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## **Towards the Green Economy through Innovations: the role of Industrial Relations**

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### **Abstract**

The challenges faced by the trade unions and firms in the last years, mainly brought by the economic crisis that is still shacking the EU labour markets, has diverted, to some extent, the attention of social actors from green issues toward issues concerning the adverse effects of the crisis on the labour markets and workers. The Italian case is an example. Hence, in this paper we attempt to tackle the somewhat overlooked issue of if and how industrial relations might play a role in the process of greening the economy, mainly through the lever of innovation adoption and organizational change, two factors that can be characterised by information and consultation between firms and unions. We do this for the Italian case, focusing the attention on a highly industrialised and unionised region in the north-east: Emilia-Romagna. At first, we interview key players at EU and Italian level (e.g. Unions representatives) about the role of the industrial relations to boost proper green innovations and create synergies between economic and environmental performances. Secondly, we econometrically assess the quality of industrial relations as a driver of eco-innovation adoption, through a quantitative exercise that is based upon a large survey on manufacturing firms located in the Emilia-Romagna region. The results show two interesting main evidences: being a unionised firm does not relate with the adoption of eco-innovation, however when we look at the industrial

relation climate we find a positive relation between the union involvement in the decision making process and the propensity to eco-innovate



# Towards the Green Economy through Innovations: the role of Industrial Relations \*

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Very preliminary version: do not quote or diffuse

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Keywords: Eco-innovation; Industrial Relations; Manufacturing

JEL codes: O30; O33; L6; J5

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# 1 Introduction

The challenges faced by the trade unions in the last years, mainly brought by the economic crisis that is still shacking the EU labour markets (there are more than 23.5 million unemployed), has probably diverted part of the energy of the unions from green issues, through the diffusion of eco-bargaining, toward issues concerning the adverse effects of the crisis on the labour markets and workers: e.g. Work programme of the European social partners 2012-2014 and Framework of Action on Youth Employment (<http://www.etuc.org/r/20>). The disruptive power of the crisis could have also undermined the well-established and structured social dialogue matured in the last decades among EU social partners.<sup>1</sup> However, it has been recognised that social partners are of extreme importance in dealing with the implementation of reforms and measures to cope with the crisis challenges (Eurofound, 2009). Social partners may bargain over measures that preserve employment, they know the skill gaps in the labour market, so they can possibly address the training programmes towards those kinds of skills and they can act as moderators when the adoption of unpopular measures is necessary. Moreover, the crisis has shifted the primary focus of the bargaining process toward wages, after the acknowledgment of their slower increase in EU with respect to productivity from the mid-90s (ETUC, 2010) and the need to boost the demand in EU. When green arguments and industrial relations are jointly considered the main challenge for unions becomes how to integrate green issues in the actual recession scenario. ETUC is firmly committed to the creation of a global agreement that makes it possible to reach ambitious goals in terms of CO2 reduction in order to avoid an increase of more than 2C by the end of the century (ETUC, 2012a). Contextually, ETUC is extremely sensible to the social dimension of the transition toward a green economy and provides guidance to set up a roadmap that necessarily needs to start from the workplaces and from the actions that the ETUC affiliates may implement at local level, possibly exploiting the experience accumulated through best practices (ETUC, 2012b). The need and strong willingness of ETUC to include the environmental issues in the agenda as an opportunity to exit from the slowdown with a greener and sus-

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<sup>1</sup>We here refer to trade unions and employers or their representative organisations. The social partners are involved in the social dialogue, which can also be thought as a tripartite dialogue involving a third partner: the government.

tainable economy represents the starting point from which we can enucleate the highlights and the considerations from interviews to union representative and union policy advisers <sup>2</sup>. Because the role of unions in shaping both the EU policy agenda and, at micro level, in influencing the firms adoption of eco-innovation is relevant, the next paragraphs aim to provide a picture of unions position and interventions at macro and micro levels. This double layer perspective is helpful in providing insights on unions capacity to influence the eco-innovation adoption, which is a critical issue on the deployment of actual and future policies aiming to fulfil the 2050 energy roadmap objectives.

## 2 Background literature

Can we say that unionised firms and among them those having good quality industrial relations are more benevolent toward the environment?

The literature on industrial relations and the labour economics literature stresses the relevance the working conditions have in the unions objectives: the non-exploitation of workers has been always a pillar in the union agenda. We here want to investigate whether the non-exploitation of the environment is in the agenda of unions representatives at firm level and not only in the agenda of national and international unions confederations.

In the vast literature on innovation determinants the constituencies of the institutional context have been widely study: let's think, on this point, about the stream of literature concerning the national systems of innovations (.....) or the regional systems of innovations (.....). This are simply two examples of literatures that take into consideration the relevance of the institutional factors in determining the propensity to innovate, its intensity and its diffusion. However, little emphasis has been give to some of the basic elements that constitute the institutional system in which the firms are embedded and that can contribute to the capacity of innovate of different countries and regions (Coriat and Weinstein, 2002). One of these elements is the system of industrial relations. The role of the latter in the economic system has been analysed both at macro (.....) and micro (.....) levels. In what follows we consider the micro level studies which has usually firms as

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<sup>2</sup>We do not intend to draw any general conclusion, but simply reporting the opinions of the unions interviewed.

unit of analysis

Less neglected has been the mere presence of unions in the system, without considering the specific framework given by the industrial relations, as an element that can alter the propensity to innovate of the firm (Menezes-Filho and Van Reenen, 2003; Freeman, 2007). The usual tenet is to consider unions as an element of the economic system that may directly or indirectly hamper the firm innovative capacity. On the one hand, unions may have a conservative behaviour that directly constitute an obstacle to innovation activity. On the other hand, they may indirectly be an obstacle to innovation activity because they generate hold up problems: the rent seeking behaviour of the union, aimed to capture the rents associated to the investment in innovation, reduces the incentive to invest for management.

When industrial relations are considered and the quality of the dialogue between unions and firm's management is taken into consideration the impact of unions on innovation activity may shift from negative to positive: when unions and management have a non adversarial relations and establish a win-win strategic behaviour in pursuing common goals and gains, the unions presence at firm level can be an element that spur innovation activity instead of hampering it (Metcalf, 2003). Again with (Metcalf, 2003) we can argue that cooperative industrial relations can be assimilated to the concept of partnership. In fact, "[a] workplace is defined having a partnership when a union negotiates pay and management negotiates with, or consults, the union(s) on recruitment, training, payment systems, handling grievances, staff planning, equal opportunities, health and safety and performance appraisals" (Metcalf, 2003, p.158). Therefore, it can be argued that the impact of unions on innovation is mediated by the industrial relations climate and that such impact has to be empirically verified, given the absence of univocal theoretical insights (see for example (Antonioli, 2009))

### 3 Qualitative evidence from interviews <sup>3</sup>

#### 3.1 European unions confederations: Environment is a primary issue, but the social dimension must be preserved

The ETUC position on environmental bargaining is a progressive one. At EU level ETUC adopts a strong and positive position on climate policy negotiation. Notwithstanding the crisis of the EU labour market the green issues are on the agenda and they will remain in the future. (see Tab B1 in AppendixB for the list of respondents). As an example, ETUC is strongly aware of the problems linked to the ETS low CO<sub>2</sub> price, over-allocation of allowances, carbon leakage. For such a reason, ETUC has recently supported the backloading procedure, which is a measure to contrast the low CO<sub>2</sub> prices, due to an excess of emission allowances, postponing the auction for further emission allowances. However, ETUC considers the backloading a simple emergency measure and it put forward a Just Transition (JT) approach. The JT roadmap is for sure steep and it necessitates of ambitious policies and interventions, as well as it calls for a stable and serious investment plan. The ETUC proposes to tackle the climate change through a set of policies and actions that can be included in the Lisbon Strategy. The objective of ETUC is that workers share the gains of a transition toward a greener economy (Scott, 2009). The structural changes in employment needed to develop a green continent must be foreseen in order to set up and deploy the necessary complementary policies in education and training. In favouring a transition towards a sustainable economy ETUC is also active in promoting an international dialogue dimension with WTO and ILO, as well as with other international partners, because of its awareness that climate change is a global challenge, which can see the EU as leader in tackling such a challenge. A final point stressed by the ETUC advisor is that labour and environment must not be regarded as alternative choices. A transition towards a greener economy can and must be developed with a strong social dimension. If green policies are coupled with labour policies, such as policies addressed to sustain workers re-training, then there is no risk for workers

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<sup>3</sup>This section is an extract of a CECILIA2050 ([www.cecilia2050.eu](http://www.cecilia2050.eu)) report (INDUCING GREENHOUSE GASES ABATING INNOVATIONS THROUGH POLICY PACKAGES. EX POST ASSESSMENTS FROM EU SECTORS) on stakeholders perceptions, in this case unions perceptions, on the state of the art of the debate and of the policies and actions toward a sustainable growth



given by a low-carbon economy: green and labour policies must proceed concurrently becoming two main pillars for the EU growth . As far as the industryAll position is concerned we can affirm that it shares the ETUC considerations. More specifically, the policy adviser, said that especially for energy intensive sectors a long term strategy aiming at sustain innovation and reorganization for a general reduction of material and energy utilization is supported. The competitive advantages in these sectors, but also in the other ones, must be achieved through innovation strategies rather than simple cost saving strategies. The transition strategy toward a greener economy and toward a reduction in energy use for energy intensive sectors through innovation and reorganization has more general implications in terms of education and training of the workforce. On this point it might be the case that green policies, inducing environmental innovations, may displace the labour force in the short run, especially in a recession period. Indeed, pricing environmental externalities may hinder the competitiveness of energy intensive sectors. Hence, short run and long run objectives must be conjugated in order to secure both sustainability and employment protection.

### **3.2 Italian National Confederations: green effort and some successful cases**

Unions confederations are certainly engaged on green issues They clearly recognise the need for a long term and integrated policy approach on the energy issue and on the sustainable development process. At the same time the UIL confederation argues, in its official documents <sup>4</sup>, that pricing environmental externalities through the back-loading procedure might be detrimental for the EU manufacturing sectors competitiveness, especially in a period of economic crisis.

The position of the three major unions confederations (CGIL, CISL and UIL) in Italy is common. All of them declare a strong commitment toward the achievement of 2050 roadmap targets through the interplay of both green strategies and social strategies within the JT framework According to CGIL respondents, environment, work and social equity are three objectives that must guide the policymakers in order to overcome the contingent crisis (CGIL, 2013). Focusing the attention only on labour issues is a myopic strategy that would lead to a dead-end street. It is out of doubt that choos-

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<sup>4</sup><http://www.uil.it/ambiente/default.htm>

ing a green strategy will lead to a loss of jobs, especially in brown sectors, as also stated by CISL (CISL, 2013). However, such a loss would be more than compensated by the creation of new green jobs. For this reason the CGIL points to a just transition approach and to decent jobs, but in order to do so it is necessary that workers that will lose their jobs can be relocated in new sustainable sectors while maintaining the same qualifications, duties and working conditions. The way to achieve this aim is to ensure continuing education, retraining and social protection. To achieve the objectives above mentioned it is necessary to ensure adequate financial resources, granting public support for investment and research, acting in derogation of the Stability Pact for specific types (green) of local and regional investments and securing a better use of European Structural Funds. The same concern about the management of the transition is shared by CISL respondent, who states that the environmental policy is an issue that is strengthening in the union agenda. However, one of the main complaint is that in Italy there are lobbies and large enterprises working in the energy sector that rather than representing drivers toward a green society constitute an obstacle, because they linger in the exploitation of existing rents. In the opinion of the respondent it is crucial to avoid in the next future deployment of green policies the errors made during the ETS first phase in terms of allocation of pollution allowances. No trade-off is perceived between labour and green strategies, provided that EU and Italy locate themselves on a JT path.

### **3.3 Union representatives considerations: lack of debate on environmental issues**

If the situation at EU level is a progressive one with the trade unions directly active in proposing green policies and at Italian national level the effort of the three major confederation on green issues is not questionable, the perception of the base, the firm level union representatives and union organisers and that of a Former General Secretary, is more critical. The general state of the industrial relations that emerges from the respondents words is negative. The respondents affirm that not much is left to the unions on issues such as work organization and innovation, the leadership is in the managements hands. The trade unions presence is only marginal and residual in defining innovation strategies. Unions usually react in an adaptive and defensive way to the management actions, especially in the

last years of crisis <sup>5</sup>. The respondents perception is that the Italian industrial relations have suffered from a sort of cultural regression in the relations between firms and unions in the last decades. The responsibility is both of the firms and of the unions, which did not realized to be in the middle of a restructuring process of the Italian capitalism. The weakening of the social dialogue has been also reflected on the debate on environmental issues, which is substantially absent. The interviewed union representatives agree in considering the debate on green issues out of the agenda. According to their perception, neither at firm level, nor at national level the Italian unions put forward strong propositions in terms of environmental policy. As far as the application of compulsory and not compulsory green behaviours and strategies the union representatives perceive a wide gap between small and large firms, in favour of the latter (also for what concerns health and security issues). An example comes from Dalmine, a leading metallurgy firms, with several establishments abroad. Dalmine is strongly committed to reduce the environmental impact of its production as well as to make the work environment more secure and healthier. However, the environmental innovations introduced, only partially due to a binding policy, had for sure a positive effect on efficiency. Without this positive effect on the cost/benefit balance for the firm it might have been the case that the environmental innovation had not been introduced. By the same token, another respondent confirms that according to his experience many firms introduce environmental innovations and green processes to get eco labels they can spend as a marketing tool. As stated by the ETUC respondent, also for the Italian firm level trade unions representatives there is no trade-off between labour and environment. However, the lack of sensitivity from firms and trade unions on green issues hampers the possibility to open a proper debate that leads to policy actions. In particular, according to a respondent, trade unions simply try to manage the adverse effects of the crisis on workers with a defensive strategy, without strongly pushing for strategies trying to exploit the green economy as an opportunity for new jobs. In synthesis, the faint attempt to introduce eco-bargaining in the last years have been hampered by the crisis. However, at national level the attempt to introduce environmental issues in the debate is still alive, as it emerges from the national confederations position. With this aim, training programmes have been activated

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<sup>5</sup>This is especially the position of the former General Secretary.

in order to find a political path sustained by trade unions and addressed to introduce green elements in the bargaining activity (e.g. environmentally friendly process and product). If processes and products change in order to become greener, it emerges the necessity to rethink the quantity and quality of workers, implementing coordinated green and labour policies.

### 3.4 Main insights

The last set of information collected through the un-structured interviews can lead us to draw the first main insight. The respondents listed a set of issues that can be put under the general heading of obstacles to green economy, as perceived by the trade unions. Starting from the EU level, the main obstacle is constituted by the lack of adequate monetary investment to sustain the policies endorsed in order to reach the 2050 environmental goals. The road-map for building a low-carbon economy cannot be followed without serious investments. If EU leaders want to combine transition by not losing important parts of industries in Europe and considerably reducing green-house gases emissions they have to settle a proper amount of financial investment and it has to be certain <sup>6</sup>. At the Italian level, beside the lack of investments, the green policy uncertainty (and lack of green policies) plays a major role in undermining a path toward a green economy. The feeling expressed by the respondents is that it would be better, also for small firms, having a more stringent but certain policy rather than making adjustments as necessary because of an uncertain environmental policy. The second main insight is that unions do not constitute an obstacle to green strategies potentially adoptable by the firms, as well as they do not hamper with their policy strategy the adoption of green policies. On the contrary, they consider environmental and labour policies as synergic elements of a JT approach. The third insight that emerges at micro level is that the dialogue between management and unions may be a strong driver of environmental strategies adoption, coupled with complementary competitive strategies. This last point deserves a great attention both from policy makers and scholars, as well as practitioners, because it represents the deployment moment of

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<sup>6</sup>On this point an example is the EU behavior in financing Carbon Capture and Storage (CCS) projects: the funding designed to be awarded to these kind of projects this year and amounting to around 1.2 billion euros was diverted toward renewable energy projects, also because of the lack of guarantee from member states to co-finance such projects both because of austerity measures and because of the very low price of CO2

more general green policies. Without a strong commitment at micro level of unions, workers and firms (management) the green strategies, if not binding, run the risk to be ignored .

## 4 Setting the research questions

From the previous literature it results to be interesting to test whether being unionised is related to the propensity to eco-innovate. If the gains from eco-innovation in terms of cost abatement for the firm have to be split with the employees because of the rent seeking behaviour of union representative we can expect a negative sign associated to the unionisation variable. On the contrary we may have a positive sign if the industrial relations are participative. So the research question is:

H1 *Is unionisation positively or negatively related to EIs?*

The second main research question derives both by the past literature, which, although scarce as reminded above, illustrate some kind of relation between the quality of the industrial climate and the propensity to innovate, the less adversarial the climate the higher the propensity to innovate, and by the insights provided by qualitative interviews to unions representative that report a low level of debate on green issues. For the reasons above the second research questions is:

H2 *Is a high level of involvement of union representatives on green innovation strategy related to the adoption of EIs?*

In answering this question we are able to verify the association between the degree of unions involvement and the adoption of EIs of different types. We are able to verify if the lack of discussion and involvement, as reported by the unions experts, is an obstacle to the EIs adoption.

## 5 Quantitative evidence

### 5.1 Data and empirical strategy

In order to test our research hypotheses, we base the analysis on micro level data coming from a unique dataset concerning a sample of 555 Italian

manufacturing firms with at least 20 employees located in Emilia-Romagna region, NUTS 2 level of analysis, which counts the 4th regional GDP in Italy and creates the 3rd regional industrial value added, counting around the 7% of the Italian population. The information collected refer to the pre-crisis period (2006-2008). The random sample is stratified by size, geographic location (province level, NUTS 3) and sector. It is well representative of the population, showing only minor distortions (see Tab. B2).

The multidimensional type of questionnaire that investigates several dimensions of the firm innovation activity, including the environmental one, and provide information on the unions involvement in the decision making process on six dimensions of the innovation activity (see Tab. 1) is well suited to support the analysis according to our main research question. As we can see the presence of union representatives at firm level implies some form of involvement in the decision process: a large minority of firms do not involve unions at all (No involvement). At the same time only a small fraction of firms, even smaller than that of non-involving firms, bargains with unions during the decision process regarding changes over one of the six innovation dimensions. The large majority of firms inform the union representatives about changes they plan to introduce and a non negligible fraction of firms consult the unions.

Firms seem to be aware of the importance of good quality industrial relations as tool that can facilitate and smooth the adoption of innovations.

Moreover, as Tab. 2 shows the unionised firms are those more inclined to introduce some kind of EIs, which we distinguish in four types: EIs introduced in order to reduce the consumption of energy (ENERGY), to reduce the emissions of CO<sub>2</sub> (CO<sub>2</sub>), to reduce the emissions of other air, soil and water polluters (EMISSION) and to change the process and obtain green certificates (EMASISO). A general variable is also used to capture whether a firm introduced at least one of the EIs mentioned above (see Tab. 3).

As far as the explicative variables of the decision to introduce EIs are concerned we use information that refer to technology push, demand pull and regulatory determinants of EIs. These types of determinants are crucial for EIs as for other innovations, so they are relevant variables to be included in our analysis, but here they serve as background relevant factor, while

Table 1: Unions involvement in the decision process on six innovation dimensions (402 obs.)

Innovation dimension	Degree of involvement	Freq.	%
Organisational Innovations	No involvement	50	12.44
	Information	229	56.97
	Consultation	83	20.65
	Bargaining	40	9.95
Training	No involvement	56	13.93
	Information	219	54.48
	Consultation	96	23.88
	Bargaining	31	7.71
Technological Innovation	No involvement	61	15.17
	Information	237	58.96
	Consultation	77	19.15
	Bargaining	27	6.72
ICT implementation	No involvement	82	20.4
	Information	220	54.73
	Consultation	73	18.16
	Bargaining	27	6.72
Environmental Innovation	No involvement	74	18.41
	Information	224	55.72
	Consultation	77	19.15
	Bargaining	27	6.72
Intenationalisation Strategies	No involvement	96	23.88
	Information	211	52.49
	Consultation	70	17.41
	Bargaining	25	6.22

the main focus is on the role of unionisation and of the industrial relations climate, which are elements that add upon the main determinants of EIs

Table 2: Distribution of EIs between unionised and non-unionised firms

	Union presence at firm level		
	No	Yes	Total
	%	%	%
<b>ECOINNO</b>			
No	83.7	78.6	80.0
Yes	16.3	21.4	20.0
Total	100.0	100.0	100.0
<b>ENERGY</b>			
No	90.2	83.3	85.2
Yes	9.8	16.7	14.8
Total	100.0	100.0	100.0
<b>CO2</b>			
No	92.2	87.1	88.5
Yes	7.8	12.9	11.5
Total	100.0	100.0	100.0
<b>EMISSIONS</b>			
No	89.5	84.6	85.9
Yes	10.5	15.4	14.1
Total	100.0	100.0	100.0
<b>EMASISO</b>			
No	92.8	82.8	85.6
Yes	7.2	17.2	14.4
Total	100.0	100.0	100.0

as they are also relevant for the introduction of other innovations. Tab. 4 reports the description of the explicative variables used in the analysis.



Table 3: EIs variables

Variable	Construction
<i>EIs</i>	
Environmental innovation ( <b>ECOINNO</b> )	Dummy variable: 1 if the firm introduced an environmental innovation; 0 otherwise
Energy/Material reduction per unit of product ( <b>ENERGY</b> )	Dummy variable: 1 if innovations addressed to reduce use of materials and/or energy by output unit (included recycling) have been adopted; 0 otherwise
CO2 reduction ( <b>CO2</b> )	Dummy variable: 1 if innovations addressed to reduce CO2 emissions have been adopted; 0 otherwise
Emissions reduction for soil, water and air ( <b>EMISSIONS</b> )	Dummy variable: 1 if innovations addressed to reduce emissions for soil, water and air have been adopted; 0 otherwise
Adoption of procedures like EMAS and ISO14001 ( <b>EMASISO</b> )	Dummy variable: 1 if procedures that structurally identify environmental performance have been adopted; 0 otherwise

Table 4: Covariates

Variable	Construction
<b>Controls</b>	
Size dummies	Size dummies by employee: size_1 20-49 empl.; size_2 50-99 empl.; size_3 100-249 empl.; size_4 $\geq 250$ empl.
Sector dummies	Sector dummies based on two digit NaceRev.1 classification (Food, Machinery, NonMetallicMineralProd, CokeChemical, WoodRubberPlasticOther, Textile, Shoes, PaperPrinting, Metallurgy). Sectors were grouped according to the RAMEA grouping.
EI.Share_Munic	Share of eco-innovating firms geographically clustered in the same municipality
CO2_VA_PROV	CO2 emissions/Value Added by Province
Export	Percentage of turnover made on international markets
FDLBRIC	Dummy: 1 if firm invested in BRIC countries; 0 otherwise
<b>INNO</b>	
ICT	Composite index capturing the presence of complex ICT adopted within the firm
TrainCov	Percentage of permanent workers covered by training programmes
OrgInno	Composite organisational index capturing changes both in labour organisation and in production organisation
TechInno	Composite index capturing technological innovation activities both on the input side and on the output side
<b>PASTPERF</b>	
VAEMP0305	Average value added per capita (in log) on the period 2003-2005

The first step of the analysis is to estimate the following 'eco-innovation function' for unionised and non-unionised firms:

$$Prob(Y = 1|\mathbf{x}) = \Phi(\mathbf{x}'\beta)$$

where:  $\mathbf{x}$  includes the Controls, INNO variables and a dummy variable capturing the presence of unions at firm level (Union\_d);  $\Phi$  is the standard normal distribution

The second step of the analysis is to estimate the following 'eco-innovation function' for unionised firms, accounting for the industrial relations climate:

$$Prob(Y = 1|\mathbf{z}) = \Phi(\mathbf{z}'\beta)$$

where:  $\mathbf{z}$  includes the Controls, INNO variables and the firm past performance and industrial relations variables, which capture, at first, the union representatives involvement on all the different strategic spheres listed (organisation, technology, ICT, training, EIs, internationalization) with a single index (UNIONINV) and, secondly, through specific involvement dummies for the EIs(UnionInfoEI, UnionConsEI, UnionBargEI) that capture the presence of information, consultation or bargaining on the strategic decision to implement EIs;  $\Phi$  is the standard normal distribution

## 6 Results

As we can see in Tab.5, from a very preliminary analysis, it is possible to note that unionisation does not influence *per se* the probability to eco-innovate as specifications (1) and (2) evidence. On the contrary, when we analyse the linkage of industrial relations with EI we notice that specific types of involvement matter. Information and bargaining are related to EI, irrespectively of the type of eco-innovation. Looking at the specific types of EI Tab.6-9 we see that the same positive significance of the industrial relations variables capturing information and bargaining are found for two specific types of EIs: innovation to reduce CO2 emissions and organisational change to meet eco standards. It seems that an 'U' shaped relation between union involvement and EI emerges: a managerial driven way of introducing EI (when unions are only informed about the managerial intents) and an

industrial relations driven way (when EIs are introduced through a process of bargaining between unions and management) provide a positive influence on the probability to adopt EI.

Table 5: Probit results with ECOINNO as dependent variable

	(1)	(2)	(3)	(4)	(5)
Large	0.009 (0.039)	0.013 (0.039)	0.003 (0.041)	-0.004 (0.041)	-0.002 (0.040)
Ets	0.043 (0.027)	0.042 (0.027)	0.010 (0.033)	0.005 (0.033)	-0.014 (0.033)
BOMOREPR	-0.024 (0.028)	-0.024 (0.028)	-0.043 (0.032)	-0.042 (0.032)	-0.038 (0.032)
VAEMP0305nomiss	0.129*** (0.048)	0.133*** (0.048)	0.164*** (0.058)	0.163*** (0.057)	0.160*** (0.057)
share_ecoinno_comune	0.707*** (0.061)	0.711*** (0.061)	0.774*** (0.074)	0.780*** (0.074)	0.774*** (0.074)
export	0.046 (0.042)	0.049 (0.042)	0.086* (0.049)	0.087* (0.049)	0.075 (0.048)
FDLBRIC	0.022 (0.039)	0.023 (0.039)	0.013 (0.042)	0.015 (0.042)	0.005 (0.041)
OrgProd	0.151*** (0.043)	0.150*** (0.043)	0.141*** (0.051)	0.136*** (0.051)	0.143*** (0.049)
OrgLab	0.036 (0.071)	0.040 (0.071)	0.079 (0.079)	0.071 (0.080)	0.063 (0.077)
coverage_indet	0.128*** (0.036)	0.127*** (0.035)	0.112*** (0.042)	0.112*** (0.042)	0.123*** (0.042)
In_RD	-0.021 (0.034)	-0.020 (0.034)	-0.056 (0.040)	-0.057 (0.040)	-0.057 (0.041)
Ex_RD	0.000 (0.027)	0.000 (0.027)	0.022 (0.032)	0.021 (0.032)	0.019 (0.032)
TechInvest	0.069 (0.046)	0.069 (0.045)	0.121** (0.059)	0.123** (0.058)	0.109* (0.060)
union_d		-0.016 (0.030)			
UnionInv				0.049 (0.057)	
UnionInfoEI					0.108** (0.048)
UnionConsEI					0.052 (0.058)
UnionBargEI					0.122* (0.065)
<i>N</i>	555	555	402	402	402

Marginal effects; Standard errors in parentheses  
(d) for discrete change of dummy variable from 0 to 1

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 6: Probit results with ENERGY as dependent variable

	(1)	(2)	(3)	(4)	(5)
Large	0.005 (0.035)	0.001 (0.035)	-0.000 (0.039)	0.004 (0.040)	0.004 (0.038)
Ets	0.070*** (0.025)	0.071*** (0.025)	0.078*** (0.029)	0.081*** (0.029)	0.064** (0.028)
BOMOREPR	-0.004 (0.026)	-0.004 (0.026)	-0.008 (0.032)	-0.009 (0.032)	-0.009 (0.032)
VAEMP0305nomiss	0.100** (0.048)	0.097** (0.048)	0.119* (0.061)	0.118* (0.061)	0.116* (0.059)
share_ecoinno_comune	0.442*** (0.043)	0.439*** (0.043)	0.504*** (0.055)	0.503*** (0.055)	0.499*** (0.053)
export	0.061 (0.040)	0.059 (0.040)	0.063 (0.047)	0.063 (0.047)	0.049 (0.047)
FDLBRIC	0.022 (0.036)	0.021 (0.036)	0.043 (0.038)	0.042 (0.038)	0.030 (0.036)
OrgProd	0.137*** (0.041)	0.139*** (0.041)	0.108** (0.048)	0.111** (0.049)	0.117** (0.047)
OrgLab	0.052 (0.073)	0.048 (0.073)	0.075 (0.081)	0.078 (0.082)	0.072 (0.081)
coverage_indet	0.099*** (0.031)	0.101*** (0.031)	0.121*** (0.038)	0.121*** (0.038)	0.128*** (0.038)
In_RD	0.069* (0.040)	0.069* (0.040)	0.057 (0.052)	0.056 (0.051)	0.074 (0.054)
Ex_RD	0.034 (0.024)	0.034 (0.024)	0.054* (0.029)	0.055* (0.029)	0.052* (0.029)
TechInvest	0.055 (0.047)	0.055 (0.047)	0.043 (0.055)	0.042 (0.055)	0.041 (0.054)
union_d		0.021 (0.029)			
UnionInv				-0.026 (0.059)	
UnionInfoEI					0.082* (0.043)
UnionConsEI					0.003 (0.059)
UnionBargEI					0.070 (0.062)
<i>N</i>	555	555	402	402	402

Marginal effects; Standard errors in parentheses  
(d) for discrete change of dummy variable from 0 to 1

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 7: Probit results with CO2 as dependent variable

	(1)	(2)	(3)	(4)	(5)
Large	0.002 (0.034)	-0.001 (0.034)	0.003 (0.037)	-0.007 (0.037)	-0.006 (0.035)
Ets	0.035 (0.025)	0.035 (0.025)	0.021 (0.030)	0.016 (0.030)	0.002 (0.029)
BOMOREPR	0.033 (0.027)	0.033 (0.027)	0.041 (0.033)	0.044 (0.033)	0.048 (0.033)
VAEMP0305nomiss	0.134*** (0.045)	0.131*** (0.045)	0.164*** (0.056)	0.165*** (0.055)	0.162*** (0.054)
share_ecoinno_comune	0.305*** (0.041)	0.303*** (0.040)	0.365*** (0.047)	0.370*** (0.048)	0.368*** (0.046)
export	0.036 (0.039)	0.034 (0.039)	0.044 (0.046)	0.047 (0.045)	0.040 (0.044)
FDLBRIC	-0.061 (0.043)	-0.061 (0.042)	-0.048 (0.044)	-0.043 (0.044)	-0.056 (0.041)
OrgProd	0.148*** (0.042)	0.149*** (0.041)	0.110** (0.048)	0.103** (0.048)	0.112** (0.047)
OrgLab	-0.001 (0.075)	-0.005 (0.075)	-0.004 (0.083)	-0.011 (0.085)	-0.022 (0.083)
coverage_indet	0.075** (0.030)	0.077** (0.030)	0.099*** (0.036)	0.098*** (0.037)	0.102*** (0.036)
In_RD	0.034 (0.032)	0.034 (0.032)	0.002 (0.039)	0.002 (0.039)	0.013 (0.041)
Ex_RD	0.039 (0.024)	0.039 (0.024)	0.078*** (0.028)	0.075*** (0.027)	0.075*** (0.027)
TechInvest	0.033 (0.041)	0.033 (0.041)	0.016 (0.047)	0.018 (0.047)	0.012 (0.047)
union_d		0.015 (0.028)			
UnionInv				0.063 (0.051)	
UnionInfoEI					0.147*** (0.056)
UnionConsEI					0.107* (0.063)
UnionBargEI					0.171** (0.068)
<i>N</i>	555	555	402	402	402

Marginal effects; Standard errors in parentheses  
(d) for discrete change of dummy variable from 0 to 1

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 8: Probit results with EMISSIONS as dependent variable

	(1)	(2)	(3)	(4)	(5)
Large	0.023 (0.036)	0.022 (0.036)	0.017 (0.037)	0.007 (0.037)	0.008 (0.037)
Ets	0.034 (0.027)	0.034 (0.027)	0.005 (0.033)	-0.001 (0.033)	-0.006 (0.033)
BOMOREPR	0.009 (0.029)	0.008 (0.029)	0.006 (0.034)	0.009 (0.034)	0.011 (0.033)
VAEMP0305nomiss	0.084* (0.049)	0.083* (0.049)	0.102* (0.058)	0.102* (0.057)	0.101* (0.058)
share_ecoinno_comune	0.387*** (0.045)	0.387*** (0.046)	0.461*** (0.051)	0.465*** (0.052)	0.461*** (0.052)
export	0.042 (0.042)	0.041 (0.042)	0.068 (0.049)	0.068 (0.048)	0.067 (0.048)
FDLBRIC	-0.030 (0.043)	-0.030 (0.043)	-0.018 (0.041)	-0.014 (0.041)	-0.019 (0.041)
OrgProd	0.106** (0.043)	0.106** (0.043)	0.086* (0.051)	0.079 (0.051)	0.082 (0.051)
OrgLab	0.032 (0.077)	0.031 (0.077)	0.057 (0.086)	0.048 (0.087)	0.044 (0.086)
coverage_indet	0.094*** (0.035)	0.095*** (0.035)	0.105*** (0.040)	0.105*** (0.040)	0.110*** (0.040)
In_RD	0.017 (0.037)	0.017 (0.037)	0.025 (0.052)	0.024 (0.052)	0.024 (0.054)
Ex_RD	0.007 (0.027)	0.007 (0.027)	0.049 (0.031)	0.047 (0.030)	0.048 (0.030)
TechInvest	0.029 (0.043)	0.028 (0.043)	0.066 (0.060)	0.067 (0.059)	0.061 (0.060)
union_d		0.006 (0.031)			
UnionInv				0.068 (0.055)	
UnionInfoEI					0.066 (0.047)
UnionConsEI					0.067 (0.051)
UnionBargEI					0.099 (0.063)
<i>N</i>	555	555	402	402	402

Marginal effects; Standard errors in parentheses  
(d) for discrete change of dummy variable from 0 to 1

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$



Table 9: Probit results with EMASISO as dependent variable

	(1)	(2)	(3)	(4)	(5)
Large	0.063*	0.054	0.046	0.039	0.043
	(0.035)	(0.035)	(0.041)	(0.041)	(0.039)
Ets	0.007	0.009	-0.010	-0.015	-0.028
	(0.027)	(0.027)	(0.035)	(0.035)	(0.035)
BOMOREPR	0.004	0.004	-0.009	-0.007	-0.005
	(0.029)	(0.028)	(0.036)	(0.036)	(0.036)
VAEMP0305nomiss	0.130***	0.122***	0.153**	0.151**	0.149**
	(0.046)	(0.046)	(0.062)	(0.061)	(0.061)
share_ecoinno_comune	0.440***	0.430***	0.473***	0.476***	0.471***
	(0.049)	(0.048)	(0.060)	(0.061)	(0.059)
export	0.052	0.047	0.066	0.066	0.057
	(0.040)	(0.041)	(0.051)	(0.051)	(0.051)
FDLBRIC	-0.040	-0.040	-0.050	-0.046	-0.054
	(0.039)	(0.039)	(0.046)	(0.045)	(0.044)
OrgProd	0.069*	0.070*	0.093*	0.087*	0.093*
	(0.040)	(0.040)	(0.051)	(0.051)	(0.050)
OrgLab	0.091	0.083	0.106	0.098	0.090
	(0.066)	(0.066)	(0.085)	(0.086)	(0.084)
coverage_indet	0.071**	0.075**	0.086**	0.085**	0.096**
	(0.032)	(0.032)	(0.041)	(0.041)	(0.041)
In_RD	-0.026	-0.029	-0.039	-0.040	-0.036
	(0.032)	(0.032)	(0.044)	(0.044)	(0.046)
Ex_RD	0.012	0.012	0.029	0.027	0.025
	(0.026)	(0.025)	(0.032)	(0.032)	(0.032)
TechInvest	0.043	0.040	0.107*	0.108*	0.098
	(0.042)	(0.042)	(0.061)	(0.061)	(0.062)
union_d		0.050*			
		(0.030)			
UnionInv				0.056	
				(0.058)	
UnionInfoEI					0.095**
					(0.048)
UnionConsEI					0.038
					(0.059)
UnionBargEI					0.113*
					(0.066)
<i>N</i>	555	555	402	402	402

Marginal effects; Standard errors in parentheses

(d) for discrete change of dummy variable from 0 to 1

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## 7 Conclusions

We have analysed the role of unionisation and industrial relations on the propensity to eco-innovate of a representative sample of manufacturing firms located in a highly unionised and industrialised region of the northern-east of Italy: Emilia-Romagna. Unionisation does not seem to play a role *per se* as EIs 'determinants': firms with union representatives do not have higher propensity to innovate in the eco-realm. The first hypothesis (H1) does not seem to be supported nor in a sense, a negative relation between unionisation and EIs, neither in the other one, a positive relation of unionisation, possibly mediated by participative industrial relations.

The latter are related to EIs, when we test their role for the unionised firms: in particular, the strongest relations emerge with the adoption of CO2 reduction emissions technologies and with EMAS and ISO adoption. A 'U shaped' relation emerges: simply informing unions (managerial drive way of adopting EIs) or bargaining with them on innovation strategic decision (industrial relations drive way of introducing EIs) positively relate with EIs adoption probability, while consulting them does not relate with EIs. H2 is then supported, although EIs does not seem to be exclusively industrial relations driven, but also managerial driven.

The role of social dialogue at firm level does emerge as an important driver of EIs and it should be taken into account both by policy makers and by relevant stakeholders.

## 8 Appendix A

Selected questions to show the information collected for EI and UNION variables. The answers refer to the period 2006-2008.

### ENVIRONMENTAL INNOVATION (EI)

Q1: Did the firms adopt environmental products and/or process technological innovations that induced the following benefits?

	Yes/No
1. Reduction in the use of materials and/or energy by output unit (including recycling)	
2. CO2 emissions reduction	
3. Emission reductions that improve the quality of soil, water and air	

ENERGY=1 if Reduction in the use of materials and/or energy by output unit (included recycling) marked as Yes; 0 otherwise

CO2=1 if CO2 emissions reduction marked as Yes; 0 otherwise

EMISSIONS=1 if Emission reductions that improve the quality of soil, water and air; 0 otherwise

Q2: Has the firm procedures that structurally identify its environmental performance?

Procedure	Yes/No
1. EMAS	
2. ISO 14001	
3. Others such as LCA, ISO14040, .....(specify)	

EMASISO=1 if EMAS or ISO14001 or Others is marked as Yes; 0 otherwise

### UNIONISATION AND INDUSTRIAL RELATIONS

Q3: Do you have union representatives at firm level:  Yes  No Q4: Were the union representatives involved on the following indicated issues?

Issues	Not involved	Informed	Consulted	Bargained with
1. Organisational Innovations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Training	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Technological Innovation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. ICT implementation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Environmental Innovation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Internationalisation Strategies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## 9 Appendix B

Table B1: Interviewed Union Representatives

	Role	Confederation
<b>EU Level</b>		
Interview 1	Policy advisor	ETUC
Interview 2	Policy advisor	industryAll
<b>Italian Level</b>		
Interview 3	In charge of Environment and territory Department	CGIL National
Interview 4	In charge of Environment and territory Department	CGIL National
Interview 5	In charge of Energy Department	CGIL National
Interview 6	In charge of Environment Health and Security Department	CISL National
Interview 7	Former General Secretary of FIOM and researcher on labour issues is now member of many Italian and International scientific committees and editorial boards	IRES-CGIL, Emilia-Romagna, Italy
Interview 8	Union organiser	FIOM-CGIL, Emilia-Romagna, Italy
<b>Firm Level</b>		
Union representatives of Lovato Electric, Dalmine and Zanardi	Firm level union representatives	CGIL, Lombardia, Italy

Table B2: Distribution by sector, size and geographical location of population and sample firms

<b>Population</b>								
<i>Sectors</i>	Freq.	Percent	<i>Size</i>	Freq.	Percent	<i>Province</i>	Freq.	Percent
CokeChemical	130	3.2	20-49	2720	66,86	Out region	91	2.24
Food	382	9.39	50-99	726	17,85	BO	904	22.22
Machinery	1,387	34.1	100-249	414	10,18	FC	346	8.51
Metallurgy	883	21.71	250+	208	5,11	FE	196	4.82
NonMetallic	285	7.01				MO	891	21.9
PaperPrinting	197	4.84				PC	200	4.92
Shoes	236	5.8				PR	381	9.37
Textile	119	2.93				RA	229	5.63
WoodRubberPlasticOther	449	11.04				RE	667	16.4
						RN	163	4.01
Total	4,068	100		4,068	100		4,068	100
<b>Sample</b>								
<i>Sectors</i>	Freq.	Percent	<i>Size</i>	Freq.	Percent	<i>Province</i>	Freq.	Percent
CokeChemical	28	5.05	20-49	208	37,48	Out region	20	3.6
Food	49	8.83	50-99	193	34,77	BO	115	20.72
Machinery	232	41.8	100-249	96	17,30	FC	40	7.21
Metallurgy	94	16.94	250+	58	10,45	FE	30	5.41
NonMetallic	42	7.57				MO	124	22.34
PaperPrinting	19	3.42				PC	25	4.5
Shoes	12	2.16				PR	49	8.83
Textile	23	4.14				RA	32	5.77
WoodRubberPlasticOther	56	10.09				RE	96	17.3
						RN	24	4.32
Total	555	100		555	100		555	100

Table B3: Unionisation by size and sectors

Size	Union		
	0	1	Total
0: 20-49	101	102	203
1: 50-99	40	137	177
2: 100-249	11	95	106
3: $\geq 250$	1	68	69
Total	153	402	555

  

Sectors	0	1	Total
Food	8	41	49
Textile	11	12	23
Shoes	2	10	12
WoodRubberPlasticOther	13	43	56
PaperPrinting	7	12	19
CokeChemical	6	22	28
NonMetallic	6	36	42
Metallurgy	33	61	94
Machinery	67	165	232
Total	153	402	555

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