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Services and systemic innovation: a cross-sectoral analysis

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Abstract: This essay presents a cross-sectoral analysis of innovation in some types of services, namely air traffic control, retail banking, and health care. The provision of such services is organized in network structures whose development relies on competences and activities that cut across traditional sectoral and industrial boundaries. The conceptual background provided by the recent synthesis approach explains these features by elaborating a new concept of system of innovation. In so doing, this approach paves the way for new understanding of innovation in services as the endogenous outcome of knowledge growth within and across technologies, organizations, and institutions.

1. Introduction

This paper explores the dynamics of innovation in service activities as diverse as air traffic control, retail banking, and health care. While these differ in the markets they serve, the underpinning knowledge base, and the nature of the supporting institutional structures, the case studies reviewed here highlight commonalities across their innovation patterns. The analysis presented in this paper adds yet one more chapter to the complicated relationship between services and innovation. In what follows, we argue that scholars of economics and business studies alike circumvented the terms of this relationship by focusing on the 'diversity' of services in relation to what they are, rather than what they do or how they do it. The conceptual framework within which the case studies have been developed, the synthesis approach, builds upon key concepts of the economics of innovation literature to address these gaps and to pave the way for new understanding.

Synthesis studies apply the concept of systems of innovation to service activities organized on network structures that have come to play a strong role

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in the innovation process. The dynamics of these systems share the characteristic of being problem driven, but differ from one another in that they follow idiosyncratic patterns of development. The scope of the analysis is to understand the process through which such structures transform themselves (Andersen *et al.*, 2000; Howells, 2000; Tether and Metcalfe, 2004). Synthesis studies explain system evolution as a process of problem olving, stimulated or constrained by the agents' ability to command technological knowledge. In this perspective, innovation is understood as an endogenous response to overcome the limitations that render the set of activities inadequate for the purpose of the systems. Great attention is paid to the co-evolution of technological, organizational, and institutional domains, which defines over time the conditions of access to and use of knowledge.

The paper is structured as follows. In Section 2, we begin with an overview of different understandings in the literature of services, and explore the connections that have been made with the innovation process. Section 3 is divided in two sub-sections in which we first present the conceptual tenet of the synthesis approach followed by empirical case studies on service innovation. These are critically analysed in Section 4. The last section summarizes and concludes.

2. Services and innovation: shifting perspectives

For a long time economists and business scholars have wrestled with the need to elaborate a systematic framework for the analysis of services. In the early economics literature, the role of services in the process of economic development was associated with structural change, which underpinned the cyclical turnover of industries and sectors (Petit, 1986; Maddison, 1991; Schettkal and Yocarini, 2003).[1] Contributions within this literature share a 'negative' understanding, whereby services are all that is neither agriculture nor manufacturing. This view of services as derivative activities of industry-based economies persisted also in the face of evidence that, beginning the 1970s, service sectors have accounted for growing shares of value added and employment, reaching an average 70% in most OECD economies (OECD, 2000). To emphasize the long overdue need for a 'positive' definition of services in the literature, Miles (2000: 371) attributes to services 'Cinderella status'. In recent years, the role of services in the innovation process has been widely reconsidered and studied. Yet, a degree of dissatisfaction persists as to which analytical framework best explains the relationship between

1 The economics literature discussed the emergence of services well before the materialization of what today we call service economies. Important contributions can be tracked back to the theory of stages economic development (Fisher, 1935; Clark, 1940), which emphasized cyclical reallocations of the labour force across sectors of the economy: first, from agriculture to industry-based economies, and subsequently from industry to services – the *tertiary* sector. A comprehensive review of various interpretations on the rise of services can be found in Schettkat and Yocarini (2003).

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services and innovation (Tether *et al*., 2001; Miles, 2000, 2005; Metcalfe and Miles, 2000). In this section we overview the main streams of studies that emerged in the context of two antithetic interpretations: the assimilation and demarcation approaches.

2.1. Assimilation studies

Keith Pavitt (1984) can be considered the forerunner of the so-called 'assimilation' approach to service innovation. His classification of technological trajectories[2] across sectors included services in the 'passive adopters' category. The underlying conjecture was that opportunities for innovation in services are restricted to the mere adoption of new technologies developed in the capital goods sector. This is based on the observation that many service activities are heavy users of information and communication technologies (ICTs) available 'off the shelf'. In this approach, services are considered – paraphrasing Teece (1986) – more like specialized assets; that is, activities subordinated to manufacturing. A few years later Barras (1986, 1990) went further down this road with a study on innovation in the financial sector. Reversing the product cycle theory (Abernathy and Utterback, 1978), he argued that adoption of new technologies is followed by quality improvements and, eventually, by new services – referred to as 'user sector'. According to many, this study of ICTs adoption overlooks relevant aspects such as organizational and institutional changes, which were crucial complements to ICT in financial services' innovation (Uchupalanan, 2000; den Hertog, 2000; Consoli, 2005a). A broader source of criticism is that Barras sought to generalize his model indiscriminately to all service activities (Tether *et al*., 1997; Sundbo, 1998). Subsequently, Soete, and Miozzo (1989, 2001) took the taxonomic approach a step further with a classification of services structured according to functional criteria. They singled out four categories of activities:

(i) Production intensive, scale intensive, and network services (e.g. banks and telecommunication services);
(ii) transport and travel services, wholesale trades, and distribution;
(iii) specialized technology suppliers and science-based services (e.g. software and business services);
(iv) public and social services, personal services, and retail trade (e.g. health-care services).

Soete and Miozzo's analysis unpacked the functional characteristics of service activities and offered an undoubtedly richer picture of the variety of innovation processes involved. In so doing, they also undermined Pavitt's conjecture that all services are supplier dominated, as this applies only to one category of the new taxonomy, namely the last. Summing up, taxonomic models deserve

2 Pavitt's (1984) classification includes four categories divided by typologies of sectors: 'supplier dominated', 'scale intensive', 'specialist suppliers', and 'science based'.

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credit for the very effective use of the data available at the time, and for the systematic categorization of a wide range of economic activities. Even so, the view they offer of economic systems as aggregates of static sectors leaves key questions open, particularly those concerning the possibility that new activities or new agents emerge, bearing influence on the structure of the system.

2.2. Demarcation studies

The criticisms raised towards taxonomic models paved the way to a new body of work in the second half of the 1990s. According to the main tenet of the 'demarcation' approach, specific features such as intangibility and co-determination confer uniqueness to services. This point was made with clarity by Gallouj and Weinstein (1997) who revised the Lancastrian model by Saviotti and Metcalfe (1984) to argue that the combination of characteristics embodied in a service is unique because its output is intangible. This implies that, unlike manufactured products, a service outcome can never be replicated exactly, no matter how many times it is reproduced. The argument goes even further when customization induced by user–producer is considered (Gadrey and Gallouj, 1998; Sundbo and Gallouj, 2000; Gallouj, 2002). As service firms often customize their output around customers' requirements, in principle any variant in the mode of service provision can be considered an innovation.

It seems clear that striving to portray services as 'different' led demarcation studies to take arguably too far an analysis built upon a selective view of physical characteristics (or lack thereof) of service activities. In particular, they aroused two sources of criticism. First, the association between services and manufacturing is downplayed from the outset. As will be seen, the benefits of such a divide are debatable when considering that empirical studies rather indicate complementarity between the two (Antonelli, 1998; Howells, 2004). Second, the conjectured flexibility of services due to user–producer interactions is a generalization that would require further qualification (Tether, 2005). Though empirical evidence underscores the role of demand in shaping innovation in the service sector (European Commission, 2004: 24), provider–user interactions are generally rather heterogeneous, and their coordination implies considerable costs of gathering highly dispersed information (von Hippel, 2005). This suggests a cautious consideration of the variety of user–producer interactions and of the impact that these exert, depending on the content and the mode of service provision. Miles (2005) makes this point clearly: activities such as Knowledge Intensive Business Services (KIBS), which consist in the exchange of information, are more easily influenced by users' feedback than other types of services where such feedback is indirect or not relevant at all.

The picture portrayed by these two approaches on service innovation is a cause for discomfort for manifold reasons. First, most studies looked at static characteristics of services, insisting particularly on a number of features

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(Miles, 2000, 2005): the outcomes of services are intangible and, thus, do not undergo processes of storage and transportation like manufactured goods (co-substantiality); as the acts of production and use (often) coincide, many services involve some form of cooperation between users and providers (co-terminality); most service activities are information ntensive, although the role of information can vary enormously across them. In sum, most of these studies focussed on what services 'are' within given sectoral boundaries, rather than on what they do and how. Second, and as a consequence of the former, the tendency to lump together service activities in a homogeneous clod contributed to hide the considerable heterogeneity. The latter applies to the markets they serve, their modes of organization, and the institutional framework in which they emerge and develop (Tether, 2003; Miles, 2005). Service industries are characterized by greater variety of skills and greater intensity in the use of technology than had been previously perceived (OECD/Eurostat, 1997). Yet one more reason for dissatisfaction is that early studies on 'service innovation' assimilated concepts and tools of the analysis of technological change that had been developed in relation to manufacturing. As we have seen in the review of the literature, this gave way to extreme views of services as either subordinate or totally distinct from manufacturing.

The view we take here is that services produce value by generating transformations over time and space, the outcome of which can be either physical (e.g. a haircut, a surgery operation) or immaterial (e.g. consultancy, an online bank statement) (Miles, 1996; Tether and Metcalfe, 2004). Empirical works increasingly suggest that innovation in services involves re-organization of the set of activities underpinning their systems of provision. This implies that, first, such a process cannot be detached by the institutional conditions of access to and use of knowledge, and, second, that not all services are relevant to the innovation process, or at least not to the same degree. Much attention has been paid in recent years to services that are organized in network structures spanning various upstream and downstream markets, thereby defying traditional sectoral boundaries. These systems are characterized by distributed processes of innovation in which organizational, strategic, and relational factors come to play a key role, beyond the archetypal 'product and process' umbrella (Howells, 2000; Metcalfe and Tether, 2004; Miles, 2005). Growing empirical evidence points out that their mode of operation is shaped by the emergence of platforms of activities stretching across sectors and industries, both within services as well as between services and manufacturing (Antonelli, 1998; Howells, 2000, 2004).

These observations provide ground for a new conceptual perspective that departs from the dichotomies that characterized the early literature on service innovation. In the next section, we present the 'synthesis' approach, which emerged recently in the context of innovation studies as a promising alternative to pursue this line of research.

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3. The Synthesis approach to service innovation: concepts and evidence

This section introduces the key elements of analysis of the synthesis approach to service innovation. We follow this with a review of empirical case studies developed within this new conceptual framework.

3.1. The conceptual elements

The synthesis approach to service innovation blends the theoretical elements from innovation studies of Neo-Schumpeterian tradition with empirical analysis drawn from detailed case studies (Coombs and Miles, 2000; Tether, 2003; Drejer, 2004). Central to this approach is the concept of system of innovation, which is the logical structure that connects the purpose for which a system exists to the set of activities that are set out to achieve it. Innovation in this context is understood as an endogenous response to the limitations that make the current set of activities inadequate for such a purpose (Andersen *et al*., 2000; Tether and Metcalfe, 2004). Such changes generate a path of problems and solutions through the application of new knowledge and the reorganization of the activities, which shift the system's purpose in an open-ended fashion (Metcalfe and Ramlogan, 2005). Allied to this is the idea that innovation involves reconfiguration of knowledge across partially connected technical, organizational, and institutional domains (Langlois, 1988; Loasby, 1991; Metcalfe, 2002). But as knowledge is heterogeneously dispersed across individuals (Hayek, 1945), changes in its structure entail reconfiguration of the mechanisms that make communication possible and effective (Nelson, 2003; Metcalfe and Ramlogan, 2005). Therefore, as put aptly by Loasby (1991), a system thrives on the diversity of the forms of specialization within, but, at the same time, requires coherence through coordination across the activities in which knowledge is embodied.

This notion of coordination as engine of economic development can be traced back to a seminal article by Richardson in which he claims (1972: 888; emphasis added):

> It is convenient to think of an *industry* as carrying out an indefinitely large numbers of *activities* related to the discovery and estimation of future wants, to research, to development and design, to the execution and co-ordination of processes of *physical* transformation … And we have to recognize that these activities have to be carried out by organizations with appropriate capabilities, or, in other words, with appropriate knowledge, experience and skills … What concerns us here is the fact that organizations will tend to specialize in activities for which their capabilities offer some comparative advantages … But the organization of industry has also to adapt itself to the fact that activities may be *complementary*.

This understanding of industry as an economic environment in which sets of organized activities are the unit of analysis shares common grounds with

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the system perspective elaborated in the context of synthesis studies. Both approaches emphasize that such environments are dynamic in a two-fold sense. First, they span an 'indefinitely' large number of activities and are, therefore, open to discovery (Klein, 1977; Loasby, 1991). Second, and related to the former, such activities are organized around a purpose – 'discovery' according to Richardson – the achievement of which depends on the division of labour through specialization. The approach developed in the context of synthesis studies however is necessarily broader, for three reasons. The first is that services involve both physical and non-physical transformations. The second is that the development of most systems of service provision entails the creation of platforms of activities stretching across sectors and industries. In so doing, the object of analysis of synthesis studies becomes the process through which such systems develop, which is obviously beyond Richardson's scope. The third, related to the former, is that the search for and the implementation of solutions is uncertain because it depends on adaptation of the institutional architectures that determine the conditions of access to and use of knowledge (Tether and Metcalfe, 2004; Antonelli, 2005).

Summing up, synthesis studies place the dynamics of service activities within a broader conceptual frame. In particular, they emphasize the interplay among institutional conditions and the interactive processes in the creation and application of knowledge. Four complementary elements are central to this approach:

- the *context*, consisting in the institutional structure and set of instituted practices as defined by a specific historical pattern;
- the emergence of a *problem*, or some type of limitation in the existing system;
- *solution design*, involving new knowledge and ranging from advances in basic science to engineering physical artefacts; and finally
- The *Implementation of the solution*, which requires coordination of various types of knowledge with the elements of a system. This is effectively the connection of various domains like technologies, organizations, and institutions.

We will now present three case studies developed in the context of the synthesis approach.

3.2. Empirical evidence from cross-sectoral case studies on service innovation

In this section we review case studies on service innovation in three areas: air traffic control, retail banking, and health care. The criteria for their inclusion are threefold. First, we hold them representative of a wider typology of services organized around network structures which have come to play a strong role in the innovation process (Howells, 2000). Second, this selection consists of activities that fall into three (out of four) service macro-sectors according to standard

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classifications for accounting purposes.[3] In so doing, the paths of development of the systems are coherent with the characteristics that their contexts bear. Third, the evolution of these systems of service provision is characterized by interactions cutting across different, yet progressively complementary, sectors and industries. This, in turn, draws attention towards the development of various forms of coordination across the associated technologies, organizations, and institutions.

(i) Air traffic control: The first work by Tether and Metcalfe (2003) looks at the incidence of procedural innovation in air traffic management, a service consisting in directing aircrafts during landing and take-off procedures. The biggest provider in the UK is National Air Traffic Services Ltd. (NATS), which is organized as a network made of four control centres distributed across the country. The case study takes steps from data indicating the growing pressure exerted by air traffic on major European airports'[4] operating procedures. The obvious solution of increasing capacity to accommodate the increased traffic volumes (i.e. the sheer volume of departures and arrivals) through the construction of additional runways was ruled out in some cases, including London Heathrow, on environmental grounds. Nevertheless, the study shows that greater efficiency was achieved without expansion in the size of the physical facilities. The example of Heathrow airport is paradigmatic: despite the runway infrastructure having been in place since the 1960s, data show that the airport not only avoided saturation but also managed to achieve better capacity management. A key ingredient of this successful recipe was a mix of physical and procedural improvements. New technologies such as radar systems or recent aircraft technologies, as well as changes in the layout of the runways, fall in the former group. But a form of innovation that proved crucial to enhance efficiency was the institution of new rules for traffic management that have been implemented through cooperation[5] between pilots and air traffic controllers (Tether and Metcalfe, 2003: 449). This case study provides important insights into the development of dynamic capabilities through the organization of activities and the correlation of different forms of knowledge. In particular, it demonstrates that capacity growth does not necessarily require size expansion when efficient reconfiguration of existing practices can suffice. This is referred to as the 'soft' side of innovation in services (Tether, 2005).

(ii) Retail banking: The second case study looks at the experience of British banking, a sector that has been radically transformed during the last three

3 In the International Standard Industrial Classification (ISIC), services are divided in four groups: (a) Wholesale and Retail Trade, and Restaurants and Hotels; (b) Transport and Storage and Communication (wherein Air Traffic Control is accounted for); (c) Finance, Insurance, Real Estate, and Business Services (Retail Banking); (d) Community Social and Personal Services (Health Care).

4 The study compares London Heathrow with Paris Charles de Gaulle and Frankfurt airports.

5 Indeed the authors label learning by cooperating, the division of labour and of knowledge in a team where continuous interaction shapes the procedures (Tether and Metcalfe, 2003: 462).

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decades (Consoli, 2005a). A number of important steps contributed to shape this pattern of industrial development. In the beginning, limitations in the ability to manage large information datasets stimulated the automation of existing practices in banking, predominantly in the US and the UK, between the 1950s and the 1960s. The process of automation triggered a sequence of problems and solutions that proved crucial in shaping the design of banking services. The first step was to implement processors to re-organize back-office operations, soon followed by the development of new front-office channels such as automated teller machines (ATMs). Over the years, however, the process of automation of automated transactions became increasingly complex and involved cooperation among banks (Consoli, 2005b, 2005d), between banks and firms with ICTs expertise (Child and Loveridge, 1990; Fincham *et al*., 1994), and more recently between banks and retailers (Howells and Hine, 1993). But the evolution of banking is a systemic process that could have not been possible without a new regulatory framework, which was a catalyst for competition,[6] and without the impact of consumers' adoption of new payment instruments, which operated effectively as a selection mechanism. Demand feedback determined the success or the failure of some types of automated banking services and undermined the notion that massive investments in ICTs lead *de ipso facto* to lower operative costs (Chiesa and Manzini, 1998). Despite the removal of time and space constraints, adoption of banking services depends on the uneven distribution of capabilities across customers (Consoli, 2005b, 2005c; Corrocher, 2006).[7]

(iii) Health care: Three case studies in different areas of health care provide interesting insights on the emergence of systems of medical innovation.

The first study on ophthalmology tracks the development of diagnostic techniques for glaucoma (Consoli *et al*., 2005). Without delving into technical details, suffice it say that for many years diagnosis of glaucoma was based on measurements of intra-ocular pressure (IOP).[8] This lock-in into what would turn out to be the 'wrong' scientific paradigm offers a clear example of how, paraphrasing Loasby (1998), the way in which the science base defines a problem forges the range of techniques, for good or for bad. An important breakthrough for research on glaucoma was the dismantling of the IOP conjecture, which is indeed insufficient for a correct diagnosis. More than this, the discovery that glaucoma is not a single disease but rather a heterogeneous group of disorders

6 This is significant if we bear in mind that the history of banking, in the UK as much as in many other countries, has been traditionally characterized by varying forms of restrain to competition. Today building societies, large retailers and – more recently – Internet banks have become a serious challenge to the supremacy of traditional banks.

7 For a discussion on the relationship between consumers and innovation, see Langlois (2001), Loasby (2001), Metcalfe (2001a), and Steedman (2001). For the role of capabilities in this process, see Langlois and Cosgel (1998).

8 This is the circulation of aqueous humour inside the eye.

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provided solid ground for the design of new techniques and the development of associated diagnostic procedures through the institution of various forms of cooperation. On the one hand, information exchanges fostered through scientific publications and informal networks of practice provided much scope for the individuation of new areas of research. The evolution of scientific understanding of glaucoma is mirrored also by qualitative changes in the channels of communication. The bibliometric analysis by Consoli *et al.* (2005) shows that other than traditional ophthalmology outlets, scientific publications on glaucoma have been increasingly featured in journals concerned with the wider field of molecular genetics. On the other hand, greater resonance within the scientific community stimulated the institution of units of cross-disciplinary research such as university-based research hospitals. The latter represent a pivotal organizational innovation in which laboratory research is blended with the provision of health-care services. In other words, research hospitals bridge the traditionally separated spheres of basic science and technology. In recent years these have become key nodes for the coordination of design improvement and testing of new diagnostic and therapeutic procedures in ophthalmology as well as in other areas of health care (Mina *et al.*, 2005).

The second study on medical innovation focuses on the development of a surgical technique for the substitution of the intra-ocular-lens (IOL) in patients with *cataracts*, a condition in which the crystalline lens of the eye becomes opaque. Metcalfe *et al.* (2005) analyse the process of radical innovation that shaped the technique of replacing the cataract with a functioning IOL. Initially the achievement of an individual, this breakthrough provided the basis for a system of service delivery the creation and development of which relied upon coordinated interactions across different domains. Various forms of knowledge allowed the translation of the scientific discovery into standard ambulatory procedure. First, advances in basic science allowed smaller incisions in surgical procedure. Second, market knowledge paved the way for commercialization of foldable lenses, whose manufacturing had been perfected through experimentation with new materials and designs.

The third study focuses on the evolution of the medical knowledge on *Percutaneous Translumimal Coronary Angioplasty* (PTCA) in cardiology (Mina *et al.*, 2004, 2005). PTCA is a procedure which has established itself as a standard surgical treatment for patients with constricted coronary arteries. The problem and the theorized solution are rather intuitive. As the flow of blood in the artery is constricted by a plaque, it is necessary to dilate it by using a balloon-tipped catheter in order to restore normal circulation. PTCA, however, managed to achieve wide diffusion only after years of cumulative trial and error and systematic interactions with other areas of vascular surgery, as well as diagnostic services (i.e. angiography). A key role in this process was played, again, by the coordination of various types of knowledge. Technical knowledge was necessary to contrast unforeseen problems such as the discovery that arteries tend to block

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again after the insertion of catheters. This, in turn, needed to be complemented by market knowledge in the large-scale commercialization of stents,[9] which are commonly used to support the wall of the artery. Similar to the other cases, PTCA became a standard ambulatory practice only after a process of institutional adaptation, which required implementation of informal and formal types of regulation.

4. Discussion

In this section we seek to analyse the main dynamics of innovation observed in the systems of service provision presented above. The case studies on service innovation highlight the role of institutions as mechanisms of social coordination underpinning the growth and reconfiguration of knowledge. Institutions of the kind we are interested in confer on a system of interacting agents the coherence necessary for innovation (Langois, 1986; Loasby, 1991; Nelson, 1995, 2003; Hodgson, 1998; Antonelli, 2001; Metcalfe, 2001b). They encompass formal and informal rules of behaviour critical for the generation and use of technological knowledge across the stages outlined by Antonelli (2005): (i) the dispersion across a multiplicity of agents; (ii) the opportunities provided by relative proximity in the knowledge space; (iii) the emergence of systematic interactions; and (iv) the impact of switching costs and initial conditions in stimulating or constraining the emergence of complementarities.

Each one of the systems of service provision analysed above is characterized by high levels of coordination of different types of knowledge. We identify two forms of such coordination, namely horizontal and vertical complementarities. The former are usually generated across dimensions that are not necessarily organized in a hierarchical fashion, such as interactions between the back-office and front-office departments of a bank, or among members within a scientific community. By contrast, vertical complementarities exhibit hierarchy in the forms of communication, ranging from informal exchanges, such as that between laboratory and practice in health care, to formal regulation, such as the design of security and confidentiality policy in a financial system. Both these types of complementarity are emergent properties of evolving systems. From this viewpoint, it can be appreciated that changes in the organization of activities through reconfiguration of the vertical and horizontal relations in a system mirror changes in the structure of knowledge. Let us connect these observations to the case studies *vis-à-vis* Table 1, which synthesizes the key dynamics of the systems of service provision in terms of problem sequences and the underpinning processes of institutional transformation.

9 A stent is a metal tube that can be inserted permanently into an artery to hold it open. An evolution of the original design is a drug-eluting stent, which reduces the chance of arteries being blocked again.

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Table 1.

	Air Traffic	Retail Banking	Glaucoma	IOL	PTCA
Problem	Increased volume of traffic	Increased volume of information	Deterioration of eyesight	Deterioration of eye's lens	Artery blockage
Designed solution	Expand runway capacity	Automation of back-office and front-office	Diagnosis formulation by measuring IOP	Replacement of the lens by surgery	Dilating artery by surgery
Emerging solution	Procedural change	Increased competition & service diversification	Multi-factor disease & multi-diagnostic techniques	Small incision & foldable lenses	Inserting balloon
Vertical complementarities	IATA, European Regulation, local authority and national carrier	New regulation of the financial system (formal)	Laboratories & clinical practice (research hospitals)	FDA (formal)	FDA (formal)
		Banks & retailers (informal)		Insurance companies & health-care managers	NHLBI (semi-formal)
		Among banks	Ophthalmologists & device manufacturers		Registry (informal)
		Banks and customers		Surgeons & lens manufacturers	Surgeons & stent manufacturers
Horizontal complementarities	Airlines & traffic controllers	Banks and firms within horizontally-related markets	Scientific community (publications)	Clinical practice & training	Clinical practice & training
Spatial character of innovation	National	National	International collaborative	International collaborative	International collaborative

In the case study on Air Traffic Control, horizontal complementarities were stronger than vertical ones. In fact, standard operating procedures for air traffic control are designed by a supranational authority – the International Air Transport Association (IATA) – but their implementation depends on vertical coordination among European Regulation, local authorities, and the largest operator at each airport (this is likely to be a national carrier, e.g. British Airways in Britain). The key procedural changes, however, are negotiated between airlines and traffic controllers, rather than superimposed by a regulatory body. This substantiates the tenet that service firms are characterized by strong orientation towards organizational change in their innovation activities (Sundbo, 1998; Miles, 2005). Enhanced management of air traffic control can be attributed to the development and the adaptation of skills and of collaborative interactions, which are sometimes referred to as the 'soft side' of innovation in services (Tether, 2005).

The second case study on banking innovation features a wider set of formal and informal relations and of associated complementarities. Vertical relations, e.g. explicit and implicit forms of regulation, contributed significantly to the elimination of barriers to entry. In turn, changes in the spectrum of vertical relations stimulated horizontal complementarities spanning conflicts between British banks and retailers for the deployment of point of sale (PoS) technologies, as well as collaboration between banks for developing procedures to implement a shared network for automated transactions (Howells and Hine, 1993; Consoli, 2005d). Yet one more important aspect of innovation in retail banking is that commercial exchanges, once regulated almost exclusively by fiat money – whose institutional character was long ago discussed by Menger (1892) – are now based on the emerging social institution of electronic signals (Moini, 2001).

In the case of glaucoma, the effects of horizontal complementarities such as scientific publications were reinforced by the institution of research hospitals as primary centres of research and trial (Consoli *et al.*, 2005: 19). The paradigm shift also paved the way to improved methods of glaucoma diagnosis, based on the joint use of various techniques and devices rather than a single one.[10] The diffusion of the IOL surgical procedure was heavily influenced by conflicts within the US ophthalmic community. This resulted in the transfer of regulatory powers at the top of the regulatory ladder to the Food and Drug Administration (FDA). The latter established strict safety and quality rules on procedures, reducing the scope for experimentation, and bolstered the growth of an industry

10 In spite of remarkable scientific progress, many aspects of the pathogenesis of this disease remain unknown. In fact, a standard ophthalmic examination includes a combination of techniques: measuring IOP (tonometry), assessment of the drainage angle (gonioscopy), inspection of the optic nerve (ophthalmoscopy), and visual field measurement (perimetry). None of them is by itself sufficient for a correct diagnosis. This makes the case of glaucoma idiosyncratic, because, contrary to several other cases, the development of diagnostics did not involve the emergence of a single dominant design.

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around the new standards (Metcalfe *et al.*, 2005: 18). Also, the financial rules that regulate the liability to cover medical costs exerted pressure towards the transformation of IOL surgery into common ambulatory practice and stimulated closer collaboration between surgeons and ophthalmic companies, and between nurses and clinicians. At yet another level, the reconfiguration of the knowledge base provided important feedback on the education and training system. Moreover, the diffusion of the surgical procedure for PTCA created scope for cumulative forms of informal and formal regulation. These ranged from the creation of a registry to the institution of regular workshops and an official database in 1979, to the division of regulatory labour between two competent agencies in the US – the National Heart, Lung, and Blood Institute (NHLBI) and the FDA. Having provided a stable framework for scientific understanding and practice, these shades of regulation opened up the way to new commercial developments (Mina *et al.*, 2004; Ramlogan *et al.*, 2005). This reflects the principle, underlying most of the reviewed systems of innovation, that engineering solutions imply combining individual creativity with a coherent understanding of the institutional framework. Similar to the glaucoma case, formal regulation and the consolidation of operative standards within a network of professionals were crucial for medical progress (Langlois and Savage, 2001).

Before concluding, two broad considerations are in order. First, the case studies show that the organization of these service activities involved different patterns of division of labour between the public and the private spheres. In UK retail banking, payment services are typically supplied by private firms under the supervision of independent regulatory bodies. In the case of health care, the interplay is more intricate. Health-care services are regulated by public institutions, while their supply involves a mix of private and public organizations. Besides, their provision is funded through joint public and private monies, aimed at bridging basic research with development of new technologies and techniques. The business of air traffic control is dominated by public–private partnerships, which, in contrast to the former two, operate for the most part outside the umbrella of regulation. Systems of service provision are also characterized by variety in the geographical boundaries within which activities are organized. Services that are strongly tied to a national framework, such as air traffic control and banking, tend to be shaped by forms of regulation designed on a local basis. In contrast, when such systems involve international collaborations, such as in the case of health care, the prevailing regulatory framework is likely to be some type of self-regulation made up of semi-informal arrangements to compensate for lack of formal action by governments.

A second consideration is that over-generalizations of the kind observed in previous research on service innovation need to be taken with due caution. First, because even though service activities are characterized by interaction, considerable diversity can be observed in the protocols through which such

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interaction takes place.[11] This, in turn, is reflected in the ways in which activities are organized at various levels spanning firms, institutions, and consumers. The case studies show that differences in the organization of service activities matter, for they fuel idiosyncratic patterns of division of labour and the associated institutions for the coordination of knowledge. The synthesis approach captures these aspects by placing elements of analysis outlined in previous works in a broader frame. In so doing, rather than the physical characteristics (or lack thereof) of services, the metric in synthesis studies is the dynamic interplay among complementary domains underpinning service provision. Similar to taxonomic studies, service innovation is defined in relation to functional aspects of services, e.g. what they do. Unlike taxonomic studies, however, the synthesis approach encompasses cases in which sectoral boundaries are neither given nor static. At the same time, synthesis studies highlight also the 'socially mediated' nature of the innovation process whereby a variety of agents contribute to the design and the implementation of new solutions. Though the interactive nature of services was a staple also of the demarcation approach, synthesis studies qualify the nature and the extent of such interactions and their differential impact on the innovation process. There is another reason to be cautious. Synthesis studies focus on types of services in which the organization is founded on networks that differ in scale and in structure, but share the characteristic of benefiting from the creation of platforms of activities connecting industries and sectors. The study of these activities defies orthodox distinctions and fuels new understanding of the complementarity between services and manufacturing. In sum, this body of work suggests an interesting scenario in which manufacturing and some services emerge as co-specialized, to maintain Teece's (1986) terminology or, more broadly, complementary – in Richardson's (1972) sense – activities.

5. Concluding remarks

Where does this journey through airports, banks, and hospitals leave us in search of points of reference for the study of service innovation? This essay has suggested that, having been played out too soon by early literature, the role of services in modern economies gained full recognition only recently. This has fuelled empirical research whose results can be synthesized in three complementary stylized facts. First, some services play a bigger part in the innovation process than was previously perceived. Second, these service activities are becoming more research and technologically intensive due to the combined effect of a growing knowledge base and the associated coordination mechanisms. Third, and related to this, a considerable number of service activities are being organized around networks that fuel interaction across industries and sectors. Therefore, within

11 Take, for example, automated banking transactions and a haircut; both are services that involve some kind of interaction with customers, albeit very different forms.

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the boundaries of a system of service provision, different types of service firms tend to become involved at various levels of the production process.

The synthesis approach, which recently emerged at the interface between the management and the economics literatures, captures these stylized facts in the wider analysis of innovation. By capturing its forms and extent in the experiences of specific industries, synthesis studies address questions concerning the emergence and the development of systems of service provision. Unlike previous approaches, they are not concerned by what services 'are', but rather by what services 'do' and 'how'. Coherent with the Neo-Schumpeterian tradition upon which they draw, synthesis studies show that innovation is the endogenous outcome of the coordination of different forms of knowledge within and among technological, organizational, and institutional domains.

The case studies reviewed in this paper span a range of areas – air traffic control, retail banking and health care – in which innovation processes cut across traditional sectoral and industrial boundaries. Crucial in these works are the routes by which new knowledge stimulates changes in the organization of a system of service provision. These processes can be understood within the broader context of a changing division of labour, which, in turn, draws attention towards the intertwining of three building blocks of the economics of innovation: namely, the interdependence of production and consumption; the changing balance between public and private modes of provision; and the growing role of distributed innovation processes, built upon new forms of organization that transcend sectoral and geographical boundaries.

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