CRITICAL ISSUES IN NETWORKING AND TECHNOLOGICAL CHANGE

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Abstract
Nowadays, networking and technological change are very important in the business sector. These terms are common in the academic field and they are also essential for entrepreneurs. Firms develop relationships with various types of enterprises which, directly or indirectly, affect their performance. In general, business relationships can perform a variety of functions for those involved, through the activity links, actors, resources, etc. The development of new ideas and technological inventions combine different knowledge and competencies. This paper presents some issues related to the analysis of technological change within networks, the interaction of companies and the management issues in the business networks.

Keywords: *technological change, alliances, business, management.*

JEL classification: *M21, O30.*

Introduction

The technology at the foundation of products and markets has changed and companies must find a way to adapt to that change. Generally speaking, an established firm has three options for obtaining the new technology: merging with or acquiring a company that already possesses the technology; developing the required capabilities by using existed resources; or entering into some form of alliance. Since severe consequences for companies that fail to anticipate or respond to radical product innovations that transform an industry, firms must move quickly to secure a position of market leadership, and the right alliance can jump – start those efforts.

The relationship between technological change and employment has remained both controversial and highly topical during the technological revolution. In the first sub–period, which corresponds to a phase of industrialization roughly up to the second half of the nineteenth century, it slowly appeared that technical change, by means of increased mechanization, could simultaneously reduce employment in some activities and lead to an increase in employment in other activities. In the second sub–period starting with the last third of the nineteenth century, witnessed some improvement of working conditions and wages, while steam technology matured and was quickly followed, at the turn of the century, by the rise of electric power. A smooth process of change is introduced and is expressed in the production function. The third sub–period, in the aftermath of World War I, remains transitional as regards both the evolution of techniques and economic thought. Industrial machinery was mainly driven by electrical power at the time, and the main technical issues centered on organizational aspects as raised by the concentration of capital and the implementation of Taylorist methods of scientific work organization. Nowadays, the fundamental characteristic is the

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Nowadays, the fundamental characteristic is the pervasiveness of technological changes related to information technologies taking advantage of the miniaturization process. There is also an important concern for many economists to moderate the idea that technological advancement may displace much of the manufacturing work, creating unemployment, social disruption and human hardship.

Technology acquisition and discontinuous technological change

To maintain their competitive standing, companies must master the new technology and ensure that their products and processes fully exploit it. When faced with a discontinuous technological change (DTC), an established firm has three options for obtaining the new technology: merging with or acquiring a company that already possesses the technology; developing the required capabilities by using existed resources; or entering into some form of collaboration. Because of time to market pressures and industry uncertainty, alliances often take precedence over the two options for acquiring the new technology. However the attractiveness of partnerships also varies as a result of changes in the level of urgency and uncertainty throughout the DTC life cycle.

A relatively low sense of urgency and high levels of industry uncertainty mark the advent of a radical innovation. Firms are not yet certain how the new technology will affect the industry, and they may not feel compelled to enter into technology sourcing alliances. As the new technology takes hold and the levels of urgency and uncertainty -peak – the motivation for entering into a technology sourcing alliance also reaches its highest level. Firms must move quickly to secure a position of market leadership, and the right alliance can jump – start those efforts. During the latter stages in the DTC life cycle, the technology and the market requirements become more stable, the level of urgency and industry uncertainty decrease, and firms often shift their focus from alliances to internal development and acquisitions.

In his article, "Marketing Myopia", Theodore Levitt (1975) describes the discontinuous technological change as a phenomenon. DTC occurs when product innovation for a mature industry starts from a new and different technology base. These radical innovations can lead to either a new product class life cycle, or a discontinuity in an existing life cycle, following the substitution of a new product or process for an old one. Examples of DTC include fiber optic cable as a replacement for cooper wire transmission, high definition TV as a replacement for conventional TV and compact discs as a replacement for records and tapes.

Levvit warns of severe consequences for companies that fail to anticipate or respond to radical product innovations that transform an industry. For such a firm, these outcomes range from a significant missed opportunity to a substantial loss of market share. Thus, an important management issue is how do corporations renew their core technology, products, and processes as a basis for continued competitive vitality?
Increasingly, companies attempt to meet this challenge by using alliances to obtain critical technology necessary to produce products in an industry that is undergoing DTC. An alliance is defined as a collaborative relationship among firms to achieve a common goal that each firm could not easily accomplish alone. The most common forms of alliances include joint ventures, technology licensing agreements, partnerships, networks, clusters or various forms of R&D consortia. Primarily, companies formed an alliance because each require the others complementary technology to create innovative products for a DTC market.

Because a DTC dramatically changes the industry in which it occurs, its effect on incumbent firms is profound. Not only can a DTC deliver substantially better product performance and give birth to a host of new competitors, but also it often requires technology that is not part of an established firm's core competence. Thus, incumbent firms must find ways to add skill to their core repertoire.

A DTC change dramatically the product – class conditions, so firms who do not develop early the prerequisite product development capabilities risk failure. Much of this urgency is related to winning a dominant market share before competitors can.
This need for rapid new product development often precludes internal development of critical technologies, elevating the attractiveness of an external technology acquisitions method, such an alliance. Alliances allow firms that lack new product development technology to leverage partners' existing technological capabilities to speed new product development.

Generally speaking, technology is more expensive when acquired through a merger/acquisition than through an alliance. Although a firm has more control of technology gained through merger/acquisition, it must pay for both the critical technology it seeks and technology/assets that it may already have or not need. An alliance, on the other hand, allows a firm to avoid acquiring superfluous technology and assets.

Employment and technological change

The relationship between technological change and employment, a much-debated issue since the beginning of the industrial era, remains both controversial and highly topical, requiring discussion and review of the following issues:

a. Past questions and theories are still relevant;
b. Employment issues are specific and need to be treated separately from general questions pertaining to the economics of technological change;
c. General approaches cannot cover all the complexities issue;
d. The advanced economies may currently be experiencing a change of technological paradigm, which can only be fully appreciated in historical perspective.

The development of industrial activities was accompanied by cumulative and interdependent changes in techniques, whereas prior to the mid – eighteenth century techniques seemed tied to groups or social organizations. In this early period users were the creators, or close to the creators, those who had codified the techniques.

While science and technology were not always far apart, and indeed there was during the renaissance some perception of the overall power of technical change, is still true that in pre-industrial times each technique seemed to have a direct relation of its own with its user. Rules of use were rather strictly codified. No links were established between techniques, no common potential for change was widely perceived. Such segmentation and codification may be considered as a dominant, distinctive feature of the complementary relation between men and techniques prior to the revolution. Social groups could be endangered and eventually disappear if the technique with which they are associated was superseded by another. However there was no clear understanding that such events could affect other parts of society once the new technique met the needs of that society.

The process of industrialization made it clear that the spread of machinery had impacted on the whole of society. The notion of technical change came out of the recognition that changes in techniques could be cumulative and affect a wide range of activities. It is useful to distinguish three sub-periods within the long span of time

starting with the early phase of industrialization and ending with the economic depression of the 1930s and World War II.

In the first sub–period, which corresponds to a phase of industrialization roughly up to the second half of the nineteenth century, it slowly appeared that technical change, by means of increased mechanization, could simultaneously reduce employment in some activities and lead to an increase in employment in other activities. A large share of the labor force became directly dependent upon industrial jobs, technical change appeared as a real threat.

In contrast, the second sub–period, starting with the last third of the nineteenth century, witnessed some improvement of working conditions and wages, while steam technology matured and was quickly followed, at the turn of the century, by the rise of electric power. A smooth process of change is introduced and is expressed in the production function. The idea that capital and labor are substitutes starts to be applied at the level of the representative firm. This new theoretical framework rules out from the start the possibility of technological unemployment, once market adjustments are properly allowed for.

The problem of technological unemployment reappeared in the economic literature in the 1920s, in the aftermath of World War I, at the beginning of the third sub–period. This sub–period remains transitional as regards both the evolution of techniques and economic thought. Industrial machinery was mainly driven by electrical power at the time, and the main technical issues centered on organizational aspects as raised by the concentration of capital and the implementation of Taylorist methods of scientific work organization.

The thesis that the new technological system started diffuse in the 1970s has been based on the pervasiveness of technological changes related to information technologies taking advantage of the miniaturization of microprocessors. The co-existence of a marked diffusion of a new technological system with slower productivity growth appeared to be paradoxical. The fact that technological diffusion, slow growth of the economy and persistent unemployment existed together led some to raise again the issue of technological unemployment.

New approaches to this issue led economic theorists to stress the importance of technological change per se as a behavioral process at least partly endogenous to the growth process. The uncertainty induced by the evolution of such complex interdependent systems as modern open economies was also widely acknowledged. Many theoretical developments have been presented to account for the interaction between invention, innovation and diffusion on the one hand, and investment, work organization, productivity growth and distribution on the other.

Nowadays, an important concern for many economists is to soften the idea that technological change could reduce overall employment. "This lump of labor fallacy, positing that there is a fixed amount of work to be done so that increased labor productivity reduces employment, is intuitively appealing and demonstrably false. Technological improvements create new products and services, shifting workers from older to newer activities. Higher productivity raises incomes, increasing demand for labor throughout the economy. Hence, in the long run technological progress affects the composition of jobs not the number of jobs" (Autor et al., 2010).

According to a study for the Committee on Employment and Social Affairs of the European Parliament entitled "Impact of Technological and Structural Change on Employment: Prospective Analysis 2020 - Background Report" (2002), since the early 1970s the Member States of the European Union (EU) have suffered from high rates of unemployment, while, in the United States, with which the performance of the EU is often compared, the main problem has been a decline of wages of low-educated workers

in real terms. One possible interpretation is that in fact both the EU and the United States are facing a common problem of an oversupply of unskilled labor. In Europe trade unions and minimum wage regulations have succeeded in protecting the pay, but not the jobs. In the United States pressures in labor market have led to the sacrifice of the wage levels while leading to better employment prospects.

In industrialized countries employment is affected by a great number of transient phenomena, such as seasonal fluctuations and business cycles. In the long run probably the most significant changes in employment are brought by productivity and innovation. Productivity tends to grow over time and by itself alone reduces the demand for labor and other inputs per each unit of output. However, improved productivity reduces the costs of supplied goods or services and therefore increases their demand, thus tending to compensate for at least a part of the job losses. Innovation brings about new products, services, enterprises, and even industries that create new jobs, though this may come at the cost of job losses amongst the less innovative sectors and companies.

For a long period, technological change was regarded as exogenous to the economic system. Now, when it is also treated as endogenous, the analysis is tending to be formalistic. Conventional neoclassical models simply fail to capture either the large degree of uncertainty, imperfect understanding and trial and error or the essential element of creative destruction that usually accompany the generation of new technical knowledge.

The utilization of new technology normally involves the generation of additional, incremental units of knowledge that are required to adapt the original idea to the specific circumstances in which it is to be applied. This leads to structural change and economic growth being a central hypothesis in many evolutionary perspectives on the relation between technology and growth (Freeman and Soete, 1990, 2009). In this context, information and communication technologies (ICT) are recognized as a radical innovation that unlocks important growth potential for the world economy (OECD, 2000).

However, technology is a key factor shaping economic growth and the changes in growth rates. Evidently, this in itself is something that evolutionary economics has in common with new growth theory. What is specific to evolutionary economics is the question of how technological change adds to the variability of trend growth rates (Verspagen, 2001).

New paths and further research

Areas for future research include empirical and longitudinal verification of the effects of the DTC life cycle on firm motivations to use alliances for technology acquisition. Also, it would be interesting to see if business growth opportunities for firms increasingly require capabilities that exist outside established core competence.

In addition further research on the elements of an alliance competence and the relationship of such a competence to competitive advantage is becoming less of a destination and more of a journey. Gains are often short lived and imitable. As firms respond to this challenge, alliances are increasingly being used to obtain resources and pursue opportunities that lead to new sources of competitive advantage. Given this, how much does an alliance competence lend to a firm's ability to develop sustainable competitive advantage?

In reviewing contemporary developments in the analysis of the effect of technological change on employment one is struck by the complementarities, which exists between the various approaches.

a. Developing the analysis of the adjustment/learning processes may rank first on the research agenda. The insistence on the largely embodied nature of technological change should not obscure the fact that there is a close gap between the installment of equipment and its 'efficient' use, even at a local level. Research on incentives and strategic behavior within the new industrial economics would seem to be called for.

b. Some steps have been made to account for product innovation by modeling it as product differentiation. This helps, in particular, to give some content to the notion of technological competitiveness. Nevertheless, this product innovation side remains a weak part of the analysis, especially when it comes to empirical investigation. Horizontal differentiation seems to refer mainly to incremental innovations, while vertical differentiations remains a difficult concept to apply. It follows that crude assumptions on demand effects still play a crucial part in assessing the 'compensation effects' of technological change. There is no easy way out of this black hole, although debates could be clarified. Regarding the diffusion of IT, for instance, various externalities are at work producing networking effects, all of which may help to understand the rigidity of some learning processes on the end users side.

c. Finally, a major structural break has occurred as technological change increasingly takes place on a worldwide level. The pace of technical change is set at the worldwide level, thereby reducing the room for manoeuvre for any individual economy trying to adjust in accordance with the characteristics of its labor force. In such circumstances it is all the more important to assess the stringent conditions for positive institutional adjustments. This leads directly to a call for further research upon national systems of innovation and their dynamic in space and time.

REFERENCES

1. Christidis, P.; Hernandez, H.; Lievonen, J. (2002) Impact of Technological and Structural Change on Employment: Prospective Analysis 2020, *Background Report - Study for the Committee on Employment and Social Affairs of the European Parliament, IPTS – ESTO,* Joint Research Centre (DG JRC), Institute for Prospective Technological Studies, EUR 20258 EN, European Commission.
2. Foster, R.N. (1986) *Innovation: The Attacker's Advantage,* New York, Summit Books.
3. Freeman, C.; Soete, L. (1990) Information technology and the global economy, *Open Access publications from Maastricht University*, urn:nbn:nl:ui:27-6327, Maastricht University.
4. Freeman, C.; Soete, L. (2009) Developing science, technology and innovation indicators: What we can learn from the past, *Research Policy*, Elsevier, vol. 38(4), pages 583-589.
5. Graham, B.W.M. (1996) Changes in Information Technology, Changes in Work, *Technology in Society*, 18:373-385.
6. Grover, V.; Teg, J.; Segars, A.H.; Fiedler, K. (1998) The influence of information technology diffusion and business process change on perceived productivity: The IS executive's perspective, *Information & Management* 34, 141-159.
7. Hamel, G.; Prahalad, C.K. (1994) Competing for the Future, Boston, MA: *Harvard Business School Press*. http://dx.doi.org/10.1787/703445834058.
8. Katz, L.F. (2010) Grand challenges in the study of employment and technological change: A white paper prepared for the National Science Foundation, *Harvard University and NBER, Creative Commons Attribution-NoDerivs*. Available at: http://creativecommons.org/licenses/by-nd/3.0/.
9. Krieder, S.; Zachary, G.P. (1994) Vague new world, *Wall street Journal* A1, A4.
10. Lambe, C.J.; Speakman, R.E. (1997) Alliances, External Technology Acquisition, and Discontinuous Technological Change, *Journal of Product Innovation Management*, 14:102-116.

11. Leoncini, R. (1998) The nature of long-run technological change: innovation, evolution and technological systems, *Research Policy 27*, 75-93.
12. Levitt, T. (1975) Marketing Myopia, *Harvard Business Review*, Reprint 75507, September-October.
13. OECD (2000a) Science Technology and Industry Outlook, *Organisation for Economic Co-operation and Development*, Paris.
14. OECD (2000b) A new economy? The role of innovation and information technology in recent OECD economic growth, *Organisation for Economic Co-operation and Development*, Paris.
15. Peretto, F.P. (1999) Industrial development, technological change, and long-run growth, *Journal of Development Economics 59*, 389-417.
16. Petit, P. (1995) Employment and technological change. Handbook of the economics of innovation and technological change, *Blackwell Handbooks in Economics*, 366-409.
17. Prahalad, C.K.; Hamel, G. (1990) The core competence of the corporation, *Harvard Business Review* 68(3):79-91.
18. Stoneman, P. (1995) Handbook of the economics of innovation and technological change, *Blackwell Handbooks in Economics.*
19. Tushman, M.L.; Anderson, P. (1986) Technological discontinuities and organization environments, *Administrative Science Quarterly* 31(3): 439-465.
20. Utterback, J.M. (1994) Mastering the Dynamics of Innovation, Boston, MA: *Harvard Business School Press*.
21. Verspagen, B. (2001) Economic Growth and Technological Change: An Evolutionary Interpretation, OECD Science, Technology and Industry Working Papers, 2001/01, *OECD Publishing*.