

Extended Abstract Submission for PhD Students Session

The aim of this extended abstract is to report the progress of my DPhil research¹. The paper is organized as follows: the first section reviews the literature and introduces the research question. The second section describes the pilot fieldwork and shows preliminary results. This is followed by the third section, which presents the conclusions.

1. Literature review and research question

The research topic concerns the impact of technology policy on regional network creation in high-technology activities in developing countries. Developing countries must address technology policy if they aspire to socio-economic development (Chang, 1994; Sagasti, 2002). The thesis deals with the three areas of technology policy, network governance and firms' innovation. Network governance is seen here as the main linkage between technology policy and innovation in firms. It has not been adequately addressed by the literature relating to the research topic, which instead focuses on the sorts of experiences faced by developed countries.

Local networks may be positively stimulated by government technology policy implementation. Its formulation is centralized and could be implemented either by the local, regional, or national government. Government actions require the community of innovators to be well rooted in a socially stable and economically developed local society (Bianchi and Bellini, 1991: 487). This represents a strong constraint for economies at an earlier socio-economic developmental stage, because their networks are often misaligned and with weak governance. It means that different elements are pulling in contrasting and often contradictory directions, and have weak linkages among themselves.

The theoretical and empirical literatures reviewed argue that it is extremely important, if not essential, to have both strong network governance and network alignment for effective technology policy. However, effective outcomes are not assured. In addition, networks of innovators in weak governance and misalignment contexts sometimes succeed in technological innovation and catching-up with technology leaders as copiers of the technology frontier.

Considering the network governance approach, we argue that network governance is essential for explaining firms' innovation, since it is related to bottom-up policy (bottom-up policy is not centrally formulated, as with top-down policy, and instead it is collectively constructed) in the sense that it can drive the system into innovation. The network governance approach is related to top-down policy in the sense that it can be a transmission mechanism for helping to avoid the top-down policy's failure.

The literature review above provides evidence for two conclusions. Strong network governance and alignment are possibly not essential conditions for firms to achieve innovation and technology policy effectiveness. However, the more coordination in the network, the better is likely to be the outcome. The Brazilian experiences indicate that regions without socially stable and economically developed societies are sometimes able to shape and implement technology policy satisfactorily. It is still

¹ This short abstract has benefited from the comments of Professor Nick von Tunzelmann (DPhil supervisor) and Professor Ed Steinmueller from SPRU. An early version of this abstract was presented at the Globelics Academy 2005.

necessary to investigate how this comes about, in order to add to the literature so far produced (Souza and Garcia, 1999; Suzigan *et al.*, 2001; Seibel *et al.*, 2001; Machado, 2003).

The second conclusion relates to top-down technology policies. The government's technology policy does not affect only firms; it affects the whole network, of which firms are part. In countries at an early economic development stage firms face more difficulties in innovating, since they are often embedded in misaligned and weak networks. Additionally, in these countries it is common for government technology policies to suffer from discontinuity or be inappropriate to firms' needs (regarding the Brazilian experience see Velho and Saenz, 2002). Considering these factors, it is necessary to bring evidence of top-down technology policy effectiveness over those firms, including the network governance role.

The literature concerned with Brazilian industries' performances, and industrial and technology policies shortcomings in Brazil shows, among others: 1) the weaknesses and constraints of the country's institutional and economic environment; 2) the decrease of the state presence in setting up the institutional framework for firms to innovate in the 90s; 3) the lack of coordination among firms within a network; and 4) the lack or weakness of linkages between firms and institutions that support their innovation activities. Considering these evidences the literature indicates what are the relevant topics to be addressed either by firms, institutions or government if the country aims to reach economic development.

However, the literature does not show in depth what is the role of network governance for technology policy impacts on firms' innovation. In this sense, this research proposes the following research question:

In what ways does network governance at the regional level influence technology policies directed at firms' innovation?

2. Pilot fieldwork and preliminary results

In order to start investigating this research question, a pilot fieldwork was implemented comprising 12 interviews. The interviewees were from research centres, the local state university (UNICAMP), SOFTEX, and other supporting organizations in Campinas, a city known by the importance of its ICT industry. The interviewees mentioned that the Recife software network is very innovative, and despite being a young one has managed to technologically catch up with more mature networks, like the Campinas one. The network governance issue has been mentioned by several interviewees as an important aspect for the result showed by the Recife network, and especially the central presence of a network articulator. There were four main results from the pilot fieldwork.

First, following this round of interviews it was deemed that the methodology for answering the research question should involve a comparison between two Brazilian software networks (Campinas - São Paulo State and Recife – Pernambuco State). These networks seem to be presenting different levels of governance intensity.

Second, comparing these two networks showed a methodological advantage, since both networks were aimed at by the central government technology policy through the SOFTEX Programme at the beginning of the 1990s. They were created under the same financial conditions and support.

Third, the pilot fieldwork results suggests that the SOFTEX Programme affected the two different networks in different and opposite directions. The table below summarises the information gathered during the pilot fieldwork and shows that a

comparison between the Campinas and the Recife network are good cases for answering the research question of this research.

Table 1 – Campinas and Recife software networks comparison

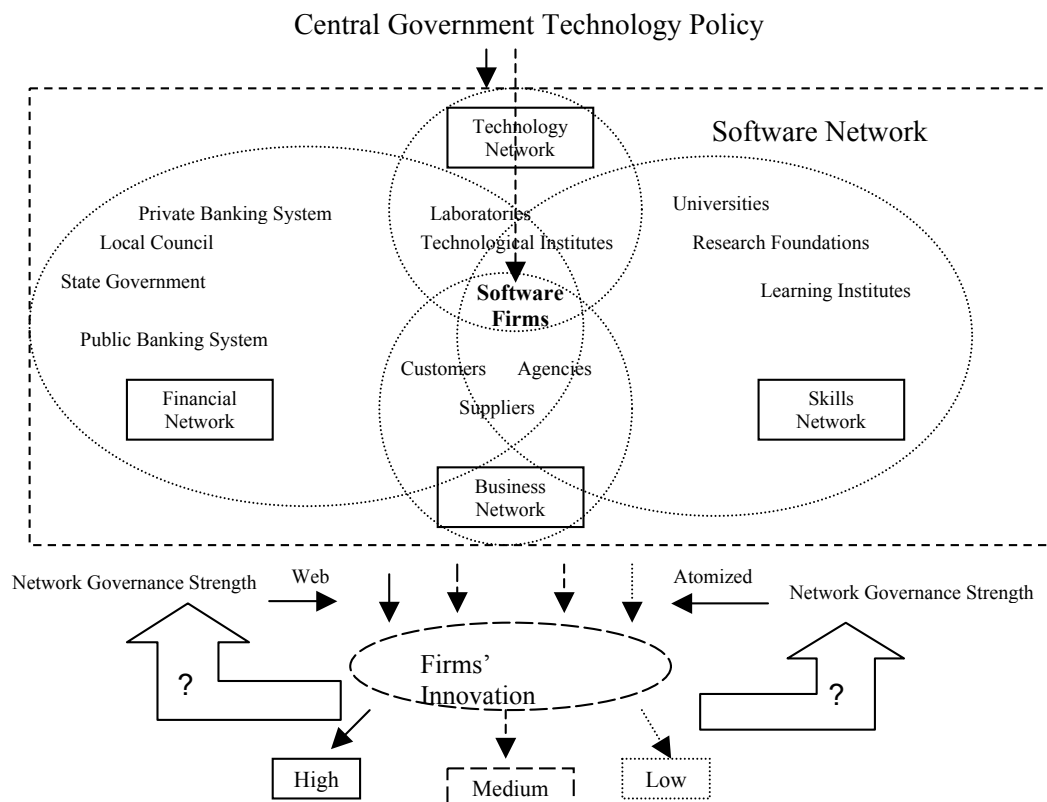
Networks/Characteristics	Campinas	Recife
HDI 2000	0,852	0,797
Network characteristics - age	1970's	1990's
Network characteristics - maturity	Mature	Young
Influence of SOFTEX - infra-structure	Low	High
Influence of SOFTEX - policy adoption	High	Low
Articulator's presence	No	Yes
Articulation	Low	High
Role of local university	Autonomous	Dependent
Network Governance	Weak	Strong

Sources: Pilot fieldwork interviews, August 2004.

HDI (Human Development Index) from UNDP (United Nations Development Programme)

Fourth, the pilot fieldwork helped in the clarification of the analytical framework that will be used in the thesis (Figure 1). The preliminary analytical framework now indicates how the elements of technology policy, network governance and innovative firms will be analysed in this research in each software network.

Figure 1. Preliminary analytical framework



Source: own elaboration

The software network is comprised of four sub-networks: skills network, financial network, technology network and business network. The central government technology policy may interfere on all sub-networks in different ways and software firms more directly when policies are directed to them. Here we want to understand

how the central policy influences the network as a whole, and how its arrangement affects software firms.

In this research, network governance is understood as the dyadic ties that hold different institutions within a network. Using this concept the research developed a heuristic tool for measuring the network governance strength, which is a combination of two factors: the structure of the network (web or atomized) and its number of ties. This was inspired by social network concepts developed by Granovetter (1973 and 1985). Therefore, the network governance strength measurement results from the level of collaborativeness that the institutions have between each other, these are: 1) web-like (maximum strength), 2) semi web-like (intermediate strength), 3) semi atomized (intermediate strength) and 4) atomized (minimum strength)². With regard to the two intermediate strength stages (2 and 3), empirical evidence from fieldwork will elucidate whether structure or number of ties are more relevant. Once the fieldwork data is analysed we will be able to understand which of the two intermediate stages show higher strength. The diagram 1 summarizes the network governance strength measurement.

Diagram 1: Network governance strength

		Structure	
		Atomized	Web
Density (Number of ties)	(-) ties	Atomized ties	Web ties
	(+) ties	Atomized ties	Web ties

Source: own elaboration.

As mentioned above, the network governance strength is measured by the level of collaborativeness that the institutions have between each other. Once innovation is at stake network agents will seek collaboration with other agents for several reasons, but for this research they were classified as follows: 1) open information source, 2) acquisition of knowledge, 3) acquisition of technology, 4) access to new sources of financing, 5) access to commercial information and 6) innovation co-operation (Oslo Manual, OECD, 2005). During the interviews firm and other agents will have the opportunity to mention any other reasons for collaboration. In addition, we understand that several motives could drive agents to be linked to particular agents and not others, here we summarized them as follows: a) trust, b) opportunity, c) cost, d) knowledge (availability and accessibility), e) collective identity and f) geographical proximity. Again, firms and other agents will have the opportunity to mention any other motives for collaboration during interviews.

3. Concluding remarks

From March to June 2009 the research will be implementing the fieldwork in Brazil, when all agents of the two networks (Campinas and Recife) will be interviewed. The data collection is going to use semi-structured interviews with software firms and an open questionnaire with all other agents of the network. In addition, a two-page electronic survey will be implemented with software firms.

² It is important to mention that the 'label' atomized is not related to the discussion presented by Granovetter (1985) on the under-socialized and over-socialized concepts of human action, meaning that atomized ties occur when network agents are related to one another on an isolated fashion.

Main References:

- Bell, M. and K. Pavitt (1992). National Capabilities for Technological Accumulation: Evidence and Implications for Developing Countries. World Bank's Annual Conference on Development Economics, Washington, D.C.
- Bianchi, P. and N. Bellini (1991). "Public policies for local networks of innovators." *Research Policy* 20(Networks of innovators): 487-497.
- Boyer, R. and J. R. Hollingsworth (1997). Part I - The Variety of Institutional Arrangements and Their Complementarity in Modern Economies. *Contemporary Capitalism: the Embeddedness of Institutions*, Cambridge University Press: 49-93.
- Chang, H.-J. (1994). *The Political Economy of Industrial Policy*.
- Cimoli, M. and N. Correa (2002). Trade Openness and Technological Gaps in Latin America: a 'Low Growth Trap', *Laboratory of Economics and Management - Working Paper Series*, Sant'Anna School of Advanced Studies.
- DeBresson, C. and F. Amese (1991). "Networks of innovators: A review and introduction to the issue." *Research Policy* 20 (Networks of Innovators): 363-379.
- Evans, P. B. (1995). *Embedded Autonomy*, Princeton University Press.
- Granovetter, M. (1973) *American Journal of Sociology*, 78, 1360-1380.
- Granovetter, M. (1985) *The American Journal of Sociology*, 91, 481-510.
- Freeman, C. (1991). "Networks of innovators: A synthesis of research issues." *Research Policy* 20(Networks of innovators): 499-514.
- Machado, S. A. (2003). Dinâmica dos arranjos produtivos locais: um estudo de caso em Santa Gertrudes, a nova capital da cerâmica brasileira. Escola Politécnica. São Paulo, Universidade de São Paulo: 162.
- North, D. (1990). *Institutions, Institutional Change and Economic Performance*, Cambridge University Press.
- OECD (1992). *Technology and the Economy: the Key Relationships*. Paris, OECD Publications Services.
- OECD (2005) *Oslo Manual: Guidelines for collecting and interpreting innovation data*, OECD: Organization for Economic Co-Operation and Development, Paris.
- Sagasti, F. T. S. C. K., *Innovation and the Human Condition in the 21st Century*, FORO Nacional / International Lima, Peru. (2003). *The Sisyphus Challenge: Knowledge, Innovation and the Human Condition in the 21st Century*, FORO Nacional / International Lima, Peru.
- Seibel, S., J. Meyer-Stamer, et al. (2001). *Globalização e os Desafios para as Indústrias Italiana, Espanhola e Brasileira de Revestimentos Cerâmicos*. *Cerâmica Industrial*. 6 - Novembro/Dezembro: 28-33.
- Souza, M. C. and R. Garcia (1999). *Sistemas Locais de Inovacao em Sao Paulo. Globalizacao e Inovacao Localizada: Experiencias de Sistemas Locais no Mercosul*. J. E. Cassiolato and H. M. M. Lastres. Brasilia, IBICT/MCT: 300-334.
- Suzigan, W., J. Furtado, et al. (2001). *Perspectivas de Reestruturação das Políticas de Financiamento do Desenvolvimento Tecnológico no Brasil. Pesquisa: Inovação e Difusão em Sistemas Produtivos Locais: Evidências e Sugestões de Políticas*. Campinas, Convênio FINEP/FUNDAP No. 64-00-0284-00: 1-62.
- Velho, L. and T. W. Saenz (2002). *R&D in the Public and Private Sector in Brazil: Complements or Substitutes?*, INTECH Discussion Paper Series.
- Veloso, F., A. J. J. Botelho, et al. (2003). *Slicing the knowledge-based economy in Brazil, China and India: A tale of 3 software industries*, Softex/MIT: 42.
- von Tunzelmann, N. (2003). *Network alignment in the catching-up economies of Europe*.