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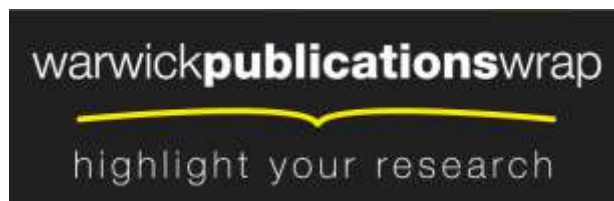
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5. University involvement in wine region development: a comparative case study between Universidad de Talca (Chile) and Universidad de Cuyo (Argentina)

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1. Introduction

Since 1980s the concept of ‘national system of innovation’ has emerged to study the linkages between firms, organizations and knowledge creation institutions (Freeman, 1987; Lundvall, 1992, 2002). The conception of the innovation system is based on several assumptions. One assumption considers that key elements of the knowledge base are highly localized. Another assumption is that the interactive nature of the innovation process means that it is socially embedded. As a consequence of both the localized nature of the knowledge base and the socially embedded context of the interactive learning process, systems of innovation differ significantly in terms of their capacity for capitalizing on new sources of knowledge and their productive capabilities (Feldman et al, 2006). Cooke (1992, 2001) coined the term ‘regional system of innovation’ to describe the systems of innovation localized in a region, a level below the national system of innovation that might have cultural or historical

homogeneity and where localized economic development can be identified. However, regional systems of innovation differ in their level of development.

Schiller (2006) suggests that in nascent innovation systems in developing countries like Argentina and Chile it is more important to learn how to assimilate and improve existing technologies rather than to generate new ones, since many technologies are often only new to the local firms. In this situation universities can become important actors in emerging regional innovation systems (Giuliani and Arza, 2009). In this role universities provide for qualified workforce, locally adapted research, appropriate services and technologies for their regional stakeholders. By doing this universities are at the same time enhancing the absorptive capacity of the regional system of innovation and directly supporting technological change and development for less resourceful small to medium firms, which may not have technological capabilities as developed as large firms. In this way universities can have an important role in the economic development of their regions through networking processes that connect university with industry. However, there is relatively little awareness by university managers and regulators about the specific roles and techniques universities employ to participate in regional economies and promote their development; what universities are actually doing in this regard; and how to manage their involvement better (Gray, 1999; Rowley et al, 1997). Our goal is to address this gap between general public expectation and detailed management techniques of university involvement with regional industries. We focus on definition and measurement of linkages between universities and industries, following the suggestions of Cano (1998) and Lang and Zha (2004) to propose indicators aimed at measuring the existence of these links that can be comparable across countries and regions. The goal of this chapter is to contribute to the literature on management of

the involvement of universities in regional development through linkages and to provide policy implications for university managers, higher education policy makers, local government officials and regional industry associations on this area.

This chapter applies the proposed measurement framework to two universities located in wine producing regions in Argentina and Chile. In the case of Argentina, the paper assesses the role of Universidad de Cuyo located in the heart of Mendoza, the largest Argentinean wine-producing region. In the case of Chile, the paper reviews the role of Universidad de Talca located in the Maule Valley, one of the largest wine-producing regions in Chile. The universities were chosen because they are regional universities embedded in the wine region, which is one of the conditions for localized regional systems of innovation. The chapter is structured as follows. First, there is a conceptual design of the measurement framework. Second, the context of comparative case studies is presented. Third, methodology and resulting indicators are discussed. Finally, conclusions and policy implications are provided.

2. A measurement framework for linkages between industry and university

Godin (2005) points out in his thorough study of the history of science and technology indicators that measurement systems are intimately tied to social values and political objectives, in their design, operation and interpretation. They are not neutral, nor entirely objective and never extremely accurate. Sometimes they invent and define issues that have not necessarily existed before and stakeholders to advance their own social or economic agendas use them. For example, using indicators to create systems of ranking against ‘leaders’ or ‘best practice’ is an exceptionally powerful application, as in the case of the business school rankings developed by the media. Unfortunately

this comes at the price of significant and often misleading oversimplification (Rappoport et al, 2004) and can cause very negative distortions to university strategy. The benchmarking and quality improvement literature is much more sophisticated in its application of indicators than the media, of course, and its focus on alignment and process helps overcome many of these criticisms (Phipps, 2000; Bender and Schuh, 2002). Doerfel and Ruben (2002) show that performance measurement and benchmarking applied to higher education is an emerging field and most feasible for mature areas like teaching, research and employee management but it is still difficult for new areas like university-industry linkages and regional development involvement.

2.1. The role of universities in regional systems of innovation

In recent years the traditional research and teaching missions of universities have been extended to direct interactions with regional stakeholders (Etzkowitz, 2001).

Universities and public research organizations became important knowledge sources in regional innovation systems and partners in industrial innovation processes. The essence of this process resides in the linkages that are being built between universities and industry (Giuliani and Arza, 2009). There are two models of university involvement in regional development. First, the generative role serves regional needs directly by providing boundary-spanning activities like incubators and science parks (Schiller, 2006). Second, a developmental role consists of adjusting research and teaching activities to regional needs (Lundvall, 2002; Etzkowitz, 2001). In any case, universities can take over a broader developmental role at the regional level since academic or even administrative autonomy of universities allows them to respond to

the regional needs more efficiently through long-term relationships with local actors (Boucher et al., 2003). University-industry linkages vary in their degree of institutionalization, which may range from the informal hiring of professors and ad-hoc services, to long-term partnerships and joint research centers (Giuliani and Arza, 2009). In this exploratory study, we concentrate on defining the performance measures of the following activities related to the level of engagement of universities in the development of their regions:

➤ Training

The OECD (1999) has recommended that new universities should be created with the explicit, central mandate to promote regional development through training people (Boucher et al., 2003; Karlsson and Johansson, 2006). In the case of the wine industry, the increasing complexity of wine making processes implies the need to train people in sophisticated processes. Similarly, the use of diverse grape varieties, in many cases exogenous to those regions, also implies more sophisticated viticulture practices, including the knowledge of new varieties from different countries. Therefore training activity is key to enhance the capability of the region to absorb new knowledge and generate solutions to production problems.

➤ Research

The role of developing and transferring knowledge is the subject of intense ongoing research. Gibbons et al. (1993) claim that the university is no longer the dominant institution developing knowledge. Nevertheless, Godin and Gingras (2000) show that the university is still a major source of economically important knowledge produced through R&D. University's engagement in research should be considered in the context of the industry. For example, R&D processes in

natural resource-based industries may follow two paths (Coenen et al., 2006): R&D processes that occur inside large multinational corporations, or research institutes with close ties to industry that are established in regions where the natural resources are exploited. In the first case, regional universities can be powerful engines for attracting R&D activities from multinationals. In the second case, regional universities can offer their facilities and faculty for establishing research institutes to investigate local specific problems in wine production, which in turn may generate patents related to solutions to wine production issues in different regions. For example, universities can perform research in fermentation technology and enzyme technology (Fleet, 1993) as well as controlling grape vine growth rates.

➤ Consulting/servicing

Mowery (2007) stresses that faculty consulting, although undocumented and underemphasized by universities, is generally regarded by industry as significantly more important for knowledge transfer than patents. In this case, the motivation of the industry is to solve immediate problems or realize opportunities (Arvanitis et al., 2005). Looking at the relationships between universities and industry from this point of view, there is another activity similar to consulting, which is laboratory and testing services (Arvanitis et al., 2005; Lester, 2003). Laboratory services are examples of outsourcing functions strongly based on knowledge, which require investments that exceed the available resources of small and medium enterprises (SMEs). In the case of the wine industry, winemaking activities require numerous tests that make economic sense to be performed in a central location with specialized people like in universities.

➤ Facilitating linkages

Lawton-Smith (2006) and Lester (2003) examine different forms by which interaction takes place between universities and industry, stressing, among others, commercial ventures by universities and commercial activities by academics, technicians and students. Karlsson and Johansson (2006) find that entrepreneurship is an essential input to the growth of regions and, in turn, dynamic functional regions develop a number of entrepreneurs. Universities can play a role of a multi-disciplinary ‘honest broker’ to build social capital in a region (Cooke 2002). Yusuf and Nabeshima (2007) assert that universities should consider building local innovation systems as central to their missions to promote the development of the region. The formation of linkages also depends on the strength of firms’ knowledge base (Giuliani and Arza, 2009), so the formation of linkages strongly depends on the fulfillment of the training and research roles of the regional universities. In a wine region, universities can support the development of communities of practice around specific issues like soil conservation.

2.2. The measurement framework

There is always a difficult tradeoff between accuracy and feasibility of obtaining the information, and completeness and parsimony that can be used for theory testing (Arthurs et al., 2009). However, the starting point for designing a measurement framework should be the functionality desired. The literature discussed above has suggested many actions (for example, selling licenses, teaching entrepreneurship). For each activity selected for the framework, we have one or more indicators which are the items measured (for example, number of licenses, number of entrepreneurship

courses in current year). We have grouped the actions into broader categories, called activities, and the resulting activity level determines the general level of involvement of the universities and the fulfillment of their role in regional development. For the indicators, we have been inclusive rather than exclusive in order to see which measures are more feasible and meaningful.

We note three significant design decisions that define a set of limitations to our framework. First, the framework focuses only on the university itself and does not measure anything about the main regional industry with which the university is involved. This places certain limitations on what kind of analysis can be made, but is necessary to keep the complexity of data gathering within a limit. Second, we measure direct, numerical variables as opposed to opinions on a sliding numerical scale. Thorn and Soo (2006) do the latter in their study of quality indicators for Peruvian universities. We hope our choice results in more accurate and objective data than gathering expert opinion, although it presents other problems such as comparability if the indicators are not clearly explained or there are different standards for similar activities across regions or countries. Third, the framework measures how universities relate to a particular industrial sector in a region. This requires that all measurements refer only to the regional industry in question, which adds a methodological difficulty of determining what activities are directly related to the development of the industry. For example, when we measure the number of courses, we mean only those courses which have a significant, explicit, or complete, focus on the industry. We would not count a general accounting course, but we would count a course like ‘accounting in wine companies’. Obviously there will be some imprecision and judgment involved. Therefore our study aims to not only measure the intensity of the universities in the four activities described with respect to the most important industry in a region, but

also to explore the methodological considerations on implementing a system of performance measuresⁱ that allow policy makers to define policies to engage in higher levels of interactions between industry and university.

3. The context

3.1. Knowledge stocks and flows in wine regions

Coenen et al. (2006) suggest that agro-food industry knowledge originates from agriculture practices. The knowledge in this industry has largely drawn upon empirical and experimental up-scaling of artisan processes, as well as substitution processes to replace specific raw materials by means of chemical or biological synthesis. This type of knowledge is related to activities that work as solutions to practical problems. Thus innovation in agricultural industries refers to the application or novel combination of existing knowledge to solve practical problems during growing or processing process of agricultural products.

In this respect, there are two main issues related to the flow of knowledge from generators to users. One is the capacity of the user to understand the new knowledge, and the second is the connection between the generators of knowledge with the users of this knowledge. Therefore the existence of learning patterns within a region depends on the knowledge accumulated by local firms and on their different contributions to the enhancement of the local knowledge base (Giuliani and Bell, 2005). However, these patterns are not homogeneous since firms have heterogeneous capacities to absorb knowledge flows. In this aspect, regional universities can act to strengthen the knowledge base of weaker firms by providing knowledge workers or training workers of less resourceful firms, which increases the stock of knowledge.

The wine industry, like any agribusiness industry, involves two main processes: growing and manufacturing. Small producers are mainly specialized in grape growing, and backwards-integrated wine producers, which have direct control on viticulture and wine making processes, integrate both grape growing and wine producing. Two professions are the most appropriate for conducting knowledge generation, transference and application on all the phases of the productive chain in wine firms: oenologists and agronomists. There are also other actors who can transfer knowledge, such as researchers from public research institutes, people who have worked in other firms with similar technologies, or consultants. Therefore the capacity of a winery to absorb and generate knowledge is mainly determined by the employment of these workers and the linkages with these experts.

There is no assurance that having an oenologist or/and an agronomist will generate or apply new knowledge, since it is necessary that they engage into processes of knowledge exchange with peers in the region through communities/networks of professionals. Oenologists and agronomists may be able to produce and internalize shared understandings through collaborative problem-solving activities embedded in inter-organizational relations (Malmberg and Power, 2005; Håkanson, 2005; Coenen et al., 2006).

In conclusion, the main actors in a wine region are connected professionals who have the capabilities to understand R&D advances and transform them into applied knowledge to solve problems in grape growing and wine producing. While these actors may act autonomously, they nevertheless need to be connected to receive and exchange knowledge. A critical institution in the development and connection of these professionals can be a regional university if it has a prominent role and is respected in its region.

3.2 The universities in our study

Table 1 shows a summary of the universities studied and their regions.

| Descriptor | Wine Industry | |
|---------------------------------------|-----------------------------|--------------------------------------|
| | Universidad de Talca, Chile | Universidad de Cuyo, Argentina |
| Urban District Population (est.) | 190,000 | 540,000 |
| City and location | Talca, 250km S. of Santiago | Mendoza, 1,000 km W. of Buenos Aires |
| Ownership | Public | Public |
| Date of founding | 1981 | 1939 |
| Total number of students | 6,900 | 31,500 |
| Total number of FTE faculty | 236 | 498 |
| Local GDP per capita US\$ (estimated) | 7,200 | 9,000 |
| Vine planted area – ha. (estimated) | 30,000 | 140,000 |
| Exports from region (2006 estimated) | US\$ 150 millions | US\$ 360 millions |

Table 1. Summary of Wine Regions and Universities Characteristics. Sources: UNC 2006 and Tiffin 2008

Universidad de Cuyo (Argentina). The School of Agricultural Sciences of Universidad Nacional de Cuyo is located at 18 km from the city of Mendoza, in Lujan de Cuyo. Mendoza and the greater urban region have a combined population of 540000. In Lujan de Cuyo there are 94 well-known wineries, such as Chandon and Norton, specialized in premium varietals and sparkling wines. Mendoza has always been at the center of the Argentinean wine industry (see McDermott and Corredoira in this book for a detailed discussion of the evolution of Argentinean wine industry). The School has 1300 students and 103 hectares of occupied land with a farm, an experimental winery, an experimental factory of olive oil and preserves. There are a number of institutes in the School: the Institute of Animal Biology, the Institute of

Soil and Irrigation, the Institute of Vine and Wine and the Institute of Food Science. There are two specific programs aimed at the wine industry: a Bachelor of Science (BSc) in oenology and viticulture and a Master of Science in viticulture and oenology, where students can obtain a double diploma with the École Nationale Supérieure Agronomique de Montpellier (AGRO-Montpellier) and INRA-Montpellier (Institut National de la Recherche Agronomique). Besides, wine is part of common undergraduate courses such as Agricultural Engineering and the Bachelor in Food Safety.

Universidad de Talca (Chile). Only the Universidad de Talca and the Universidad Catolica del Maule are located in the heart of Maule Valley wine region. The Pontificia Universidad Catolica de Chile and the Universidad de Chile are located in Santiago, Chile's capital, which is close to the large wine region of Maipo Valley. The Universidad Catolica del Maule has a very small involvement with the wine industry through a wine-testing laboratory. The Universidad de Talca has more developed connections with the wine industry so it matches our criteria of location in the region and involvement with the industry. While the Universidad de Talca is immersed in a wine area, its strategies relate only vaguely to the regional industry, although it maintains a different level of engagement at country level through a research consortium with the wine industry and other universities in Chile (Cusmano et al in this book). In engaging with the industry, there is a specific intent to decentralize operational decisions to particular specialized centers. This is the approach taken with regard to the wine industry when CTVV (Centro Tecnológico de la Vid y Vino) was established. In the Universidad de Talca there are no specialized degrees in wine. The percentage of students in agriculture degrees obtaining jobs in the wine region is 50 per cent: 30 per cent of students work in activities related directly to the wine industry

(vineyards and cellars), and 20 per cent work in activities indirectly associated to the wine industry (irrigation, selling inputs from distributors, fertilizer companies, etc.). In the area, there is also a strong production of apples, kiwis, corn seeds and rice, that competes for students' attention and final job location. Some students move to other wine regions for their jobs.

4. Analysis of university involvement in wine regions: a comparative study between Universidad de Talca (Chile) and Universidad de Cuyo (Argentina)

4.1. Data collection

The research methodology consisted of data gathering processes occurred between September 2006 and September 2007. Our interviews were with Deans and Directors of different areas in each university. The interviews were mainly structured around the set of indicators that we developed to measure the involvement of local universities in their regional context in terms of training, research, consultancy and facilitators of linkages discussed in Section 2. We preferred to collect the values for our indicators through interviews to explain their use and avoid ambiguous interpretations of the interviewees. The use of structured interviews with performance indicators also helped us to realize the differences in terms of focus pursued by each university. Interviews were complemented with open questions and secondary data to triangulate and interpret the results. The information presented refers to the year 2007.

In the following section, we present the comparative measuresⁱⁱ obtained from our review of the Universidad de Talca and the Universidad de Cuyo. All measurements refer to the wine regional industry (see Section 2.2 for the methodological challenges involved).

4.2. Training activity

| Training indicators | | | |
|--|--|-------|-------|
| Activity | Indicators | Talca | Cuyo |
| Degree Programs and Courses | Specialized degrees in wine industry | 0 | 2 |
| | Average number of students currently enrolled in the specialized degrees per year | 0 | 30 |
| | Courses related to wine industry outside the specialized degrees per year | 5 | 0 |
| | Average number of students taking these courses outside the specialized degrees per year | 100 | 0 |
| Post Degree Diploma Courses | Courses per year | 1 | 3 |
| | Students per course | 20 | 25 |
| Continuing Corporate Education | Courses related to the wine industry per year | 5 | 10/15 |
| Industry Scholarships | Scholarships paid by wine industry per year | 0 | 5/6 |
| Management of Continuing Corporate Education | Executive education staff responsible to support corporate education in general | 1 | 1 |

Table 2. Training Indicators

The indicators in Table 2 measure the intensity of the university-industry linkages through the process of educating and training the workers required by the industry. These linkages can be formal like degrees and postgraduate programs accredited by higher education agencies, or informal like specialized courses aimed at specific issues or scholarships paid by the industry to attend diverse courses in the university. While these activities are not directly generating knowledge, they are necessary to develop the absorptive capabilities of the firms to use new knowledge (Giuliani and Bell, 2005). Therefore, measures capturing the intensity of these activities will be leading indicators of future development in firms and in the regional industry.

In Talca students can obtain a generalist degree in Agronomist Engineering (undergraduate) and a Master in International Agribusiness with Göttingen University

(Germany), but wine education has not a specific degree. Nevertheless, there are courses in viticulture, oenology and vinification as part of the undergraduate degrees. In terms of Diplomaⁱⁱⁱ courses, a center offers a course in irrigation, in which at least a third of the students come from the wine industry. In Talca it is felt that the local market for companies is limited so there are few courses related to corporate education. The training role is where the Universidad de Cuyo puts its greatest attention. As said above, there are two courses related directly to wine: a Degree in Oenology and Viticulture and a Master of Science in Viticulture and Oenology in conjunction with École Nationale Montpellier and INRA-Montpellier. Moreover, there are a variety of diploma courses related to every aspect of vine growing such as water management and soil conservation. There is a strong market for in-company programs as well as technical support. Training that is related to the wine industry is dispersed among many departments in the School of Agribusiness, which have long lasting linkages with the sector. Every year, there at least 5/6 students attending the Master of Science course funded through industry scholarships.

We observe that the Universidad de Talca does not develop its training function as intensively as the Universidad de Cuyo, when measured through the number of courses and activities related to education specifically directed to the wine industry, as Table 2 shows. Since most graduates in wine-related degrees come from the Pontificia Universidad Católica and the Universidad de Chile in Santiago (Kunc and Bas, 2009), training in wine seems to be centralized in the capital city rather than localized at regional level like in Argentina. Among the many reasons for this situation is the closeness of Santiago to Talca, the reputation and relative size of the Pontificia Universidad Católica and the Universidad de Chile with respect to Talca in terms of

researchers (see Giuliani and Rabellotti in this book for more information on Pontificia Universidad Catolica and Universidad de Chile).

4.3. Research activity

| Research indicators | | | |
|---|--|-------|------|
| Activity | Indicators | Talca | Cuyo |
| | | | |
| Research aimed at wine industry in Formal Units | Research units | 3 | 40 |
| | Number of academic staff involved in research units | 5 | 120 |
| | % academic staff involved in research units with PhD | 66 | 15 |
| Formal Research Diffusion Mechanism | Research diffusion mechanisms such as trade fairs, open courses, newsletters per year related to the wine industry | 4 | 4 |
| Technology Transfer | Licenses negotiated in the wine industry per year | 1 | 3 |
| Funding related to wine industry related research (all values are in thousand US dollars) | Total value of grants to research units from public sources per year | 2017 | 300 |
| | Total value of grants to research units from private sources per year | 30 | 0 |
| | Total value of research grants to individual professors from public sources per year | 88 | 5 |
| Research Management (related to wine industry) | Management staff in each individual research units | 1 | 0 |
| | Research management office staff | 2 | 8 |

Table 3. Research Indicators

Table 3 presents the data related to research activity. The set of indicators presented in Table 3 aims to measure the intensity of formal knowledge generation activities directly related to the wine industry in each university. Indicators include most of the activities taken into account in the literature from research units to research outputs, including mechanisms for diffusing and transferring knowledge. Indicators also capture the corresponding responses from the industry and government through funding levels, and the amount of interaction is measured through an indirect indicator related to the administrative effort to manage these linkages.

Talca has three specific research units dedicated to research in the wine industry: the Centro Tecnológico de la Vid y el Vino, founded in 1996; a consortia named Tecnovid with the Universidad de Chile, the Universidad Federico Santa María, the

two main industry associations (Chilevid and Corporacion Chilena del Vino) and a company, Toneleria Nacional; and CITRA, related to irrigation and climate. In each of these centers, there are on average 1.5 Full Time Equivalent (FTE) faculty engaged who have PhDs or are studying for a PhD. On the other hand, Cuyo has 40 research units specialized in each subject area taught, for example irrigation, soil management, vine, etc., but there are not specific funded research centers as in Talca. The high number of research units in Cuyo, which may seem to indicate a more intensive research activity compared with Talca, is determined by the requirements of Argentinean higher education national law,^{iv} that faculties should be actively engaged in research. However, only 15 per cent of academic staff in Cuyo actually has a PhD and 35 per cent has a Master of Science. The main reason for the better performance in research of Talca is related to changes in Chilean higher education system which has recently pushed professors not only to engage into internationally relevant research, as measured by the journal citation systems like ISI, but also to obtain PhDs from international universities (Tiffin and Kunc, 2009), while Argentinean public universities have not moved towards this direction.

In Chile the government has been very active in providing funds for research to the wine industry as well as to regional universities. The two research units of Talca (CTVV and CITRA) and the technological consortium (Tecnovid) have been financed using government funds. In Argentina there is no specific funding for research units from the government and most of the funding is assigned on a project basis to individual faculties. Therefore the funding available is clearly different between Talca and Cuyo. Unfortunately the funding from industry is almost zero when compared to public funds.

In terms of outputs, the situation is less clear. Talca produces four annual events related to the diffusion of its research within the wine industry, such as seminars and conferences, and has generated one license of technology related to the wine industry per year. Cuyo produced a similar number of events to Talca, such as conferences and four newsletters, and has transferred technology in three instances (yeast, vine management and irrigation efficiency) during the year under consideration. While there is infrastructure supporting the development of research in both universities, there are not any established fundraising activities.

The research indicators illustrate a conflicting picture. While there seems to be higher levels of research activity in Talca compared to Cuyo in terms of research funding, Cuyo seems to have more people doing research and more technology transfer instances. One explanation for this difference is related to the size of Cuyo compared to Talca in terms of faculty and the faculty performance review existing in Cuyo (see footnote 4), which has been implemented by request of a national law, that measures the faculty engagement with industry through agreements with firms and intellectual contributions. However, the faculty activity in Cuyo is not supported by grants or measured in terms of peer review publications. In terms of the impact of these activities, Cuyo may be also more active than Talca as it has more technology transfer licenses with the industry. While Talca has most of its faculties with PhDs (66 per cent), which is in line with recent trends in Chilean higher education system (Tiffin and Kunc, 2009), Cuyo has very few faculties with PhDs, which may be affecting its research outputs although we did not have information to confirm this appreciation. Undoubtedly the larger size (see Table 1) of Cuyo compared to Talca plays an important role in explaining the differences in levels of intensity obtained for the measures.

4.4. Consulting/Service activity

| Consulting/Service indicators | | | |
|---|--|-------|------|
| Activity | Indicators | Talca | Cuyo |
| | | | |
| Research Extension Office (research projects) | Number of people in this office | 0 | 5 |
| | Number of research contracts oriented to the industry | 1 | 25 |
| University Consulting Corporation | Number of units devoted to consulting | 2 | 1 |
| | Number of consulting contracts | 20 | +10 |
| Individual faculty consulting | Number of professors who consult | 7 | 100 |
| | Total number of contracts per year | 33 | 100 |
| Laboratory Services | Average number of laboratory contracts per year (in the case of Talca includes legal product quality certifications) | 1000 | 60 |
| Management | Laboratory staff, excluding technicians and non-office operational people | 7 | 50 |
| | Consulting office staff | 0 | 15 |
| | Staff in the research and development extension office | 0 | 5 |

Table 4. Consulting/Service Indicators

Table 4 presents a measurement of the informal linkages in knowledge transfer, such as consultancy contracts or instances where the industry can outsource some of its knowledge intensive requirements, for example laboratory services for testing products, to universities. While the levels of activities diverge significantly, a set of indicators measuring the quality of the intensity of these activities can provide clearer information.

The R&D Extension office is not actively looking for R&D contracts and grants. The consulting processes for the university consulting corporation are run either by the research units in Talca (Table 3) or by a co-operative in Cuyo (Table 4). The faculty of the Universidad de Cuyo has set up a co-operative which runs all the consulting contracts with the industry since faculty cannot be hired directly by firms.

The co-operative manages the relationship with the industry and the money that is paid to the faculty. We perceive that there is not a clear separation between the activities of the R&D extension office, the units engaged in the consulting company and the private consulting projects of individual faculty members of both universities. The indicators do not seem to capture the high level of engagement with the industry according to the resources existing in each university.

In terms of laboratory services, the Universidad de Cuyo has six laboratories for diverse subjects: molecular biology, soil, nematology, viticulture/oenology, cold weather and waste management. In that sense, the laboratories existing in the Universidad de Cuyo provide with full services to different actors in the local wine industry as well as projects in other areas of Argentina (60 projects). In the case of Talca most of the laboratory contracts come from the wine industry located not only in the Maule valley but also in the close Colchagua valley. The Universidad de Talca operates numerous laboratory service contracts (1000 services per year) dealing with issues such as appellation control and evaluation of vine clones to be free from virus (the main task of CTVV). Therefore the high volume of activity is mainly driven by law requirements rather than the intention of exploiting unique and sophisticated knowledge. However, the laboratory services' activities seem to be a good way of engaging with industry in providing value-added services in areas where the industry does not have skills or sufficient economies of scale.

4.5. Developing linkages activities

| |
|--------------------------------|
| Developing Linkages indicators |
|--------------------------------|

| Activity | Indicators (during present year) | Talca | Cuyo |
|---|---|-------|---------------|
| | | | |
| Practicum | Students getting term jobs in the industry per year | 24 | 60 |
| Graduate Placement | % students who get permanent jobs in the wine industry per cohort | 50 | 100 |
| Alumni | University alumni in firms related to the wine industry | 49 | 500 |
| Agreements with Technical Schools | Formal links established | 1 | 1 |
| Faculty Industry Placements | Full time faculty on industrial placements | 0 | 10 |
| Faculty Employment | Full time professors who have left the university to take up wine industry jobs, over the past 3 years. | 1 | 5 |
| | Full time professors who have held full time employment in wine industry organizations before | 0 | 4 |
| Professionals Teaching | Wine industry professionals teaching full courses | 0 | 100 |
| Research Collaboration | Outputs coauthored with people from the wine industry | 1 | Not available |
| Internships | scholarships for students to spend time in the industry | 0 | 5 |
| Management of Industry Development | public awareness infrastructure or activity staff | 4 | Not available |
| Management of Students in the Workplace | practicum staff | 2 | 8 |
| | alumni staff | 1 | 0 |

Table 5. Developing Linkages Indicators

Indicators in Table 5 quantify the level of activities related to building linkages between industry and university. For example, students' internships are seen as valuable activities to put theory into practice and foster the connections between firms and university. The development of alumni networks is an important action to establish permanent linkages between industry and university, as well as role exchange between academic staff and professionals.

All students in the Universidad de Cuyo should undertake a *practicum* (short term professional practice) in small, medium and large wineries as requirement to obtain their degrees, as Table 5 shows. In Cuyo most of the students come from wine companies or are related to local wineries/farms. The Universidad de Cuyo also runs a College of Agriculture with an Agricultural Technician's diploma/qualification for people that do not intend to obtain a university degree. College students are usually working within small family-owned wineries and they may not enroll in a university

degree. Therefore technical qualifications are important for the development of basic absorptive capabilities in small firms. The large size of the wine industry, as well as the large city – Mendoza – implies a high volume of new students and a high retention rate of graduates in the region and the wine industry (100 per cent of students obtained jobs in the wine industry either because the size of the wine industry facilitates absorbing them or because these students already came from wine firms (see McDermott and Corredoira in this book). Therefore the Universidad de Cuyo seems to be strongly connected with the industry either through the alumni network or through professors who have previously worked for wineries or are professionally engaged with the wine industry (100 out of 120 faculty members in the School of Agricultural Sciences). The Universidad de Cuyo appears to be an active member of the regional economic system since through its graduates it is part of different institutions, such as the regional food safety institute (ISCAMEN), the local branch of the national agricultural institute (INTA) or the national association established by the industry (Fondo Viti).

On the other hand, the Universidad de Talca does not have a strong influence on the development of linkages with the wine industry at regional level, neither through the development of knowledge workers nor through the movement of professionals from the industry to the university and vice versa. In the case of the Universidad de Talca there seems to be more contractual relationships between the university and the industry, for example the use of laboratory services (Table 4). The small number of students in Talca, due to its location in a low population area and the competition from the universities located in Santiago such as the Pontificia Universidad Catolica, may be affecting the low numbers shown in the indicators appearing in Table 5.

5. Concluding remarks

Our chapter explains the level of intensity in university-industry linkages using a set of indicators. We measure the intensity of the university-industry linkages at regional level in two wine regions located in Argentina and Chile. Our study is exploratory due to lack of data for some indicators and owing to the methodological challenges (see section 2.2) faced during the development and data gathering. Nevertheless the findings are interesting in terms of lessons for measuring and managing university-industry linkages and the development path taken by the two regions in our study. Our concluding remarks can be categorized in three areas: lessons from our cases, lessons on the development and management of measures for university-industry linkages, and policy implications.

First, Table 6 summarizes our findings in terms of our two cases. We have grouped our findings in the four dimensions by which we measured the intensity of university involvement in wine region development: training, research, consulting and service providers to local industry, and facilitating future linkages.

| Linkage | Talca | | Cuyo | |
|------------------------------|--|--|---|--|
| | Talca | | Cuyo | |
| Training | Low intensity without specific courses | | High intensity with undergraduate and master courses | |
| Research | High intensity in funding | | High intensity in resources committed but low funding | |
| Consulting/Serviceing | High intensity in laboratory services | | High intensity in evaluation services | |
| Facilitating future linkages | Low intensity in network development | | High intensity in network development | |

Table 6. Level of intensity in university-industry linkages

The highest level of university involvement in wine regional development differs between Cuyo and Talca. In the case of the Universidad de Cuyo training activities such as undergraduate courses and an international master in wine represent its highest commitment to the industry. In the case of the Universidad de Talca laboratory services for certification purposes are the main linkage with the wine industry located in the region. In terms of university-industry linkages to develop local knowledge through research, our review showed that the two universities are actively engaged in combining existing knowledge to solve practical problems through their research units, such as adaptation and calibration of weather and irrigation systems to local characteristics. In the case of Talca, several centers that had been created with significant funding from the industry to provide laboratory services, have grown, diversified, and are largely self-supporting. However, the centers are not linked to academic research. Part of the reason is the necessity to generate operational funding, part is the lack of interest by industry in supporting research and part the lack of support from the university to free the faculty involved from teaching obligations. The role of academics as consultants seems to be well developed in both universities but there is no evidence of long-term relationships with firms. The level of activities facilitating linkages between universities and industry is still low, and although informal comments from our interviewees suggested the intention to develop science parks or even incubators, these ideas are still in design phase. More involvement of global and local wineries or even suppliers to the wine industry with these local universities may help to develop their involvement with region development.

We conclude from the analysis of our measures that the Chilean wine region of Maule and Argentina's largest wine region are following two different paths in regional development. The Chilean wine region of Maule seems to focus on

exogenous knowledge sources, such as graduates from centrally located universities like the Pontificia Universidad Catolica de Chile, identified in micro level studies by Giuliani and Bell (2005), combined with more intensive local university-industry linkages related to knowledge-based services like laboratory services. University involvement is mainly managed through the provision of knowledge-based services. Argentina's largest wine region development seems to be more endogenously driven through local university-industry linkages (albeit the recent establishment of foreign firms is changing this situation). The high intensity of training activities and facilitating linkages, such as professors in the industry, leads to the existence of strong networks formed by graduates and professors embedded in diverse institutions, also found in McDermott and Corredoira in this book about networks and institutions in Argentinean wine industry. The Universidad de Cuyo shows a good interaction at the regional level but it is not clear what value is generated for the industry and the regional development, an aspect that needs further research. In this case, there is an active management of university-industry linkages through the development of networks.

Second, our exploration of university-industry linkages measurement left a number of suggestions to develop measurement systems in Higher Education, more specifically the management of university-industry linkages. The importance of clear measurement systems cannot be overstated since they are not neutral as they define issues that have not necessarily existed before and can cause distortions to university strategy, especially in their interactions with industry. For example, it is worth to mention the following issues:

- Differences related to university degrees and diplomas reduce the meaning of standard categories for graduates and knowledge worker development.

- Definition of university functions in a standard way since most administrative offices have multiple functions (for example research management, research extension and technology transfer) so it is sometimes difficult to measure the intensity of the engagement of universities with their regional industry.
- Within a single indicator there can be a great deal of variability of the phenomenon measured; courses can vary from full semester and focused entirely on the industry, to an optional, very short workshop or seminar; research publications can have great differences in their importance with respect to patents and licenses. Therefore counting events like courses and seminars or publications and patents as equal is convenient, widely practiced, but it may be misleading.
- Some data are not gathered by universities in activities related to their role as promoter of the region, as in the case of consulting activities, or it is impossible to tell from databases exactly where alumni are working.

To conclude, only the combination of micro level analysis, such as Giuliani and Arza (2009), together with network analysis like in McDermott and Corredoira in this book, can shed light on the issues and problems that macro level analysis, like the set of measures presented in this chapter, has highlighted. Only multilevel analysis will be able to identify the forces affecting the process of catch-up in emerging industries like wine.

Third, we can observe that both Chilean and Argentinean wine regions have infrastructure issues such as lack of private and public finance support for research. Although wineries can acquire extra-regional knowledge directly through their relationships with their foreign owners or through foreign consultants (Giuliani and Bell, 2005), universities need support to bring extra-regional knowledge through alliances with foreign universities in certain programs (especially at postgraduate

level) and foreign research centers. It is encouraging to see efforts in developing a qualified workforce and appropriate services and technologies for regional firms, especially those firms that do not have the resources to hire or bring foreign consultants, but universities need public support to intensify their activities. It is clear that university is an important contributor to regional development by providing trained people, advanced knowledge, technical problem solving and opportunity realizing. But perhaps its most important role is networking to encourage industry and government to work with the university to develop the region. All universities can play this role, not just the large, metropolitan ones. For resource-based industries development it is critical that small, peripheral universities become aware of their potential to link with their main regional industries on multiple levels and be supported by government regulation to do so. Jacob et al. (2003) suggest that public regulators have an obligation to structure the system so the burden of doing this linkage does not fall solely on the universities; otherwise, the universities will only undertake those components that generate revenue like laboratory services or individual faculty engaging in consulting projects.

ⁱ Performance measurement systems represent a balance between output measures – the performance and impact of an organisation – and the measures that will drive future organizational performance – input measures (Kunc, 2008).

ⁱⁱ A detailed explanation of each measure can be obtained from the authors.

ⁱⁱⁱ Diploma is the generic name given in the Chilean higher education system to courses aimed directly to practitioners where the content is mainly practical.

^{iv} The Argentinean Law N° 24 521 establishes the obligation for the staff to be active in research as part of their performance evaluation every five years to maintain the post, which

has to be subject to public evaluation. However, the definition of research is not clear and does not imply the obligation to publish in ISI journals or English language journals.

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