining fossil fuel resource availability. One of the possible solutions is biomass, which can deliver large quantities of energy at low net CO_2 emission levels. However, an often-heard concern is that large-scale biomass plantations might increase pressure on the productive land and might cause a substantial increase of food prices (McCarl and Schneider, 2001; Azar, 2003). In contrast, many scientists claim that the food policies that were established after the 2nd World War resulted in today's overproduction of food, and hence the welfare impact of the increased pressure on land may be limited (Tilman et al., 2002; Trewavas, 2002; Wolf et al., 2003).

To increase biofuel supply and to reduce the demand pressure on land, multi-product crops can be utilized. Dornburg (2004) defines multi-product crops as “crops that can be split into two or more different parts that are used for different applications”. A major product of the crop can for instance be food, while another part of the crop is used as energy, i.e. is used as solid fuel or converted to liquid fuel, and still another part of the crop is used for e.g. material applications. In this paper, we focus on multiproductivity of agriculture, forestry and biomass sectors, *i.e.* on multi-product crops that can be used for energy purposes. We refer to the residuals generated in these sectors as by-products.

There are several studies that quantify by-products on the global scale. According to Fisher and Schrattenholzer (2001), the energy potential of by-products of wheat, rice, grains, protein feed and other crops are between 18-25 ExaJoule per year (EJ/y), equivalent to 4-6% of world energy use. Hoogwijk et al. (2003), based on several studies, give even higher estimates of 10-32 EJ/y for using agricultural residuals in bioenergy production. For forestry residuals, their estimates are between 10 and 16 EJ/y. A study focusing on GHG emission in Europe is performed by Gielen et al. (2001). The results of the GLUE-11 simulation model (Yamamoto et al., 2001), where different scenarios concerning exogenous population growth and demand for energy are applied, suggest that biomass residuals can potentially satisfy 30 percent of world energy demand in 1990 i.e. 114EJ/y. There are also many studies that establish the biomass and biomass by-products potential for individual countries (Radetzki, 1997; van den Broek et al., 2001; Ignaciuk et al., 2005b). Most of these studies are based on linear techniques that have a fixed proportion of residuals per process. What all these models lack is insight in how these by-products can influence energy prices, agricultural prices, production of biomass and the supply of agricultural commodities.

Bottom-up models as the ones described above are characterized by a detailed description of the energy sector and specific technologies, but they do not take into account the interlinkages with the rest of the economy and often assume that energy demand is exogenous and independent of prices (Zhang and Folmer, 1998). The alternative is to specify economic behavior from a top-down perspective. Top-down models are aggregated models that are able to capture the secondary effects of energy policy on other economic sectors and on trade (Springer, 2003). There are many top-down models that involve detailed economic analysis of the energy sector, and that are able to provide the secondary effects of shifting energy production, e.g. Breuss and Steininger (1998), Kumbaroglu (2003), McFarland et al., (2004), Babiker (2005), and Ignaciuk et al., (2005a). However, none of these investigate the interaction between multi-product crops and prices and quantities on related markets. Therefore we choose to incorporate essential bottom-up information on multiproductivity in a top-down CGE framework. More detailed discussions of top-down versus bottom-up models can be found in Böhringer (1998), Klinge Jacobsen (1998) and Dellink (2003).

In this paper, we assess the impact of climate policies on sectoral production levels and prices of land, food, electricity and other commodities, when multi-product crops are accounted for. We investigate to what extent the multi-product crops increase the economic potential of bioelectricity production. Moreover, we analyze the land use reallocations initiated by these policies by distinguishing various land types. For these purposes, we present a general equilibrium model for a small open economy where agricultural and biomass sectors are explicitly modeled. We choose this line of analysis because it allows us to comprise the bottom-up information about multi-productivity with the general description of the whole economy in an applied general equilibrium (AGE) setting. This allows us to analyze how responses to energy policies influence main economic sectors and indirectly the whole economy. The model is applied to Poland. Poland is a suitable case, as the land prices are relatively low and the modernization of the agricultural sector is still going on. Hence, we expect that the economic potential for biomass production in Poland is rather high.

This paper is structured as follows. Section 2 presents the background information about multi-product crops. In Section 3 the model characteristics are described and to the end of this section data and scenarios are briefly described. In Section 4 the results are gathered and discussed. The last section concludes.

2. Multi-product crops and bioelectricity production in Poland

2.1. *MULTI-PRODUCT CROPS*

From 1990 onwards, the Polish economy started its restructuralization towards market economy. One of the first observed changes was declining agricultural production. It was caused by (i) a decrease of relative wages and an increase of prices and (ii) an import of cheaper (subsidized by e.g. EU) food products (Okuniewski, 1996). In recent years wages increased, but this fact is not mirrored in an increase in the demand for food. Food is considered to be a basic good, and thus an increase in income results in a less than proportional increase in demand for this commodity. Empirical analysis of the Polish situation confirms this theory (Hunek, 1996).

Recent analyses show that the current level of agricultural production in Poland can be obtained from an area that is 14.9% smaller than the current acreage. It means that around 2.8 mln ha can be used for other production than agriculture (Wos, 1998; Gradziuk, 2001).

Such a situation provides scope to develop other activities. One of the options is to use this land for energy crops. Biomass in Poland comes from several sources, including (i) traditional agriculture, (ii) forestry, and (iii) biomass plantations (Kowalik, 1994; Gradziuk, 1999). Currently, however, it is marginally used for energy production. The potentials for using e.g. rape or cereals straw are large. Traditionally, straw is utilized for various purposes: (i) as fodder, or (ii) as lining for live stock, and (iii) as organic fertilizer and insulation material

(AEBIOM, 1999). Recently, the share of cereals production in total agricultural production increased, and the animal production decreased. This results in large straw surplus. According to EC Brec (2004), the amount of straw that technically can be used for energy production equals 11.3 mln t (170PJ). Gradziuk (2001) calculates that in the beginning of twenty first century overproduction of straw (from cereals and rape) sums to 11.6 mln ton. The European Biomass Association (AEBIOM) assumes that 22 mln ton of straw can be used for non-agricultural purposes in Poland (AEBIOM, 1999). Straw, that is produced as a by-product of hemp can be also used as an energy source. According to Dornburg (2004), 2.5 ton of straw per ha can be collected resulting in 1.25 thousand ton of hemp straw in Poland that can be used in e.g. bioelectricity sector. For the analysis in this paper we chose the conservative estimates of straw production. Our selection is presented in Table 1.

Table 1
Theoretical and technical energy potential of residuals use in Poland

Type of residuals	Potential use	
	Mln ton	PJ
Cereals straw	4.46	73.5
Wheat straw	4.44	73.5
Rape straw	1.4	23
Hemp straw	0.00125	0.02
Forestry residuals	3.27	53.9

Source: Based on: Gradziuk (2001), Dornburg (2004) , EC Brec (2004)

The Forestry sector also provides by-products that can be utilized for energy production. Gradziuk (2001) calculates that in Poland over 170 thousands m^3 of wood residuals can be used for e.g. bioelectricity. For our analyses we convert these residuals into straw equivalents by using the average caloric content of the residuals.

2.2. *BIOELECTRICITY SECTOR*

Coal is dominant in the production of electricity in Poland. Around 97% of all electricity generated in the country comes from coal-fired plants that are very inefficient. In 1997, 135.0 billion kWh of electricity was generated in Poland from which only from which 0.6 from renewable energy. In 2000, the situation was similar; 135.2 billion kWh was produced, from which 0.5 kWh from renewable energy. Poland is a net electricity producer. In 2001, Polish government set goals concerning an increase of bioelectricity share in total electricity production to 7.5% by 2010 and 14% by 2020. Hence, in the future the shares of ‘green’ electricity are expected to increase drastically.

In 1999 most of the ‘green’ electricity was produced from small hydro plants, but there is not much scope for expansion of this type of electricity in Poland. Other potential sources for electricity production are (i) solar panels, (ii) wind mills and (iii) biomass. Solar energy is relatively expensive compared to other renewable sources. To produce relatively cheap wind energy, the wind parks need to have good geographical conditions. Right now, only in the northern part of Poland there is some development in this field, but both atmospheric conditions and negative community attitude do not encourage further developments. Hence, in the future, it is expected that the biomass is going to play a larger role in the production of green electricity.

Currently, in Poland, biomass is used mainly to generate heat. However, there are a few working plants combining production of heat and electricity, mostly using forestry products. Besides these, willow and hemp are considered to have a high potential for use in electricity production (EC Brec, 2004).

The costs of biomass-based plants generating electricity are currently 2 to 3 times higher than similar plants fueled by oil or gas (Zurawski, 2004). However, within the coming years, the electricity sector has to undertake serious modernization in order to fulfill both efficiency and environmental standards (Lynch, 2005). Most of the old plants need to be replaced, creating a large scope for development of new and clean biomass-based plants. In Poland, since many years, there is a tendency to develop small-scale plants that can be placed based on availability of crops in the region, thereby minimizing transport costs of biomass.

3. Model specification

To assess the impact of climate policies on land use allocation, sectoral production levels and prices of land, food, electricity and other commodities, we present an applied general equilibrium (AGE) model with special attention to biomass and multi-product crops. The section starts with the general description of the economic model, followed by a discussion of the specific elements related to biomass and environmental policy. Then, the data and scenarios are briefly presented.

3.1. GENERAL SPECIFICATION

The model describes the entire economy, with explicit detail in the representation of production of traditional agricultural and biomass crops. It is an extended version of the model described in Ignaciuk et al. (2005). Our model distinguishes 35 sectors, including 6 agricultural and biomass sectors. Moreover, the bioelectricity sector is explicitly described. As in all applied general equilibrium models (AGEs), all markets clear, which means that supply equals demand for all goods through adjusting relative prices (Ginsburgh and Keyzer, 1997). We include three types of primary production factors: labor, capital and land.

A *representative consumer* maximizes utility under the condition that expenditures on consumption goods do not exceed income. Utility is represented by a nested constant elasticity of substitution (CES) function[1]:

$$U = CES\left(C_i, EL^N; \sigma^U\right) \tag{1}$$

in which U is utility, C_i is the consumption of commodities from sector i (excluding electricity) and $EL^N = CES\left(C_e, C_{be}; \sigma^{EL}\right)$ denotes electricity consumption, where C_e and C_{be} are consumption of Electricity and Bioelectricity respectively. This specification allows for different substitution possibilities between different consumption goods, such as between

[1] The CES function $Y_i = \left(\alpha_1 X_1^\rho + \alpha_2 X_2^\rho\right)^{1/\rho}$ with $\rho = (\sigma\text{-}1)/\sigma$ is written as $Y_i = CES(X_1,X_2;\sigma)$.

conventional electricity and bioelectricity: parameters σ^U and σ^{EL} are the constant substitution elasticities and equal 0.5 and 0.75, respectively. Consumers own production factors and consume produced goods. Labor supply is fixed, while the wage rate is fully flexible. All taxes are collected by the government that uses them to finance public consumption and pay lump-sum transfers to private households.

Producers maximize profits subject to the available production technologies. Production technologies are represented by nested CES functions. Following Rutherford and Paltsev (2000), production functions of different commodities have a six-level nesting structure (cf. Figure 1).

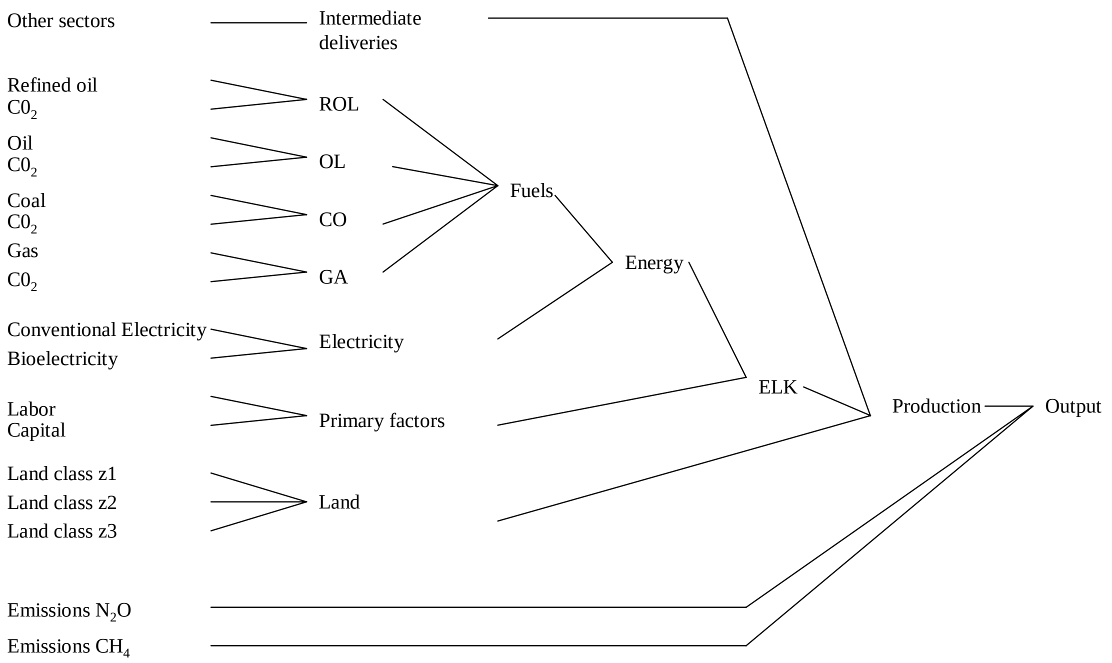

Figure 1
Nested CES function

In the model, we assume that Poland is a small open economy. It means that neither domestic prices nor traded quantities change the 'world market prices'. The international market is assumed to be large enough to absorb any quantities of goods produced in Poland and it can satisfy any Polish import demands. Trading partners are not modeled explicitly, however, they are addressed, following Keller (1980) as the 'Rest of the World' (RoW). The demand by the RoW represents Polish exports and its supply represents Polish imports. In this model, we choose the Armington specification for traded goods, assuming that domestic and foreign goods are imperfect substitutes (Armington, 1969). This allows for a difference in prices between domestically produced goods and their international substitutes. Hence, an increase in domestic prices leads to a shift in demand towards the competitive imports, but only to a limited extent. Similarly, a change in domestic prices will have a limited impact on exports.

The interactions between the various production sectors are relevant, as the agricultural and energy sectors have strong links with the rest of the economy. An economy-wide model, such as the AGE-framework provides, allows us to take these interlinkages fully into account.

Moreover, the indirect impacts of environmental policies are incorporated (cf. (Dellink, 2005)), ensuring a consistent assessment of the economic costs of environmental policy.

3.2. THE BIOMASS MODULE

Four land classes are identified to capture differences in productivity from different land types. Agricultural and biomass crops can grow on three different land use classes *z1*, *z2*, *z3*, which correspond to the six land classes used in the Polish land classification system (GUS, 2002c). Land type *z1* comprises very good and good land (class I & II), *z2* reasonably good and average (class III & IV) and *z3* poor and very low quality (class V & VI). Forestry grows on the *z4* type of land.

In the formation of utility and in the production function, emissions (emission permits) are incorporated as a necessary input. Environmental policy is implemented by reducing the number of emission permits the government auctions. This way of modeling environmental policy ensures that a cost-effective allocation is achieved (Dellink, 2005).

The emissions of the major greenhouse gases, CO_2, N_2O and CH_4, are included, all expressed in CO_2 equivalents. Data on emissions is obtained from Sadowski (2001). CH_4 and N_2O data are directly linked to output. As CO_2 emissions come mostly from fossil fuel combustion they enter the production function assuming a fixed relation with fossil fuel use (cf. Figure 1).

In our model, we deal with multiproductivity characteristics of cereals, rape, hemp and forestry products by including straw or residuals as a by-product, as explained in Section 2. The by-products are produced in fixed proportions to the production of the main product, and can be used only by the bioelectricity sector. Besides using labor and capital, the bioelectricity sector has the choice between using willow, hemp, wood, and straw and residuals as inputs, with high elasticity of substitution. In the benchmark, straw is not available as input, which allows us to analyze the impact of using by-products in the scenarios.

3.3. THE EU SUBSIDY ON LAND USE

In May 2004, Poland joined the EU. This historical moment initiated some changes in the agricultural and forestry sectors. Since the entry date Polish farmers are subjects to extensive European subsidies. These subsidies cover traditional agricultural crops, energy crops and aforestation practices. The Polish government chooses a relatively simple subsidy scheme. Each farmer that owns a land of acreage of more than 1 ha receives on yearly basis 61 Euro per ha[2]. Moreover, farmers get 72 Euro subsidy per ha if they grow traditional agricultural crops on his land. For a detailed list of crop subsidies see UKIE (2004). Grass landowners receive 69 Euro subsidy per ha. The energy crops are subsidized in the amount of 45 Euro per ha (EU, 2003).

The EU proposed a long-term program for Poland, regarding afforestation of agricultural land (UKIE, 2004). In present value terms, using a discount factor of 4%, landowners receive 175 Euro per ha for afforested land.

[2] One zloty (zl) equals around 0.25 Euro (exchange rate 27.06.2003 http://www.xe.com).

The EU subsidies are paid from external sources, namely EU. The traditional agriculture and biomass sectors are directly subsidized, but the Forestry sector only gets subsidy on land that is converted into forestry.

The foreign financing of the EU subsidies is simulated in the model by endowing the RoW with assets that can exactly cover the payments involved in the subsidies. To ensure *ex post* balance between the assets and payments involved, this endowment is rationed endogenously in the model.

3.4. DATA

A Social Accounting Matrix (SAM) for Poland is specified in order to determine the benchmark equilibrium. GTAP5 data for 1997 (Dimaranan and McDougall, 2002), are adopted in our model. In the SAM, agricultural and biomass data are disaggregated based on the FEPFARM model built by Mueller (1995), using FAO (2005) land use data for Poland. The FEBFARM model provides the shares of production costs.

Substitution elasticities between the different inputs in the production and utility functions are specified based on Kemfert (1998), Rutherford and Paltsev (2000), Kiuila (2000), and Dellink (2005).

Data on land use pattern and emissions are obtained from Polish statistics (GUS, 2002b; 2002a). Data on agricultural and biomass residuals are taken from Gradziuk (2001) Dornburg (2004) and EC Brec (2004). The full data set used in the model can be obtained from authors.

3.5. SCENARIOS

We present two policy scenarios aimed at increasing the share of bioelectricity in total demand for electricity and at reducing CO_2 emissions. For each scenario, we adopt some restriction on the number of emission permits and applied bioelectricity subsidy rate. This allows us to investigate at which level of climate policy the national targets for bioelectricity use are achieved. Polish policy makers set goals concerning an increase of bioelectricity share in total electricity production to 7.5% by 2010 and 14% by 2020.

The following scenarios are adopted

- Scenario S, the single-product setting, considers the introduction of emission permits in steps of 5% and adoption of a bioelectricity subsidy of 25%.
- Scenario M, the multi-product setting, adopts the same rate of emission permits reduction and subsidy on bioelectricity but incorporates the multiproductivity of agricultural and biomass sectors.

4. Results and discussion

This section comprises the results of the policy analysis for both scenarios.

General results

Figure 2 presents the welfare impacts for scenarios S and M, at different levels of emission permit reduction.

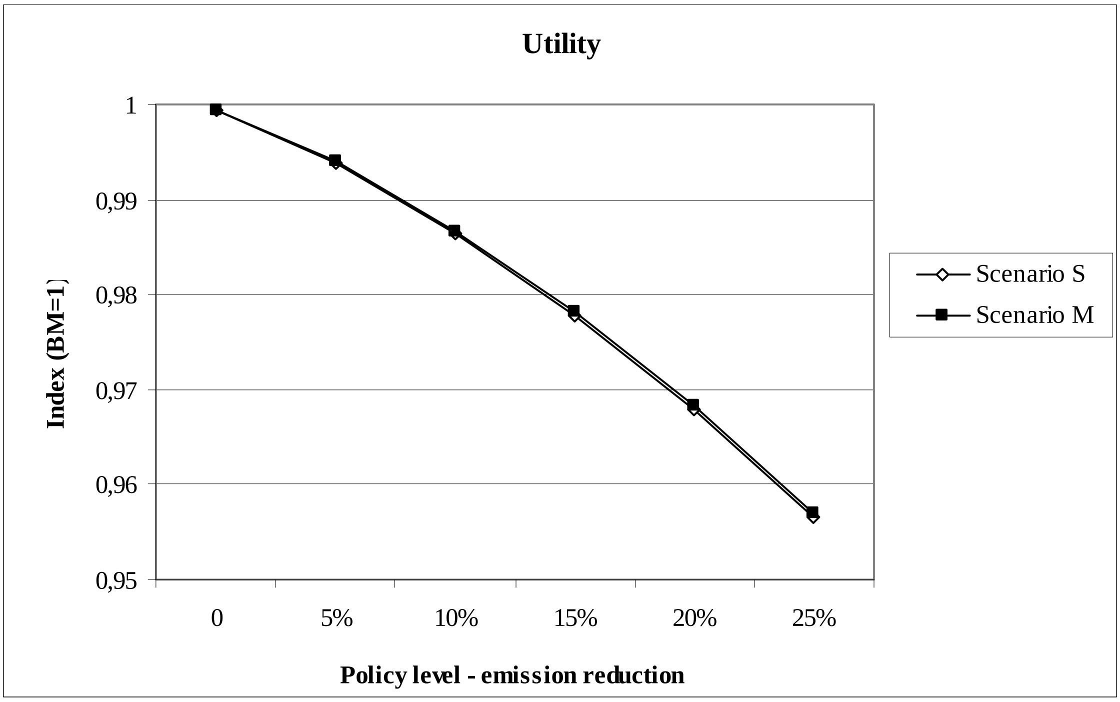

Figure 2
Utility change for single-product (S) and multi-product (M) scenarios for different levels of emission reduction in unilateral setting (for Poland)

Clearly, the environmental policy leads to welfare costs. It should be stressed that the environmental benefits of these policies are not taken into account in this measure of welfare, and hence it cannot be concluded whether these policies are justified. The welfare costs of these policies tend to be decreasing more than proportionately with increasing stringency of environmental policy, and the impacts are virtually the same for the single- and multi-product settings.

Production

Table 2 comprises the results of production changes in a unilateral setting for different emission reduction levels. The economy adapts to the reductions in allowed emissions by switching towards (i) ‘clean’ energy; (ii) ‘clean’ production; and (iii) ‘clean’ consumption. Since the Bioelectricity sector is very small compared to conventional Electricity, it has to grow considerably to achieve the policy target: more than 1000 percent in both scenarios. Labor and capital, released primarily from the declining Electricity sector, are used to intensify the production of Bioelectricity sector. In the multi-product setting scenario, these changes are stronger than in the single-product setting. Since the by-products are cheap, the Bioelectricity sector demands them in large quantities, and the availability of multi-product crops can keep production costs in the Bioelectricity sector relatively low. This allows for an additional increase in production of bioelectricity of roughly one third (1342% vs. 1023%, at 10% emission reduction level).

Table 2
Changes in the production in selected sectors, for Poland, for all scenarios for an emission reduction of 10% and 25% (% change compared to benchmark)

	10% emission Reduction		25% emission reduction	
	Scenario S	Scenario M	Scenario S	Scenario M
Other Agriculture	-1	-1	-5	-5
Rape	29	35	56	64
Willow	1086	1457	2060	2656
Hemp	92	108	168	195
Wheat	-2	-2	-5	-5
Other Cereals	3	4	3	4
Forestry	4	5	6	7
Coal	-9	-9	-23	-23
Oil	-17	-16	-40	-40
Gas	-14	-14	-34	-34
Electricity	-10	-12	-22	-24
Bioelectricity	1023	1342	1840	2333
Industry	-2	-2	-5	-5
Services	-1	-1	-4	-4

The biomass sectors such as the sectors producing rape, willow or hemp increase their production substantially in both scenarios to meet the demand for biofuels in the Bioelectricity sector. This indicates that the availability of by-products can only partially reduce the competition between agricultural and biomass crops. Essentially, all by-products that are available will be used in the Bioelectricity sector, but any further expansion in this sector will have to be based on biomass crops that are explicitly grown for energy purposes. There are two countering mechanisms. On the one hand, climate policy increases the price of these by-products substantially, and thereby increases revenues in the agricultural sectors. On the other hand, the higher costs for emission permits imply that the agricultural sectors face increased production costs.

The other agricultural sectors decrease their production only to a minor extent; one percent with 10% emission reduction and five percent with 25% emission reduction. This result is not as surprising as it may seem at first sight. First, the arable agricultural sector in Poland is relatively clean in terms of GHGs emission (the use of fertilizers is relatively low in Poland), and hence requires few emission permits and there is relatively small need for reducing demand for these goods. Secondly, absolute levels of employment in the agricultural sector will remain roughly equal, and capital use will decline less than output. Thus, agricultural production intensifies. This illustrates the importance of the CGE approach: there are several mitigating mechanisms that limit the impact of environmental policy on agricultural production, that are not captured in a partial equilibrium model.

Both in scenarios S and M the dirty sectors decrease their production substantially (see Table 2). In the multi-product setting, these losses are slightly smaller, as the availability of the by-products reduces the need to use scarce production factors to produce biomass.

Sectoral impacts increase in a non-linear manner with more stringent climate policy: small changes in the production structure, needed to reduce emissions by 10%, can be achieved at relatively low costs, but more stringent environmental policies will affect production substantially stronger. This holds not only for the "losers", but also for the "winners": stringent environmental policy is in the best interest of the clean production sectors.

Bioelectricity shares

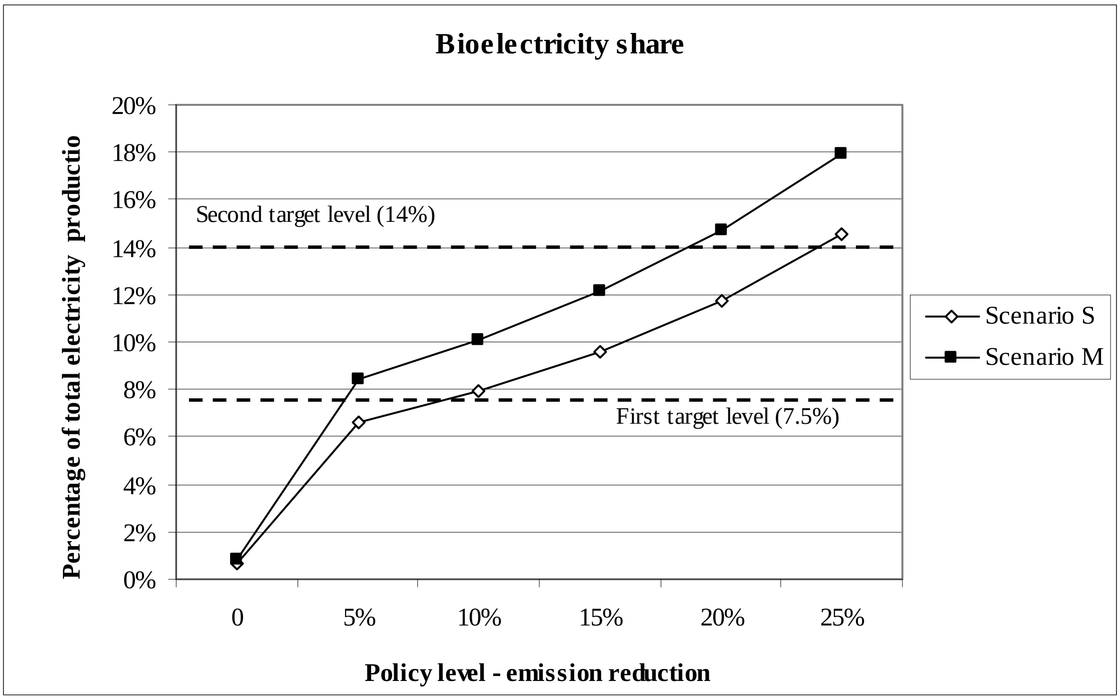

Figure 3
Bioelectricity share, for Poland, for single-product (S) and multi-product (M) scenarios for different levels of emission reduction in unilateral setting

Figure 3 presents the influence of the implementation of the scenarios on the share of bioelectricity in electricity production. The results show clear differences between the bioelectricity shares for single-product and multi-product settings. Notably, for every level of emission reduction, in multi-product setting there are higher shares of bioelectricity than in single-product setting. This does not come as a surprise, considering the fact that in the multi-product setting bioelectricity producers can benefit from the availability of cheap biofuels in the form of straw. The picture clearly confirms the main impact of the availability of multi-product crops as discussed above: the existing by-products are used in the Bioelectricity sector even at low rates of emission reductions, but beyond that, these by-products can only provide a marginal contribution to the expansion of the Bioelectricity sector.

The first policy goal of 7.5% bioelectricity share is reached with around 10% and 5% emission reduction, for scenarios S and M respectively. The more stringent goal of 14% requires a much more ambitious climate policy: 25% emission reduction in single-product setting. When by-products are available, i.e. in the multi-product setting, such a reduction in the number of permits induces the share of bioelectricity to rise to around 18%.

Both lines observe a kink at a 10% emission reduction level, which can be attributed to the introduction of the biomass subsidy in the scenarios that does not exist in benchmark. This leads to an instant increase in the bioelectricity share and is an essential part of the strategy to achieve the national policy targets for the share of bioelectricity (this issue is investigated in more detail in Ignaciuk et al., 2005).

Prices

Table 3
Prices of selected commodities, for Poland, for both scenarios in unilateral setting

		10% emission reduction		25% emission reduction	
	BM	Scenario S	Scenario M	Scenario S	Scenario M
Prices of selected commodities (in % change compared to benchmark)					
Other Agriculture		2%	2%	5%	5%
Rape		0%	0%	-1%	-1%
Willow		0%	0%	0%	0%
Hemp		0%	0%	1%	0%
Wheat		0%	0%	1%	1%
Other Cereals		1%	1%	2%	2%
Forestry		0%	0%	0%	0%
Electricity		3%	3%	9%	9%
Bioelectricity		-20%	-22%	-21%	-23%
Price of emission permits (in Euro per ton of carbon)					
Emission permit		4.8	4.7	15.0	14.8
Prices of land (in Euro per ha, referred to benchmark prices from 1997)					
Very good land (z_1)	91.4	82.7	81.8	71.7	70.8
Good land (z_2)	66.4	68.6	69.3	67.3	67.3
Poor land (z_3)	37.1	48.5	51.8	54.4	59.8
Forestry land (z_4)	37.1	47.4	50.5	53.1	58.4

Note: Price levels are expressed in relation to the numéraire, the Consumer Price Index.

The policies adopted in the model also induce price changes. The impact of the emission reduction policies on the relative price level for a selection of goods is presented in Table 3. Generally, the prices of dirty goods go up compared to the prices of cleaner goods, as the production costs for the dirty sectors increase substantially due to the expensive emission permits; the emission permit prices for two policy levels are reported in Table 3. The price of bioelectricity decreases relatively to other prices, because it benefits from a subsidy and cheap by-products.

We can observe an increase of agricultural commodity prices. However, this increase is low, at most 5%, even though the emission permit price rises to around 15 Euro per ton of carbon. Such small increase in prices, despite the competition for land, shows that the competition between agriculture and biomass is less strong in our CGE setting than commonly encountered in a partial equilibrium framework. Table 3 also presents the price levels of different land types; we observe an increase in prices for good (type z_2), poor (type z_3), and forestry (type z_4) land types. This increase is caused by several factors. First, there is increased competition for land, as more biomass crops are demanded to fuel the clean Bioelectricity sector. Second, in the multi-product setting (Scenario M), the productivity of land increases due to the availability of by-products. Perhaps more surprisingly, the price of very good land (type z_1) decreases, though it remains the most expensive land type. The large demand for biomass crops primarily increases the pressure on z_2 and z_3 and the additional production of the Forestry sector puts an upward pressure on z_4. With increasing stringency of climate policy, all the land prices tend to wards the same price. This effect is governed by the possibilities to used different land types for producing different crops: biomass crops will start out on poor land, but can also use better land types, and agricultural land can be converted to forestry land. These substitution possibilities tend to even out the differences in land prices between the different types.

The permit price increases nonlinear with the stringency of the policy; with 10% emission reduction a permit for a ton of carbon costs 5 Euro and with 50% emission reduction it costs 15 Euro. This is more or less in line with the results obtained in integrated assessment models as reported in Weyant (2004).

Land use

Table 4 presents the land allocation for scenarios S and M at 10% and 25% emission reduction levels. In the single-product scenario, there is less reallocation of land than in the multi-product scenario, in line with the changes in economic activity of the related sectors.

Table 4
Land use (in 1000 ha), in Poland, with 10% and 25% emission reduction for scenario S and M

			10% emission reduction		25% emission reduction	
		BM	Scenario S	Scenario M	Scenario S	Scenario M
Other Agriculture	Z1*	102,4	100,6	100,5	98,6	98,3
	Z2**	1839,5	1784,1	1778,8	1726,2	1717,7
	Z3***	1051,6	997,1	988,7	952,0	939,6
Rape	Z1	0,0	0,0	0,0	0,0	0,0
	Z2	349,4	443,5	458,9	534,8	557,6
	Z3	87,3	108,3	111,5	128,9	133,3
Willow	Z1	0,0	0,0	0,0	0,0	0,0
	Z2	0,0	0,0	0,0	0,0	0,0
	Z3	0,5	6,2	8,1	11,2	14,2
Hemp	Z1	0,0	0,0	0,0	0,1	0,3
	Z2	0,0	0,0	0,0	0,0	0,0
	Z3	0,1	0,3	0,3	0,2	0,0
Wheat	Z1	87,4	85,2	84,7	83,5	82,7
	Z2	1570,1	1510,6	1499,1	1461,8	1444,5
	Z3	897,7	844,2	833,3	806,2	790,2
Other Cereals	Z1	218,6	222,6	223,1	226,2	227,0
	Z2	3894,5	3915,2	3916,6	3930,7	3933,8
	Z3	2301,1	2261,3	2249,8	2240,3	2223,9
Forestry	Z4^	8769,0	8890,0	8915,7	8968,7	9006,2

* Very good land (z_1)
** Good land (z_2)
*** Poor land (z_3)
^ Forestry land (z_4)

We consider forestry and willow production to carry out functions that attribute to nature conservation, since they contribute to sustaining biodiversity, improve the quality of land and create a suitable environment for many species (Borjesson, 1999; Londo et al., 2005). Moreover, forest plantations and other biomass plantations have the potential to sequester carbon in the soil (Tolbert et al., 2002). In the multi-product setting, a climate policy of 25% emission reduction induces a conversion of agricultural land in Forestry area of 237 thousands hectares. Adding the acreage gained by willow plantation, the acreage of natural areas increases with 250 thousands hectares. This large increase is caused by (i) the EU subsidy, (ii) the fact that Forestry sector produces fuel for bioelectricity and, (iii) related to that, by increased demand for clean electricity. Hence, the policies implemented contribute not only to lower CO_2 emissions and a higher share of bioelectricity, but also to an increase in semi-natural areas. In the single-product scenario, the gains for nature are lower, showing the role of by-products in the changes in the Forestry sector.

5. Sensitivity analysis

The reactions of producers and consumers depend on the calibrated elasticities as used in the CES functions. We conduct a sensitivity analysis on the values of these elasticities by de- and increasing the values of one elasticity at a time with 50%, using a policy level of 25% in scenario M as reference. The main results of these additional simulations are reported in Table 5 and briefly discussed here.

Table 5
Main results of the sensitivity analysis on 25% emission reduction in scenario M

	Utility	Share of bioelectricity	Price of emission permit	Price of Other Agriculture	Land use Forestry
Reference (sc. M)	-4.3%	18.0%	59.3	4.8%	2.7%
Low σ_{ELK}	-6.5%	26.4%	85.4	7.1%	5.7%
High σ_{ELK}	-3.1%	14.3%	45.0	3.6%	2.0%
Low σ_{Elec}	-4.5%	3.4%	62.9	5.0%	0.0%
High σ_{Elec}	-3.8%	46.3%	51.4	4.3%	14.2%
Low σ_{Ener}	-4.5%	18.3%	61.9	5.0%	2.6%
High σ_{Ener}	-4.1%	17.7%	56.9	4.6%	2.8%
Low σ_{PR}	-4.3%	17.9%	59.9	4.9%	3.5%
High σ_{PR}	-4.3%	17.9%	58.8	4.7%	2.2%
Low σ_{Z}	-4.3%	17.9%	59.3	4.8%	2.0%
High σ_{Z}	-4.3%	18.0%	59.3	4.8%	3.3%
Low σ_{Trade}	-4.4%	18.4%	62.3	5.0%	2.7%
High σ_{Trade}	-4.2%	17.7%	56.6	4.6%	2.7%

When the substitution elasticity between energy and primary production factors in the production function is reduced (e.g. for Other Agriculture from 0.5 to 0.25), welfare costs as measured by the change in utility increase substantially to 6.5%. This shows that in the reference scenario producers can limit the costs of the environmental policy by substituting away from energy towards labor and capital. This is a clear example of the importance of the feedback effects that occur in the CGE setting. Essentially, the lower elasticity implies that there are fewer possibilities to avoid an impact of the policy on behavior of all producers and consumers. Thus, there is more demand for bioelectricity (the share increases to 26.4%), a higher emission permit price, more competition for the agricultural sector (as indicated by the stronger increase in the price of Other Agricultural goods) and more conversion of land to forestry.

Increasing the value of this elasticity by 50% (for Other Agriculture to 0.75) has the opposite effect, as expected. It is however worth noting that the sensitivity is not symmetric: an increase in the elasticity has a smaller impact on the results than a decrease.

The results are also influenced by a increase in the substitution elasticity between electricity and bioelectricity. These two goods are close substitutes, reflected in the reference case by an elasticity of 12. Increasing this elasticity implies that the two goods are even closer substitutes, and it is no surprise that this lowers the welfare costs of the policy, reduces the emission permit price and diminishes the competition with agriculture. Almost half of all electricity is produced from biomass (46.3%), to a large extent through the increased production of wood in forestry.

A lower substitution elasticity between electricity and bioelectricity has much less pronounced effects: only the share of bioelectricity and the conversion of land towards forestry change substantially, but the welfare costs and emission permit prices are hardly affected.

Changes in the other major substitution elasticities have a much smaller or even negligible effect on the results, indicating that the results are fairly robust against most parameter values chosen. For instance, the substitution elasticity between different land types, which is difficult to calibrate empirically, plays only a minor role; it has some effects on forestry land, but virtually none on utility.

6. Conclusions

In this paper we present a general equilibrium model to investigate the effects of climate policies on biomass and bioelectricity and their influence on the economy and resulting land reallocation.

Before discussing the results; we would like to mention some of the major caveats of our model. First, we address the issue in a comparative-static manner. A dynamic model would be able to describe the transition path toward cleaner economy. Secondly, environmental benefits are not taken into account in the measure of welfare, and hence it cannot be concluded whether the proposed policies are justified. Moreover, only when the benefits are accounted for we can calculate the efficient levels of policies and determine optimal production quantities. Thirdly, one should keep in mind that the model is a stylized representation of the economy, and though it is calibrated using the best available data, numerical results from the simulations should be interpreted with sufficient care. Despite these limitations, we would like to highlight some interesting results.

Given our assumptions, utilizing multi-product crops can contribute to the policy target of increasing the share of bioelectricity in total electricity consumption; however, the potential to boost production of bioelectricity through the use of multi-product crops turns out to be limited. Only 2-3% of total electricity production can be produced using by-products. Existing by-products from agricultural crops, such as straw, will be utilized as a cheap input for bioelectricity production, but further expansion of the bioelectricity sector will have to be based on biomass crops explicitly grown for energy purposes. Utilization of multi-product crops has virtually no effects on the welfare costs of environmental policy.

Despite the increased demand for biofuels, the adverse effects on the agricultural sector are limited. This result can be explained by several mechanisms. First, the GHGs emission levels in this sector are relatively low. Secondly, the biomass sectors are very small compared to the agricultural sector, and hence a relatively small reduction in land use by the agricultural sector is consistent with a huge boost in biomass production. Thirdly, the biomass sectors have large potentials to grow on the poorer land types, which are much cheaper. Fourth, the agricultural sector can to some extent substitute away from land to labor and capital, which is released from the industrial sectors, and so intensify its production per hectare. Fifth, due to the EU subsidies, production of land intensive sectors becomes more profitable. Finally, the CGE framework incorporates essential feedback effects that are absent in partial equilibrium studies. The importance of these feedbacks is illustrated by the sensitivity of the price of agricultural products for the elasticity of substitution between energy and primary factors.

The policies presented in this paper not only have a positive impact on emission reduction and the share of bioelectricity, but also on nature conservation. Both scenarios induce a strong increase in the acreage of forestry and biomass plantations, thereby leading to reestablishment of semi natural areas. Thus, substantial environmental gains can be reached in several domains.

One of the most noticeable effects of climate policies on the economy is a switch in production and consumption towards 'clean' commodities. By comparing results for different reduction levels, it can be seen that the sectoral impacts increase in a non-linear manner: small changes in the production structure to reduce emissions by 10% can be achieved at relatively low costs, but more stringent environmental policies will affect production and costs substantially stronger. This holds not only for the "losers", but also for the "winners", in our case mainly the biomass producers. Stringent environmental policy is in the best interest of these clean production sectors.

References

AEBIOM, 1999, Biomass News 8 - Biomass Use in Poland, http://www.ecop.ucl.ac.be/aebiom/biomassnews/News8/Biomass8_4.htm.

Armington, P., 1969, A Theory of Demand for Products Distinguished by Place of Production, (IMF Staff Papers 16, Washington).

Azar, C. (Ed.). 2003, Emerging Scarcities - Bioenergy-Food Competition in a Carbon Constrained World, (Resources for the future Inc. John Hopkins University Press (forthcoming).

Babiker, M. H., 2005, Climate change policy, market structure, and carbon leakage, Journal of International Economics 65, 421-445.

Bohringer, C., 1998, The synthesis of bottom-up and top-down in energy policy modeling, Energy Economics 20, 233-248.

Borjesson, P., 1999, Environmental Effects of Energy Crop Cultivation in Sweden - I Identification and Quantification, Biomass and Bioenergy 16, 137-154.

Breuss, F., and K. Steininger, 1998, Biomass Energy Use to Reduce Climate Change: A General Equilibrium Analysis for Austria, Journal of Policy Modeling 20, 513-535.

Broek van den, R., S. Teeuwisse, K. Healion, T. Kent, A. van Wijk, A. Faaij, and W. Turkenburg, 2001, Potentials for Electricity Production from Wood in Ireland, Energy 26, 991-1013.

Dellink, R., 2005, Modelling the Costs of Environmental Policy - A Dynamic Applied General Equilibrium Assessment, (Edward Elgar, Cheltenham, Northhampton, MA).

Dellink, R., M. W. Hofkes, E. C. v. Ierland, and H. Verbruggen, 2003, Dynamic Modelling of Pollution Abatment in a CGE Framework, Economic Modelling 21, 965-986.

Dimaranan, B. V., and R. A. McDougall (Eds.), 2002, Global Trade, Assistance and Production: The GTAP 5 Data Base, (Department of Agricultural Economics. Purdue University, Center for Global Trade Analysis).

Dornburg, V., 2004, Multifunctional Biomass System, (Utrecht University, Utrecht).

EC Brec, 2004, Wdrozenia, (EC Baltic Renewable Energy Centre, Warsaw).

EU, 2003, Council Regulation (EC) No 1782/2003, http://europa.eu.int/eur-lex/en/archive/2003/l_27020031021en.html.

FAO, 2005, Agricultural Data, http://faostat.fao.org/faostat/collections?subset=agriculture.

Fischer, G., and L. Schrattenholzer, 2001, Global Bioenergy Potentials through 2050, Biomass and Bioenergy 20, 151-159.

Gielen, D., M.A.P.C. de Feber, A.J.M. Bos, and T. Gerlagh, 2001, Biomass for Energy or Materials? A Western European Systems Engineering Perspective, Energy Policy 29, 291-302.

Ginsburgh, V., and M. Keyzer, 1997, The Structure of Applied General Equilibrium Models, (The MIT Press, Cambridge, London).

Gradziuk, P., 1999, Mozliwosci Wykorzystania Surowcow Pochodzenia Rolniczego na Cele Energtyczne, Roczniki Naukowe 1, 233-238.

Gradziuk, P., 2001, Produkcja i Kierunki Wykorzystania Slomy (Straw Use and Production), in A. Grzybek, P. Gradziuk, and K. Kowalczyk, eds, Sloma - Energetyczne Paliwo (Straw - Energy Fuel), (Wies Jutra, Warszawa (Warsaw)).

GUS, 2002a, Biuletyn Statystyczny (Statistical Yearbook), (Glowny Urzad Statystyczny (Polish Statistics), Warsaw).

GUS, 2002b, Skup i Ceny Produktow Rolnych w 2001 Roku (Quantities and Prices of Agricultural Commodities in 2001), (Glowny Urzad Statystyczny (Polish Statistics), Warsaw).

GUS, 2002c, Srodki Produkcji w Rolnictwie w 2001 Roku (Production Inputs in Agriculture in 2001), (Glowny Urzad Statystyczny (Polish Statistics), Warsaw).

Hoogwijk, M., A. Faaij, R. v. d. Broek, G. Berndes, D. Gielen, and W. Turkenburg, 2003, Exploration of the ranges of the Global Potential of Biomass for Energy, Biomass and Bioenergy 25, 119-133.

Hunek, T., 1996, Zarys Teorii Miedzynarodowej Integracji Gospodarczej - Lekcja dla Akcesji Polski z Unia Europejska, (IRWiR PAN, Warsaw).

Ignaciuk, A., A. Ruijs, and E. C. van Ierland, 2005a, Can Climate Policies Contribute to Nature Conservation? On Biomass and Land Use in an AGE Approach, MWP 15 (Wageningen University, Wageningen).

Ignaciuk, A., F. Vohringer, A. Ruijs, and E. C. van Ierland, 2005b, Competition between biomass and food production in the presence of energy policies: a partial equilibrium analysis, Energy Policy In Press, Corrected Proof.

Keller, W. J., 1980, Tax Incidence: a General Equilibrium Approach, (North-Holland, Amsterdam).

Kemfert, C., 1998, Estimated substitution elasticities of a nested CES production function approach for Germany, Energy Economics 20, 249-264.

Kiuila, O., 2000, Badanie Kosztow Dostosowywania Polskiej Gospodarki do Drugiego Protokolu Siarkowego. Model Rownowagi Ogolnej. (Costs of Adapting Poland's economy to the Second Sulfur Protocol. A General Equilibrium Model), Wydzial Ekonomii, (Warsaw University, Warsaw)

Klinge Jacobsen, H., 1998, Integrating the bottom-up and top-down approach to energy-economy modelling: the case of Denmark, Energy Economics 20, 443-461.

Kowalik, P., 1994, Potencjalne Mozliwosci Energetycznego Wykorzystania Biomasy w Polsce, Gospodarka Paliwami i Energia 3, 9-12.

Kumbaroglu, G. S., 2003, Environmental taxation and economic effects: a computable general equilibrium analysis for Turkey, Journal of Policy Modeling 25, 795-810.

Londo, M., J. Dekker, and W. ter Keurs, 2005, Willow short-rotation coppice for energy and breeding birds: an exploration of potentials in relation to management, Biomass and Bioenergy 28, 281-293.

Lynch, R., 2005, An Energy Overview of the Republic of Poland, http://www.fe.doe.gov/international/CentralEastern%20Europe/plndover.html.

McCarl, B. A., and U. A. Schneider, 2001, Greenhouse Gas Mitigation in U.S. Agriculture and Forestry, Science 294, 2481-2482.

McFarland, J. R., J. M. Reilly, and H. J. Herzog, 2004, Representing energy technologies in top-down economic models using bottom-up information, Energy Economics 26, 685-707.

Mueller, A. M., 1995, Fepfarm - mixed-integer farm simulation model of farms in the Tarnovsky Gory Pilot Project - Poland, (Personal E-mail (November 2003),

Okuniewski, J., 1996, Czynniki Ksztaltujace Sytuacje Wsi i Rolnictwa u Progu XXI Wieku, (IRWiR PAN, Warsaw).

Radetzki, M., 1997, The Economics of Biomass in Industrialized Countries: An Overview, Energy Policy 26, 545-554.

Rutherford, T. F., and S. V. Paltsev, 2000, GTAP-Energy in GAMS: The Dataset and Static Model, (University of Colorado, Boulder).

Sadowski, M., A. Olecka, A. Romanczuk, M. Radwan-Rohrenschef, and A. Sienkiewicz, 2001, Third National Communication to the Conference of the Parties to the United Nations Framework Convention of Climate Change, (Institute of Environmental Protection, Warsaw), 109.

Springer, U., 2003, The market for tradable GHG permits under the Kyoto Protocol: a survey of model studies, Energy Economics 25, 527-551.

Tilman, D., K. G. Cassman, P. A. Matson, R. Naylor, and S. Polasky, 2002, Agricultural Sustainability and Intensive Production Practicies, Nature 418, 671-677.

Tolbert, V. R., J. Todd, D. E., L. K. Mann, C. M. Jawdy, D. A. Mays, R. Malik, W. Bandaranayake, A. Houston, D. Tyler, and D. E. Pettry, 2002, Changes in soil quality and below-ground carbon storage with conversion of traditional agricultural crop lands to bioenergy crop production, Environmental Pollution 116, S97-S106.

Trewavas, A., 2002, Malthus Foiled Again and Again, Nature 418, 668-670.

UKIE, 2004, Doplaty Obszarowe i Inne Korzysci dla Polskiego Rolnika po Wejsciu do Unii Europejskiej, (Urzad Komitetu Integracji Europejskiej, Warsaw), 1-3.

Weyant, J. P., 2004, Introduction and overview, Energy Economics 26, 501-515.

Wolf, J., P. S. Bindraban, J. C. Luijten, and L. M. Vleeshouwers, 2003, Exploratory study on the land area required for global food supply and the potential global production of bioenergy, Agricultural Systems 76, 841-861.

Wos, A. (Ed.). 1998, Priorytety Naczelne i Branzowe w Strategii Rozwoju Sektora Rolno-Spozywczego, (FAPA, Warsaw).

Yamamoto, H., J. Fujino, and K. Yamaji, 2001, Evaluation of Bioenergy Potential with a Multi-Regional Global-Land-Use-and-Energy Model, Biomass and Bioenergy 21, 185-203.

Zhang, Z., and H. Folmer, 1998, Economic modelling approaches to cost estimates for the control of carbon dioxide emissions, Energy Economics 20, 101-120.

Zurawski, J., 2004, Energie Odnawialne (Renewable Energy), Cieplej, http://cieplej.pl/Ekologia_OZE/1051547464.shtml.

NOTE DI LAVORO DELLA FONDAZIONE ENI ENRICO MATTEI

Fondazione Eni Enrico Mattei Working Paper Series

Our Note di Lavoro are available on the Internet at the following addresses:

http://www.feem.it/Feem/Pub/Publications/WPapers/default.html
http://www.ssrn.com/link/feem.html
http://www.repec.org

NOTE DI LAVORO PUBLISHED IN 2004

IEM	1.2004	*Anil MARKANDYA, Suzette PEDROSO and Alexander GOLUB*: Empirical Analysis of National Income and So2 Emissions in Selected European Countries
ETA	2.2004	*Masahisa FUJITA and Shlomo WEBER:* Strategic Immigration Policies and Welfare in Heterogeneous Countries
PRA	3.2004	*Adolfo DI CARLUCCIO, Giovanni FERRI, Cecilia FRALE and Ottavio RICCHI:* Do Privatizations Boost Household Shareholding? Evidence from Italy
ETA	4.2004	*Victor GINSBURGH and Shlomo WEBER:* Languages Disenfranchisement in the European Union
ETA	5.2004	*Romano PIRAS:* Growth, Congestion of Public Goods, and Second-Best Optimal Policy
CCMP	6.2004	*Herman R.J. VOLLEBERGH:* Lessons from the Polder: Is Dutch CO2-Taxation Optimal
PRA	7.2004	*Sandro BRUSCO, Giuseppe LOPOMO and S. VISWANATHAN* (lxv): Merger Mechanisms
PRA	8.2004	*Wolfgang AUSSENEGG, Pegaret PICHLER and Alex STOMPER* (lxv): IPO Pricing with Bookbuilding, and a When-Issued Market
PRA	9.2004	*Pegaret PICHLER and Alex STOMPER* (lxv): Primary Market Design: Direct Mechanisms and Markets
PRA	10.2004	*Florian ENGLMAIER, Pablo GUILLEN, Loreto LLORENTE, Sander ONDERSTAL and Rupert SAUSGRUBER* (lxv): The Chopstick Auction: A Study of the Exposure Problem in Multi-Unit Auctions
PRA	11.2004	*Bjarne BRENDSTRUP and Harry J. PAARSCH* (lxv): Nonparametric Identification and Estimation of Multi-Unit, Sequential, Oral, Ascending-Price Auctions With Asymmetric Bidders
PRA	12.2004	*Ohad KADAN* (lxv): Equilibrium in the Two Player, k-Double Auction with Affiliated Private Values
PRA	13.2004	*Maarten C.W. JANSSEN* (lxv): Auctions as Coordination Devices
PRA	14.2004	*Gadi FIBICH, Arieh GAVIOUS and Aner SELA* (lxv): All-Pay Auctions with Weakly Risk-Averse Buyers
PRA	15.2004	*Orly SADE, Charles SCHNITZLEIN and Jaime F. ZENDER* (lxv): Competition and Cooperation in Divisible Good Auctions: An Experimental Examination
PRA	16.2004	*Marta STRYSZOWSKA* (lxv): Late and Multiple Bidding in Competing Second Price Internet Auctions
CCMP	17.2004	*Slim Ben YOUSSEF:* R&D in Cleaner Technology and International Trade
NRM	18.2004	*Angelo ANTOCI, Simone BORGHESI and Paolo RUSSU* (lxvi): Biodiversity and Economic Growth: Stabilization Versus Preservation of the Ecological Dynamics
SIEV	19.2004	*Anna ALBERINI, Paolo ROSATO, Alberto LONGO and Valentina ZANATTA:* Information and Willingness to Pay in a Contingent Valuation Study: The Value of S. Erasmo in the Lagoon of Venice
NRM	20.2004	*Guido CANDELA and Roberto CELLINI* (lxvii): Investment in Tourism Market: A Dynamic Model of Differentiated Oligopoly
NRM	21.2004	*Jacqueline M. HAMILTON* (lxvii): Climate and the Destination Choice of German Tourists
NRM	22.2004	*Javier Rey-MAQUIEIRA PALMER, Javier LOZANO IBÁÑEZ and Carlos Mario GÓMEZ GÓMEZ* (lxvii): Land, Environmental Externalities and Tourism Development
NRM	23.2004	*Pius ODUNGA and Henk FOLMER* (lxvii): Profiling Tourists for Balanced Utilization of Tourism-Based Resources in Kenya
NRM	24.2004	*Jean-Jacques NOWAK, Mondher SAHLI and Pasquale M. SGRO* (lxvii):Tourism, Trade and Domestic Welfare
NRM	25.2004	*Riaz SHAREEF* (lxvii): Country Risk Ratings of Small Island Tourism Economies
NRM	26.2004	*Juan Luis EUGENIO-MARTÍN, Noelia MARTÍN MORALES and Riccardo SCARPA* (lxvii): Tourism and Economic Growth in Latin American Countries: A Panel Data Approach
NRM	27.2004	*Raúl Hernández MARTÍN* (lxvii): Impact of Tourism Consumption on GDP. The Role of Imports
CSRM	28.2004	*Nicoletta FERRO:* Cross-Country Ethical Dilemmas in Business: A Descriptive Framework
NRM	29.2004	*Marian WEBER* (lxvi): Assessing the Effectiveness of Tradable Landuse Rights for Biodiversity Conservation: an Application to Canada's Boreal Mixedwood Forest
NRM	30.2004	*Trond BJORNDAL, Phoebe KOUNDOURI and Sean PASCOE* (lxvi): Output Substitution in Multi-Species Trawl Fisheries: Implications for Quota Setting
CCMP	31.2004	*Marzio GALEOTTI, Alessandra GORIA, Paolo MOMBRINI and Evi SPANTIDAKI:* Weather Impacts on Natural, Social and Economic Systems (WISE) Part I: Sectoral Analysis of Climate Impacts in Italy
CCMP	32.2004	*Marzio GALEOTTI, Alessandra GORIA ,Paolo MOMBRINI and Evi SPANTIDAKI:* Weather Impacts on Natural, Social and Economic Systems (WISE) Part II: Individual Perception of Climate Extremes in Italy
CTN	33.2004	*Wilson PEREZ:* Divide and Conquer: Noisy Communication in Networks, Power, and Wealth Distribution
KTHC	34.2004	*Gianmarco I.P. OTTAVIANO and Giovanni PERI* (lxviii): The Economic Value of Cultural Diversity: Evidence from US Cities
KTHC	35.2004	*Linda CHAIB* (lxviii): Immigration and Local Urban Participatory Democracy: A Boston-Paris Comparison

KTHC	36.2004	*Franca ECKERT COEN and Claudio ROSSI* (lxviii): Foreigners, Immigrants, Host Cities: The Policies of Multi-Ethnicity in Rome. Reading Governance in a Local Context
KTHC	37.2004	*Kristine CRANE* (lxviii): Governing Migration: Immigrant Groups' Strategies in Three Italian Cities – Rome, Naples and Bari
KTHC	38.2004	*Kiflemariam HAMDE* (lxviii): Mind in Africa, Body in Europe: The Struggle for Maintaining and Transforming Cultural Identity - A Note from the Experience of Eritrean Immigrants in Stockholm
ETA	39.2004	*Alberto CAVALIERE:* Price Competition with Information Disparities in a Vertically Differentiated Duopoly
PRA	40.2004	*Andrea BIGANO and Stef PROOST:* The Opening of the European Electricity Market and Environmental Policy: Does the Degree of Competition Matter?
CCMP	41.2004	*Micheal FINUS* (lxix): International Cooperation to Resolve International Pollution Problems
KTHC	42.2004	*Francesco CRESPI:* Notes on the Determinants of Innovation: A Multi-Perspective Analysis
CTN	43.2004	*Sergio CURRARINI and Marco MARINI:* Coalition Formation in Games without Synergies
CTN	44.2004	*Marc ESCRIHUELA-VILLAR:* Cartel Sustainability and Cartel Stability
NRM	45.2004	*Sebastian BERVOETS and Nicolas GRAVEL* (lxvi): Appraising Diversity with an Ordinal Notion of Similarity: An Axiomatic Approach
NRM	46.2004	*Signe ANTHON and Bo JELLESMARK THORSEN* (lxvi): Optimal Afforestation Contracts with Asymmetric Information on Private Environmental Benefits
NRM	47.2004	*John MBURU* (lxvi)*:* Wildlife Conservation and Management in Kenya: Towards a Co-management Approach
NRM	48.2004	*Ekin BIROL, Ágnes GYOVAI and Melinda SMALE* (lxvi)*:* Using a Choice Experiment to Value Agricultural Biodiversity on Hungarian Small Farms: Agri-Environmental Policies in a Transition al Economy
CCMP	49.2004	*Gernot KLEPPER and Sonja PETERSON:* The EU Emissions Trading Scheme. Allowance Prices, Trade Flows, Competitiveness Effects
GG	50.2004	*Scott BARRETT and Michael HOEL:* Optimal Disease Eradication
CTN	51.2004	*Dinko DIMITROV, Peter BORM, Ruud HENDRICKX and Shao CHIN SUNG:* Simple Priorities and Core Stability in Hedonic Games
SIEV	52.2004	*Francesco RICCI*: Channels of Transmission of Environmental Policy to Economic Growth: A Survey of the Theory
SIEV	53.2004	*Anna ALBERINI, Maureen CROPPER, Alan KRUPNICK and Nathalie B. SIMON:* Willingness to Pay for Mortality Risk Reductions: Does Latency Matter?
NRM	54.2004	*Ingo BRÄUER and Rainer MARGGRAF* (lxvi): Valuation of Ecosystem Services Provided by Biodiversity Conservation: An Integrated Hydrological and Economic Model to Value the Enhanced Nitrogen Retention in Renaturated Streams
NRM	55.2004	*Timo GOESCHL and Tun LIN* (lxvi): Biodiversity Conservation on Private Lands: Information Problems and Regulatory Choices
NRM	56.2004	*Tom DEDEURWAERDERE* (lxvi): Bioprospection: From the Economics of Contracts to Reflexive Governance
CCMP	57.2004	*Katrin REHDANZ and David MADDISON:* The Amenity Value of Climate to German Households
CCMP	58.2004	*Koen SMEKENS and Bob VAN DER ZWAAN:* Environmental Externalities of Geological Carbon Sequestration Effects on Energy Scenarios
NRM	59.2004	*Valentina BOSETTI, Mariaester CASSINELLI and Alessandro LANZA* (lxvii): Using Data Envelopment Analysis to Evaluate Environmentally Conscious Tourism Management
NRM	60.2004	*Timo GOESCHL and Danilo CAMARGO IGLIORI* (lxvi):Property Rights Conservation and Development: An Analysis of Extractive Reserves in the Brazilian Amazon
CCMP	61.2004	*Barbara BUCHNER and Carlo CARRARO*: Economic and Environmental Effectiveness of a Technology-based Climate Protocol
NRM	62.2004	*Elissaios PAPYRAKIS and Reyer GERLAGH*: Resource-Abundance and Economic Growth in the U.S.
NRM	63.2004	*Györgyi BELA, György PATAKI, Melinda SMALE and Mariann HAJDÚ* (lxvi): Conserving Crop Genetic Resources on Smallholder Farms in Hungary: Institutional Analysis
NRM	64.2004	*E.C.M. RUIJGROK and E.E.M. NILLESEN* (lxvi): The Socio-Economic Value of Natural Riverbanks in the Netherlands
NRM	65.2004	*E.C.M. RUIJGROK* (lxvi): Reducing Acidification: The Benefits of Increased Nature Quality. Investigating the Possibilities of the Contingent Valuation Method
ETA	66.2004	*Giannis VARDAS and Anastasios XEPAPADEAS*: Uncertainty Aversion, Robust Control and Asset Holdings
GG	67.2004	*Anastasios XEPAPADEAS and Constadina PASSA*: Participation in and Compliance with Public Voluntary Environmental Programs: An Evolutionary Approach
GG	68.2004	*Michael FINUS*: Modesty Pays: Sometimes!
NRM	69.2004	*Trond BJØRNDAL and Ana BRASÃO*: The Northern Atlantic Bluefin Tuna Fisheries: Management and Policy Implications
CTN	70.2004	*Alejandro CAPARRÓS, Abdelhakim HAMMOUDI and Tarik TAZDAÏT*: On Coalition Formation with Heterogeneous Agents
IEM	71.2004	*Massimo GIOVANNINI, Margherita GRASSO, Alessandro LANZA and Matteo MANERA*: Conditional Correlations in the Returns on Oil Companies Stock Prices and Their Determinants
IEM	72.2004	*Alessandro LANZA, Matteo MANERA and Michael MCALEER*: Modelling Dynamic Conditional Correlations in WTI Oil Forward and Futures Returns
SIEV	73.2004	*Margarita GENIUS and Elisabetta STRAZZERA*: The Copula Approach to Sample Selection Modelling: An Application to the Recreational Value of Forests

CCMP	74.2004	*Rob DELLINK and Ekko van IERLAND*: Pollution Abatement in the Netherlands: A Dynamic Applied General Equilibrium Assessment
ETA	75.2004	*Rosella LEVAGGI and Michele MORETTO*: Investment in Hospital Care Technology under Different Purchasing Rules: A Real Option Approach
CTN	76.2004	*Salvador BARBERÀ and Matthew O. JACKSON* (lxx): On the Weights of Nations: Assigning Voting Weights in a Heterogeneous Union
CTN	77.2004	*Àlex ARENAS, Antonio CABRALES, Albert DÍAZ-GUILERA, Roger GUIMERÀ and Fernando VEGA-REDONDO* (lxx): Optimal Information Transmission in Organizations: Search and Congestion
CTN	78.2004	*Francis BLOCH and Armando GOMES* (lxx): Contracting with Externalities and Outside Options
CTN	79.2004	*Rabah AMIR, Effrosyni DIAMANTOUDI and Licun XUE* (lxx): Merger Performance under Uncertain Efficiency Gains
CTN	80.2004	*Francis BLOCH and Matthew O. JACKSON* (lxx): The Formation of Networks with Transfers among Players
CTN	81.2004	*Daniel DIERMEIER, Hülya ERASLAN and Antonio MERLO* (lxx): Bicameralism and Government Formation
CTN	82.2004	*Rod GARRATT, James E. PARCO, Cheng-ZHONG QIN and Amnon RAPOPORT* (lxx): Potential Maximization and Coalition Government Formation
CTN	83.2004	*Kfir ELIAZ, Debraj RAY and Ronny RAZIN* (lxx): Group Decision-Making in the Shadow of Disagreement
CTN	84.2004	*Sanjeev GOYAL, Marco van der LEIJ and José Luis MORAGA-GONZÁLEZ* (lxx): Economics: An Emerging Small World?
CTN	85.2004	*Edward CARTWRIGHT* (lxx): Learning to Play Approximate Nash Equilibria in Games with Many Players
IEM	86.2004	*Finn R. FØRSUND and Michael HOEL*: Properties of a Non-Competitive Electricity Market Dominated by Hydroelectric Power
KTHC	87.2004	*Elissaios PAPYRAKIS and Reyer GERLAGH*: Natural Resources, Investment and Long-Term Income
CCMP	88.2004	*Marzio GALEOTTI and Claudia KEMFERT*: Interactions between Climate and Trade Policies: A Survey
IEM	89.2004	*A. MARKANDYA, S. PEDROSO and D. STREIMIKIENE*: Energy Efficiency in Transition Economies: Is There Convergence Towards the EU Average?
GG	90.2004	*Rolf GOLOMBEK and Michael HOEL* : Climate Agreements and Technology Policy
PRA	91.2004	*Sergei IZMALKOV* (lxv): Multi-Unit Open Ascending Price Efficient Auction
KTHC	92.2004	*Gianmarco I.P. OTTAVIANO and Giovanni PERI*: Cities and Cultures
KTHC	93.2004	*Massimo DEL GATTO*: Agglomeration, Integration, and Territorial Authority Scale in a System of Trading Cities. Centralisation versus devolution
CCMP	94.2004	*Pierre-André JOUVET, Philippe MICHEL and Gilles ROTILLON*: Equilibrium with a Market of Permits
CCMP	95.2004	*Bob van der ZWAAN and Reyer GERLAGH*: Climate Uncertainty and the Necessity to Transform Global Energy Supply
CCMP	96.2004	*Francesco BOSELLO, Marco LAZZARIN, Roberto ROSON and Richard S.J. TOL*: Economy-Wide Estimates of the Implications of Climate Change: Sea Level Rise
CTN	97.2004	*Gustavo BERGANTIÑOS and Juan J. VIDAL-PUGA*: Defining Rules in Cost Spanning Tree Problems Through the Canonical Form
CTN	98.2004	*Siddhartha BANDYOPADHYAY and Mandar OAK*: Party Formation and Coalitional Bargaining in a Model of Proportional Representation
GG	99.2004	*Hans-Peter WEIKARD, Michael FINUS and Juan-Carlos ALTAMIRANO-CABRERA*: The Impact of Surplus Sharing on the Stability of International Climate Agreements
SIEV	100.2004	*Chiara M. TRAVISI and Peter NIJKAMP*: Willingness to Pay for Agricultural Environmental Safety: Evidence from a Survey of Milan, Italy, Residents
SIEV	101.2004	*Chiara M. TRAVISI, Raymond J. G. M. FLORAX and Peter NIJKAMP*: A Meta-Analysis of the Willingness to Pay for Reductions in Pesticide Risk Exposure
NRM	102.2004	*Valentina BOSETTI and David TOMBERLIN:* Real Options Analysis of Fishing Fleet Dynamics: A Test
CCMP	103.2004	*Alessandra GORIA e Gretel GAMBARELLI:* Economic Evaluation of Climate Change Impacts and Adaptability in Italy
PRA	104.2004	*Massimo FLORIO and Mara GRASSENI*: The Missing Shock: The Macroeconomic Impact of British Privatisation
PRA	105.2004	*John BENNETT, Saul ESTRIN, James MAW and Giovanni URGA*: Privatisation Methods and Economic Growth in Transition Economies
PRA	106.2004	*Kira BÖRNER*: The Political Economy of Privatization: Why Do Governments Want Reforms?
PRA	107.2004	*Pehr-Johan NORBÄCK and Lars PERSSON*: Privatization and Restructuring in Concentrated Markets
SIEV	108.2004	*Angela GRANZOTTO, Fabio PRANOVI, Simone LIBRALATO, Patrizia TORRICELLI and Danilo MAINARDI*: Comparison between Artisanal Fishery and Manila Clam Harvesting in the Venice Lagoon by Using Ecosystem Indicators: An Ecological Economics Perspective
CTN	109.2004	*Somdeb LAHIRI*: The Cooperative Theory of Two Sided Matching Problems: A Re-examination of Some Results
NRM	110.2004	*Giuseppe DI VITA*: Natural Resources Dynamics: Another Look
SIEV	111.2004	*Anna ALBERINI, Alistair HUNT and Anil MARKANDYA*: Willingness to Pay to Reduce Mortality Risks: Evidence from a Three-Country Contingent Valuation Study
KTHC	112.2004	*Valeria PAPPONETTI and Dino PINELLI*: Scientific Advice to Public Policy-Making
SIEV	113.2004	*Paulo A.L.D. NUNES and Laura ONOFRI*: The Economics of Warm Glow: A Note on Consumer's Behavior and Public Policy Implications
IEM	114.2004	*Patrick CAYRADE*: Investments in Gas Pipelines and Liquefied Natural Gas Infrastructure What is the Impact on the Security of Supply?
IEM	115.2004	*Valeria COSTANTINI and Francesco GRACCEVA:* Oil Security. Short- and Long-Term Policies

IEM	116.2004	*Valeria COSTANTINI and Francesco GRACCEVA:* Social Costs of Energy Disruptions
IEM	117.2004	*Christian EGENHOFER, Kyriakos GIALOGLOU, Giacomo LUCIANI, Maroeska BOOTS, Martin SCHEEPERS, Valeria COSTANTINI, Francesco GRACCEVA, Anil MARKANDYA and Giorgio VICINI*: Market-Based Options for Security of Energy Supply
IEM	118.2004	*David FISK*: Transport Energy Security. The Unseen Risk?
IEM	119.2004	*Giacomo LUCIANI*: Security of Supply for Natural Gas Markets. What is it and What is it not?
IEM	120.2004	*L.J. de VRIES and R.A. HAKVOORT*: The Question of Generation Adequacy in Liberalised Electricity Markets
KTHC	121.2004	*Alberto PETRUCCI*: Asset Accumulation, Fertility Choice and Nondegenerate Dynamics in a Small Open Economy
NRM	122.2004	*Carlo GIUPPONI, Jaroslaw MYSIAK and Anita FASSIO*: An Integrated Assessment Framework for Water Resources Management: A DSS Tool and a Pilot Study Application
NRM	123.2004	*Margaretha BREIL, Anita FASSIO, Carlo GIUPPONI and Paolo ROSATO*: Evaluation of Urban Improvement on the Islands of the Venice Lagoon: A Spatially-Distributed Hedonic-Hierarchical Approach
ETA	124.2004	*Paul MENSINK*: Instant Efficient Pollution Abatement Under Non-Linear Taxation and Asymmetric Information: The Differential Tax Revisited
NRM	125.2004	*Mauro FABIANO, Gabriella CAMARSA, Rosanna DURSI, Roberta IVALDI, Valentina MARIN and Francesca PALMISANI*: Integrated Environmental Study for Beach Management:A Methodological Approach
PRA	126.2004	*Irena GROSFELD and Iraj HASHI*: The Emergence of Large Shareholders in Mass Privatized Firms: Evidence from Poland and the Czech Republic
CCMP	127.2004	*Maria BERRITTELLA, Andrea BIGANO, Roberto ROSON and Richard S.J. TOL*: A General Equilibrium Analysis of Climate Change Impacts on Tourism
CCMP	128.2004	*Reyer GERLAGH*: A Climate-Change Policy Induced Shift from Innovations in Energy Production to Energy Savings
NRM	129.2004	*Elissaios PAPYRAKIS and Reyer GERLAGH*: Natural Resources, Innovation, and Growth
PRA	130.2004	*Bernardo BORTOLOTTI and Mara FACCIO*: Reluctant Privatization
SIEV	131.2004	*Riccardo SCARPA and Mara THIENE*: Destination Choice Models for Rock Climbing in the Northeast Alps: A Latent-Class Approach Based on Intensity of Participation
SIEV	132.2004	*Riccardo SCARPA Kenneth G. WILLIS and Melinda ACUTT*: Comparing Individual-Specific Benefit Estimates for Public Goods: Finite Versus Continuous Mixing in Logit Models
IEM	133.2004	*Santiago J. RUBIO*: On Capturing Oil Rents with a National Excise Tax Revisited
ETA	134.2004	*Ascensión ANDINA DÍAZ*: Political Competition when Media Create Candidates' Charisma
SIEV	135.2004	*Anna ALBERINI*: Robustness of VSL Values from Contingent Valuation Surveys
CCMP	136.2004	*Gernot KLEPPER and Sonja PETERSON*: Marginal Abatement Cost Curves in General Equilibrium: The Influence of World Energy Prices
ETA	137.2004	*Herbert DAWID, Christophe DEISSENBERG and Pavel ŠEVČIK*: Cheap Talk, Gullibility, and Welfare in an Environmental Taxation Game
CCMP	138.2004	*ZhongXiang ZHANG*: The World Bank's Prototype Carbon Fund and China
CCMP	139.2004	*Reyer GERLAGH and Marjan W. HOFKES*: Time Profile of Climate Change Stabilization Policy
NRM	140.2004	*Chiara D'ALPAOS and Michele MORETTO*: The Value of Flexibility in the Italian Water Service Sector: A Real Option Analysis
PRA	141.2004	*Patrick BAJARI, Stephanie HOUGHTON and Steven TADELIS* (lxxi): Bidding for Incompete Contracts
PRA	142.2004	*Susan ATHEY, Jonathan LEVIN and Enrique SEIRA* (lxxi): Comparing Open and Sealed Bid Auctions: Theory and Evidence from Timber Auctions
PRA	143.2004	*David GOLDREICH* (lxxi): Behavioral Biases of Dealers in U.S. Treasury Auctions
PRA	144.2004	*Roberto BURGUET* (lxxi): Optimal Procurement Auction for a Buyer with Downward Sloping Demand: More Simple Economics
PRA	145.2004	*Ali HORTACSU and Samita SAREEN* (lxxi): Order Flow and the Formation of Dealer Bids: An Analysis of Information and Strategic Behavior in the Government of Canada Securities Auctions
PRA	146.2004	*Victor GINSBURGH, Patrick LEGROS and Nicolas SAHUGUET* (lxxi): How to Win Twice at an Auction. On the Incidence of Commissions in Auction Markets
PRA	147.2004	*Claudio MEZZETTI, Aleksandar PEKEČ and Ilia TSETLIN* (lxxi): Sequential vs. Single-Round Uniform-Price Auctions
PRA	148.2004	*John ASKER and Estelle CANTILLON* (lxxi): Equilibrium of Scoring Auctions
PRA	149.2004	*Philip A. HAILE, Han HONG and Matthew SHUM* (lxxi): Nonparametric Tests for Common Values in First-Price Sealed-Bid Auctions
PRA	150.2004	*François DEGEORGE, François DERRIEN and Kent L. WOMACK* (lxxi): Quid Pro Quo in IPOs: Why Bookbuilding is Dominating Auctions
CCMP	151.2004	*Barbara BUCHNER and Silvia DALL'OLIO*: Russia: The Long Road to Ratification. Internal Institution and Pressure Groups in the Kyoto Protocol's Adoption Process
CCMP	152.2004	*Carlo CARRARO and Marzio GALEOTTI*: Does Endogenous Technical Change Make a Difference in Climate Policy Analysis? A Robustness Exercise with the FEEM-RICE Model
PRA	153.2004	*Alejandro M. MANELLI and Daniel R. VINCENT* (lxxi): Multidimensional Mechanism Design: Revenue Maximization and the Multiple-Good Monopoly
ETA	154.2004	*Nicola ACOCELLA, Giovanni Di BARTOLOMEO and Wilfried PAUWELS*: Is there any Scope for Corporatism in Stabilization Policies?
CTN	155.2004	*Johan EYCKMANS and Michael FINUS*: An Almost Ideal Sharing Scheme for Coalition Games with Externalities
CCMP	156.2004	*Cesare DOSI and Michele MORETTO*: Environmental Innovation, War of Attrition and Investment Grants

CCMP	157.2004	*Valentina BOSETTI, Marzio GALEOTTI and Alessandro LANZA*: How Consistent are Alternative Short-Term Climate Policies with Long-Term Goals?
ETA	158.2004	*Y. Hossein FARZIN and Ken-Ichi AKAO*: Non-pecuniary Value of Employment and Individual Labor Supply
ETA	159.2004	*William BROCK and Anastasios XEPAPADEAS*: Spatial Analysis: Development of Descriptive and Normative Methods with Applications to Economic-Ecological Modelling
KTHC	160.2004	*Alberto PETRUCCI*: On the Incidence of a Tax on PureRent with Infinite Horizons
IEM	161.2004	*Xavier LABANDEIRA, José M. LABEAGA and Miguel RODRÍGUEZ*: Microsimulating the Effects of Household Energy Price Changes in Spain

NOTE DI LAVORO PUBLISHED IN 2005

CCMP	1.2005	*Stéphane HALLEGATTE*: Accounting for Extreme Events in the Economic Assessment of Climate Change
CCMP	2.2005	*Qiang WU and Paulo Augusto NUNES*: Application of Technological Control Measures on Vehicle Pollution: A Cost-Benefit Analysis in China
CCMP	3.2005	*Andrea BIGANO, Jacqueline M. HAMILTON, Maren LAU, Richard S.J. TOL and Yuan ZHOU*: A Global Database of Domestic and International Tourist Numbers at National and Subnational Level
CCMP	4.2005	*Andrea BIGANO, Jacqueline M. HAMILTON and Richard S.J. TOL*: The Impact of Climate on Holiday Destination Choice
ETA	5.2005	*Hubert KEMPF*: Is Inequality Harmful for the Environment in a Growing Economy?
CCMP	6.2005	*Valentina BOSETTI, Carlo CARRARO and Marzio GALEOTTI*: The Dynamics of Carbon and Energy Intensity in a Model of Endogenous Technical Change
IEM	7.2005	*David CALEF and Robert GOBLE*: The Allure of Technology: How France and California Promoted Electric Vehicles to Reduce Urban Air Pollution
ETA	8.2005	*Lorenzo PELLEGRINI and Reyer GERLAGH*: An Empirical Contribution to the Debate on Corruption Democracy and Environmental Policy
CCMP	9.2005	*Angelo ANTOCI*: Environmental Resources Depletion and Interplay Between Negative and Positive Externalities in a Growth Model
CTN	10.2005	*Frédéric DEROIAN*: Cost-Reducing Alliances and Local Spillovers
NRM	11.2005	*Francesco SINDICO*: The GMO Dispute before the WTO: Legal Implications for the Trade and Environment Debate
KTHC	12.2005	*Carla MASSIDDA*: Estimating the New Keynesian Phillips Curve for Italian Manufacturing Sectors
KTHC	13.2005	*Michele MORETTO and Gianpaolo ROSSINI*: Start-up Entry Strategies: Employer vs. Nonemployer firms
PRCG	14.2005	*Clara GRAZIANO and Annalisa LUPORINI*: Ownership Concentration, Monitoring and Optimal Board Structure
CSRM	15.2005	*Parashar KULKARNI*: Use of Ecolabels in Promoting Exports from Developing Countries to Developed Countries: Lessons from the Indian LeatherFootwear Industry
KTHC	16.2005	*Adriana DI LIBERTO, Roberto MURA and Francesco PIGLIARU*: How to Measure the Unobservable: A Panel Technique for the Analysis of TFP Convergence
KTHC	17.2005	*Alireza NAGHAVI*: Asymmetric Labor Markets, Southern Wages, and the Location of Firms
KTHC	18.2005	*Alireza NAGHAVI*: Strategic Intellectual Property Rights Policy and North-South Technology Transfer
KTHC	19.2005	*Mombert HOPPE*: Technology Transfer Through Trade
PRCG	20.2005	*Roberto ROSON*: Platform Competition with Endogenous Multihoming
CCMP	21.2005	*Barbara BUCHNER and Carlo CARRARO*: Regional and Sub-Global Climate Blocs. A Game Theoretic Perspective on Bottom-up Climate Regimes
IEM	22.2005	*Fausto CAVALLARO*: An Integrated Multi-Criteria System to Assess Sustainable Energy Options: An Application of the Promethee Method
CTN	23.2005	*Michael FINUS, Pierre v. MOUCHE and Bianca RUNDSHAGEN*: Uniqueness of Coalitional Equilibria
IEM	24.2005	*Wietze LISE*: Decomposition of CO2 Emissions over 1980–2003 in Turkey
CTN	25.2005	*Somdeb LAHIRI*: The Core of Directed Network Problems with Quotas
SIEV	26.2005	*Susanne MENZEL and Riccardo SCARPA*: Protection Motivation Theory and Contingent Valuation: Perceived Realism, Threat and WTP Estimates for Biodiversity Protection
NRM	27.2005	*Massimiliano MAZZANTI and Anna MONTINI*: The Determinants of Residential Water Demand Empirical Evidence for a Panel of Italian Municipalities
CCMP	28.2005	*Laurent GILOTTE and Michel de LARA*: Precautionary Effect and Variations of the Value of Information
NRM	29.2005	*Paul SARFO-MENSAH*: Exportation of Timber in Ghana: The Menace of Illegal Logging Operations
CCMP	30.2005	*Andrea BIGANO, Alessandra GORIA, Jacqueline HAMILTON and Richard S.J. TOL*: The Effect of Climate Change and Extreme Weather Events on Tourism
NRM	31.2005	*Maria Angeles GARCIA-VALIÑAS*: Decentralization and Environment: An Application to Water Policies
NRM	32.2005	*Chiara D'ALPAOS, Cesare DOSI and Michele MORETTO*: Concession Length and Investment Timing Flexibility
CCMP	33.2005	*Joseph HUBER*: Key Environmental Innovations
CTN	34.2005	*Antoni CALVÓ-ARMENGOL and Rahmi İLKILIÇ* (lxxii): Pairwise-Stability and Nash Equilibria in Network Formation
CTN	35.2005	*Francesco FERI* (lxxii): Network Formation with Endogenous Decay
CTN	36.2005	*Frank H. PAGE, Jr. and Myrna H. WOODERS* (lxxii): Strategic Basins of Attraction, the Farsighted Core, and Network Formation Games

CTN	37.2005	*Alessandra CASELLA and Nobuyuki HANAKI* (lxxii): Information Channels in Labor Markets. On the Resilience of Referral Hiring
CTN	38.2005	*Matthew O. JACKSON and Alison WATTS* (lxxii): Social Games: Matching and the Play of Finitely Repeated Games
CTN	39.2005	*Anna BOGOMOLNAIA, Michel LE BRETON, Alexei SAVVATEEV and Shlomo WEBER* (lxxii): The Egalitarian Sharing Rule in Provision of Public Projects
CTN	40.2005	*Francesco FERI*: Stochastic Stability in Network with Decay
CTN	41.2005	*Aart de ZEEUW* (lxxii): Dynamic Effects on the Stability of International Environmental Agreements
NRM	42.2005	*C. Martijn van der HEIDE, Jeroen C.J.M. van den BERGH, Ekko C. van IERLAND and Paulo A.L.D. NUNES*: Measuring the Economic Value of Two Habitat Defragmentation Policy Scenarios for the Veluwe, The Netherlands
PRCG	43.2005	*Carla VIEIRA and Ana Paula SERRA*: Abnormal Returns in Privatization Public Offerings: The Case of Portuguese Firms
SIEV	44.2005	*Anna ALBERINI, Valentina ZANATTA and Paolo ROSATO*: Combining Actual and Contingent Behavior to Estimate the Value of Sports Fishing in the Lagoon of Venice
CTN	45.2005	*Michael FINUS and Bianca RUNDSHAGEN:* Participation in International Environmental Agreements: The Role of Timing and Regulation
CCMP	46.2005	*Lorenzo PELLEGRINI and Reyer GERLAGH*: Are EU Environmental Policies Too Demanding for New Members States?
IEM	47.2005	*Matteo MANERA*: Modeling Factor Demands with SEM and VAR: An Empirical Comparison
CTN	48.2005	*Olivier TERCIEUX and Vincent VANNETELBOSCH* (lxx): A Characterization of Stochastically Stable Networks
CTN	49.2005	*Ana MAULEON, José SEMPERE-MONERRIS and Vincent J. VANNETELBOSCH* (lxxii): R&D Networks Among Unionized Firms
CTN	50.2005	*Carlo CARRARO, Johan EYCKMANS and Michael FINUS*: Optimal Transfers and Participation Decisions in International Environmental Agreements
KTHC	51.2005	*Valeria GATTAI*: From the Theory of the Firm to FDI and Internalisation:A Survey
CCMP	52.2005	*Alireza NAGHAVI*: Multilateral Environmental Agreements and Trade Obligations: A Theoretical Analysis of the Doha Proposal
SIEV	53.2005	*Margaretha BREIL, Gretel GAMBARELLI and Paulo A.L.D. NUNES*: Economic Valuation of On Site Material Damages of High Water on Economic Activities based in the City of Venice: Results from a Dose-Response-Expert-Based Valuation Approach
ETA	54.2005	*Alessandra del BOCA, Marzio GALEOTTI, Charles P. HIMMELBERG and Paola ROTA*: Investment and Time to Plan: A Comparison of Structures vs. Equipment in a Panel of Italian Firms
CCMP	55.2005	*Gernot KLEPPER and Sonja PETERSON*: Emissions Trading, CDM, JI, and More – The Climate Strategy of the EU
ETA	56.2005	*Maia DAVID and Bernard SINCLAIR-DESGAGNÉ*: Environmental Regulation and the Eco-Industry
ETA	57.2005	*Alain-Désiré NIMUBONA and Bernard SINCLAIR-DESGAGNÉ*: The Pigouvian Tax Rule in the Presence of an Eco-Industry
NRM	58.2005	*Helmut KARL, Antje MÖLLER, Ximena MATUS, Edgar GRANDE and Robert KAISER*: Environmental Innovations: Institutional Impacts on Co-operations for Sustainable Development
SIEV	59.2005	*Dimitra VOUVAKI and Anastasios XEPAPADEAS* (lxxiii): Criteria for Assessing Sustainable Development: Theoretical Issues and Empirical Evidence for the Case of Greece
CCMP	60.2005	*Andreas LÖSCHEL and Dirk T.G. RÜBBELKE*: Impure Public Goods and Technological Interdependencies
PRCG	61.2005	*Christoph A. SCHALTEGGER and Benno TORGLER*: Trust and Fiscal Performance: A Panel Analysis with Swiss Data
ETA	62.2005	*Irene VALSECCHI*: A Role for Instructions
NRM	63.2005	*Valentina BOSETTI and Gianni LOCATELLI*: A Data Envelopment Analysis Approach to the Assessment of Natural Parks' Economic Efficiency and Sustainability. The Case of Italian National Parks
SIEV	64.2005	*Arianne T. de BLAEIJ, Paulo A.L.D. NUNES and Jeroen C.J.M. van den BERGH*: Modeling 'No-choice' Responses in Attribute Based Valuation Surveys
CTN	65.2005	*Carlo CARRARO, Carmen MARCHIORI and Alessandra SGOBBI*: Applications of Negotiation Theory to Water Issues
CTN	66.2005	*Carlo CARRARO, Carmen MARCHIORI and Alessandra SGOBBI*: Advances in Negotiation Theory: Bargaining, Coalitions and Fairness
KTHC	67.2005	*Sandra WALLMAN* (lxxiv): Network Capital and Social Trust: Pre-Conditions for 'Good' Diversity?
KTHC	68.2005	*Asimina CHRISTOFOROU* (lxxiv): On the Determinants of Social Capital in Greece Compared to Countries of the European Union
KTHC	69.2005	*Eric M. USLANER* (lxxiv): Varieties of Trust
KTHC	70.2005	*Thomas P. LYON* (lxxiv): Making Capitalism Work: Social Capital and Economic Growth in Italy, 1970-1995
KTHC	71.2005	*Graziella BERTOCCHI and Chiara STROZZI* (lxxv): Citizenship Laws and International Migration in Historical Perspective
KTHC	72.2005	*Elsbeth van HYLCKAMA VLIEG* (lxxv): Accommodating Differences
KTHC	73.2005	*Renato SANSA and Ercole SORI* (lxxv): Governance of Diversity Between Social Dynamics and Conflicts in Multicultural Cities. A Selected Survey on Historical Bibliography
IEM	74.2005	*Alberto LONGO and Anil MARKANDYA*: Identification of Options and Policy Instruments for the Internalisation of External Costs of Electricity Generation. Dissemination of External Costs of Electricity Supply Making Electricity External Costs Known to Policy-Makers MAXIMA

IEM	75.2005	*Margherita GRASSO and Matteo MANERA*: Asymmetric Error Correction Models for the Oil-Gasoline Price Relationship
ETA	76.2005	*Umberto CHERUBINI and Matteo MANERA*: Hunting the Living Dead A "Peso Problem" in Corporate Liabilities Data
CTN	77.2005	*Hans-Peter WEIKARD*: Cartel Stability under an Optimal Sharing Rule
ETA	78.2005	*Joëlle NOAILLY, Jeroen C.J.M. van den BERGH and Cees A. WITHAGEN* (lxxvi): Local and Global Interactions in an Evolutionary Resource Game
ETA	79.2005	*Joëlle NOAILLY, Cees A. WITHAGEN and Jeroen C.J.M. van den BERGH* (lxxvi): Spatial Evolution of Social Norms in a Common-Pool Resource Game
CCMP	80.2005	*Massimiliano MAZZANTI and Roberto ZOBOLI*: Economic Instruments and Induced Innovation: The Case of End-of-Life Vehicles European Policies
NRM	81.2005	*Anna LASUT*: Creative Thinking and Modelling for the Decision Support in Water Management
CCMP	82.2005	*Valentina BOSETTI and Barbara BUCHNER*: Using Data Envelopment Analysis to Assess the Relative Efficiency of Different Climate Policy Portfolios
ETA	83.2005	*Ignazio MUSU*: Intellectual Property Rights and Biotechnology: How to Improve the Present Patent System
KTHC	84.2005	*Giulio CAINELLI, Susanna MANCINELLI and Massimiliano MAZZANTI*: Social Capital, R&D and Industrial Districts
ETA	85.2005	*Rosella LEVAGGI, Michele MORETTO and Vincenzo REBBA*: Quality and Investment Decisions in Hospital Care when Physicians are Devoted Workers
CCMP	86.2005	*Valentina BOSETTI and Laurent GILOTTE*: Carbon Capture and Sequestration: How Much Does this Uncertain Option Affect Near-Term Policy Choices?
CSRM	87.2005	*Nicoletta FERRO*: Value Through Diversity: Microfinance and Islamic Finance and Global Banking
ETA	88.2005	*A. MARKANDYA and S. PEDROSO*: How Substitutable is Natural Capital?
IEM	89.2005	*Anil MARKANDYA, Valeria COSTANTINI, Francesco GRACCEVA and Giorgio VICINI*: Security of Energy Supply: Comparing Scenarios From a European Perspective
CCMP	90.2005	*Vincent M. OTTO, Andreas LÖSCHEL and Rob DELLINK*: Energy Biased Technical Change: A CGE Analysis
PRCG	91.2005	*Carlo CAPUANO*: *Abuse of Competitive Fringe*
PRCG	92.2005	*Ulrich BINDSEIL, Kjell G. NYBORG and Ilya A. STREBULAEV* (lxv): Bidding and Performance in Repo Auctions: Evidence from ECB Open Market Operations
CCMP	93.2005	*Sabrina AUCI and Leonardo BECCHETTI*: The Stability of the Adjusted and Unadjusted Environmental Kuznets Curve
CCMP	94.2005	*Francesco BOSELLO and Jian ZHANG*: Assessing Climate Change Impacts: Agriculture
CTN	95.2005	*Alejandro CAPARRÓS, Jean-Christophe PEREAU and Tarik TAZDAÏT*: Bargaining with Non-Monolithic Players
ETA	96.2005	*William BROCK and Anastasios XEPAPADEAS* (lxxvi): Optimal Control and Spatial Heterogeneity: Pattern Formation in Economic-Ecological Models
CCMP	97.2005	*Francesco BOSELLO, Roberto ROSON and Richard S.J. TOL* (lxxvii): Economy-Wide Estimates of the Implications of Climate Change: Human Health
CCMP	98.2005	*Rob DELLINK, Michael FINUS and Niels OLIEMAN*: Coalition Formation under Uncertainty: The Stability Likelihood of an International Climate Agreement
CTN	99.2005	*Valeria COSTANTINI, Riccardo CRESCENZI, Fabrizio De FILIPPIS, and Luca SALVATICI*: Bargaining Coalitions in the Agricultural Negotiations of the Doha Round: Similarity of Interests or Strategic Choices? An Empirical Assessment
IEM	100.2005	*Giliola FREY and Matteo MANERA*: Econometric Models of Asymmetric Price Transmission
IEM	101.2005	*Alessandro COLOGNI and Matteo MANERA*: Oil Prices, Inflation and Interest Rates in a Structural Cointegrated VAR Model for the G-7 Countries
KTHC	102.2005	*Chiara M. TRAVISI and Roberto CAMAGNI*: Sustainability of Urban Sprawl: Environmental-Economic Indicators for the Analysis of Mobility Impact in Italy
ETA	103.2005	*Livingstone S. LUBOOBI and Joseph Y.T. MUGISHA*: HIV/AIDS Pandemic in Africa: Trends and Challenges
SIEV	104.2005	*Anna ALBERINI, Erik LICHTENBERG, Dominic MANCINI, and Gregmar I. GALINATO*: Was It Something I Ate? Implementation of the FDA Seafood HACCP Program
SIEV	105.2005	*Anna ALBERINI and Aline CHIABAI*: Urban Environmental Health and Sensitive Populations: How Much are the Italians Willing to Pay to Reduce Their Risks?
SIEV	106.2005	*Anna ALBERINI, Aline CHIABAI and Lucija MUEHLENBACHS*: Using Expert Judgment to Assess Adaptive Capacity to Climate Change: Evidence from a Conjoint Choice Survey
CTN	107.2005	*Michele BERNASCONI and Matteo GALIZZI*: Coordination in Networks Formation: Experimental Evidence on Learning and Salience
KTHC	108.2005	*Michele MORETTO and Sergio VERGALLI*: Migration Dynamics
NRM	109.2005	*Antonio MUSOLESI and Mario NOSVELLI*: Water Consumption and Long-Run Urban Development: The Case of Milan
SIEV	110.2005	*Benno TORGLER and Maria A. GARCIA-VALIÑAS*: Attitudes Towards Preventing Environmental Damage
SIEV	111.2005	*Alberto LONGO and Anna ALBERINI*: What are the Effects of Contamination Risks on Commercial and Industrial Properties? Evidence from Baltimore, Maryland
SIEV	112.2005	*Anna ALBERINI and Alberto LONGO*: The Value of Cultural Heritage Sites in Armenia: Evidence from a Travel Cost Method Study
CCMP	113.2005	*Mikel GONZÁLEZ and Rob DELLINK*: Impact of Climate Policy on the Basque Economy
NRM	114.2005	*Gilles LAFFORGUE and Walid OUESLATI*: Optimal Soil Management and Environmental Policy

NRM	115.2005	*Martin D. SMITH and Larry B. CROWDER* (lxxvi): Valuing Ecosystem Services with Fishery Rents: A Lumped-Parameter Approach to Hypoxia in the Neuse River Estuary
NRM	116.2005	*Dan HOLLAND and Kurt SCHNIER* (lxxvi): Protecting Marine Biodiversity: A Comparison of Individual Habitat Quotas (IHQs) and Marine Protected Areas
PRCG	117.2005	*John NELLIS*: The Evolution of Enterprise Reform in Africa: From State-owned Enterprises to Private Participation in Infrastructure — and Back?
PRCG	118.2005	*Bernardo BORTOLOTTI*: Italy's Privatization Process and Its Implications for China
SIEV	119.2005	*Anna ALBERINI, Marcella VERONESI and Joseph C. COOPER*: Detecting Starting Point Bias in Dichotomous-Choice Contingent Valuation Surveys
CTN	120.2005	*Federico ECHENIQUE and Mehmet B. YENMEZ*: A Solution to Matching with Preferences over Colleagues
KTHC	121.2005	*Valeria GATTAI and Corrado MOLTENI*: Dissipation of Knowledge and the Boundaries of the Multinational Enterprise
KTHC	122.2005	*Valeria GATTAI*: Firm's Intangible Assets and Multinational Activity: Joint-Venture Versus FDI
CCMP	123.2005	*Socrates KYPREOS*: A MERGE Model with Endogenous Technological Change and the Cost of Carbon Stabilization
CCMP	124.2005	*Fuminori SANO, Keigo AKIMOTO, Takashi HOMMA and Toshimasa TOMODA*: Analysis of Technological Portfolios for CO_2 stabilizations and Effects of Technological Changes
CCMP	125.2005	*Fredrik HEDENUS, Christian AZAR and Kristian LINDGREN*: Induced Technological Change in a Limited Foresight Optimization Model
CCMP	126.2005	*Reyer GERLAGH*: The Value of ITC under Climate Stabilization
PRCG	127.2005	John *NELLIS*: Privatization in Africa: What has happened? What is to be done?
PRCG	128.2005	*Raphaël SOUBEYRAN*: Contest with Attack and Defence: Does Negative Campaigning Increase or Decrease Voters' Turnout?
PRCG	129.2005	*Pascal GAUTIER and Raphael SOUBEYRAN*: Political Cycles : The Opposition Advantage
ETA	130.2005	*Giovanni DI BARTOLOMEO, Nicola ACOCELLA and Andrew HUGHES HALLETT*: Dynamic Controllability with Overlapping targets: A Generalization of the Tinbergen-Nash Theory of Economic Policy
SIEV	131.2005	*Elissaios PAPYRAKIS and Reyer GERLAGH*: Institutional Explanations of Economic Development: the Role of Precious Metals
ETA	132.2005	*Giovanni DI BARTOLOMEO and Nicola ACOCELLA*: Tinbergen and Theil Meet Nash: Controllability in Policy Games
IEM	133.2005	*Adriana M. IGNACIUK and Rob B. DELLINK*: Multi-Product Crops for Agricultural and Energy Production – an AGE Analysis for Poland

(lxv) This paper was presented at the EuroConference on “Auctions and Market Design: Theory, Evidence and Applications” organised by Fondazione Eni Enrico Mattei and sponsored by the EU, Milan, September 25-27, 2003

(lxvi) This paper has been presented at the 4th BioEcon Workshop on “Economic Analysis of Policies for Biodiversity Conservation” organised on behalf of the BIOECON Network by Fondazione Eni Enrico Mattei, Venice International University (VIU) and University College London (UCL) , Venice, August 28-29, 2003

(lxvii) This paper has been presented at the international conference on “Tourism and Sustainable Economic Development – Macro and Micro Economic Issues” jointly organised by CRENoS (Università di Cagliari e Sassari, Italy) and Fondazione Eni Enrico Mattei, and supported by the World Bank, Sardinia, September 19-20, 2003

(lxviii) This paper was presented at the ENGIME Workshop on “Governance and Policies in Multicultural Cities”, Rome, June 5-6, 2003

(lxix) This paper was presented at the Fourth EEP Plenary Workshop and EEP Conference “The Future of Climate Policy”, Cagliari, Italy, 27-28 March 2003

(lxx) This paper was presented at the 9th Coalition Theory Workshop on "Collective Decisions and Institutional Design" organised by the Universitat Autònoma de Barcelona and held in Barcelona, Spain, January 30-31, 2004

(lxxi) This paper was presented at the EuroConference on “Auctions and Market Design: Theory, Evidence and Applications”, organised by Fondazione Eni Enrico Mattei and Consip and sponsored by the EU, Rome, September 23-25, 2004

(lxxii) This paper was presented at the 10th Coalition Theory Network Workshop held in Paris, France on 28-29 January 2005 and organised by EUREQua.

(lxxiii) This paper was presented at the 2nd Workshop on "Inclusive Wealth and Accounting Prices" held in Trieste, Italy on 13-15 April 2005 and organised by the Ecological and Environmental Economics - EEE Programme, a joint three-year programme of ICTP - The Abdus Salam International Centre for Theoretical Physics, FEEM - Fondazione Eni Enrico Mattei, and The Beijer International Institute of Ecological Economics

(lxxiv) This paper was presented at the ENGIME Workshop on “Trust and social capital in multicultural cities” Athens, January 19-20, 2004

(lxxv) This paper was presented at the ENGIME Workshop on “Diversity as a source of growth” Rome November 18-19, 2004

(lxxvi) This paper was presented at the 3rd Workshop on Spatial-Dynamic Models of Economics and Ecosystems held in Trieste on 11-13 April 2005 and organised by the Ecological and Environmental Economics - EEE Programme, a joint three-year programme of ICTP - The Abdus Salam International Centre for Theoretical Physics, FEEM - Fondazione Eni Enrico Mattei, and The Beijer International Institute of Ecological Economics

(lxxvii) This paper was presented at the Workshop on Infectious Diseases: Ecological and Economic Approaches held in Trieste on 13-15 April 2005 and organised by the Ecological and Environmental Economics - EEE Programme, a joint three-year programme of ICTP - The Abdus Salam International Centre for Theoretical Physics, FEEM - Fondazione Eni Enrico Mattei, and The Beijer International Institute of Ecological Economics.

2004 SERIES	
CCMP	*Climate Change Modelling and Policy* (Editor: Marzio Galeotti)
GG	*Global Governance* (Editor: Carlo Carraro*)*
SIEV	*Sustainability Indicators and Environmental Valuation* (Editor: Anna Alberini)
NRM	*Natural Resources Management* (Editor: Carlo Giupponi)
KTHC	*Knowledge, Technology, Human Capital* (Editor: Gianmarco Ottaviano)
IEM	*International Energy Markets* (Editor: Anil Markandya)
CSRM	*Corporate Social Responsibility and Sustainable Management* (Editor: Sabina Ratti)
PRA	*Privatisation, Regulation, Antitrust* (Editor: Bernardo Bortolotti)
ETA	*Economic Theory and Applications* (Editor: Carlo Carraro)
CTN	*Coalition Theory Network*

2005 SERIES	
CCMP	*Climate Change Modelling and Policy* (Editor: Marzio Galeotti)
SIEV	*Sustainability Indicators and Environmental Valuation* (Editor: Anna Alberini)
NRM	*Natural Resources Management* (Editor: Carlo Giupponi)
KTHC	*Knowledge, Technology, Human Capital* (Editor: Gianmarco Ottaviano)
IEM	*International Energy Markets* (Editor: Anil Markandya)
CSRM	*Corporate Social Responsibility and Sustainable Management* (Editor: Sabina Ratti)
PRCG	*Privatisation Regulation Corporate Governance* (Editor: Bernardo Bortolotti)
ETA	*Economic Theory and Applications* (Editor: Carlo Carraro)
CTN	*Coalition Theory Network*