THE CO-DESIGN OF CONTRACTUAL AND EXTRA-CONTRACTUAL GOVERNANCE: LESSONS FROM THE PROJECT-BASED ECONOMY

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ABSTRACT

Organizational economics tends to express a pessimistic view on the effectiveness of inter-firm contracts under uncertainty, and sees the use of authority and of relational governance as possible remedies. Organization theory inspires some skepticism on the effectiveness of these therapies. In particular, it identifies also reasons to expect a sustained level of formalization in strategic alliances and, conversely, to expect a moderate use of centralization. To help filling this gap, this study empirically assesses the relationship between uncertainty and complexity in the context of strategic alliances, and the use of formalization and centralization for their governance. The assessment extends to the intensity of use and the relationships of three modes of governance: contractual, formal extra-contractual, and informal and social. This exercise is carried out on a new database that collects information on 540 project-based alliances. We find that inter-organizational projects employ a mix of contractual and extra-contractual governance mechanisms. Different from usual conceptualization, these agreements are not characterized by high informality. Extra contractual governance seems to be employed to respond to additional factors, rather than to substitute or complement formal agreements. Finally, the pattern of allocation of property rights also interestingly deviates from standard property right theory predictions, to conform to a more pluralist, negotiation based view.

1. Organizational and economic views of contracts

Organizational economics has studied the role of contracts in inter-firm relationships extensively, examining issues connected to the opportunism and self-interest of the parties involved in the relationship, and usually considering contract incompleteness as a problem (e.g. Brousseau and Glachant 2002). Recent economic research on inter-firm contracts has come closer to organizational views by endogeneizing the degree of completeness and articulation of contracts; the typical propositions having been that the higher the uncertainty, the lower the optimal degree of completeness, articulation and formalization (Bernheim and Whinston 1998; Crocker and Reynolds 1993) and that the higher the competitiveness of the game, the higher the optimal level of formalization and of specification of contingent payoffs (Klein 2000). These propositions lead to the conclusion that, contractual governance tends to 'fail' altogether under the simultaneous presence of uncertainty (hence of contract incompleteness) and conflict of interests; and tend to be replaced by the 'command' of one party, based on property rights holding of that party (Williamson 1975, 1985; Grossman and Hart 1986). A possible alternative remedy has been typically identified in the complementary or alternative use of 'relational contracting' (Williamson 1979; Macneil 1978; Al Najjar1985; Baker et al 2002; Poppo and Zenger 2002) 'Relational contracting' refers mostly to the completion of incomplete contingent claim contracting through extra-contractual mechanisms, typically conceived as informal, ranging from reciprocity and serial equity, to socialization to industry norm to cultural objective alignment .

An extension and refinement of these propositions is warranted as it is doubtful that 'informal and social governance' - either based on calculative, 'incentive-based' cooperation or non-calculative 'rule-based' cooperation – can tell the entire story of governance in highly uncertain and innovative activities. In fact, both clear incentives and clear norms and rules are difficult to define in highly uncertain and relatively unique ventures, where relevant actions and their payoffs are not known ex-ante; and even less is known what appropriate behaviors are (Grandori 2006). Second, a concentration of property and decision rights is also an unsatisfactory response if relevant knowledge at the start is distributed and new knowledge should be generated for conducting a project or activity (Demsetz 1999; Grandori, forthcoming).

This paper refines and extends these ideas, also by means of connecting them to organization theory definitions and propositions on formalization (use of written, interpersonally controllable documents, either of an enforceable or unenforceable kind).

In organization studies as well as in organizational economics uncertainty is considered a major source of failure of formalization (Burns and Stalker 1961; Lawrence and Lorsch 1967). However, this proposition typically refers to aleatory, environmental variability. Other components of uncertainty, namely all components deriving from 'complexity' (system size, differentiation and interdependence of components, number of elements to be taken into account and memorized) are known to have a positive relationship with formalization and hierarchization (Simon 1969). In addition, setting-up a transparent, legitimate, rational-legal, organizational justice system is a classic function of formal organization in organization theory (Weber 1922; Blau and Scott 1962) (a much wider notion than simple safeguarding against opportunisms). This general function explain why informal systems are also often unduly centralized (Pugh et al 1969), as high informality opens the doors to the regulation of activities by power and force relationship. Organizational economics is also beginning to acknowledge a role for fairness as a predictor of contractual arrangements (Lafontaine and Masten 2002). Cooperations that are explicitly set up among a few identifiable, empowered parties – as in strategic alliances – a sustained level of formalization is therefore to be expected.

As to centralization, the information processing-based organization theory we are referring to, would predict that system complexity should be positively related to the formation of hierarchy for coordination reasons (Simon 1969; Galbraith 1974) and that task uncertainty is negatively related to centralization because it typically connects to distributed knowledge resources (Grandori 2007).

In sum countervailing forces are likely to act on the optimal level of formalization and centralization of governance in uncertain, multi-party (hence multiple interests) alliances.

The study presented here empirically assesses the relationship between these variables and the intensity of use of three modes of governance: contractual governance, formal extra-contractual governance, and informal and social governance. In doing so it also enquires on the relations of complementarity, substitutability and supplementarity among them.

The study is guided by some conjectures on possible mixes of the three modes, exploiting the possibility of differential use of them on different matters, rather than by the idea of assessing which mode is better under

which circumstances, or even on the general intensity of each aggregate mode. In fact, Grandori (2001, 2005) hypothesized, and recent case study research corroborates (Grandori and Furlotti 2006) that 'flexible formalization' is achievable by formalizing procedural and constitutional matters rather than tasks and contingencies in the face of uncertainty. In particular, contractual formalization that establishes a 'society' rather than regulating an exchange can provide incentives to invest and at the same time allow adaptation, by specifying the identity of partners and the fundamental obligations and rights as to resource commitment, outcomes appropriation and the termination of the relationship; and the fundamental rules and procedures for taking decisions. An association of resources and a constitution specifying decision procedures should avoid the rigidity and costs (or even the impossibility) of writing articulated contracts on all possible actions and contingencies, while locking in resources, that are essential to the achievement of the objectives of the collaboration.

In this perspective, the major way for achieving flexibility is not to shift from contractual to extra-contractual or informal governance, but to shift from the specification of actions and contingencies (tasks) to the specification of residual rewards and decision rights over actions. Hence, we do not expect tasks to be highly specified in any governance mode in highly uncertain projects.

The specific allocation of association rights and obligations (typically investment commitments and property rights, and separation rights), and the content of the constitutional rules may and should vary. On that ground too we are going to propose empirical evidence and theoretical arguments that contradict one tenet that has been prevailing in property rights theory, namely that property right sharing is never efficient (Hart 1995; Hansman 1996). The reason for concentration given in that perspective apparently hinges on the cost of the decision process (property right sharing would raise decision and negotiation costs). In turn, this is supposed to lower the incentives to invest on the part of critical resource holders. Without denying the possible relevance of decision process costs, they have to be traded off with important advantages of assigning property rights in proportion to the investments of both financial and human capital, rather than to the party that 'value them most'. Those advantages include: to provide incentives to co-invest to all partners (Gibbons 2004), also in the form of fair payoff division procedures – as proportionality to investments (Raiffa 1982), and to reach better decisions by allocating decision rights to the parties that are more competent, to the advantage of those investing critical financial and technical assets too (Demsetz 1999).

2. Data and measures

The evidence presented here is drawn from a large data-base (540 questionnaires) on the governance of inter-firm projects in a variety of industry and nations (the KGP project).[1] Questionnaire on inter-firm project-

[1] KGP is the international research project 'Knowledge , Governance and Projects: Configurations and Dynamics of the Project-based Economy' (2004-2007) coordinated by Anna Grandori, Crora-Bocconi University; partners: Patrick Cohendet (University of Strasbourg and Montreal), Mark Ebers (University of Colone), Gernot Grabher (University of Bonn), Peter Maskell (Copenhagen Business School), Andrea Prencipe (SPRU - University of Sussex and Università of Pescara); and funded by the Italian Ministry for Education, University and Research (MIUR) and by the collaborating universities. The KGP was extended to two new scientific partners: the U. of Tilburg (Leon Oerlemans) and the U. of Bologna (A. Lipparini).

based alliance contracts provide data on which matters are regulated contractually and extra-contractually in inter-firm projects. Each questionnaire describes one project that was 'successful' in the sense of having been completed and having produced an outcome of value.

2.1. The sample

Tables 1 and 2 provide a description of the sample in terms of industries, location and response rate. The industries in which to carry out the research ('high tech', 'creative', and 'engineering'; henceforth, respectively, 'HT', 'C' and 'E') were chosen because they are characterized by projects that are significantly different in terms of uncertainty and complexity. Each industry was targeted in at least two countries in order to control for institutional settings.

Interviewees were asked to select a project completed within the last three years, which involved different legal entities as partners, in which they or their organization was a key partner and which was successful, in the sense of having been economically viable and having produced a valuable output.

As projects were accessed through any of their main partners, the criteria used to construct the listings of firms were not likely to influence the representativeness of the sample. For this reason, we used convenience sampling and firms were selected using either national statistical offices or industry listings. Up to three projects could be accessed through the same firm. Firms contacted were those operating in each country, independently of the location of their headquarters.

As project level data is typically not available in national or industry statistics and reports, the population of projects is unknown. Indirect data on the population was gathered by recording the reason for refusal to respond.

The interviewing process required the interviewers to identify a suitable respondent. As the persons who have the best overview of projects have different job titles in different industries, specific roles were targeted in specific industries (e.g., account managers in advertisement, CEO/owner in small high-tech firms, project managers in engineering and engineering design firms). However, this targeting was used as an initial guide only. A cursory overview of the role of respondents in their organization and in the project shows that almost all respondents held at least managerial responsibilities.

Candidate interviewees were contacted by phone. Once they agreed to take part in the survey, the interview protocol required the interviewer to help the interviewee to select the project and two key project partners. A questionnaire with these data already filled in was to be mailed or e-mailed the interviewee, and returned by the same means. Researchers were available to provide clarifications if needed. In practice, the protocol differed between samples.[2]

[2] In Denmark, interviewers were able to complete the data collection on the telephone, without sending the questionnaire by e-mail or mail. I in Italy, it was not possible to begin to fill in the questionnaire over the phone. Highlights of the instructions section about how to choose the project and the partners were repeated in the accompanying e-mail.

It was agreed that, when possible, information about age, ownership, sales, number of employees, and percentage of export in sales of the respondent firms should be gathered. In addition, information on the NACE code corresponding to the project's activity should be gathered. Different samples differ significantly in the extent to which this information could be obtained.

Each section introduces the variables it analyzes. Table 3 explains how the variables of interest to this study have been operationalized.

3. Statistical analyses

3.1. General incidence of governance modes

Our first analysis investigates the degree of specification of governance mechanisms in formal enforceable documents (contractual governance), in non-enforceable internal documents (extra-contractual governance) and through the norms, habits and practices of the industry or ad hoc specific informal agreements among the parties (institutional and social governance). An exploratory factor analysis indicates that items within each mode of specification are quite highly correlated, and that each mode identifies a governance dimension of its own. Correlation coefficients and descriptive statistics are illustrated in Table 4.

Rather than on the intensity of specification within each mode, we focus on the specification *across* modes. Our initial, qualitative considerations are inspired by Figure 1, which summarizes the descriptive statistics graphically. First of all, it is apparent from the figure that for each mechanism of governance contractual specification is higher than the two alternative ways of extra-contractual specification; and that formalization in non contractual documents is more intensively employed that informal and social governance. For several items, contractual specification is in the neighborhood of values representing "Extensive specification of rights and obligations under conceivable specified conditions". The pattern supports the general conjecture that formal contractual governance is indeed possible and used in complex and uncertain activities.

Our second observation is that the ranking of items by their degree of *extra contractual* specification does *not* parallel their ranking in contractual specification. This suggests that there is no clear indication of a *complementarity* relationship between the two ways of formalizing governance mechanisms. At the same time, we notice that the ranking of items by their degree of extra contractual specification is *not the reverse* of their ranking in contractual specification, which suggests that there is no clear indication either of a substitution relationship between the two ways of formalizing governance mechanisms.

The previous two comments apply also to the relationship between contractual specification, and institutional and social specification. In sum, the type of relationship between the three modes of specification must be assessed at the level of the individual mechanism.

We make such assessment with the help of Table 5, which shows the results of paired sample tests of the difference of means between alternative formalizations of the same governance mechanism. As was already evident from Figure 1, all the differences are positive and, with two exceptions, they are statistically

significant. If large differences can be constructed as indicia of substitution relationship, and small differences of complementary relationship, we should tentatively propose that the extra contractual (formal and informal) specification of prices and of warranties and indemnities (expressions of substantive, transactional matters) is substitute with their contractual specification; while complementary between contractual and extra-contractual governance modes is visible in the case of decision and control rights (expressions of procedural constitutional matters).

The orders of the differences in Panels 1 and 2 of Table 5 (and the size of differences relating to the same mechanism) are roughly the same. It is implicit in the previous findings that the mechanisms of extra contractual and social governance stand among each other in a relationship which is the opposite of the one they have with contractual governance. This is exemplified rather strikingly by property rights.

The differences involving task specification are smallish, and not very large, in each of the three types of comparison. In absolute terms, the contractual specification of tasks has an intermediate level of 1.81. This confirms the hypothesis that on this subject, neither internal documents nor social governance can specify more effectively what cannot be done in contracts.

3.2. Uncertainty and complexity effects

We turn now to the potential predictors of the use of different governance mechanisms. As the focus shifts on the predictors, we temporarily summarize each mode of specification through a summated scale of its seven items. This simplification is warranted by the relative unidimensionality of each construct.[3] As shown in Table 6, the correlations between individual items that capture the uncertainty of the project (the last four of the table) and governance variables are rather small. Therefore, it is unlikely that even in more sophisticated modeling, any single item turns out to be an important predictor of governance aspects. Accordingly we focus on the sector as a potential composite measure of complexity and a predictor of governance. To investigate whether our conjecture is correct we carry out several analyses of variance using the project sector as an explanatory factor.

To take into account the potential problems of carrying out repeated ANOVA on the same sample (possible increase Type I errors; possible reduction in multivariate variance as a result of correlation between the dependent variables) we preliminarily analyze our sample with MANOVA. MANOVA should tell us whether the explanatory factor has explanatory power at all, in relation to the whole set of dependent variables that characterize the projects in terms of size, uncertainty and complexity. Yet, to interpret MANOVA's findings we still need follow-up univariate ANOVAs that focus on the effects of the independent variable (henceforth: IV) for each dependent variable (henceforth: DV). Finally, post-hoc comparisons, to detect which pairs of groups differ from one another, complete our investigations.

[3] Cronbach alpha for the first three items of Table 3 is, respectively, 0.81, 0.89 and 0.89.

A logarithmic transformation has been applied to some variables, to reduce skewness and to better meet the assumptions of multivariate normality required by MANOVA. Despite the transformations all variables still fail the Shapiro-Wilk test of normality. However, visual inspection and kurtosis values reveal that none of the variables is platykurtic. Therefore we can expect no serious reduction of the power of MANOVA.

Table 7 reports the results of our MANOVA and of subsequent analyses. A significant value of for all the four statistics employed (Panel A) tells us that a linear combination of the DVs do varies as a function of the project type.[4]

The results shown in Panel B indicate that with the exception of the differentiation of requisite competences, for all the DVs the means of each group are statistically different at the 0.01 level of significance: indeed different types of projects are characterized by systematic differences in task characteristics, size, duration and uncertainty. Next, we carry out pair-wise comparisons to investigate which pairs of groups differ from one another. The group representative of highest uncertainty is presumably HT projects. Therefore we are interested in the differences between this type of projects on one side, and E and C project on the other. The results of this investigation are displayed in Panel C.[5] One empirical regularity uncovered by this analysis is that HT and E projects differ systematically on a much larger number of characteristics than HT and C projects. As indicated by negative differences, HT project are smaller than E projects on all measures of size, and last for significantly shorter periods (E projects are more complex, also in terms of the number and differentiation of tasks). HT projects are also are associated with higher levels of uncertainty than E projects, at least when this is measured by the percentage of activities that required revision, by the percentage of innovative activities employed and by the percentage of activities of the whole project for which it was necessary to exchange knowledge. As to the comparison between HT and C projects, the former have larger budgets and require longer times to completion and to reveal whether the project was successful or not, and involve a larger percentage of innovative activities. However, they do not require a more intensive exchange of knowledge among the partners, nor they have a greater percentage of activities which it is necessary to revise during the course of the project.

The comparison between C and E projects does not tell a very different story from the comparison between the latter and HT ones. C projects are smaller, employ more innovative activities and require a greater exchange of knowledge among the parties. However, unlike HT projects, creative projects obtain indications of success significantly quicker than E ones.

In sum, E, C and HT projects can be considered as representative of increasing and qualitatively different levels of uncertainty. E projects can be considered as representative of situations of uncertainty largely due to 'computational complexity': very high number of components and connections to be regulated. HT and C projects are subject to stronger uncertainty, intended as problem solving and discovery intensity, as new knowledge has to be generated and exchanged for conducting them.

[4] The statistics employed were Wilk's Lambda, Hotelling's trace, Pillai' trace and Roy's gcr.

[5] These comparison applied Tamhane T2 statistics, a conservative pairwise comparisons test based on the t test, which does not assume that the populations have the same variance.

Having established that the industry sector is a meaningful composite measure of the complexity of the project, we investigate whether it also a useful predictor of its governance. Once more, the investigation is carried out by MANOVA and follow-up analyses. The dependent variables are the three groups of seven items of each governance specification mode.

Contractual formalization – With regards to this mode, the multivariate analysis indicates that a linear combination of these items differs significantly among project types (Table 8). Subsequent univariate analyses indicate that almost all items, except the specification of separation procedures, and the specification of monetary rewards, contribute to the difference. However, the post hoc comparison of group means reveals that three of these items differ significantly between HT and E projects, three again between C and E projects, and one between HT and C. In particular, in comparison with E projects, *HT (and C) projects specify less in detail the duration of the project and the tasks to be performed, but HT projects specify more clearly the assignments of property rights*. As to the comparison between HT and C projects, the only significant difference is that decision rights are more specified in the latter. Finally, C projects appear lighter than E ones in bureaucratic governance, as they specify less in detail warrantees and indemnities.

Extra-contractual formalization – Multivariate analysis shows that, as a whole, extra-contractual formalization differ across project types (Table 9). The pattern is analogous to that observed for contractual formalization. Most items are responsible for the observed difference, with the exception of the specification of decision rights and of separation procedures, on which informal governance plays a greater role in all cases. As to group comparison, post-hoc tests reveal a significant difference between HT and E projects for three items: duration, warranties and monetary terms. In all cases specification is lower in HT projects (which, therefore, are more open-ended and include less market-like mechanisms as well as less bureaucratic mechanisms). For most items C projects are approximately in the same relationships with E ones as HT projects. However, C projects specify tasks significantly less. Finally, HT and C projects differ in their formal extra-contractual specification of property rights and decision rights, as well as of tasks, with both of them being more specified in HT projects.

Informal governance – With regards to the extent to which various rights and duties are informally regulated by the norms, habits and practices of the industry or by ad hoc specific informal agreements among the parties, the general pattern is that the core matters of the analyzed agreements are regulated by self-enforceable informal agreements or by socially enforceable norms only to a limited extent. Given that, the systematic difference across projects types in this regard are also not very important and significant (Table 10).[6]

3.3. Assignments of property rights

[6] Just one item seems to be responsible for this difference: HT projects use informal definition of decision and control rights more than other projects

Our final set of analyses addresses the measures of the inequality of assignment of various property rights among the actors of the project. Property rights assignments within a project have been originally measured by asking the respondent what was, in percentage terms, the participation of each project partner to the governance of the project. To assess the degree of inequality of these assignments, we resorted to the Gini coefficient. This measure of statistical dispersion has several desirable properties. In particular, the fact of being population invariant allows us to use it for comparing the dispersion of rights assignments in projects with different numbers of participants.

The practical implementation of this strategy had to overcome one difficulty. Each project, as we said, has a variable number *n* of partners. For each project we observe the percentage of decision rights assigned to the *key partners*. In general the number of key partners (k) is equal or smaller than *n*. The decision rights assigned to the key partners need not sum up to 100%, as other partners may hold some rights. However across all partners, decision rights must sum up to 100%. We needed to calculate the Gini coefficient G of the distribution of rights in each project in a way that takes into account the fact that in general we do not observe the exact right assignments of the partners from $k+1^{th}$ to $n^{th.}$**.** The strategy that we followed was to make alternative assumptions on the distribution of rights among the unobserved project partners, and calculate the corresponding G. We assumed two extreme distributions: a) all the rights not assigned to the three key partners are evenly distributed among the remaining partners; b) just one actor holds all the rights not assigned to the three key partners. We then calculated one value of G in correspondence of each hypothesis, and the average of the two values thus obtained. All the analyses in this paper employ the average G. This is justified for three reasons. First, for most projects, the percentage of rights held by the key partners is in the neighborhood of 90%. Second, the range between the extreme values of G is rather small, on average around 0.01-0.02, versus mean values of G between 0.74 and 0.88.[7] Third, the results of our analyses are not seriously impacted on by the choice of one G or another.

Table 11 reports the descriptive statistics and the correlations for the Gini indexes of five categories of rights. As we said, the means of the indexes range from 0.74 to 0.88, versus theoretical extreme values of 0 and 1, representing, respectively, perfectly uniform and perfectly concentrated distributions. A lower value of the number of observations N indicates that the item on property rights on assets was not applicable to a considerable number of projects. Correlations are substantial, yet far from perfect for every pair of coefficients.

To assess the extent to which the degree of inequality differs across different rights, we conducted paired sample tests of difference of means. Table 12 reports the tests results. In the leftmost 'Pairs' column, the items are listed in decreasing ordered of the Gini index. As higher values of the Gini index indicate more unequal distributions, the results in the Table inform us that in project governance assignments of output ownership and control rights (in that order) are significantly more concentrated than assignments of other rights. Moreover, rights on monetary results are significantly more unequal than assignments of asset

[7] Data available from the authors.

ownership. Although an imperfect correlation between various types of rights has been observed also by Kaplan and Stroemberg (2003), a partial misalignment between cash flow rights and asset ownership is not in line with common wisdom.

As we did with the degree of specification of governance mechanisms, we assessed also whether project complexity and uncertainty, as proxied by the industry sector, associate with different degrees of inequality of rights assignments. Table 13 indicates that the concentration of decision rights, control rights and rights on monetary results differ significantly across industry sectors, while that of asset and output ownership does not. In particular, C projects exhibit greater concentration of the three significant rights than HT projects, and greater concentration of rights on monetary results than E ones. By contrast, no appreciable difference can be detected between E and HT projects.[8]

4. Conclusions

Empirical evidence shows that inter-organizational projects employ a mix of contractual and extra-contractual governance mechanisms. Coherently with our framework, and differently from usual conceptualization, these agreements are not characterized by high 'relational intensity' in the sense of high informality, nor by a 'mix' or juxtaposition between informal relational governance and transactional, task specific formal contracts. Formal contracts are not highly 'incomplete' contracts either. They are associational and constitutional contracts, quite complete on fundamental rights. These contracts are flexible not because they are informal but because they are associational and constitutional. Actually, this pattern holds also for extra-contractual governance. Hence, in designing governance arrangements, a main distinction runs between the levels of regulation (general versus detailed, procedural versus substantive) rather than between formal and informal and contractual versus extra-contractual.

Some further principles 'add on' this general guideline, i.e. further regulatory mechanisms can be added (rather than substituted) in order to respond to other factors. They can therefore be conceived as 'supplements' (rather than either substitutes or complements). For example, the degree of formal articulation in task description has to be high in case of high complexity (large number of matters and partners) of the action system; while the degree of formal procedural regulation can be lower, in general because it is a more cooperative issue, and in particular in those cases where a rich set of customs and habits are available. Hence the results of the study confirms that the relations of complementarity, substitutability and supplementarity have to be assessed at the level of single mechanisms, and not at the level of aggregate modes of governance (e.g. contractual versus extra-contractual).

[8] These analyses have been carried out on a subsample that excluded the four largest projects with budget ≥ 1 bln EUR and the Canadian projects. Unlike the previous analyses, these cases seem to have a disproportionate impact of the results. This is quite understandable for the largest projects. Large budgets also associate with large number of partners. Therefore the limits of our measure of the Gini index (which relies on information on the key partners only) become more apparent. The impact of Canadian projects on the results is less clearly understandable. A more uncertain industry affiliation than for other countries, due to greater difficulty to establish the NACE code of the project may be responsible for the influence.

The pattern of allocation of property rights also interestingly deviates from standard property right theory predictions, to conform to a more pluralist, negotiation based view, as rights are shared, at least to some extent, and different rights are allocated to different partners.

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APPENDIX

Table 1: Overview of the sample

Location	Firms contacted	Projects	Response Rate
Germany (Bonn)	760	100	13,2%
Denmark	463	101	21,8%
Italy	584	93	15,9%
Germany (Cologne)	462	128	27,7%
Silicon Valley	155	50	32,3%
Sophia Antipolis	114	18	15,8%
Montreal	500	50	10,0%
Total sample	**3.038**	**540**	**17,8%**

Table 2: Projects per industry and country

	Germany	Denmark	Italy	Montreal	Sophia Antipolis	Silicon Valley	
Creative Industry	73	47	1	3	0	0	124
Engineering Industry	134	21	86	3	2	0	246
High Tech Industry	22	32	6	44	16	50	170
Total	229	100	93	50	18	50	540

Table 3: Operationalization of variables

Variable	*Operationalization*
Degrees of contractual specification	Q.: "How were the following matters regulated in written, legal, enforceable contracts between the three key partners?"
1 DCS property rights	0 = "Not specified in contracts"
2 DCS decision and control rights	1= "General principles specified"
3 DCS tasks	2 = "Extensive specification of rights and obligations under conceivable specified conditions"
4 DCS duration	3 = "Complete specification of rights and obligations so that they hold under any condition"
5 DCS separation procedures	
6 DCS warrantees and indemnities	
7 DCS prices, fees and royalties	
Degrees of contractual specification	Q.: "To what extent were the following matters regulated by written internal charts, procedures and job descriptions *(e.g. of the type used in internal organization)* in the relation between the three key partners?"
8 ECS property rights	0 = "Not specified in contracts"
9 ECS decision and control rights	1= "General principles specified"
10 ECS tasks	2 = "Extensive specification of rights and obligations under conceivable specified conditions"
11 ECS duration	3 = "Complete specification of rights and obligations so that they hold under any condition"
12 ECS separation procedures	
13 ECS warranties and indemnities	
14 ECS prices, fees and royalties	
Degrees of social and institutional specification	
15 ISS property rights	Q.: "To what extent were the following matters regulated by the norms, habits and practices of the industry or by ad hoc specific informal agreements among the parties in your project, rather than being written into a contract or into internal documents, in the relation between the three key partners?"
16 ISS decision and control rights	0 = "Not specified in contracts"
17 ISS tasks	1= "General principles specified"
18 ISS duration	2 = "Extensive specification of rights and obligations under conceivable specified conditions"
19 ISS separation procedures	3 = "Complete specification of rights and obligations so that they hold under any condition"
20 ISS warranties and indemnities	
21 ISS prices fees and royalties	
Project complexity and knowledge intensity	
22 Contractual formalization	Sum of items 1-7
23 Extra contractual formalization	Sum of items 8-14
24 Relational governance	Sum of items 15-21
25 Log10 Project size: persons	Log10 total # of persons in project
26 Log10 Project size: partners	Log 10 total # of independent entities – either physical or legal persons – providing distinguishable input
27 Log10 Project size: budget	Log 10 of project budget in Euros
28 Log10 Project duration (weeks)	
29 Differentiation of requisite competences	100 - the largest share of the full range of activities that a single person would have been fully qualified to carry out (irrespective of acceptable work-load)
30 Log10 Coincident feedback (weeks)	Log 10 # weeks after which indicators of success were available, during the life of the project
31 Log10 Lagged feedback (weeks)	Log 10 # weeks after which indicators of success were available, after project completion
32 % revised activities	% of activities of the whole project for which it was necessary to revise when, how or which activities should be carried out
33 % innovative activities	% of activities of the whole project for which it was necessary to generate new knowledge (e.g., new approaches, new analytic schemes)
Inequality of property rights assignments	
34 Gini of asset ownership	(Gini index of inequality of) participation (in % terms) of each project partner to the governance of the project
35 Gini of output ownership	Same as above
36 Gini of monetary results	Same as above
37 Gini of decision rights	Same as above
38 Gini of control rights	Same as above

Table 4 – Project governance: descriptive statistics and correlations

PANEL A: Contractual formalization

		1	2	3	4	5	6	7
1	DCS property rights	1						
2	DCS decision and control rights	0.440	1					
3	DCS tasks	0.216	0.363	1				
4	DCS duration	0.191	0.289	0.534	1			
5	DCS separation procedures	0.393	0.458	0.367	0.400	1		
6	DCS warrantees and indemnities	0.367	0.384	0.380	0.427	0.620	1	
7	DCS prices, fees and royalties	0.287	0.321	0.375	0.474	0.362	0.458	1
	Mean	1.71	1.42	1.81	1.97	1.53	1.87	2.22
	Std. Deviation	1.18	1.10	0.98	0.97	1.15	1.08	0.89
	Minimum	0	0	0	0	0	0	0
	Maximum	3	3	3	3	3	3	3
	N	*540*	*540*	*540*	*540*	*540*	*540*	*540*

Note: DCS: "Degree of contractual specification".

PANEL B: Extra contractual formalization

		1	2	3	4	5	6	7
1	ECS property rights	1						
2	ECS decision and control rights	0.580	1					
3	ECS tasks	0.350	0.487	1				
4	ECS duration	0.423	0.438	0.676	1			
5	ECS separation procedures	0.517	0.512	0.466	0.508	1		
6	ECS warranties and indemnities	0.491	0.490	0.533	0.640	0.629	1	
7	ECS prices, fees and royalties	0.462	0.439	0.547	0.670	0.563	0.738	1
	Mean	0.91	1.07	1.52	1.51	0.98	1.17	1.48
	Std. Deviation	1.13	1.08	1.05	1.14	1.14	1.20	1.24
	Minimum	0	0	0	0	0	0	0
	Maximum	3	3	3	3	3	3	3
	N	*540*	*540*	*540*	*540*	*540*	*540*	*540*

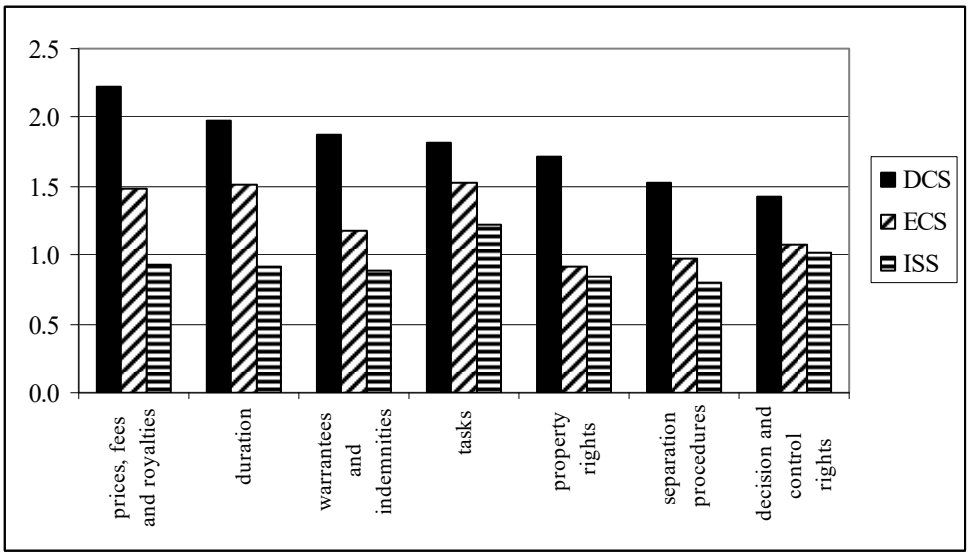
Note: ECS: "Extra-contractual specification".

PANEL C: Informal governance

		1	2	3	4	5	6	7
1	ISS property rights	1						
2	ISS decision and control rights	0.516	1					
3	ISS tasks	0.429	0.570	1				
4	ISS duration	0.483	0.414	0.624	1			
5	ISS separation procedures	0.594	0.458	0.459	0.563	1		
6	ISS warranties and indemnities	0.536	0.388	0.519	0.625	0.684	1	
7	ISS prices fees and royalties	0.536	0.427	0.562	0.670	0.612	0.722	1
	Mean	0.85	1.01	1.22	0.91	0.80	0.89	0.93
	Std. Deviation	1.07	1.06	1.04	1.11	1.05	1.09	1.12
	Minimum	0	0	0	0	0	0	0
	Maximum	3	3	3	3	3	3	3
	N	*540*	*540*	*540*	*540*	*540*	*540*	*540*

Note: ISS = "Informal and social specification"

Figure 1 – Governance mechanisms: mean degrees of specification



Note: DCS: "Degree of contractual specification"; ECS: "Extra-contractual specification"; ISS = "Informal and social specification"

Table 5 – Paired sample tests of difference of means between alternative formalizations of the same governance mechanism

	Paired Differences				
		95% C-I of the Difference			
	Mean	Lower	Upper	t (df 539)	Sig. (2-tailed)
Panel 1: DCS *minus* ECS					
Property rights	0.80	0.68	0.91	13.51	0.000
Prices, fees and royalties	0.74	0.63	0.85	13.04	0.000
Warranties and indemnities	0.70	0.59	0.81	12.42	0.000
Separation procedures	0.55	0.44	0.65	9.97	0.000
Duration	0.46	0.36	0.56	8.73	0.000
Decision and control rights	0.35	0.24	0.46	6.45	0.000
Tasks	0.29	0.19	0.40	5.41	0.000
Panel 2: DCS *minus* ISS					
Prices, fees and royalties	1.29	1.18	1.41	21.63	0.000
Duration	1.06	0.94	1.18	17.11	0.000
Warranties and indemnities	0.98	0.86	1.1	15.69	0.000
Property rights	0.86	0.73	0.99	12.90	0.000
Separation procedures	0.73	0.6	0.85	11.44	0.000
Tasks	0.60	0.47	0.72	9.31	0.000
Decision and control rights	0.41	0.28	0.54	6.12	0.000
Panel 3: ECS *minus* ISS					
Duration	0.60	0.48	0.72	9.88	0.000
Prices, fees and royalties	0.55	0.43	0.67	8.99	0.000
Tasks	0.31	0.19	0.42	5.07	0.000
Warranties and indemnities	0.28	0.16	0.40	4.70	0.000
Separation procedures	0.18	0.07	0.29	3.21	0.001
Property rights	0.06	-0.06	0.18	1.04	0.299
Decision and control rights	0.05	-0.07	0.18	0.87	0.385

Table 6– Summated scales of project governance and project features: correlations and descriptive statistics

	1	2	3	4	5	6	7	8	9	10	11	12
Contractual formalization	1											
Extra contractual formalization	0.362	1										
Relational governance	0.008	0.237	1									
Log10 Project size: persons	0.306	0.092	-0.147	1								
Log10 Project size: partners	0.185	-0.011	-0.056	0.557	1							
Log10 Project size: budget	0.310	0.200	-0.167	0.677	0.394	1						
Log10 Project duration (weeks)	0.160	0.118	-0.081	0.422	0.221	0.525	1					
Differentiation of requisite competences	0.188	0.092	-0.049	0.319	0.197	0.334	0.203	1				
Log10 Coincident feedback (weeks)	0.043	0.016	-0.051	0.133	0.007	0.262	0.418	0.075	1			
Log10 Lagged feedback (weeks)	0.022	0.033	0.073	-0.050	0.009	0.040	0.184	0.027	0.265	1		
% revised activities	0.011	-0.048	-0.073	0.040	0.048	0.079	0.109	-0.053	0.097	-0.019	1	
% innovative activities	0.002	-0.068	-0.044	-0.065	-0.014	-0.096	0.052	0.035	0.050	-0.009	0.327	1
Mean	12.53	8.65	6.61	1.42	0.72	5.98	1.64	68.10	0.98	0.85	28.57	25.92
Std. Deviation	5.07	6.18	5.88	0.61	0.37	1.25	0.52	25.13	0.55	0.61	24.75	23.11
Minimum	0	0	0	0.00	0.30	2.70	0.00	0	0	0	0	0
Maximum	21	21	21	4.54	2.88	10.56	3.62	100	2.32	2.49	100	100
N	*540*	*540*	*540*	*539*	*540*	*540*	*540*	*540*	*540*	*540*	*540*	*540*

Table 7 – Project features: Multivariate analysis of variance (MANOVA)

PANEL A: Factor

		Value Label	N
Project class	1	Engineering	239
	2	Creative	103
	3	High-Tech	132
	Total		474

PANEL B: Multivariate Tests

Multivariate Test	Value	F	
Pillai's Trace ***	0.463	11.571	p < 0.01
Wilks' Lambda **	0.580	11.986	p < 0.01
Hotelling's Trace ***	0.648	12.402	p < 0.01
Roy's Largest Root*	0.499	19.169	p < 0.01

*: The statistic is an upper bound on F that yields a lower bound on the significance level; **: exact; ***: approximate

PANEL C: Univariate ANOVAs

Dependent Variable	F	
Log10 Project size: persons	19.188	p < 0.01
Log10 Project size: partners	11.130	p < 0.01
Log10 Project size: budget	57.652	p < 0.01
Log10 Project duration (weeks)	29.791	p < 0.01
Differentiation of requisite competences	1.733	n.s.
Log10 Coincident feedback (weeks)	15.675	p < 0.01
Log10 Lagged feedback (weeks)	5.398	p < 0.01
% revised activities	7.129	p < 0.01
% innovative activities	32.149	p < 0.01
% kw exchange requirement	24.878	p < 0.01

PANEL D: Post hoc comparison of group means

	I: High-Tech; J: Engineering			I : High-Tech; J: Creative		
Dependent Variable	Mean Diff. (I-J)	Std. Error		Mean Diff. (I-J)	Std. Error	
Log10 Project size: persons	-0.376	0.065	p < 0.01	-0.090	0.071	n.s.
Log10 Project size: partners	-0.182	0.037	p < 0.01	-0.079	0.037	n.s.
Log10 Project size: budget	-0.875	0.133	p < 0.01	0.453	0.150	p < 0.01
Log10 Project duration (weeks)	-0.225	0.055	p < 0.01	0.204	0.074	p < 0.05
Differentiation of requisite competences	4.549	2.787	n.s.	5.298	3.382	n.s.
Log10 Coincident feedback (weeks)	0.021	0.056	n.s.	0.344	0.075	p < 0.01
Log10 Lagged feedback (weeks)	0.008	0.066	n.s.	0.225	0.080	p < 0.05
% revised activities	9.888	2.732	p < 0.01	4.188	3.605	n.s.
% innovative activities	19.013	2.466	p < 0.01	10.228	3.367	p < 0.01
% kw exchange requirement	19.831	3.208	p < 0.01	1.936	4.035	n.s.

(Table 7 – Continued)

	I: Creative; J: Engineering		
Dependent Variable	Mean Diff. (I-J)	Std. Error	
Log10 Project size: persons	-0.286	0.065	$p < 0.01$
Log10 Project size: partners	-0.103	0.040	$p < 0.05$
Log10 Project size: budget	-1.328	0.121	$p < 0.01$
Log10 Project duration (weeks)	-0.430	0.061	$p < 0.01$
Differentiation of requisite competences	-0.749	2.961	n.s.
Log10 Coincident feedback (weeks)	-0.324	0.068	$p < 0.01$
Log10 Lagged feedback (weeks)	-0.217	0.071	$p < 0.01$
% revised activities	5.700	3.087	n.s.
% innovative activities	8.785	2.818	$p < 0.01$
% kw exchange requirement	17.895	3.548	$p < 0.01$

Table 8 – Contractual governance: multivariate analysis of variance

PANEL A

Multivariate Tests
Factor variable: Project Class

	Value	**F**	
Pillai's Trace ***	0.164	5.967	$p < 0.01$
Wilks' Lambda **	0.841	6.020	$p < 0.01$
Hotelling's Trace ***	0.183	6.073	$p < 0.01$
Roy's Largest Root *	0.138	9.198	$p < 0.01$

*: The statistic is an upper bound on F that yields a lower bound on the significance level; **: exact; ***: approximate

PANEL B

Univariate ANOVA's
Factor variable: Project Class

Dependent Variable	F	
DCS property rights	7.078	$p < 0.01$
DCS decision and control rights	3.212	$p < 0.05$
DCS tasks	12.165	$p < 0.01$
DCS duration	6.087	$p < 0.01$
DCS separation procedures	0.929	n.s.
DCS warrantees and indemnities	4.709	$p < 0.01$
DCS prices, fees and royalties	1.799	n.s.

PANEL C

Post hoc comparison of group means

	I: High-Tech; J: Engineering			I : High-Tech; J: Creative		
Dependent Variable	Mean Diff. (I-J)	Std. Error		Mean Diff. (I-J)	Std. Error	
DCS property rights	0.466	0.121	$p < 0.01$	0.215	0.147	n.s.
DCS decision and control rights	0.017	0.114	n.s.	-0.298	0.137	$p < 0.1$
DCS tasks	-0.363	0.102	$p < 0.01$	0.136	0.132	n.s.
DCS duration	-0.245	0.102	$p < 0.05$	0.123	0.135	n.s.
DCS separation procedures	-0.038	0.124	n.s.	0.147	0.152	n.s.
DCS warrantees and indemnities	-0.177	0.115	n.s.	0.204	0.151	n.s.
DCS prices, fees and royalties	-0.173	0.103	n.s.	-0.180	0.121	n.s.

	I: Creative; J: Engineering		
Dependent Variable	Mean Diff. (I-J)	Std. Error	
DCS property rights	0.251	0.139	n.s.
DCS decision and control rights	0.316	0.131	n.s.
DCS tasks	-0.499	0.119	$p < 0.01$
DCS duration	-0.368	0.123	$p < 0.01$
DCS separation procedures	-0.185	0.138	n.s.
DCS warrantees and indemnities	-0.381	0.135	$p < 0.05$
DCS prices, fees and royalties	0.007	0.103	n.s.

Test statistic: Tamhane
Use of alternative tests gives similar results

Table 9 – Extra-contractual formalization: multivariate analysis of variance

PANEL A

Multivariate Tests
Factor variable: Project Class

Multivariate Test	**Value**	**F**	
Pillai's Trace ***	0.126	4.479	p < 0.01
Wilks' Lambda **	0.878	4.481	p < 0.01
Hotelling's Trace ***	0.135	4.484	p < 0.01
Roy's Largest Root*	0.087	5.830	p < 0.01

*: The statistic is an upper bound on F that yields a lower bound on the significance level; **: exact; ***: approximate

PANEL B

Univariate ANOVA's
Factor variable: Project Class

Dependent Variable	F	
ECS property rights	4.445	p < 0.05
ECS decision and control rights	2.283	n.s.
ECS tasks	7.434	p < 0.01
ECS duration	6.029	p < 0.01
ECS separation procedures	1.259	n.s.
ECS warranties and indemnities	10.941	p < 0.01
ECS prices, fees and royalties	4.656	p < 0.01

PANEL C

Post hoc comparison of group means

	I: High-Tech; J: Engineering			I : High-Tech; J: Creative		
Dependent Variable	Mean Diff. (I-J)	Std. Error		Mean Diff. (I-J)	Std. Error	
ECS property rights	0.210	0.126	n.s.	0.441	0.146	p < 0.01
ECS decision and control rights	0.162	0.117	n.s.	0.299	0.136	p < 0.1
ECS tasks	-0.192	0.110	n.s.	0.275	0.137	n.s.
ECS duration	-0.276	0.121	p < 0.1	0.152	0.145	n.s.
ECS separation procedures	-0.038	0.123	n.s.	0.173	0.145	n.s.
ECS warranties and indemnities	-0.458	0.127	p < 0.01	0.102	0.148	n.s.
ECS prices, fees and royalties	-0.396	0.131	p < 0.01	-0.157	0.163	n.s.

	I: Creative; J: Engineering		
Dependent Variable	Mean Diff. (I-J)	Std. Error	
ECS property rights	-0.231	0.127	n.s.
ECS decision and control rights	-0.137	0.123	n.s.
ECS tasks	-0.468	0.126	p < 0.01
ECS duration	-0.428	0.133	p < 0.01
ECS separation procedures	-0.211	0.132	n.s.
ECS warranties and indemnities	-0.560	0.137	p < 0.01
ECS prices, fees and royalties	-0.239	0.149	n.s.

Test statistic: Tamhane
Use of alternative tests gives similar results

Table 10 – Informal governance: multivariate analysis of variance

PANEL A

Multivariate Tests
Factor variable: Project Class

Multivariate Test	**Value**	**F**	
Pillai's Trace ***	0.073	2.519	p < 0.01
Wilks' Lambda **	0.928	2.520	p < 0.01
Hotelling's Trace ***	0.076	2.521	p < 0.01
Roy's Largest Root*	0.052	3.486	p < 0.01

*: The statistic is an upper bound on F that yields a lower bound on the significance level; **: exact; ***: approximate

PANEL B

Univariate ANOVA's
Factor variable: Project Class

Dependent Variable	F	
ISS property rights	1.799	n.s.
ISS decision and control rights	5.893	p < 0.01
ISS tasks	0.331	n.s.
ISS duration	1.029	n.s.
ISS separation procedures	0.451	n.s.
ISS warranties and indemnities	1.526	n.s.
ISS prices fees and royalties	0.435	n.s.

PANEL C

Post hoc comparison of group means

	I: High-Tech; J: Engineering			I : High-Tech; J: Creative		
Dependent Variable	Mean Diff. (I-J)	Std. Error		Mean Diff. (I-J)	Std. Error	
ISS property rights	0.203	0.120	n.s.	0.045	0.141	n.s.
ISS decision and control rights	0.379	0.116	p < 0.01	0.162	0.136	n.s.
ISS tasks	-0.001	0.115	n.s.	-0.095	0.132	n.s.
ISS duration	0.090	0.123	n.s.	0.208	0.140	n.s.
ISS separation procedures	0.098	0.113	n.s.	0.018	0.136	n.s.
ISS warranties and indemnities	-0.078	0.119	n.s.	0.142	0.138	n.s.
ISS prices fees and royalties	-0.043	0.120	n.s.	0.079	0.143	n.s.

	I: Creative; J: Engineering		
Dependent Variable	Mean Diff. (I-J)	Std. Error	
ISS property rights	0.158	0.121	n.s.
ISS decision and control rights	0.217	0.118	n.s.
ISS tasks	0.093	0.117	n.s.
ISS duration	-0.118	0.123	n.s.
ISS separation procedures	0.080	0.122	n.s.
ISS warranties and indemnities	-0.220	0.122	n.s.
ISS prices fees and royalties	-0.121	0.129	n.s.

Test statistic: Tamhane
Use of alternative tests gives similar results

Table 11 – Gini coefficients of inequality of property rights assignments: Correlations and descriptive statistics

		1	2	3	4	5
1	Gini of asset ownership	1				
2	Gini of output ownership	0.351	1			
3	Gini of monetary results	0.340	0.502	1		
4	Gini of decision rights	0.308	0.412	0.499	1	
5	Gini of control rights	0.210	0.488	0.468	0.691	1
	Mean	0.74	0.88	0.78	0.77	0.81
	Std. Deviation	0.37	0.21	0.29	0.26	0.25
	Minimum	0	0	0	0	0
	Maximum	1	1	1	1	1
	N	361	428	449	517	481

Table 12 - Paired sample tests of difference of means between measures of inequality of property rights assignments between project partners

		Paired Differences					
			95% C-I of the Difference				
Pairs		Mean	Lower	Upper	t	df	Sig. (2-tailed)
Output ownership	*minus*						
	Control rights	0.07	0.04	0.09	5.79	398	0.000
	Rights on monetary results	0.07	0.05	0.10	5.97	390	0.000
	Decision rights	0.10	0.08	0.12	8.05	422	0.000
	Asset ownership	0.15	0.11	0.19	7.65	342	0.000
Control rights	*minus*						
	Rights on monetary results	0.03	0.00	0.05	1.81	415	0.072
	Decision rights	0.04	0.02	0.05	3.82	479	0.000
	Asset ownership	0.06	0.02	0.10	2.75	336	0.006
Rights on monetary results	*minus*						
	Decision rights	0.02	-0.01	0.04	1.13	441	0.260
	Asset ownership	0.06	0.02	0.10	2.90	336	0.004
Decision rights	*minus*						
	Asset ownership	0.03	-0.01	0.07	1.52	357	0.129

Note: Each pair is composed by two Gini indexes of inequality of assignments of the property rights described in the 'Pairs' columns.

Table 13 – Inequality of property rights

PANEL A: Univariate ANOVAs

Factor variable: Project Class

Dependent variable	F	
Gini of asset ownership	2.036	n.s.
Gini of output ownership	0.573	n.s.
Gini of monetary results	3.003	$p < 0.1$
Gini of decision rights	3.064	$p < 0.05$
Gini of control rights	2.374	$p < 0.1$

PANEL B: Post hoc comparison of group means

	I: High Tech; J: Engineering			I: High Tech; J: Creative		
Dependent Variable	Mean Diff. (I-J)	Std. Error		Mean Diff. (I-J)	Std. Error	
Gini of asset ownership	0.002	0.050	n.s.	0.105	0.066	n.s.
Gini of output ownership	0.019	0.029	n.s.	-0.009	0.030	n.s.
Gini of monetary results	-0.003	0.042	n.s.	-0.090	0.043	$p < 0.15$
Gini of decision rights	-0.053	0.034	n.s.	-0.091	0.036	$p < 0.05$
Gini of control rights	-0.036	0.036	n.s.	-0.080	0.036	$p < 0.1$

Test statistic: Tamhane

	I: Creative; J: Engineering		
Dependent Variable	Mean Diff. (I-J)	Std. Error	
Gini of asset ownership	-0.103	0.059	n.s.
Gini of output ownership	0.028	0.024	n.s.
Gini of monetary results	0.087	0.032	$p < 0.05$
Gini of decision rights	0.038	0.028	n.s.
Gini of control rights	0.044	0.026	n.s.