Comparing U.S. and European Views of University Involvement in Economic Development:

Individual, Disciplinary, Institutional, and Regional Factors[1]

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1. Introduction

A key challenge facing the EU lies in improving the ability to convert knowledge into commercial ventures that yield economic benefit. While the U.S. has been able to nurture and extract considerable economic value from the intangible assets represented by its scientists, much attention is now being paid to launch appropriate efforts that would *bring science and industry closer together in Europe*, particularly prospects for reaping the latent as well as tacit knowledge locked away in university scientific systems and practices. This does not imply a direct and unreflective importation of institutional practices that successfully unlocked such assets in the U.S. economy, which would be difficult and risky to pursue in Europe, since the two systems of university education differ in quite fundamental ways (Herbst, 2004). But there is much to be gained by additional direct comparisons between the two systems to detect better the options open to each.

University reform in Europe is now underway for many reasons, only some of which directly address advancing academic entrepreneurship in EU universities. The sheer expansion of the EU to nearly 30 countries calls for much greater standardization of study programs, recognition of equivalent degrees, mobility of faculty and students, and uniform practices that have benefitted the U.S. higher education system for many decades. At the same time, major changes in governance are underway, with national university systems granting greater autonomy and budgetary discretion, and movement from regulation- towards performance-based management practices. This decentralization of authority and policy-making, in turn, is shifting the center of gravity of oversight away from ministries and parliaments towards external bodies, for example, EU-wide accreditation groups, and involving new stakeholder groups such as local and regional

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governments, and business associations in the governance of institutions of higher education. Europe's steady "endogenization of universities" into its social and economic life may be expected to increase simultaneously the number and variety of stakeholders and the demands placed upon universities.

Extension of the EU universities' mission implies engagement in areas that were once typically a responsibility of other institutions. Traditional divisions of labour relegated teaching exclusively to the universities, while knowledge transfer functions and a responsibility for basic research was shared with academies of science and national research bodies. Most universities remained quite apart from the deliberate application of knowledge which was conducted within ministries and departments or by business, although individual faculty might occasionally exercise their "professor's privilege" in transferring their specific research findings to the market. At present, universities are quickly being drawn into all these functions at different rates and mixtures[4], often to permit joint and more cost-effective progress toward economic and social objectives.[5] Nations, regions and their constituent communities demand ever more assistance with tasks of strengthening the knowledge economy, restructuring basic institutions, assimilating new populations, and embedding the elements of modern societies within the constantly evolving European Union.

While the U.S. university system is often considered a benchmark for certain goals of EU higher education, that expansive literature will not be reviewed here, nor will we evaluate the many studies that examine the transfer of knowledge outputs (publications, patents, citations, etc.) from U.S. universities of various types and characteristic[6].

Europe's self-declared research universities (League of European Research Universities, 2006) have advanced a U.S.-oriented line of argument in favour of expanded funding and greater autonomy for selected universities, arguing further that Europe would also benefit from greater diversity in the types of mission universities might pursue. Based on capacities and circumstances, some might presumably seek to attain the status of world-class research universities specializing in basic "Bohr quadrant" research, while others are better suited to helping meet industry and regional needs by pursuing "Edison quadrant" research, although both might also venture selectively into the "Pasteur quadrant" as well (Stokes, 1997). The League of European Research Universities (LERU) builds the case for more favourable treatment of

4 A re-sorting of functions may result in a greater division of labour among universities, with some oriented more to internationally-competitive basic research and others to locally- or industrially-oriented applied research. (League of European Research Universities, 2006).

5 On the other hand, universities in Baltic countries have been given sole responsibility for basic research in an effort to rid their research and innovation systems of previous Soviet-style, top-down research systems dominated by ideologically-driven academies of science, a model that may still survive in other EU-10 countries.

6 See Agarawal (2001), Phan and Siegel (2006) and Perkmann and Walsh (2007) for recent, comparative literature reviews and syntheses.

existing universities generally, and basic research universities in particular, which can be seen as an effort to temper the European Union's strong policy orientation toward far more commercialization and academic entrepreneurialism.

A number of scholars have documented the 'entrepreneurial turn' of universities in the U.S. and in many other countries (Etzkowitz et al., 2000, Goldfarb and Henrekson, 2003; Kenney and Goe, 2004). While academic entrepreneurship presents a number of different faces, we refer specifically to commercialization of knowledge production and transfer within the academy as having already achieved in the U.S. a 'taken-for-granted' status in terms of institutionalization of procedures and of norms (Colyvas and Powell, 2006; Stuart and Ding, 2006). Yet casual evidence that comes from discussions with colleagues working at a variety of research universities suggests that serious concerns by various stakeholders within the academy about the efficiency, effectiveness, and ethics of commercialization of knowledge still remain. Moreover, debates within university faculty membership organizations[7] reveal this face of academic entrepreneurship may be less 'taken-for-granted' than its adherents imagine.

In this paper we address three related research questions concerning the attitudes of university faculty in the U.S. and in Europe towards their universities taking active roles in the promotion of regional economic development and knowledge commercialization. First, we ask whether faculty make a distinction between their universities taking active roles in the promotion of economic development, and commercialization. The former has many of the attributes of a 'public good' and can be viewed as part of the mission of universities to contribute to the general welfare of their regions and to the health of civil society. The latter, on the other hand, comes for many with the 'baggage' of knowledge for profit, conflicts of interest, and a turn against the Mertonian norm of 'open science'. We posit that faculty do make this distinction.

The second question is what factors explain the variation in faculty attitudes towards university involvement in economic development and commercialization more generally? We include a variety of (i) individual faculty attributes, including scholarly discipline, (ii) institutional (university) characteristics, and (iii) regional economic conditions as explanatory variables. In particular we are interested in identifying if regional economic conditions matter, controlling for individual, disciplinary, and institutional factors. We hypothesize that regions undergoing industry restructuring or in greater chronic economic distress should be positively related to favourable attitudes towards universities engaging in regional economic development, but not necessarily on attitudes towards commercialization activities.

Third, we ask if are there important differences between the attitudes of faculty in U.S. universities and those in European universities. We posit that although U.S. universities have provided early and well-known examples of academic entrepreneurship, faculty in the EU,

7 See Bergman, 2009, pp. 21-22.

driven by a perceived stronger need for 'catch-up' in global competitiveness, are more tolerant of universities extending their missions to include engagement in regional economic development and particularly in knowledge commercialization.

Following a review of the literature, we present a descriptive view of U.S. faculty attitudes in section 3, a similar descriptive analysis of European faculty attitudes in section 4, and in section 5 the results of separate multivariate ordered logit models for the U.S. and Europe to explain variation in faculty attitudes. In the last section we compare and discuss the results between the U.S. and European findings.

2. A Brief Review of the Pertinent Literature

There is by now a large extant literature on academic entrepreneurship generally. A comprehensive literature review is found in Rothaermel, Agung and Jiang (2007). This literature spans both positive and normative dimensions of universities engaging in patenting and other forms of commercialization, including the opportunities and threats posed by the 'entrepreneurial turn' (e.g., Etzkowitz, Webster, and Terra, 2000; Bok, 2003), the impacts of intellectual property laws and regulations on university technology transfer activities (e.g., Mowery et al., 2001; Murray 2006; Litan, Mitchell, and Reedy, 2007), the productivity and effectiveness of university technology transfer offices (Thursby and Kemp, 2002; Siegel et al., 2004), and motivations for, and explanations of, entrepreneurial behaviour within the academy (e.g, Owen-Smith and Powell, 2001; Stuart and Ding, 2006).

A broader concept of academic entrepreneurship is one that has been used by Clark (1998, 2003) and Davies (2001), for example, to describe the behaviour of some universities to adapt and adjust to an altered set of external demands placed on them and to develop the capacity to take advantage of new opportunities such as greater autonomy. This concept is particularly useful in terms of the narrower issue addressed in this paper because it allows us to properly place universities' involvement in the promotion of economic development both within the broader sphere of commercialization activities but also within the set of activities and strategies that universities deem valuable or important in their adjustments to a new set of opportunities and threats.

In addition to their behaviour, the attitudes of faculty and other university-based researchers about their own entrepreneurial activities have been studied (Blumenthal et al., 1996; Louis et al., 2001). There have been few attempts, however, to systematically gauge the attitudes of a *broad* range of university faculty towards the university involvement in economic development activities as well as other activities under the umbrella of academic entrepreneurship, whether they are personally engaged in such activities or not, since Lee (1996).

Lee surveyed faculty in 115 research universities in the U.S. from nine different disciplinary groupings in the natural sciences, engineering, and the social sciences. They were asked

questions about whether they approved of changes in evaluative standards of faculty performance with respect to weighing user-oriented research and patentable inventions, and whether they were in agreement with a variety of university roles involving industry collaboration. The results of Lee's study were that: (1) a large majority of faculty respondents were in favour of changes in the criteria for evaluating faculty performance by giving weight to 'user-oriented research' and patentable inventions and this represented an increase from the 1980s; (2) a majority of respondents said they agreed with their universities actively participating in local and regional development, facilitating commercialization of university-based research, and encouraging faculty to engage in consulting for private firms; *but* (3) a majority did not support their universities providing start-up assistance or make equity investments in private firms. Lee's 1996 study suggests that while there is broad (and growing) acceptance of some aspects of the 'entrepreneurial turn', there are other activities or roles – that pose the greatest perceived threats to the 'core values of the research university' (Lee, 1996, p. 860) – that are soundly opposed.

In the more than twelve years since Lee collected his data, the incidence of academic entrepreneurship, and commercialization specifically, has significantly expanded, albeit at a slower rate than from the mid-1980s to the mid 1990s. This growth is reflected in a host of different indicators that are collected annually in the U.S. by the Association of University Technology Managers (AUTM) Annual Licensing Surveys. For example, between 1995 and 2006, the number of university technology transfer offices increased from 123 to 154. From 1997 to 2006: the total number of FTE professional staff in technology transfer offices increased from 415 to 911; the number of invention disclosures increased from 10,600 to 18,900, and new patents applications filed increased from about 3,000 to 11,600. The number of new companies 'spun out' of universities was 248 in 1996, and 553 in 2006 (AUTM 2006). European knowledge transfer organizations associated with ProTon were compared with U.S.-AUTM members, which revealed invention disclosures, priority patent applications, and options and licenses reported to AUTM (U.S. research universities) are several orders of magnitude higher than European ProTon equivalents, indicating a far less advanced EU system of academic entrepreneurship at present.

The empirical literature suggests that faculty attitudes towards universities engagement in economic development and commercialization more generally will vary by discipline. Disciplines vary in the degree to which basic or applied knowledge production 'drives' disciplinary progress, the culture in which members become socialized to accept the norms of open-science; and the opportunities for faculty to become personally involved in commercialization activities if they so choose. For these reasons we expect that attitudes towards university involvement in the promotion of economic development and commercialization will be most favourable in the more applied 'Edison' disciplines (chemical engineering and computer science), least favourable in the humanities and the social sciences

(English, history, political science, economics), and somewhat mixed among the pure 'Bohr' sciences.

Attitudes may also differ based upon some of the institutional characteristics of their university. Universities as organizations have unique cultures and/or administrative policies that differentially place priority on knowledge transfer or that encourage commercialization (Feldman and Desrochers, 2004; CHEPS, 2006). Though some well-known, elite U.S. universities strongly support faculty entrepreneurship such as Stanford and MIT, the most prestigious universities have generally placed more value on basic, 'pure' research, and of upholding the norms of open-science; these values are also reflected in the standards by which individual faculty are evaluated, and by which departments and ultimately universities are ranked among peers. Thus we expect faculty from the more research intensive institutions in the U.S. and higher Shanghai-ranked universities in the EU to have less favourable attitudes towards university involvement in economic development and commercialization generally than faculty from the other universities.

Personal experience in commercialization should also explain differences in attitudes among faculty. Having previously engaged in commercialization activities should indicate *not* being opposed on ideological grounds or from previous socialization. It would also indicate having professional expertise that provide the opportunities for personally benefiting from engagement in commercialization, either for the challenge or satisfaction of successfully developing a new product or business, or the financial gain associated with it.

To our knowledge there has not been any systematic empirical investigation on whether regional economic conditions affect faculty attitudes towards university involvement in economic development and commercialization more generally. To the extent that state legislatures and other elected and policy officials in regions of the U.S. that are economically distressed or in need of industrial restructuring place pressure on publicly funded university administrations to be more directly involved in activities that advance economic development, then we speculate that any set of incentives, rewards, or sanctions from university administration officials, in addition to appeals to the 'common good', may very well affect individual faculty attitudes.

3. Faculty Attitudes in U.S. Universities

3.1 Data and Study Population

The study population for the faculty survey consists of faculty from eight selected disciplines from all research universities in the U.S. The disciplines include biological sciences, chemical engineering, computer science, economics, English, history, physics, and political science. A random sample of 71 universities stratified by public/land-grant, public non-land grant, and private was drawn from the 'Very High' and 'High' research intensive categories used by the Carnegie Foundation. The resulting sample is shown in Table 1.

Table 1: Sample of Research Universities

Research Intensity*	Public Land-Grant	Public Non Land Grant	Private	Total
Very high	13	13	16	42
High	7	14	8	29
Total	20	27	24	71

*Based upon Carnegie Foundation for the Advancement of Teaching (2006), Classification of Institutions of Higher Education

The eight disciplines were selected based upon: their ubiquity among research universities, variation in the approaches and styles of inquiry and knowledge production, and variation in the likelihood of opportunities for faculty to produce knowledge that has potential for commercialization. For each of the eight academic departments in the 71 research universities, one tenured or tenure-track faculty member was randomly selected from each academic rank: assistant, associate, and full professor, plus the department chairperson. The web page of each department was used to provide the full listing of tenured and tenure-track faculty from which the particular faculty members were drawn for the final sample. A total of 2,148 faculty members were sent web-based questionnaires in January 2007, of which 112 were returned as undeliverable. After the first set of questionnaires were sent, two additional rounds of reminders and cover letters were sent to non-respondents. In the end there were 548 usable respondents which yielded an effective response rate of 25.5 percent. Table 2 shows the regional distribution of faculty respondents.

Table 3 Regional distribution of faculty respondents in the U.S.

Census Region	Number	Percentage
Northeast	83	20.6
Midwest	104	25.8
South	153	38.0
West	63	15.6

The faculty members were asked a series of questions concerning their attitudes towards different activities under the umbrella of academic entrepreneurship. The subset of the questions for our focus here ask: "To what extent do you agree or disagree with the following statements:

1. 'My university should be actively and directly involved in assisting state and regional economic development.' "

2. 'My university should be involved in the commercialization of university-based academic research.' "

The response categories are on a five-point Likert scale from strongly agree to strongly disagree.

We analyze the variation in responses among faculty members first to indicate likely bivariate associations, and then later in the paper we present a multivariate ordered logit model to test hypothesized causal relationships.

3.2 Descriptive Results

The faculty responses on the two attitudinal questions by academic discipline are reported in Table 3, by type of university in Tables 4 and 5, and by previous experience in commercialization – measured as having ever previously applied for a patent – in Table 6.

There are clear differences in the overall faculty attitudes towards universities assisting economic development and commercialization in general. The proportion who feel universities assisting regional economic development is *inappropriate* is relatively small (14.9 percent), while the proportion who feel it is inappropriate for universities to be directly involved in commercialization jumps to 32.5 percent.

There is a high degree of consensus in faculty attitudes about whether universities should assist regional economic development *across disciplines* (though the differences are statistically significant) but when it comes to university commercialization in general substantively large differences across disciplines emerge. As expected, those faculty in the humanities and social sciences are much more disapproving than their colleagues in the Pasteur disciplines of computer science and chemical engineering, but also compared to faculty the Bohr disciplines. There are some surprises: chemical engineering faculty have lower approval attitudes than what one might expect based upon the commercialization potential of research within the field, while economics faculty in some cases have higher disapproval attitudes, not necessarily because of adherence to the norms of open science, but rather to the norms of free markets and minimal interference by government organizations, and specifically publicly supported universities engaged in 'picking winners'.

Table 3: Faculty Attitudes by Academic Discipline

	Percent respondents who disagree or strongly disagree								
	Bio	CS	Econ	Engr	Engl	Hist	Phys	PS	ALL
	(N=70)	(62)	(65)	(54)	(84)	(82)	(63)	(68)	(548)
*'My university should be . . . actively and directly involved in assisting in state and regional economic development'**	15.8	8.0	20.0	14.8	15.5	13.4	12.7	19.1	14.9

'My university should be actively Involved in the commercialization of university-based research'*	22.9	14.5	23.4	20.4	53.0	57.4	15.9	36.5	32.5

* Chi-square significant @ 0.01

When we examine the faculty attitudes by research intensity of the university in Table 4, we see that faculty in the highest research intensive universities AAU member universities are somewhat less approving of universities being engaged in assisting economic development and commercialization generally than their colleagues in the less (relatively) research intensive institutions, but the differences are not statistically significant.

Table 4: Faculty Attitudes by Research Intensity of University

	Percent respondents who disagree or strongly disagree	
	Very High (N = 219)	**High** (N = 329)
'My university should be actively and directly involved in assisting state and regional economic development'	16.3	12.6
'My university should be actively involved in the commercialization of university-based research'	33.9	30.4

When we classify universities by whether they are public land-grant, public non land-grant, or private, we see somewhat surprisingly that the attitudes of faculty from public land grant institutions towards university involvement in economic development and commercialization generally are not more approving than faculty from public non-land grant universities, despite the special mission and history of land-grant institutions and their more applied orientations. The differences in attitudes towards university involvement in economic development between faculty in public (land grant and non-land grant) and private institutions are more evident, but interestingly the differences in attitudes about university commercialization generally between faculty in public and private universities are not substantively large nor statistically significant.

Table 5: Faculty Attitudes by Ownership and Land-Grant Status

	Percent respondents who disagree or strongly disagree		
	Public Non-land grant (N= 172)	**Public Land Grant** (N = 202)	**Private** (N =173)
*'My university should be actively and directly involved in assisting state and regional economic development'**	10.3	12.2	22.1

'My university should be actively involved in the commercialization of university-based research'	30.5	33.2	32.4

* Chi-square significant at 0.001

To try to measure the magnitude of the *minimal* proportion of faculty who disapprove of university commercialization, as a benchmark, we have asked faculty in the survey whether they have ever applied for a patent. Table 6 shows the attitudinal responses cross-classified by previous patenting activity. Predictably, those faculty members who have had previous experience engaged in patenting have more favourable attitudes towards university involvement in economic development and commercialization activities generally than their colleagues. Yet for this select faculty group, there is a clear differentiation in attitudes of *appropriateness* between university involvement in economic development and commercialization generally.

Table 6: Faculty Attitudes by Previous Patenting Activity

	Percent respondents who disagree or strongly disagree	
	Patent Applicant (N= 109)	Not Patent Applicant (N = 411)
*'My university should be actively and directly involved in assisting state and regional economic development'**	7.3	16.8
*'My university should be actively involved in the commercialization of university-based research'**	11.8	37.2

* Chi-square significant at 0.001

4. Faculty Attitudes in EU Universities?[8]

The data and methods outlined above for the U.S. study are largely replicated among the EU universities listed in the Shanghai top 500, although several minor differences should be noted. First, we stratify each university's sample to distinguish among six disciplines: 1) biological sciences, 2) physics, 3) computer science, 4) chemical engineering, 5) economics and 6) history. The first two could be classified as 'Bohr' quadrant disciplines, while the next two are more clearly to be found in the 'Pasteur' quadrants frequently associated with EU technological (or U.S. Land-Grant) universities[9]. The two social science disciplines (history and economics) serve as reliable benchmark academics, designated here as 'North', which acknowledges its famous economic historian namesake; both are core university disciplines that foster strong traditions of research that offer relatively few or markedly different types of commercialization possibilities.

8 This section is drawn from Bergman, 2009.

9 See earlier discussion of Donald Stokes (1997) distinctions among basic vs. applied sciences.

Second, EU universities are not structured with the same professorial ranks found in the U.S., so webpage sampling[10] differed somewhat: we selected the director of departments or institutes of the stratified disciplines when they could be identified, plus two random additional members. We distinguished between EU academics with permanent – equivalent to full and associate professors in the U.S. -- and time-specified contracts (assistant professors) within the questionnaire. To ensure maximum comparability with the U.S. benchmark, we also inquire about teaching loads and publication records, thereby permitting us to direct our analysis of responses to faculty members who are responsible for both classic forms of academic contribution.

4.1. The Data and Study Population

The respondent characteristics are based upon 1,798 valid responses, which represent approximately 18% of the doubly-stratified (European universities ranked within the Shanghai 500 x 6 disciplines) sample of university faculty members to whom the questionnaires were sent. The responses were generated by an initial e-mail contact that included log-in and password instructions, which was then followed by three e-mail reminders. National response rates vary widely, ranging from lows of 12-14% (CZ, ES, UK) to highs of 27-30% (FI, SL, IT). The final frequency distribution of respondents is shown in Table 6.

Table 7

Distribution of EU Faculty Respondents by Country

Country	Freq.	Percent	Cum.
AT*	118	6.56	6.56
BE	56	3.11	9.68
CH*	125	6.95	16.63
CZ	12	0.67	17.30
DE	514	28.59	45.88
DK	71	3.95	49.83
ES	62	3.45	53.28

10 Unlike all other EU countries, the French system of university web-pages proved extraordinarily difficult to identify academics or their e-mail addresses. We therefore sampled the French universities and disciplines of authors listed within the ISI database. This probably introduces a slight bias toward greater research and less teaching or for journal- vs. book-based publications. We subsequently learned others had similar experiences in attempts to survey French university academics.

FI	33	1.84	55.12
FR	138	7.68	62.79
GR	16	0.89	63.68
HU	26	1.45	65.13
IE	26	1.45	66.57
IT	117	6.51	73.08
NL	161	8.95	82.04
PL	21	1.17	83.20
PT	16	0.89	84.09
SE	49	2.73	86.82
SI	8	0.44	87.26
UK	229	12.74	100.00
Total	1,798	100.00	

*Oversampled to include *all* national universities

If we regroup countries hosting the Europe's research universities into regional "university and innovation cultures", four seem reasonable: 1. **Nordic** (DK, FI, SE), 2.), **Mid-continent Core** (AT, BE, CH, DE, IE, NL, UK), 3. **Mediterranean** (FR, ES, PT, IT, GR), and 4. **EU-10** (CZ, HU, PL, SI). In general, we might expect respondents in the groups 3 and 4 to view university policies supportive of economic development and commercialization somewhat more favorably than the more economically successful countries (1 & 2). As can be seen in Table 8, Mediterranean university faculties are significantly *less* opposed to university policies aimed at regional economic development, while Mid-continent core faculties are significantly *more* opposed to university commercialization policies. Overall, European faculties are more favorably disposed toward university policies that help assist local regions than IP rights-holders.

Table 8: Faculty Attitudes by European Macro-Region

	Percent respondents who disagree or strongly disagree				
	Nordic (N=151)	Mid-Core (N=1177)	Med (N=333)	EU-10 (N=62)	ALL (N=1723)
*'My university should be actively and directly involved in assisting state and regional economic development'**	18.5	17.8	11.1	17.7	16.5

*'My university should be actively involved in the commercialization of university-based research'***	21.2	33.2	24.2	19.4	29.9

Chi-squares significant at 0.05* and 0.001**

The number of respondents varies among disciplines, with the most notable outlier being chemical engineering, which proved very difficult to sample within most university web-pages using standard nomenclature (data were not collected for European faculties of English or Political Science, whose U.S. results were known in advance to be largely redundant). Notable also is the comparatively high percentage of "Bohr" academicians in the basic sciences. Opposition to regional assistance policies within universities is least among engineers and economists and somewhat higher than average among physicists. The contrast among disciplines is stronger for university commercialization policies, with nearly half of all historians opposed but only about one-fifth of chemical engineers, the others hovering around the average. Overall, faculties in Europe's research universities are far more tolerant of policies geared to regional problems than those designed to exploit IP opportunities that arise in the course of academic duties.

Table 9: Faculty Attitudes by Academic Discipline

	Percent respondents who disagree or strongly disagree								
	Bio	**CS**	**Econ**	**Engr**	**Engl**	**Hist**	**Phys**	**PS**	**ALL**
	(N=430)	(313)	(224)	(65)	NA	(203)	(488)	NA	(1723)
*'My university should be . . . actively and directly involved in assisting in state and regional economic development'**	16.5	16.6	10.3	7.7	NA	17.7	20.3	NA	16.5
'My university should be actively Involved in the commercialization of university-based research'**	28.8	24.5	32.3	20.3	NA	45.5	28.1	NA	29.9

Chi-squares significant @ 0.01* and 0.001**

Faculty who have themselves sought patent protection of their intellectual property are far more accepting of both university policies, although even patent applicants favor regional development over commercialization objectives. Far more opposed to commercialization objectives are the vast majority of faculty who never applied for a patent, although their opposition drops nearly by half to policies that assist regional economic development.

Table 10: Faculty Attitudes by Previous Patenting Activity

	Percent respondents who disagree or strongly disagree	
	Patent Applicant (N= 70)	Not Patent Applicant (N = 1653)

*'My university should be actively and directly involved in assisting state and regional economic development'**	10.0	16.5
*'My university should be actively involved in the commercialization of university-based research'**	12.8	29.9

* Chi-square significant at 0.001

The European data also include several additional bits of information about university faculty that might bear on their views of university policies. We should report first that the composition of respondents by *gender* (81.6 male: 18.4 female) is of considerable relevance to inquiries about academic activities, since many women already balance domestic and university obligations with some difficulty and university efforts to expand their shares in scientific fields are actively pursued. It might therefore be expected that men's commercialization opportunities might be more favorable, thereby affecting their overall views of the appropriateness of such university policies.

For those respondents supplying information, about 2/3 held permanent contracts and another 30% were on limited contracts. The distinction between contracts corresponds roughly with the tenured vs. non-tenured faculty categories observed for the U.S. sample. Goldstein found no systematic relationship between levels of professor (Full +Associate~=permanent contract vs. Assistant~=limited contract) and their views concerning academic entrepreneurship issues. However, European contracts may differ more dramatically in universities since advancement to permanent contracts nearly always requires relocation to another university. This is quite unlike the case of U.S. universities where limited contracts on tenure tracks may be converted *in situ* to permanently tenured contracts if and when justified by high performance.

The respondents taught classes, conducted research and published findings, and provided uncompensated assistance to public and service institutions. Of the 1,533 respondents who taught in the past 2 years (265 did not), the median academic taught about 3 classes and published 4 peer-reviewed publication, of whom 174, or about 10%, published nothing. Less traditional activities, i.e. uncompensated public service on behalf of public stakeholders, were undertaken by 39% of responding academics. More than ¾ had recently published findings in scientific publications that were based on funded research projects.

While not yet traditional, the so-called 'third mission' of universities is said to consist of unpaid service to social and public institutions, NGOs and other professional organizations. Some have argued that unpaid service exacts an opportunity cost in terms of foregone academic prospects, which could reduce either teaching or research productivity. Engaging in unpaid public service may also lead academics to prefer that it—rather commercialization efforts—should be encouraged by university policies. On the other hand, the 39% of respondents who indicate they engage in active unpaid service are also in a position to assess potential opportunities for personal commercialization efforts or to judge economic development needs in their surrounding communities and that might benefit from university policies to stimulate the economic prospects of local firms.

Academic contact with commercial sectors might first arise when a university researcher serves on a collaborative team that includes at least one member from business and industry. The likelihood that expanded university-based academic entrepreneurship is acceptable should increase for scholars who have served on industry-member teams, which is about 47% of EU respondents. Somewhat fewer, about 1/3, have produced and submitted private reports or other studies based on firm-funded research projects. These characterizations of respondents indicate substantial contact with commercial sectors in the course of conducting routine academic functions, but they also offer an initial insight into one of the main questions explored in this paper: how entrepreneurially-inclined are EU academics (and how does this compare to U.S, academics)?

5. Explaining Variation in Attitudes in U.S. and European Universities

In the sections above we have examined patterns of faculty attitudes towards university involvement in economic development and commercialization activities generally from the U.S. and from the Europe using univariate and bivariate analyses. In order to identify which factors best explain the variation in attitudes in a multivariate analysis that allows us to control for other putative factors, we employ a set of ordered logit models.

5.1. The U.S. Case

In the U.S. analysis we combine the responses "strongly agree" and "agree" into a single category, and likewise combine "strongly disagree" and "disagree". This gives us three ordinal categories for the responses on the attitudinal questions directed towards the two dimensions of academic entrepreneurship. The responses to each of these constitute our two dependent variables. Also, we have eliminated faculty respondents from English and political science in order to be more consistent with the European study population. This gives us a usable N = 368.

The independent variables come from four groups which the extant literature and our prior exploratory research suggest may be significant.

In the first group we have a set of individual faculty characteristics. These include academic rank (full or associate professor versus assistant), amount of academic experience (years since terminal degree), scholarly discipline, research productivity (average amount of external funded research), proportion of total research funding from private industry sources, and previous experience in academic entrepreneurship (previously submitted a patent application). We expect more favorable attitudes towards academic entrepreneurship to be associated with younger faculty, with higher proportion of industry-funded research, and with previous patenting activity. The expected sign on research productivity is ambiguous. It can be argued, on the one hand, there is a trade-off between conducting funded research and technology development in terms of time allocation, and also that the most prolific researchers adopt norms that are consistent with

open science and would shun commercialization. On the other hand, every time we write and submit a research proposal we are acting entrepreneurially, and that many of the most successful researchers are those that have a different set of norms from the Mertonian ones.

The second group of variables are characteristics of the particular institutions of higher education where the faculty members are employed: the research intensity of the university (Carnegie classification), ownership and land-grant status, whether the institution is a member of the American Association of Universities (AAU), the university's Shanghai ranking, and the proportion of total R&D expenditures the university receives from industry sources. This last variable should capture the overall entrepreneurial 'climate' of the particular institution. The differences in the mission statements and the degree of dependence of revenue from state (and sometimes local) governments suggests that faculty from land-grant institutions would be most in favor of academic entrepreneurship, followed by public non-land grant and then private institutions. We suggest that higher research intensity, membership in the AAU, and higher levels of the Shanghai ranking will be *negatively* associated with favorable attitudes towards academic entrepreneurship: here basic, scholarly research is still held in the highest esteem in the reward structures, including criteria for promotion and tenure, and where the norms of open science is most deeply entrenched.

The third set of variables describes the economic conditions of the region in which the university is located. These factors deserve some discussion here as they were not included in the descriptive analysis in the earlier part of the paper.

Our first hypothesis revolves around regional economic needs. That is, faculty will be more in favor of academic entrepreneurship when the region is in economic distress and/or is undergoing economic restructuring. Why and through what 'mechanisms' should faculty attitudes be affected by such conditions? There are at least two that are suggested. The first would be through a sense of the moral obligation to work for the common good, and that universities as an important institution in the knowledge-based economy have an important role to play in improving the long-term economic well-being of the region and the state. It is associated with the re-emergence and strengthening of the 'engagement role' coming out of the tradition of public service as one of the three key missions among many institutions of higher education in the U.S. This motivation may be stronger in public rather than private universities. The second mechanism would be through a set of incentives or institutional policies that reward faculty engaging in entrepreneurship. Here, state legislatures and statewide public university governing boards may put pressure on individual campus administrations to become more entrepreneurial in the transfer of knowledge production to commercialization in the form of innovation, new businesses, and new jobs. University administrators then may change the reward and incentive structures and budgetary allocations to try to change faculty behavior accordingly.

The second hypothesis on the relationship between faculty attitudes and regional economic factors revolves around the interest (demand) for university-based research with commercialization potential from industry in the region. The greater the 'match' between university R&D assets and the sectors located in the region that can benefit from those assets, the more likely individual faculty might want to become engaged in academic entrepreneurship. Also, the concentration of private industry R&D provides an indication of the region's absorptive capacity; When there is regional private industry interest and absorptive capacity, faculty engagement may come about in a variety of ways: from industry R&D establishments employing faculty as consultants, private industry funding of faculty research, joint university-industry research projects, the sharing of lab facilities and specialized equipment, or the employment of graduate students as interns (or eventual full-time workers).

Table 11
Hypothesized Relationships

Label	Independent Variable	Expected Signs	
chemeng	Chemical engineering discipline (1/0)	+	+
econ	Economics discipline (1/0)	?	?
phys	Physics discipline (1/0)	+	+
bio	Biological sciences discipline (1/0)	+	+
compsci	Computer science discipline (1/0)	+	+
assoc and full	Associate or full faculty rank (1/0)	-	-
exp0-14	Terminal degree within last 14 years (1/0)	+	-
exp15-29	Terminal degree between 15-29 years ago (1/0)	+	+
q20_yn	Funding from private industry in last 3years (1/0)	+	+
q21_ yn	Consulting for private industry in last 3 years (1/0)	+	+
q22_med	Avg. annual research funding, $10K-99K (1/0)	?	?
q22_high	Avg. annual research funding, $100K or more (1/0)	?	?
q23_low	% research funding from priv ind, GT 0 but LT 25.0 (1/0)	+	+
q23_high	% research funding from priv ind, 25.0 or more	+	+
q24_yn	Previous patent applicant (1/0)	+	+
q2_univtype	Private university (1/0)	-	-
aau	University is AAU member (1/0)	-	-
sh1-50	University in top 50 Shanghai rankings (1/0)	-	-
sh51-100	University in 51-100 Shanghai rankings (1/0)	-	-
sh101-200	University in 101-200 Shanghai rankings (1/0)	-	-
sh201-300	University in 201-300 Shanghai rankings (1/0)	-	-
sh301-400	University in 301-400 Shanghai rankings (1/0)	-	-
sh401-500	University in 401-500 Shanghai rankings (1/0)	-	-
researchtype	University second tier research intensity (Carnegie) (1/0)	+	+
indtotrd	% university's total research exp from private industry	+	+
pcpy06	Regional per capita personal income, 2006	-	?
lq06	Manufacturing location quotient, region, 2006	+	?
lqchange	Change in mfg location quotient, 2001-06	+	?

ue06	Average monthly unemployment rate, region, 2006	+	?
totempchange	Regional employment growth rate, 2001-06	-	?
indrdoutput	Industry R&D spending as proportion of total output, state	+	?
layoffs	Mass layoffs as % of total employment, state, 2005	+	?
bio_x_indtotrd	Interaction of of biology with industry R&D spending	+	?
q9 dummy (proprietary)	Agreement with univ policy to encourage proprietary research	-	+
q16 dummy (delay)	Agreement with allowing delays in circulation of research results	-	+

Unfortunately it is not easy to find variables that measure all of these factors or mechanisms. The regional variables we include (and the sign of their expected relationship to faculty favoring academic entrepreneurship): total employment change, 2001-2006(-); manufacturing location quotient, 2006 (+); change in manufacturing location quotient, 2001-2006 (+); average monthly unemployment rate, 2006 (-); per capita personal income, 2006(-); the incidence of mass layoffs, statewide 2006(+); and the share of total state R&D performed by industry, statewide 2006 (+). The degree of matching of R&D assets in universities and industry sectors in the region is indirectly measured by creating a set of interaction variables of the faculty member's discipline (for biology, chemical engineering, and computer science) with state industry R&D spending as a proportion of industry output. These interaction variables were included in the model specifications but were subsequently deleted because they were not statistically significant.

Our fourth type of explanatory variables attempt to capture the extent of the faculty member's commitment to the Mertonian norms of open science. This is measured by attitudinal responses to the questions of whether (i) the 'university should encourage and reward faculty to engage in proprietary research with industry funding', and (ii) whether it is appropriate if 'scholarly findings are delayed for circulation and peer review for six months in order to benefit the private industry source'. We hypothesize that the stronger the commitment to the norms of open science, the lower the agreement with university involvement in commercialization generally speaking, but a higher agreement with university involvement in assisting economic development. The models are estimated with and without these two independent variables.

Table 11 lists the full set of independent variables and the hypothesized direction for both of the dependent variables. The results of the ordered logit models for each of the dependent variables for the U.S. case are shown in Tables 12 and 13. [11]

Both sets of models are significant, though the overall goodness-of-fit measures as indicated by the pseudo-R^2, are in the 0.17-0.19 range. We discuss the reasons for the relatively low explanatory power of the models below.

[11] Attitudes towards faculty entrepreneurship are entered as ordinal variables with the highest number being more favorable and the lowest number being least favorable.

In general, the individual and institutional variables are more important than regional economic factors in explaining the variation on the dependent variables. For attitudes about whether the university should be engaged in regional economic development, academic discipline[12] (except for economics) does not matter, but individuals' previous patenting activity and attitudes towards open versus proprietary science are significant. The degree of research intensity and one of the Shanghai ranking categories are significant and positively related: less research intensity and lower ranking are associated with a more favorable attitude towards university engagement in regional economic development. The only regional variable significant in this model is the dummy for the Midwest, which is negatively associated with university engagement in economic development.

In the model to explain variation in attitudes towards universities being involved in commercialization, academic discipline and individual attitudes towards open versus proprietary science are important factors. After controlling for the latter, previous patenting activity is not significant in this model. The concentration of mass layoffs in the state is the only significant regional variable and strongly related to the dependent variable. Institutional characteristics (except for one Shanghai category) are not significant here.

Neither academic rank nor number of years since receiving the terminal degree are significant in either of the models. Whether the faculty member has recently received private industry funding is not significant in either model; neither is whether the faculty member has recently consulted with private industry or the faculty member's share of externally funded research coming from private industry sources significant after controlling for other factors.

The relationship between overall research productivity and entrepreneurship has been of special interest to those studying academic entrepreneurship. Our results indicate there is no relationship between research productivity, as measured by average annual total external research funding and attitudes towards universities being engaged in economic development or commercialization more generally.

The proportion of the university's total R&D expenditures from private industry sources – an indicator of the 'entrepreneurial climate' of the university – was not significant in either model. This result, combined with the lack of significance of an individual faculty member's reliance on income or research funding from private industry, suggests that economic incentives are not important in explaining attitudes towards university engagement in economic development or commercialization.

As we mentioned above, regional economic conditions, in general, are not important factors in either model, with the one exception of the incidence of mass layoffs – an indicator of the need

[12] History is the default nominal discipline category.

for regional economic restructuring – and favoring the university to be actively involved in commercialization. It is surprising to us that the incidence of mass layoffs would not also be significant in explaining attitudes towards the university being engaged in regional economic development.

Table 12. Ordered logit results, U.S.: "My university should assist state and regional development . . ."

```
Iteration 0:   log likelihood = -330.81373
Iteration 4:   log likelihood = -274.18521

Number of obs   =        368
LR chi2(39)     =     113.26
Prob > chi2     =     0.0000
Log likelihood  =    -274.19     Pseudo R2       =     0.1712

------------------------------------------------------------------------------
        q4_3 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     chemeng |  -.3372242   .5321535    -0.63   0.526    -1.380226    .7057774
        econ |  -.7842068   .3947449    -1.99   0.047    -1.557893   -.0105209
        phys |   .6738076   .5021362     1.34   0.180    -.3103612    1.657976
         bio |  -.0803395   .4580127    -0.18   0.861     -.978028     .817349
     compsci |    .419047   .5126615     0.82   0.414    -.5857512    1.423845
assoc_and_~l |  -.3824526   .3599378    -1.06   0.288    -1.087918    .3230125
      exp014 |  -.3795168   .3722524    -1.02   0.308    -1.109118    .3500844
      exp1529 |   .3443597   .3648557     0.94   0.345    -.3707443    1.059464
   q20_yn_01 |  -.2137513   .5493781    -0.39   0.697    -1.290513    .8630101
   q21_yn_01 |   .2930424   .3007592     0.97   0.330    -.2964348    .8825197
     Q22_med |  -.4227902   .3364809    -1.26   0.209    -1.082281    .2367003
    Q22_high |  -.4481589   .3926092    -1.14   0.254    -1.217659    .3213411
     q23_low |  -.2184673   .5302466    -0.41   0.680    -1.257732    .8207969
    q23_high |  -.4621356   .5634597    -0.82   0.412    -1.566496    .6422251
   q24_yn_01 |   .7836968   .3693864     2.12   0.034     .0597128    1.507681
 q2_univtype |   -.335785    .185344    -1.81   0.070    -.6990526    .0274826
         aau |   .2885497   .6235129     0.46   0.644    -.9335132    1.510613
       sh150 |   .0350403   1.351668     0.03   0.979    -2.614181    2.684261
     sh51100 |   .8897072   1.252223     0.71   0.477    -1.564605    3.344019
    sh101200 |   .9092346   .9632807     0.94   0.345    -.9787609     2.79723
    sh201300 |    .756514   .8286901     0.91   0.361    -.8676888    2.380717
    sh301400 |   .6945403   .6248825     1.11   0.266    -.5302069    1.919288
    sh401500 |   1.238966   .6779062     1.83   0.068    -.0897055    2.567638
researchty~n |    .940673   .7472013     1.26   0.208    -.5238146    2.405161
    indtotrd |    1.36944   3.067541     0.45   0.655    -4.642831    7.381711
      pcpy06 |  -.0125459   .0088314    -1.42   0.155    -.0298552    .0047633
        lq06 |  -.2953819   .4669327    -0.63   0.527    -1.210553    .6197892
    lqchange |  -.4287097   1.399629    -0.31   0.759    -3.171933    2.314513
        ue06 |   .0215312   .2260738     0.10   0.924    -.4215653    .4646278
totempchange |  -3.250429   3.503587    -0.93   0.354    -10.11733    3.616476
indrdou~2005 |   .2069617   .1495897     1.38   0.167    -.0862288    .5001521
     layoffs |  -4.259344   42.91432    -0.10   0.921    -88.36987    79.85119
  q9_dummy_1 |  -1.164445   .3463591    -3.36   0.001    -1.843296   -.4855935
  q9_dummy_3 |  -.7849489   .3686583    -2.13   0.033    -1.507506   -.0623919
 q16_dummy_1 |   -1.02217   .4576437    -2.23   0.026    -1.919136   -.1252053
 q16_dummy_3 |  -.8658838   .4922147    -1.76   0.079    -1.830607    .0988392
  cregion_mw |  -.8037302   .4757194    -1.69   0.091    -1.736123    .1286626
  cregion_ne |  -.6125636   .4877303    -1.26   0.209    -1.568497    .3433703
cregion_so~h |   .1804833   .4420736     0.41   0.683    -.6859649    1.046932
```

```
-------------+------------------------------------------------------------------
       /cut1 |  -5.420446   1.931497                      -9.20611   -1.634781
       /cut2 |  -3.830007   1.919875                     -7.592892    -.067122
------------------------------------------------------------------------------
```

Table 13. Ordered logit results, U.S.: "My university should be involved in commercialization . . ."

```
Iteration 0:   log likelihood = -369.53051
Iteration 4:   log likelihood = -301.57597

Number of obs   =        368
LR chi2(39)     =     135.91
Prob > chi2     =     0.0000
Log likelihood  =    -301.57      Pseudo R2       =     0.1839

------------------------------------------------------------------------------
        q6_3 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     chemeng |   .5102145   .5008759     1.02   0.308    -.4714842    1.491913
        econ |   .9811845   .3867621     2.54   0.011     .2231447    1.739224
        phys |   1.417084    .449453     3.15   0.002      .536172    2.297995
         bio |   .9113505   .4360262     2.09   0.037     .0567549    1.765946
     compsci |   1.123145   .4608795     2.44   0.015     .2198376    2.026452
assoc_and_~l |   .0745708   .3460942     0.22   0.829    -.6037614     .752903
      exp014 |  -.3680144   .3582073    -1.03   0.304    -1.070088    .3340589
     exp1529 |  -.3442817   .3537536    -0.97   0.330    -1.037626    .3490626
   q20_yn_01 |   .0716671   .5187365     0.14   0.890    -.9450377    1.088372
   q21_yn_01 |   .4494411   .2906137     1.55   0.122    -.1201512    1.019033
     Q22_med |  -.2215463   .3055563    -0.73   0.468    -.8204256     .377333
    Q22_high |   .5580109   .3643303     1.53   0.126    -.1560634    1.272085
     q23_low |  -.5307877   .5105983    -1.04   0.299    -1.531542    .4699666
    q23_high |   .1203855   .5422949     0.22   0.824     -.942493    1.183264
   q24_yn_01 |   .5233248   .3557361     1.47   0.141    -.1739051    1.220555
 q2_univtype |   .0694846   .1769054     0.39   0.694    -.2772437    .4162129
         aau |   .1543399   .5845619     0.26   0.792    -.9913804     1.30006
       sh150 |  -1.266675   1.195491    -1.06   0.289    -3.609795    1.076445
     sh51100 |  -.4621038   1.090376    -0.42   0.672    -2.599202    1.674995
    sh101200 |  -.7473719   .7842484    -0.95   0.341    -2.284471    .7897267
    sh201300 |  -1.214502   .6901625    -1.76   0.078    -2.567196    .1381912
    sh301400 |  -.3511188   .5354087    -0.66   0.512    -1.400501    .6982631
    sh401500 |   .0302496   .5482989     0.06   0.956    -1.044396    1.104896
researchty~n |  -.8629302   .5863481    -1.47   0.141    -2.012151     .286291
    indtotrd |  -4.030027    3.04168    -1.32   0.185     -9.99161    1.931555
      pcpy06 |   .0030122   .0083992     0.36   0.720    -.0134501    .0194744
        lq06 |   .4563662   .4332895     1.05   0.292    -.3928657    1.305598
    lqchange |  -1.324603   1.278059    -1.04   0.300    -3.829552    1.180347
        ue06 |  -.2730831    .201529    -1.36   0.175    -.6680727    .1219065
totempchange |   2.499025   3.364698     0.74   0.458    -4.095662    9.093712
indrdou~2005 |  -.1053305   .1506504    -0.70   0.484    -.4005999     .189939
     layoffs |      149.4   41.96717     3.56   0.000     67.14585     231.6541
  q9_dummy_1 |  -1.807134   .3285152    -5.50   0.000    -2.451012   -1.163256
  q9_dummy_3 |  -1.110405   .3486108    -3.19   0.001    -1.793669   -.4271401
 q16_dummy_1 |  -.6647057   .3949062    -1.68   0.092    -1.438708    .1092961
 q16_dummy_3 |  -.5833613   .4388755    -1.33   0.184    -1.443541    .2768187
  cregion_mw |   .1885987   .4708008     0.40   0.689     -.734154    1.111351
  cregion_ne |   .1251066   .4681236     0.27   0.789    -.7923989    1.042612
cregion_so~h |   .5869062     .42754     1.37   0.170    -.2510567    1.424869
-------------+----------------------------------------------------------------
       /cut1 |  -2.438624   1.727403                     -5.824272    .9470237
       /cut2 |  -1.255017   1.723263                     -4.632549    2.122516
------------------------------------------------------------------------------
```

5.2. The EU Case (preliminary results)

The ordered logit models to explain variation in attitudes towards university engagement in regional economic development and commercialization activities generally in the case of EU faculty are presented in tables 14 and 15 **[note: a table with variable definitions and expected signs will be added].** The overall explanatory power of the models for the EU is somewhat lower compared to the models for the U.S.

In regards to explaining attitudes towards whether the university should be engaged in regional economic development, attitude towards open science versus proprietary science are highly significant and the strongest factors. Academic discipline matters but only in physics and biology (the Bohr disciplines), while having had private industry research funding is positively related to favoring university engagement in economic development. On the other hand, institutional factors and regional economic conditions are not as important: being in a Shanghai top 50 university and an increase in the concentration of regional manufacturing employment are both negatively related to the dependent variable. .

Whether the faculty member has a permanent appointment is not related nor is the number of years since receiving the terminal degree. Neither having had recent consulting activity with private industry nor previous patenting activity is related to the dependent variable.

In the model to explain the variation of faculty attitudes towards universities being involved in commercialization, the individual factors are again the strongest, including attitudes towards open science, academic discipline (computer science added to biology and physics), and experience having had research funding from private industry as well as consulting work with private industry. The regional economic conditions that are related to the dependent variable are change in GDP per capita (2001-2006) in the NUTS3 region (positive) and the unemployment rate in the NUTS3 region (also positive).

Though there is a lot of unexplained variation in attitudes towards both activities, the differences between the two models in terms of which variables are significant are small. For both engaging in regional economic development and in commercialization, individual attributes of the faculty member are much more important than institutional factors or regional economic conditions.

Table 14. Ordered logit results, EU: "My university should assist state and regional development . . ."

```
Iteration 0:   log likelihood = -1184.3773
Iteration 4:   log likelihood = -1036.4572

Number of obs   =      1272
LR chi2(23)     =       295.84
Prob > chi2     =         0.0000
Log likelihood  =   -1036.4572     Pseudo R2       =     0.1249

------------------------------------------------------------------------------
q18a_135_rev |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    Contract |  -.0569044   .1535678    -0.37   0.711    -.3578917     .244083
     exp0_14 |  -.0150464   .2030628    -0.07   0.941    -.4130421    .3829493
    exp15_29 |   .2069923   .2012535     1.03   0.304    -.1874573    .6014419
companies_01 |   .3931019   .1611675     2.44   0.015     .0772193    .7089844
  consult_01 |   .5809483   .5003888     1.16   0.246    -.3997957    1.561692
   patent_01 |   .0099571   .3429199     0.03   0.977    -.6621535    .6820677
       sh150 |  -.5464528   .2732427    -2.00   0.046    -1.081999   -.0109068
     sh51100 |  -.3518905   .2137536    -1.65   0.100    -.7708399    .0670589
    sh101200 |  -.1185657   .1682091    -0.70   0.481    -.4482494     .211118
    sh201300 |   .0042282   .1934719     0.02   0.983    -.3749698    .3834262
dat3_gd~2006 |  -.0002462   .0007828    -0.31   0.753    -.0017806    .0012881
   lqmfg2007 |  -.1807331     .21387    -0.85   0.398    -.5999105    .2384444
    lqchange |  -1.246395   .8817032    -1.41   0.157    -2.974501     .481712
ltu_une~2006 |   .0257601   .0358879     0.72   0.473    -.0445789    .0960991
dat3_dgdpk~6 |   1.194715   .7905411     1.51   0.131    -.3547172    2.744147
dat3_ue~2007 |   .0027798   .0021269     1.31   0.191    -.0013887    .0069484
disc_chemeng |  -.2563733    .385186    -0.67   0.506    -1.011324    .4985774
   disc_econ |   .2638601   .2413915     1.09   0.274    -.2092585    .7369788
   disc_phys |  -.4777201   .2022169    -2.36   0.018     -.874058   -.0813822
    disc_bio |  -.3097249    .205478    -1.51   0.132    -.7124545    .0930047
disc_compsci |  -.0742572   .2334682    -0.32   0.750    -.5318464    .3833321
 q18d_12_rev |  -2.129437   .1546354   -13.77   0.000    -2.432517   -1.826357
  q18d_3_rev |   -1.00807   .1511899    -6.67   0.000    -1.304396   -.7117429
-------------+----------------------------------------------------------------
       /cut1 |  -2.787954   .4335587                     -3.637714   -1.938195
       /cut2 |  -1.519706   .4277591                     -2.358098    -.681313
------------------------------------------------------------------------------
```

Table 15. Ordered logit results, EU: "My university should be involved in commercialization . . ."

```
Iteration 0:   log likelihood = -1329.5265
Iteration 4:   log likelihood = -1172.5532

Number of obs   =       1272
LR chi2(23)     =        313.95
```

```
Prob > chi2     =         0.0000
Log likelihood  =    -1172.5532     Pseudo R2       =     0.1181

------------------------------------------------------------------------------
q18f_135_rev |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    Contract |   .0464735   .1445468     0.32   0.748      -.236833      .32978
     exp0_14 |  -.0319802   .1884194    -0.17   0.865     -.4012754    .3373151
    exp15_29 |   .0133534   .1847681     0.07   0.942     -.3487854    .3754923
companies_01 |   .4600959   .1462134     3.15   0.002      .173523    .7466688
  consult_01 |   .9861243   .4672648     2.11   0.035      .0703021   1.901947
   patent_01 |   .0513772   .3257482     0.16   0.875     -.5870776     .689832
       sh150 |   .3124941   .2674516     1.17   0.243     -.2117013    .8366895
     sh51100 |   .0448137   .2079431     0.22   0.829     -.3627474    .4523748
    sh101200 |  -.3152823    .157635    -2.00   0.045     -.6242412   -.0063234
    sh201300 |  -.1045787    .175595    -0.60   0.551     -.4487385    .2395811
dat3_gd~2006 |  -.0008373   .0007267    -1.15   0.249     -.0022616    .0005871
   lqmfg2007 |  -.0145014   .1953995    -0.07   0.941     -.3974773    .3684746
    lqchange |  -.5323205   .8168041    -0.65   0.515     -2.133227    1.068586
ltu_une~2006 |  -.0511571   .0336688    -1.52   0.129     -.1171466    .0148325
dat3_dgdpk~6 |   1.425161   .6971159     2.04   0.041      .0588386    2.791483
dat3_ue~2007 |   .0032331   .0018003     1.80   0.073     -.0002955    .0067617
disc_chemeng |   .2168763   .3463545     0.63   0.531      -.461966    .8957185
   disc_econ |   .2833443   .2176286     1.30   0.193     -.1431999    .7098885
   disc_phys |   .5769187   .1926536     2.99   0.003      .1993245    .9545128
    disc_bio |   .6362373   .1955699     3.25   0.001      .2529274    1.019547
disc_compsci |   .5957455   .2157052     2.76   0.006      .1729711     1.01852
 q18d_12_rev |  -2.037618   .1482403   -13.75   0.000     -2.328164   -1.747073
  q18d_3_rev |   -.873011   .1379071    -6.33   0.000     -1.143304   -.6027181
-------------+----------------------------------------------------------------
       /cut1 |  -1.350972   .3963607                     -2.127825   -.5741196
       /cut2 |  -.2534142   .3943183                     -1.026264    .5194355
```

6. Conclusions

The empirical results allow us to make comparisons about: (1) differences in attitudes towards universities being engaged in economic development versus universities being engaged in commercialization, and (2) differences between the attitudes of faculty in the U.S. and in the EU towards the same two university activities.

Our starting hypotheses included: (a) faculty members make distinctions between engagement in regional economic development (legitimate) and commercialization (less legitimate); (b) regional economic conditions matter, in that faculty in regions undergoing restructuring or in greater chronic economic distress would have more favorable attitudes towards university engagement in economic development; and (c) faculty in the EU would have more favorable attitudes towards both university engagement in economic development and in commercialization, because of greater pressure in the EU for catch-up in global competitiveness.

The descriptive results indicate that there is a distinction in faculty attitudes towards university engagement in economic development and in commercialization (see Table 16). Attitudes towards the former are considerably more positive than attitudes towards the latter, on both sides of the Atlantic. We interpret this as regional economic development is perceived as a societal responsibility of higher education institutions in the globalized, knowledge economy, and does *not* represent a conflict of interest with its primary missions of teaching and knowledge creation/dissemination.

Second, however, the logit model results show that after controlling for other factors, regional economic conditions in general are not related to the attitudes towards either university engagement in economic development or commercialization, and this is true for both the U.S. and the EU. Indeed, by far the most important factors are individual faculty attributes.

Third, faculty attitudes towards university engagement in economic development and commercialization, in terms of percentage in that disagree or strongly disagree, are respectively remarkably close, overall, though there are salient differences when we look at more disaggregated groups of faculty.

Table 16 Percentage of faculty respondents disagreeing or strongly disagreeing

Activity	U.S.	EU
Universities involved in assisting regional economic development	14.9	16.5
Universities involved in commercialization of research	32.5	30.0

We intuited from the descriptive analysis that discipline matters a lot in faculty attitudes towards academic entrepreneurship, though its importance diminished when controlling for other factors. Whether the discipline is important (as evidenced by relatively low internal heterogeneity in attitudes) because of the differential opportunities to engage in some form of commercialization activity across disciplines, or because of differences in the norms of 'doing' science and scholarship often learned in graduate school through socialization, cannot be easily gauged with the data available to us. But our results provide support to the notion that the discipline as a loose form of organization and community seems to be more important than the particular university's overall entrepreneurial climate. One important source of dilution of the importance of discipline in the ordered logit models was introduction of the attitudinal variable towards open science versus proprietary knowledge. This was a strong explanatory factor and highlights that individual ideological convictions outweigh institutional and regional factors.

We ask, for both the U.S. and the EU, why is only a relatively small amount of the variation in attitudes towards academic entrepreneurship explained by the set of explanatory variables. First, responses to attitudinal questions vis a vis actual behavior are probably more subject to lower levels of reliability, and thus introducing 'noise'. This is one reason why we collapsed the original five categories measured on the Likert scale to three categories for the regression models. Second, the variation in the attitudes towards some of the entrepreneurship dimensions is small; i.e., a large proportion of faculty respondents had the same attitude on whether the university should assist state and regional economic development (61.8 percent for the U.S.),

That the regional economic conditions are not important factors in faculty attitudes perhaps should not be that surprising. University faculty are members of *multiple* communities, including the invisible (and increasingly global) college of their discipline, their university, their department or institute or research center, and, as citizens their city, state, nation, and world. One's attitudes towards academic entrepreneurship no doubt come from multiple influences, and some of these come early in the socialization process of a graduate student. We are not claiming that attitudes remain fixed during one's career, but that current economic conditions and needs of a state or region are not likely to shift attitudes *in situ*, even if accompanied by policies and incentives intended to change faculty behavior. Another possible interpretation is that faculty are self-selective in choosing their institutional affiliations: those most inclined to be 'entrepreneurial' will have a preference for working at an institution that has an entrepreneurial culture. But the development of an entrepreneurial culture within universities probably is not strongly influenced by regional economic conditions (e.g., Stanford University is hardly in a chronically distressed regional location). Our results do not provide evidence for this view – our measure of universities' entrepreneurial culture in the U.S. case was not significant – but this hypotheses should be pursued with additional data.

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