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Abstract

Liberalization is generally credited with efficiency gains and growing economic performance. However, in the network industries such a vision is generally too simplistic, as economic performance is only one of the performance criteria – there is also technical and social performance (e.g., safety) – and as there probably economic performance tradeoffs between the different actors of the broad system (e.g., air transport system). Furthermore, the liberalization of the network industries is generally accompanied by an institutional process of re-regulation, whereby institutional arrangements are created so as to guarantee and balance the various performance objectives and actors' interests. So far, it has been difficult to evaluate the effects of a given regulatory institutional system on the performance of a liberalized industry as a whole. This paper will take the case of a national air transport system (including airlines, airports, and air traffic control), namely the case of Switzerland. It will first identify the main relevant and systemic economic, technical, and social performance criteria in the air transport industry. It will then describe the current institutional regulatory framework for the case of Switzerland. Finally, it will establish, for the case of Switzerland, a relationship between this institutional regulatory framework and the industry's performance. This paper, a case study of exploratory nature, is grounded in an already existing theoretical framework which links institutions to network industry performance. In its conclusion, it will try to generalize, from the case study of Switzerland, to other countries and institutional levels (e.g., EU), as it will also try to develop, from this case, a more dynamic conceptual model of how regulatory institutions relate to performance in the air transport system.

This paper aims at linking institutional arrangements to sector performance. It thus contains both a macro and an institutional perspective. Indeed, the paper looks at the air transport sector or industry as whole, thus encompassing all relevant actors from airports, to air transport operators (airlines), and to air traffic control, but could even include suppliers and buyers along the entire air transport value chain. At this point, the paper takes a national perspective, even though this approach could be extended to a regional level. In other words, we are looking a national air transport system with all its relevant actors.

The paper then takes an institutional perspective. Institutions are defined here as the formal and often informal rules that guide the behaviour of the actors in any given sector or industry. By institutional arrangements, we define thus both the actors and the rules which prevail in a given sector or industry. It is assumed, as we will explain below, that these institutional arrangements determine the performance of an industry, i.e., in our case the performance of a national air transport sector or industry. More precisely, it is both the behaviour and performance of the various actors as well as the performance of the overall system that is determined by these institutional arrangements. Also, as we will show later, such performance is multifaceted and does not only encompass economic, but also social and technical criteria. More precisely, in the infrastructures in general and in the air transport sector in particular, the institutional arrangements determine technical performance, which in turn determine economic and social performance. Finally, economic and social performance is of course determined by the state of the technology – i.e., at every state of the technology an industry can be more or less economically performing – yet the state of the technology is evolving, and this evolution is in turn related to the institutional arrangements. Indeed, these institutional arrangements also determine technology dynamics, or in other words the degree to which the technology can and does evolve. Thus, the institutional arrangements not only determine sector or industry performance at any given moment. In addition, these same institutional arrangements also determine the degree and capacity of the technology to evolve.

The paper will outline, in chapter 2, this conceptualization of the co-evolution between technology and institutions and its implications industry performance. In doing so it builds on a conceptualization in this matter which has already been developed and which applies to the network industries more generally. However, before presenting this conceptualization, the paper will outline in chapter 1 the currently dominant conceptualization of the performance of the air transport sector. This conceptualization, we will argue, is not only insufficient, but moreover fails to adequately take into account the role played by institutions in shaping such performance. Chapter 3 then briefly presents the context and dynamics of the liberalizing air transport sector and places this dynamics within our overall conceptual framework. This serves to highlight the relationship between institutional changes on the one hand and sector performance on the other and by doing so sensitize the reader to the fact that institutional arrangements do matter, at least when performance is approached from a broader sector or industry perspective. Chapter 4 then takes the example of Switzerland. Its purpose is twofold: on the one hand, the chapter will apply the broad conceptual framework as outlined in chapter 2 to the case of Switzerland and test. On the other hand, the case of Switzerland will serve as a means to identify the concrete consequences of liberalization on air transport system performance in light of our conceptual framework and revise our model. Chapter 5, finally, will identify future challenges for research.

1. CURRENTLY DOMINANT WAYS OF DEFINING AND MEASURING PERFORMANCE IN THE AIR TRANSPORT SECTOR

The following quote from the World Trade Organization (WTO, 2005) perfectly illustrates the currently still predominant way of looking at the performance of the air transport sector or industry:

"The performance of the air transport industry depends on the same broad factors that determine economic performance. These include growth in gross domestic product (GDP), growth in international trade in goods and services, and growth in other industries that use air travel as a mode to transport cargo and people. In this context, the sustained economic growth experienced by the world economy in the past two decades and the strong performance of international trade has translated into a strong positive trend for international traffic. Industry specific factors are also important in determining performance. Here, the air transport industry is no different from other industries - exogenous shocks can exert positive and negative effects on its performance. Events such as those that occurred on 11 September 2001 are an example of how an external event can have significant consequences for the industry. Similarly, the rapid rise of the use of the internet, especially for direct business to customer contact, is another example."

This quote, along with its underlying approach, inspires to us the following three critical comments:

- first, performance of a sector or an industry is reduced to financial performance of the firms involved in this industry. Worse, it is reduced to the share price of the listed companies. Not only does this exclude from performance measures all non-listed actors, but it also excludes all public actors, let alone all actors whose performance criteria are non-financial. As a matter of fact, the air transport industry, like all other network industries, pursues many other performance criteria than purely financial ones, namely also technical (e.g., safety) and social (e.g., noise, pollution) ones. Not all these technical and social performance criteria can be reduced to financial criteria, nor can performance be reduced to the performance of firms. The World Trade Organization, like most economists, clearly has a too simplistic conception of what performance is. The view may be correct for a firm, but certainly not for an industry as a whole, and even less so for a network industry which is generally characterized by significant externalities and public goods, to use economic language, and which moreover pursues significant public policy objectives.
- Secondly, institutional and organizational aspects that could influence performance are entirely absent from this view. The air transport industry does not seem to operate in a highly institutionalized environment. To recall, airplanes can fly because countries have signed agreements among themselves, which, even if they are becoming in some countries, so-called "open-sky agreements" remain government agreements and as such per definition regulated. To recall also, the very tight safety and increasingly security regulation measures, not to mention environmental regulation or new institutional forms of alliances that structure the relationships between airlines. To recall also that airports and air traffic control are even more regulated, at times by way of ownership rather than explicit regulations. Finally, let us mention the fact the in the European Union, for example, there exists a strong movement of re-regulation leading to a highly reguilated "Singly Sky", not to mention to the emergence of an European Air Safety Authority. Instead, the World Trade Organization sees performance linket to either operations and thus tu managerial skills or to "external shocks", meaning natural disaster type events which managers are unable to influence. At best, this can be labeled a simplistic view. Hoever, we tend to think that this

view is blatantly inadequate, considering the fact that the air transport sector is not only highly institutionalized but also highly regulated. Indeed, the market is the exception and not the rule, and even the market is an institution that is regulated.

- Thirdly, and not astonishingly then, performance of the airline industry is seen by the World Trade Organization and by economists more generally as being causally linked to firm (and aggregated industry) productivity, yield, input prices, and others more, i.e., either to managerial performance or external shocks. This view totally ignores not only the institutional factors, as mentioned above, but moreover the fact that these institutional arrangements are themselves in a dialectic and thus dynamic relationship with the industry (i.e., the industry's structure and the behavior of the main actors inside thios industry). In other words, this view is not only static (non-dynamic), but more over non-dialectical.

Gonenc and Nicoletti (2000), in an OECD paper, had however offered a much more comprehensive approach to performance, albeit limited to air passenger transportation. In it, they place performance in the context of liberalization and thus give much more importance to institutional factors, and in particular to regulation. The following points made by this study are worth highlighting:

- Gonenc and Nicoletti recognize that the air transport sector is highly regulated and thus institutionalized and that such regulation obeys to various, often contradictoryobjectives (e.g., safety, national prestige, national defence, regional and urban development, environmental sustainability, public service). They even use the word "governance" to describe the institutional arrangements defining the air transport sector. However, they focus exclusively on air transportation services for passengers, and consider this to be the only relevant output of the air transport system. Nevrtheless, they conclude that, even if one looks only at are transport services to passengers, the environment remains highly regulated (even after deregulation): *"relatively few long-haul routes are open to competition"* (p.6), and *"open sky policies consititute only a partial step in this direction"* (p.6); regional markets only exist in the European Union and in the case of Australia and New Zealand; and *"at a large number of international airports congestion phenomena are reported to exist and a single airline controls more than half of the available slots"* (p.6).
- Consequently, their main preoccupation is about how air transport services (i.e., the services of the passenger airlines) can be made more efficient and how and whether these efficiency gains are being passed on to the consumers by means of reduced prices. Efficiency gains and price reductions combined are what they call "performance". Quite logically then such efficiency gains and ultimately price reductions are put into a causal relationship with competition, and competition means in this case allowing or forcing market entry by changing domestic (e.g., entry into air passenger business, initiating service on specific routes, operating aircraft above given sizes, reducing or discontinuing services, investing in airlines, establishing and applying various categories of passenger fares) and international market access rules (e.g., conditions of entry and ownership, selection of operable destinations, freedom to set capacity and fares). To recall, international passenger traffic respresent approx. 60 to 70% of total passenger traffic, meaning that international market access rules are more important for liberalization than domestic rules. Consequently, Gonenc and Nicoletti are interested in the relaxing of market access rules at both the domestic and international levels, also called de-regulation, so as to contribute to performance (efficiency gains or "productive efficiency" and price reductions for consumers or "air fares").

- However, besides the regulatory framework as an explanatory variable of efficiency and price, they introduce the intermediary variable of market structure, which they define as a combination of airport concentration and market concentration (phenomena which are by the way strongly supported by empirical research). They note in particular that market concentration is still very high and actually increasing: *"In many OECD countries and on most international routes (…) market concentration is significant and a few carriers supply air travel services. This generally occurs in the presence of an incumbent flag-carrier (often controlled by the government) (…). In addition, ailine alliances (often between incumbents) have been formed in a large number of routes"* (p.6).
- In terms of results, they note that both regulation and market concentration do affect efficiency and prices, though lower market concentration tends to rather induce productive efficiency gains, while deregulation tends to rather affect price reductions, even though this relationship is also often mediated by market structure. In essence, market structure affects both efficiency and to a lesser extent prices, which is exactly what one would expect. Thus, the main weakness of the Gonenc and Nicoletti study (due to their focus on statistical correlations) is the absence of an explicit model of how the regulatory framework affects market structure, which in turn affects efficiency and prices.[1] More precisely, we criticize the fact that their study remains quite elusive when it comes to linking market structure (and infrastructure access for that matter) to regulation, or more generally when it come sto linking institutions with market structure. We do not dispute the fact that market structure is a significant explanatory factor, but we consider market structure only as an intermediary factor, so to speak as a proxy for industry structure which in turn is heavily if nit exclusively determined by institutional factors, among which regulation, but also power relationships. We also do not dispute the fact that productive efficiency and fare prices are relevant measures of (financial) performance, but we consider financial performance as being only one of many performance measures of an industry (see below).

In this chapter we have thus highlighted how performance in the air transport sector has been approached in the past by discussing mainly the Gonenc and Nicoletti study, which is certainly the most comprehensive and most advanced conceptualization available today. We have however highlighted the fact that this conceptualization remains week on institutional factors influencing performance and that performance remains exclusively seen as being limited to productive efficiency and prices of airlines.

[1] To recall, they measure market structure at the domestic level as the number of registered scheduled passenger airlines, the number of major airlines, market share of the largest carrier in both the domestic and the international market, carrier concentration on both the domestic and international market and the proportion of the 100 busiest international routes serviced by more than 2 carriers; and at the international level as the number of route carriers, seat capacity of the largest carrier, seat capacity concentration, number of "challengers", seat capacity share of "challengers", number of third party carriers, seat capacity share of third party carriers, number of international airline alliances, seat capacity share of international airline alliances. They also measure another market concentration variable, which is the access to infrastructures, measured as congestion at departure and arrival airport as well as slot concentration at bot departure and arrival airport.

2. CONCEPTUALIZING NETWORK INDUSTRY PERFORMANCE

In this second chapter we would therefore now like to present a more comprehensive model of air transport performance, namely a model that (1) links performance to institutional arrangements and which (2) offers a more broader conceptualization of performance going beyond purely consumer related aspects. In doing so, we proceed in three steps: in a first step (2.1.) we will characterize the specific characteristics of network industries, which make these industries quite particular. In a second step (2.2.) we will relate these network industries to their institutional framework, highlighting in particular that network industry structure cannot be separated from the institutional arrangements in which these network industries operate. In a third step (2.3.) we will then identify the main network industry performance criteria, and finally (2.4.) we will relate the institutional arrangements of the network industries to their performance. It must be said that the network industries – such as railways, telecommunications, air transport, electricity, gas, and water – are quite particular industries, given the fact that the services are provided on the basis of a physical infrastructure, and that these infrastructures are often monopolistic in nature and remain so even after deregulation. We think that performance in the network industries cannot be appropriately conceptualized, subsequently measured, and ultimately promoted without a thorough understanding of the network industry nature of the air transport industry. We also think that this network nature of an industry leads to a much more significant role of institutions when conceptualizing performance.[2]

2.1. Characterization of the network industries

Infrastructures are complex systems with very specific technical, economic and political characteristics. To recall, infrastructures are based on physical networks. The allocation of goods and services is provided through these networks and they therefore constitute an important technical and economic backbone for the functioning of the related industries. Secondly, infrastructures pose challenges to institutional governance. Traditional market oriented solutions are often not possible since severe forms of market failures are involved. This includes the occurrence of positive or negative external effects, collective goods, increasing returns and network externalities. Therefore some supporting regulation is warranted to ensure the proper functioning of these sectors. Thirdly infrastructures serve major social objectives or needs that are of significant economic and political importance. Infrastructures are seen as an important foundation for the functioning of modern political and economic systems. Accordingly, politics and the corresponding political institutions are directly or indirectly involved in monitoring or even controlling the performance of these sectors.

Infrastructures are bound to physical networks that interlink different nodes with each other. Taking a technical perspective, nodes can be characterized as connectors between similar links that alter the direction of the flows in the network, or as points of exchange in which goods or services enter or exit the grid. The procurement of infrastructure related goods and services depends on the existence of these networks, making them literally the backbones of these sectors. The traditional economic approach of industries neglects a vital feature of networks, i.e., the complementarity that defines the interrelations between the various nodes and links in a given network. Typically, nodes and links cannot be used at random, but need to be approached in a coordinated way in order to produce a

[2] This chapter is inspired by Finger, Groenewegen & Künneke, 2005.

specific service. This mutual complementarity constitutes the basic synergy that is derived from the establishment of infrastructures. In order to facilitate this complementarity, some technical coordination is needed to ensure that the flows are arranged through a certain sequence of available nodes. From a technical perspective, this coordination is very elementary to safeguarding the functioning of the system.

2.2. Netwrk industries (infrastructures) and institutions

Infrastructure governance is challenged by the existence of various kinds of market failures[3] and the need to safeguard various public values and national interests. Traditionally, this challenge was solved by a strong degree of vertical integration and nationalization of essential facilities or firms. In line with the ongoing process of liberalization, the institutional coordination is nowadays much more oriented towards contracts between independent private actors. In this paragraph we shortly review how institutional governance in infrastructures can be perceived especially from an economic perspective. We focus on so-called New Institutional Economics (NIE) which encompasses various theories pertaining to how specific types of transactions can best be coordinated in specific types of governance structures (e.g., Ménard & Shirley, 2005). In NIE the focus is on market contracts on the one hand and hierarchies on the other (Williamson 1975, 1985); the former refers to decentralized coordination through spot market contracts, the latter to centralized coordination like vertically integrated firms. In between, so-called hybrids are located like bi-lateral governance (long term contracts, strategic alliances, peer groups, networks) and tri-lateral governance like sector specific arbitrage.

Economic actors replace markets for hierarchies by integrating transactions into the hierarchy (vertical integration) when it is efficient to do so, i.e., when transaction costs are lower. Coordination of transactions through contracts can become so complex and costly that the alternative of the 'organization, hierarchy, and vertically integrated firm' becomes more efficient because it economizes on transaction costs. This will especially be the case when the so-called asset specificity increases. In general, asset specificity refers to investments actors make specifically for the transaction at hand with the consequence that the investment cannot be efficiently used for other transactions. This creates 'hold ups', which make transacting parties dependent upon each other: actors are locked in. In other words, the possibility to change partner and to turn to a competing supplier or customer is limited, because of the transaction specific investments. Asset specificity reduces the pressure of competition and opens possibilities for actors to behave opportunistically. Anticipating this situation, actors wish to build in safeguards in the contracts to reduce the possibility of opportunistic behavior after the contract is signed (so-called post contractual opportunism). In the extreme, this can result in integration ('internalizing the transaction in its own hierarchy'), but also all kinds of intermediate governance structures are possible. Between spot markets and hierarchies, so-called hybrid forms of governance are created like long-term contracting, networks and peer groups.

But governance of infrastructures is not only an issue of private ordering. Because of specific characteristics of infrastructures like the public interest (universal service, interconnectivity), private

[3] As already mentioned in the introduction, the notion of market failure related to phenomena like collective goods, external effects, and network externalities. This notion refers to structural conditions that prohibit the functioning of the market mechanism.

ordering fails and government intervention is needed. Public ordering is needed when competition fails and needs restoration (e.g., competition policy, which is not specific to infrastructures). Public ordering is specifically needed in infrastructures because of the natural monopoly characteristics. Regulation can aim at controlling the power of the private monopolist (performance based regulation of prices and quality), but can also imply divestures by breaking up vertically integrated firms. The reason being opportunistic behavior of vertically integrated firms owning the infrastructure and providing services towards competing firms not owning the infrastructures (cross subsidies, predatory pricing). This would not be necessary when alternative competing infrastructures exist to which competitors can turn (like in telecom).

2.3. Network industry performance

In this section we relate the challenges for the sectorial organization to specific performance criteria so as to evaluate the functioning of infrastructures. We take three perspectives; i.e., economics, socio-politics, and technology. Accordingly, we distinguish three categories of infrastructure performance; i.e., economic performance, public value, and technical integrity. To recall, the economic organization of infrastructures is a challenge because of the occurrence of various kinds of market failures. This includes external effects, collective good characteristics, natural monopolies, and network externalities.

Typically, infrastructures exhibit positive external effects. This means that the benefits cannot all be accounted for in market prices. There are ‘free riders’ that take profit from the facilities without paying an appropriate price. This is directly related to the fact that infrastructures provide essential services over a large geographical area. For example, airports, railways, access to electric power, and communication facilities are important prerequisites for all economic activities. Proximity to a major port provides competitive advantages, which often cannot be appropriated by the investors of these facilities.

Infrastructures also exhibit public good characteristics, which economists define as non-rivalry and non-excludability of goods or services. Goods cannot be attributed to specific actors, but they serve all consumers equally. The price mechanism fails, and thus there is no economic incentive for investments. Besides, some elements of infrastructures display natural monopoly characteristics. Networks are typical examples of high one-time investments and very low variable costs. With an increasing output, average costs are decreasing. Under these conditions, only one firm can provide the services at the minimum possible costs. This was traditionally an important reason to grant many infrastructures a regulated monopoly position.

Network externalities are another typical economic feature of infrastructures. This simply refers to the fact that the benefits individual users can derive increase with the size of the network (for example: number of connections, number of nodes, number of customers). The larger the network, the higher the willingness to pay. This results in a self re-enforcing process, in which the largest network captures the entire market. Again, under these conditions markets cannot function as economic models usually assume. Obviously, under these conditions a monopoly (or at least industry concentration) develops that hampers competition.

The above mentioned market failures constitute important challenges for the sector organization. Traditional market organization is not possible or largely restricted. Often, strong governmental regulation is warranted to provide suitable economic conditions for the development of these sectors. It is very well known from textbook economics, under the circumstances of market failures private investments will not occur, or in the best case will be realized at an inferior level. Regulation or public funding is necessary to develop infrastructures under these conditions. As a consequence, traditionally the sector organization is characterized by monopolistic or at least cartelized market structures and a high degree of vertical integration.

We identify three criteria for the economic performance of infrastructures. Efficiency is a standard economic criterion that we further specify into three categories (see table No.1). Static efficiency describes the status quo of the system in terms of prices and allocative effects (Schumpeter, 1942). *Price efficiency* is realized if the price equals marginal costs. A distribution of goods and services is called allocative efficient if all customers are served that are prepared to pay the market price. As it is well known, the ideal model of perfect competitions results in price and allocative efficiency. This means that social welfare is theoretically optimized under these conditions.

Dynamic efficiency deals with the ability of the economic system to stimulate and initiate innovations that enhance productivity. While static efficiency is a traditional notion that is often applied and operationalized, dynamic efficiency is much more debatable and difficult to quantify. Dynamic efficiency mainly focuses on structural incentives for innovation related to institutional arrangements and sectorial organization. These kinds of incentives are not always straightforward to clearly operationalize or quantify. Schumpeter's and the Austrian Economic School's work is very prominent in this field. Under certain conditions, monopolies are drivers for innovation because they stimulate research & development in an attempt to capture temporary monopoly profits. Existing monopolies are replaced by new monopolies with even better technologies. This is the paradigm of '*the process of creative destruction*'.

The third criterion is the one of *system efficiency*, which is, among others, applied in the literature on large technical systems. It refers to the efficiency throughout the entire value chain of an infrastructure. This criterion addresses the network features of infrastructures and the need to coordinate the various relations between nodes and links. Network complementarities require a certain degree of coordination in order to capture synergy effects. System efficiency is realized if the synergy effects between the complementary nodes and links are maximized.

Table No.1: Economic performance criteria

Static efficiency	Price efficiency: prices equal marginal costs Allocative efficiency: all customers are served that are prepared to pay at least the market price
Dynamic efficiency (Innovation)	Refers to the capacity of the system to innovate from a systemic perspective and to the benefit of the overall system
System efficiency	Refers to the overall (systemic) efficiency of the industry, throughout all activities in the value chain

These three economic performance criteria address very different properties of infrastructures. Static efficiency is oriented towards the market structure, dynamic efficiency deals with the institutional arrangements and system efficiency highlights the network characteristics. These different performance criteria can be used to reveal differences with respect to the economic consequences of the liberalization of infrastructures. For example, competition might be very attractive from the viewpoint of static efficiency, but it might not stimulate system efficiency or dynamic efficiency.

Through the provision of essential services like energy, water, transportation and communication, infrastructures fulfill basic political and social functions that are fundamental for modern societies. We define this as the public value of infrastructures, which we further specify in two different aspects. Taking a consumers perspective, issues like accessibility to infrastructure services, safety, security of supply, reliability, and affordability are important elements that determine the public value. On the other hand there are also national interests involved. Governments might have political preferences towards a certain self-reliance of these fundamental services, or even withholding them from neighboring countries. Think, for example of air traffic control as a military means to protect a nation's territory, of the railway network as a means for regional development, or access to national energy resources like natural gas as a competitive advantage for domestic industry. Another example is the political preference for sustainable development and environmental protection. These latter kinds of public values are characterized by a collective perspective on essential infrastructure services. Table No.2 summarizes these two performance criteria with respect to the public value of infrastructures. The operationalization of these different perspectives is not intended to be limitative. Rather, it is meant to be illustrative as public value very much depends upon the nature of the specific services provided by various infrastructures.

Table No.2: Public values of infrastructures

Services of consumer interests (consumer protection)	Universal Service: quality, accessibility, affordability, reliability
Services of general (collective) interest	Security of supply, national security, social protection, environment

This paramount public interest in the functioning of infrastructures makes their functioning and their performance a highly political issue. For this reason, infrastructures are traditionally an important field of public policy and regulatory involvement. The degree of involvement however might differ. In some cases, government has complete ownership rights. Examples for public ownership include many navel ports and airports, railway tracks, energy firms, postal firms, roads, and waterways. For some other infrastructures, there are sometimes even specific ministries, like transport, energy or communication. Contrary to this very close 'hands on' public involvement, there are also cases in which contractual arrangements are sufficient to safeguard public values. This includes examples of public-private partnerships, for instance with respect to the building and operation of highways, tunnels, or railway tracks. In the course of liberalization, there is now a significant shift towards private ownership and public-private contractual arrangements, but this does not always imply less governmental involvement. Even if government is less involved in daily operation of these infrastructures, there is still an important need to clearly define the formal institutional arrangements in a way that public values are secured even under competitive market conditions. This is a challenging task, which still has to be addressed in many infrastructures as the examples in the introduction illustrate.

The network characteristics of infrastructures imply a need to secure the technical integrity of the system. This technical integrity is necessary so as to safeguard the complementarities between the nodes and links. Without a certain degree of technical integrity, no production process can take place by means of the infrastructure. This implies the existence of one or more coordination mechanisms that align and govern the technical operations within the network.

Safeguarding technical system integrity implies a need for the capacity of the overall system to correct errors or unexpected outages of network elements in a way that operations can be maintained, at least in parts of the infrastructure. In this respect relevant performance criteria include concepts like resilience, robustness, self-healing, and autonomous learning of networks. Resilience or robustness are related to the capacity of learning from past experiences and improving system characteristics in order to be prepared for future disturbances. Increasingly, modern technologies, especially in the field of ICT, offer possibilities for artificial intelligence that allow systems to adapt and learn without human intervention. The process of adaptation to a crisis and the ability to recover services autonomously is sometimes denoted as self-healing process.

Table No.3: Performance criteria for technical system integrity

Resilience or robustness	Capacity of a system that is in some kind of distress, to resist or adapt to this situation in order to maintain an acceptable level of performance.

2.4. Linking institutional arrangements to network industry performance

We have now seen that the network industries – the air transport industry included – display particular technical, economic, and political characteristics, leading to a quite particular industry structure (e.g., a remaining monopoly, tendency towards vertical integration, market concentration, and sometimes tendency towards horizontal integration). We have also indicated thre types of performance criteria that are relevant in the case of the network industries. We can relate Gonenc and Nicoletti's performance criterium of efficiency to our (economic) criterium of "static efficiency" and their criterium of price to our (political) criterium of "consumer protection". We have also seen that this very particular nature of the network industries leads to a significantly more important role played by institutions in the functioning and therefore in the performance of the network industries. In this section, we therefore would like to more clearly identify this linkage between institutions and performance in the network industries, as we think industry performance is mediated by technical coordination, which in turn is heavily determined by institutional arrangements.

At the most basic level, we start with the definition of four basic technical functions that need to be guaranteed in order to safeguard the functioning of infrastructure related networks. These basic functions need to be supported technically as well as institutionally by some institutional governance mechanism (institutional arrangement, including actors responsible for this coordination and rules defining the responsibilities of these different actors when coordinating). Such governance is characterized by the coordination mechanisms and the scope in terms of the elements of the networks to which they apply. Our hypothesis is that both technical and institutional coordination determines the performance of infrastructures.

Networks are the physical backbones of infrastructures, thus enabling the complementarity of both nodes and links. This complementarity constitutes the reason for the establishment of networks and is therefore fundamental for the satisfactory functioning of any infrastructure. Four basic functions need to be assured so as to allow for complementarity, namely interoperability, interconnection, capacity management, and system management.

- Interoperability is realized if mutual interactions between network elements are enabled in order to facilitate systems' complementarity. For example, in the railroad sector, the specification of the tracks needs to be aligned with the needs of the locomotives. In the aviation sector, airlines rely on specific navigation systems that guide planes to their destination without accidents. Interoperability ensures that the elements of the network are combinable.[4] In other words, interoperability defines the technical and institutional conditions under which infrastructure networks can be utilized. Examples are technical norms & standards and regulatory conditions for access. In this sense,

[4] Sometimes the notion of system compatibility is also used in this context. See for example Economides 1996.

interoperability is also of strategic importance. It determines the conditions of use as well as the rules for entry and exit to this specific facility. In many public infrastructures open access is required as a public service obligation. Sometimes, certain technical standards are defined in a way to establish barriers to entry for disturbing competitors.

- Interconnection deals with the physical linkages of different networks that perform similar or complementary tasks (e.g., Economides, 1996). As such, interconnection is closely related to the technical system's boundaries. Typical examples include the interconnection of different telecom networks, railroad tracks or electricity systems. Interconnection occurs sometimes even beyond the limited boundaries of specific infrastructures. In the field of ICT there is for example a growing degree of convergence between telecom networks, the Internet, and television cable systems mainly as a consequence of the introduction of the IP protocol. A similar development emerged in the transportation sector through the introduction of standardized containers. This technology allows for very fast and efficient intermodal traffic between roads, shipping, or air traffic. Containers allow for a much better interconnection between these different infrastructures.
- Capacity management: networks are scarce resources because the capacity of nodes and links is limited. Capacity management deals with the allocation of this scarce network capacity to certain users or appliances. Different levels of capacity management can be distinguished[5]. On a strategic level network access and scope are important issues. Which actors are in general allowed to use infrastructures and what is the desirable scope of service? On a tactical level the actual access to networks needs to be facilitated by suitable regulations, for instance with respect to tariffs and technical quality standards. The operational level addresses real-time capacity management issues are related to the logistical aspects of directing the flows of services and goods through the various nodes and links. The physical limitations of networks pose high demands on the balancing of demand and supply of infrastructure services, which are often not storable. The electricity sector is a very illustrative example in this respect. Since electricity storage is only possible on a very limited scale and at very high costs, power production and consumption has to be balances nearly instantaneously. There are very sophisticated models of load balancing developed for this sector.
- System management pertains to the question of how the overall system (e.g., the flow between the various nodes and links) is being managed and how the quality of service is safeguarded. Typically system management consists of short-term activities related to the actual coordination of activities within the network. This can be a very critical activity in liberalized infrastructures in which network activities are unbundled from commercial business. Indeed, the so unbundled actors pursue their own strategic objectives (e.g., conflictual objectives between the rail infrastructure operator and the rail transport operator), yet the system can only function if the operations of the involved actors are somewhat aligned. With growing fragmentation of the technical systems because of unbundling, outsourcing, and others more, there is therefore a growing need to coordinate all operations and actors involved. The most obvious example here is slot allocation, which is a new function that becomes necessary after the separation of rail infrastructure and rail transport.

Our approach assumes that the above four technical functions need to be performed satisfactorily so that any given infrastructure functions properly. Ensuring this requires a certain coherence between the

[5] Ten Heuvelhof et. al. 2003

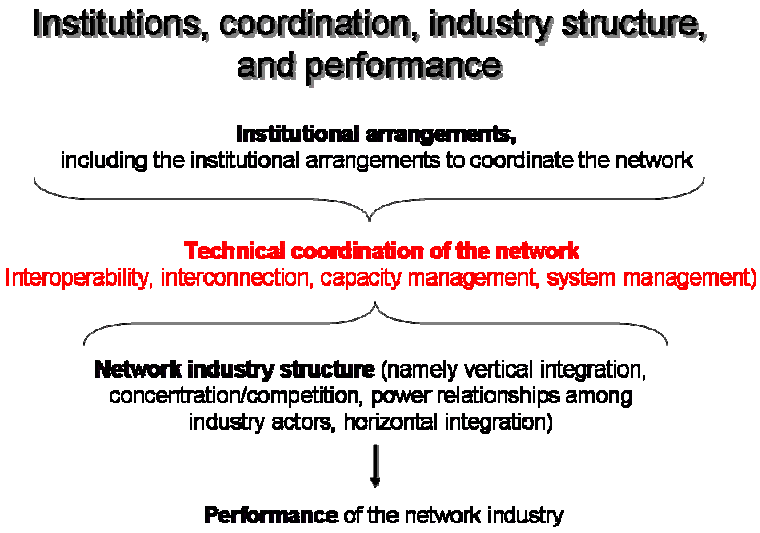
technical coordination and institutional governance. New institutional economics considers three clearly distinct mechanisms of coordination, namely markets, hierarchies, and networks. In a market system, for example, decision-making is distributed throughout numerous agents. Coordination is realized by certain institutional arrangements, but without any active planning or direct intervention. Here, the price mechanism is the invisible hand that co-ordinates the system in a way that markets are cleared and social welfare is optimized. A less perfect example of market coordination is for instance road transportation. Participants enter this infrastructure based on individual preferences and decisions. The transport service is based on the available capacity at the specific moment of use. The coordination of the functioning of the entire road transport system is effectuated by traffic rules that govern the behavior of individual users. Besides, capacity problems are solved through queuing and temporary storage, which is commonly known as traffic congestion. In other words, different technical systems require different forms of coordination mechanisms or a combination thereof, whereby the nature of the coordination mechanism depends upon the state of technological advancement. It is therefore perfectly conceivable that technical systems (for example thanks to the information and communication technologies) become more flexible and therefore more open to market coordination mechanisms.

A second aspect of coherence is related to the scope of control. Through the coordination mechanisms a certain technical and institutional scope of control is determined. For example, in the electricity sector, technical network operations are controlled and coordinated by a centralized yet regional system operator. The scope of control encompassed the physical limits of the relevant network. On the contrary, the economic activities of individual consumers or producers are only concerned with their individual preferences or production activities that might be linked through bilateral contracts even across the boundaries of different physical networks. In this example the scope of technical control is not identical to the scope of the institutionally coordinated economic activities. We consider the scope of technical and institutional coordination as coherent if they are related to comparable system boundaries.

Our hypothesis is that the degree of coherence between the technical coordination and the institutional governance (coordination) of the four major network functions determines the performance of infrastructures via the way it affects (network) industry structure, and this in terms of economic performance, public values, and technical system resilience. The four major network functions are pivotal for enabling the functioning of infrastructures and taking profit from the complementarities between the systems' nodes and links. Institutional and technological coordination is necessary to enable these functions to support the production of goods and services throughout the infrastructure. The more these coordination mechanisms are coherent, the better infrastructures perform.

Of course the three performance criteria may well be interrelated with each other. Some objectives might be complementary, while others are contradictory. High economic profitability might be contradictory with high demands for public values. Thus, performance cannot be perceived as an absolute measure but includes trade-offs between the three categories that are mentioned earlier. It can be envisaged that certain technical or institutional coordination mechanisms are oriented towards certain kinds of performance. For example, centralized coordination might be favorable with respect to safeguarding the technical system integrity and public values. On the other hand economic performance might be better in systems with decentralized bottom-up coordination.

In this chapter, we have argued that the performance of the network industries (air transport included) depends upon the way the four technical functions are coordinated (both in terms of modes and scope of coordination). This coordination is turn determined by institutional arrangements involving both actors (organizations) and the (forma and informal) rules that govern their interactions. There can be significant mismatch or incoherence between these the way these four functions are technically and institutionally governed. Furthermore, the relationship between such institutional governance and technical coordination on the one hand and industry performance on the other is far from being straight forward. As a matter of fact, it is mediated by industry structured, characterized, in turn, by the degree of vertical and horizontal integration, the degree of concentration and competition, and the power relationships among the main actors in the industry. The following graph illustrates these causal relationships:



3. AIR TRANSPORT LIBERALIZATION

Historically, the air transport sector has always been non-integrated vertically. As a matter of fact, three separate elements are constitutive of the "air transport system", namely (1) airports, which were publicly owned at a local level, (2) air traffic control (ATC), which is publicly owned at a national level, and (3) airlines, which originally were and often continue to be dominated by national flag carriers. However, despite such vertical non-integration, the air transport sector is a typical network industry as (more or less monopolistic) infrastructures (e.g., airports and ATC) are a prerequisite for air transport services to be delivered. And in reality, the sector has always functioned and to a certain extent continues to function like a vertically integrated sector. Indeed, the national flagship carrier generally has at least one hub of which it controls over 50% of the slots (see aboce Gonenc and Nicoletti, 2000) and often ATC privileges have been and continue to be granted to this national flag carrier. Furthermore, with the exception of domestic and some arer integrated markets (e.g., Europe and Australia/New Zelaand), traffic rights continue to be negotiated among governments. Change was introduced into the air transport sector via the liberalization of the airlines, first in the United States and then in Europe. Let us take here the case of the European Commission to first illustrate this liberalization process and then place it within the context of our conceptual framework.

3.1. The case of air transport liberalization in Europe

To recall, in 1957, when the treaty of Rome was signed, a common transport policy was created, but aviation was initially excluded. The American deregulation movement was an important force for the liberalization in Europe and in 1978, when the US liberalized their air transport sector, more liberal agreements were also signed between the US and some European countries (namely The Netherlands, Germany, and Belgium). Until then, European air transport was the competence of national governments and direct state control (coordination) was the rule. Under this system, airlines carriers enjoyed monopoly privileges within a restricted market and played a significant role as political instruments of their respective governments.

As a matter of fact, back in 1919, the Paris Convention had declared that states have sovereignty rights over the air transport industry above their territory. These rights led to strict government intervention in the sector. Before the end of World War II, the allied states decided to lay down principles for a new order in air transport and in 1944 The Chicago Convention on International Civil Aviation took place. The Convention reinforced the sovereignty rights as complete and exclusive and defined the so-called "freedoms" that countries could give airlines from other territories, should they chose to do so. Such freedoms (ranging from 1 to 8) are known as the "Freedom of Skies" and each one is subjected to specific conditions, which are determined through bilateral agreements between any two of the countries which are part of the Convention. So far, these freedoms have not yet been fully implemented, except in the European Union. Generally, liberalization of air transport is equaled to the granting of these freedoms.

In the mid 1980's, the European air transport was inefficient and congested. As the American one before liberalization, it was governed by many politically motivated restrictions. Monopolistic policies, flag carriers, bilateral market divisions, and high fares dominated the market (Nijkamp 1996). Change as thus in order and subsequent liberalization in Europe was then driven by three main forces (Doganis 1994): the American deregulation and the "open skies" offer made by the US; the successful revision of the bilateral agreement between the UK and the Netherlands (back in 1984/5), and more broadly the EU initiatives favoring liberalization in the aviation industry. As a matter of fact, the debate on liberalization in the European Community had started much earlier, as the European Court of Justice ruled that although Article 84(2) had effectively excluded sea and air transport from the provisions of Title V of the EEC Treaty, it could not exclude the application of the general rules of the Treaty, and therefore those related to competition, to the air transport sector. Also, in 1985 the Court found that the Council failed to fulfill its obligations to elaborate a common transport policy and in the Nouvelles frontiers case the legality of elements of national control over air transport regulation was challenged.

Subsequently, the Commission presented the "First Commission's Memorandum of 1979" (COM 79/311), which emphasized liberalization and called for a review of states subsides. In 1984, the second memorandum was issued and focused on more specific liberalization proposals. The need to liberalize the Community aviation market, to harmonize policies and to open the European market up to competition, led the Community to develop successive packages to improve the sector. Three so-called "packages" have so far been presented and two of them have been adopted:

- The first package was adopted in December 1987 and brought some flexibility to the existing rules. It revised the allocation capacity and government influence on the introduction of new fares was limited. It also made the rules on the sharing of seating capacity more flexible. This package also

initiated the transfer of authority to govern the air services market from national governments to the Commission.

- The second package was presented in June 1990. I brought further relaxation in the setting of fares and of capacity-sharing. The right to the fifth freedom was extended and the third and fourth freedoms were opened up to all Community carriers in general.
- The third package (January 1993) is considered the last stage of the EU liberalization of air transport services and represents the culmination of the liberalization process. The concept of a "Community air carrier" was introduced, as we the 8th freedom (cabotage) in April 1997.

One can see that the Community has chosen a gradualist approach for the deregulation of the European aviation market and the third package was the final phase of a series of measures. Structural barriers as airport slot availability, monopolies and state aid requires some time to be reformed. The EU has tried to bring more efficiency to the market and today, the Community air transport sector differs enormously from the market of a decade ago. The European air transport sector experienced a transfer of competence from national to supranational authorities and today, almost all important aspects of the sector are now regulated by the European Community (Sweet 1998).

European consumers have enjoyed competition and consequently lower fares. Airlines and routes have become significantly more efficient, as already noted by Gonenc and Nicoletti (2000). In the early 1990s there was a higher intra-EU traffic growth, a fact that probably would not have happened without liberalization. The number of EU cities served by non-stop services has grown and some trends from new entrant carriers (especially low cost airlines) in some countries are widely observed. Liberalization – i.e., the gradual introduction of "freedoms" between member countries up to the regulation of the European air transport service smarket – has doubtlessly been a success. And there have furthermore been significant spillovers to other parts of the world, namely when making European carriers more efficient and thus putting pressure onto the global air transport system.

However, there are also serious limits to such liberalization. First, the liberalization within Europe has not translated into global liberalization, as the basic institutional structure of the industry remains unaltered (i.e., political agreements between states). Secondly, we are now touching the technical limits as set by the network characteristics of the air transport industry, both in terms of capacity and system management. The European Commission had recognized this in the late 1990s when initiating the European Single Sky Process, which has in fact already led, in 2003 to the creation of the European Air Safety Authority (EASA), but which is far from being underway, let alone implemented. The European Commission has furthermore recognized the capacity and system management problems resulting from airports and airport slots. It has subsequently commissioned and in 2004 released a corresponding report, which has proposed trading of airport slots, and which has stirred up the industry.

In all three cases, we are now reaching institutional limits to improving the performance of the air transport industry (performance comprising all above identified indicators, i.e., economic, political, and technical ones). More precisely, we are now reaching the limits where the institutional governance (coordination) is clearly at odds with the technical coordination that would be required to the increase the performance of the air transport industry. In the next section, we will therefore try to place these considerations into our conceptual framework.

3.2. Air transport liberalization and our conceptual framework

In this chapter we now want to link the description of the air transport sector with our broader conceptual framework. We will do this in several steps: in a first step we will describe what technical coordination is in the air transport sector, given that air transport is a network industry. In a second step, we will then show how these technical functions are institutionally governed. In a thir step, we will define the relevant performance criteria of the air transport sector. This will lead us, in conclusion, to a first version of a model that links institutions to performance in the air transport sector.

From a technical point of view, the activities of airports, ATC, and airlines are strongly interrelated, and this before as well as after liberalization. As a matter of fact, there is no major technical change here: airplanes still need airports to take off and land, as well as ATC to guide them. Actually, ATC and other technical devices become ever more necessary as air traffic increases and as airlines multply. A certain technical harmonization, however, takes place because of the concentration process in the supplier industry. In purely technical terms, airplanes behave like trains or electrons, as they are transported via routes (air) and ultimately use slots (landing and take-off slots at airports). Thus, the air transport sector ultimately has to be managed as one single integrated system. Furthermore, the system has to be balanced at any single point of time: for example, ideally not more airplanes should actually take off than can land, nor should more planes fly more densely than the actual airspace available. Like in the other network industries, and from an economic perspective, this technical system management is a pure collective good that cannot be provided by market allocation. In other words, the four technical coordination functions that we have identified above as being relevant in any network industry do also apply in the air transport sector:

- Interoperability: interoperability is ensured by technically compatible devices on airplanes, ATC, and airports (e.g., radio-frequency transmissions, transponders, anti-collision systems, and others more), as well as by standardized process protocols and pilot licences, for example. Basically, interoperability technology and procedures ensure that airplanes can use airspace and airports. The standards for such interoperability have been defined by the relevant industry, as well as by international (e.g., ICAO) and regional institutions (Eurocontrol, Joint Aviation Authority). Interoperability appears to be a condition for participating in the (global) aviation industry.
- Interconnection: interconnection means that airplanes can fly (along routes) from one country to another and take off and land again. Interconnection therefore pertains to the relationships between the national air transport systems, involving both airplanes and air traffic control. Especially ATC systems need to be interconnected, so that planes can be handed over safely from one ATC provider to another. But also air space needs to be structured in similar ways so that such interconnection can take place.
- Capacity management: the main bottlenecks in the air transport sector are airport slots (so-called “slots”) and airspace (so-called “routes”). Routes are managed by air traffic control, which historically is a national activity, given in particular the military and political dimensions of controlling the airspace. However, air traffic control (and air space management more generally) are increasingly becoming integrated as a result of increase of transboundary traffic. In Europe, air space management is operated and to a certain extent integrated by Eurocontrol. Slots, in turn, are managed by the airports themselves along what is called “grandfather rights”. In other words, the slots are granted to airlines as a result of a highly complex negotiation system, and the airlines

generally can keep these slots long as they use them to a certain extent. Currently, slots appear to be the main bottleneck in the larger air transport system.

- System management: system management, in the air transport sector, means an overall approach to air transport, integrating the above three functions – but especially slot and route management , as well as integrating civil, military, leisure, and other aviation. Such system manegement takes place, at best, at the national levels, but many countries do not have such integrated system management. Especially military aviation, which occupies a significant amount of airspace, remains generally outside the aviation institutions. Also, a significant interfaces remain between airports and air traffic control.

Air transport is technically speaking a global system, something which is reflected in globally valid interoperability norms and standards set by international governmental organizations – e.g., ICAO, the International Civil Aviation Organization – professional bodies, or de facto by the suppliers and the US FAA (Federal Aviation Administration). However, as seen above, the boundaries of interconnection are still national (Europe planning to regionalize the interconnection function), the boundaries of capacity management are either local (airport slots), national (routes in most countries), or regional (in the case of Europe, e.g., Eurocontrol), and the boundaries of system management are at best national, but remain generally institutionally separated even at the national level. Ideally, all these four technical functions should be integrated at the global or in the case of system management at the continental level, which is far from being the case. This therefore means that the current institutional arrangements that govern the technical coordination functions are suboptimal, which in turn means that performance will be suboptimal. Liberalization is certainly going to improve (as we have seen) certain performance indicators, but significant improvements in performance will only be possible when the institutional arrangements will be adapted to the requirements of the technical systems functions. The following graph summarizes the above points:

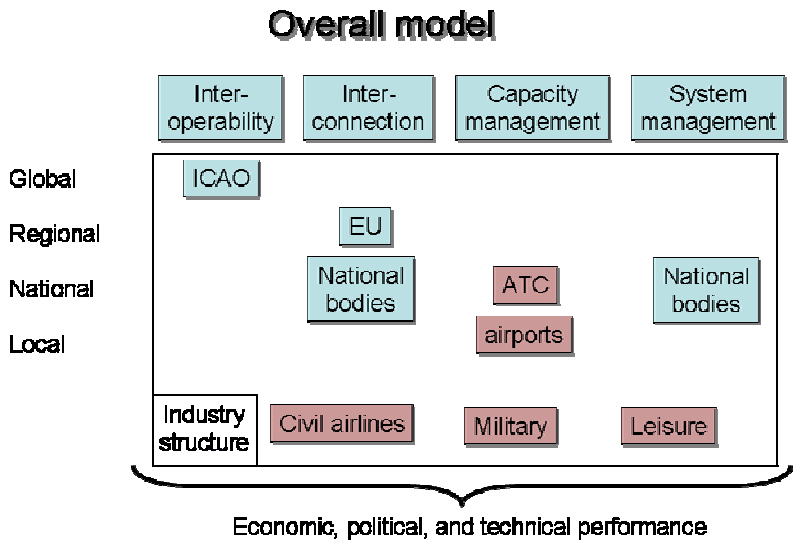
Technical and institutional coordination in the air transport sector

Technical systems functions	Technical coordination	Institutional coordination
Interoperability	between airlines and (ATC and airports) Procedures, licenses	Global (ICAO, suppliers, industry bodies)
Interconnection	Between national ATCs, between airspace structures	National, regional (EU) planned
Capacity management	Airport slots ATC routes	Local national, sub-national
System management	Between civil, military and leisure aviation Integration of above functions	Intra-national (institutions) At best national

Let us now turn to performance and performance criteria. We have seen above that, in the network industries, three types of performance criteria must be considered, namely economic performance, political performance, and technical performance. All three types of criteria alos apply in the case of the air transport sector:

- As for economic performance, one easily can see that static efficiency is a relevant indicator. Gonenc and Nicoletti have shown that such static efficience (which they call productive efficiency) has indeed increased for airlines, but it is not clear whether such static efficiency has increased for airports and ATC. Dynamic and systemic efficiencies are very difficult to assess at the current stage, and may well have not increased at all as a result of liberalization, and a systematic study on the effects of liberalization on dynamic and systemic efficiency for all three types of actors (e.g., airlines, airports, and ATC) is in order.
- As for political performance, we have distinguished between Universal Service (consumer protection) and Services of General Interest. Universal Service is defined in terms of accessibility, quality, and affordable prices for consumers, and Gonenc and Nicoletti have shown that such prices have improved as a result of regulatory changes, more than as a result of competition. As for Services of general Interest, one generally refers to safety, environmental sustainability (noise, pollution), and (security both for persons and nations, e.g., military security). We do not know, at this point, whether and how liberalization affects quality and accessibility for consumers, as well as services of general interest, and solid studies establishing these relationships would be needed..
- We have defined technical performance in the network industries as an indicator of system's resilience or robustness, i.e., the capacity of the air transport system to repair problems and to "self-heal". Overall, one can say that the air transport system is already highly reliable and safe and this despite substantial increases in air traffic, and despite the absence of appropriate institutional coordination mechanisms (see above), but further research would have to show how liberalization affects such robustness and resilience.

In short, one can say that we know still very little as to how institutional arrangements in general – and the institutional governance of the four network system functions in particular – are related to air transport sector performance in the three dimensions identified. And we know equally little as to how liberalization will affect this performance. But if our model is correct, such an essessment would have to take into account how liberalization affects the institutional governance of the four technical coordination functions first. The following graph summarizes our model:



4. THE CASE OF SWITZERLAND

Most of the Swiss network industries have experimented changes due to liberalization in recent years, often following the European trends. However, the process has been slower in Switzerland and has been influenced by the specific Swiss governance framework, in which direct democracy plays a significant role. The Public service debate is also central in Switzerland and there is a high level of public involvement at the Canton level. In general, a unified approach to regulatory authorities cannot yet be identified in Switzerland. There is indeed a clear tendency not to establish regulatory authorities, which however generally accompany liberalization processes, and this has been highlighted by a recent OECD report (OECD 2006).

Switzerland is therefore a particular, yet interesting case from our point of view: as a matter of fact, Switzerland is faced with mostly European wide liberalization measures which it cannot avoid, yet at the same time displays significant institutional resistance to such liberalization. At the same time, and not only in the air transport sector, Switzerland is at the center of European traffic routes (as it is at the center of European electricity transport, freshwater production, and railway transport), and can therefore not confront the matter. The purpose of this specific Swiss case is therefore to identify, by means of a specific case, how liberalization relates to performance in the air transport sector from an institutional perspective. In order to do so, we will first present the case of Swiss air transport, then illustrate the current institutional governance, and finally establish a link between air transport liberalization and performance in the context of this particular institutional governance system. This will lead us, in conclusion to rtefining our general model.

4.1. The Swiss situation

Before deregulation, as in other European countries, the Swiss air transport sector was characterized by a number of policies and regulations focusing on safety, local development and national prestige. The market showed a low performance, it was restrictive and highly regulated, with a single major national carrier. Since the opening up to competition, this situation has changed and the major air carrier, Swissair, underwent a number of changes, including bankrupcy, rebirth in the name of Swiss

International Airlines, and more recently acquisition by Lufthansa and integration into the Star Alliance.

The air transport in Switzerland is integrated into a complex set of international regulations. Switzerland has signed bilateral agreements with 130 countries and the Chicago Convention of 1944 determines the international framework. The bilateral agreements often present restrictions regarding ownership and control of airlines benefiting nationals of the contracting countries. The European aviation market is the most important regional market for Switzerland and the bilateral agreement with the European Union plays a central role in the openness to competition and full compatibility of the regulatory framework (OECD 2006).

As a result of its refusal to join the European Economic Area in 1992, Switzerland has remained outside the common aviation area, despite being close to the geographical centre of Europe. In 1999, Switzerland signed sector-specific bilateral agreements with the European Union, which covered 7 areas, including civil aviation. The agreements are in force since June 2002 and, Switzerland adopted the relevant Community acquis. The agreement on civil aviation contains the terms by which Swiss airlines will have access to the deregulated European market on a reciprocal basis. Considering that Switzerland has generally the same regulations as the EU, Community Law was extended to Switzerland and same flying rights for its airlines was gradually granted. In addition, discrimination on the basis of nationality is no longer allowed and Swiss companies obtained the right to establish and invest in the EU market. Regarding regulation, Community institutions have exclusive competence for monitoring compliance with the rules of competition, excluding public subsidies and restrictions on landing rights for ecological reasons. Switzerland remains responsible for monitoring State aid and has sovereign authority for ensuring compliance with the agreement's rules within its territory.

The potential economic meaning of the bilateral agreement on civil aviation in force since 2002 lies on the fact that two thirds of all passengers on direct flights leaving from Swiss airports, approach destinations in the European Union.

4.2. The Swiss institutional framework

Network industries have been opened up to competition and as a result independent regulatory authorities (IRAs) have been introduced to guarantee transparency, predictability and quality of decision-making. The establishment of such independent regulators is a trend in many countries which aim to ensure independent regulatory decision-making in order to prevent short-term political considerations and special private interests. The modern regulatory framework requires regulatory functions to be different from public strategy and ownership functions and has shown that sectors in which independent regulators have been introduced enjoy more economic benefits.

But Switzerland is only in an early stage of defining and establishing independent regulators. Some of the Swiss agencies, with their status as offices, are in fact decentralised administrative departments within their ministry, DETEC, rather than independent regulators. The situation is more complex, in the case of air transport. Some of FOCA's functions involve safety, others economic regulation and still others policy definition for the sector.

The Federal Aviation Act, which was last amended in 2004, gives The Federal Office for Civil aviation (FOCA) responsibility for all aspects of legislation and supervision of civil aviation in

Switzerland. The FOCA is part of the Federal Department of the Environment, Transport, Energy and Communications (DETEC) and is responsible for the licensing, registration and regulation of aircrafts, aircrews and airports. In addition, it supervises the control of air traffic, which is delegated to Skyguide. FOCA must ensure that high safety standards in civil aviation are maintained. Air safety is a key public policy objective and includes certification of airlines, certification of aircraft and airspace management. Toi recall, international rules give safety high importance but countries enjoy great leeway for organizing their institutional framework. FOCA is not an independent office but in practice, its director enjoys relatively high degree of administrative independence and it is appointed by the Federal Council.

Until 1988, safety was ensured by the government out of public funds. Financial autonomy was given to control services in 1996 and in 2001, they were incorporated. Today, Airspace management is the responsibility of Skyguide, which was established in 2001 with the military and civil air traffic management merger. The Swiss Confederation remains the formal owner of Skyguide and it is represented by the federal department of Environment, Transport, Energy and Communication (DETEC) and the federal department of Defence, Protection and Sport (DDPS). Skyguide must meet public services requirements (military airport services) and provide services within German airspace (it does not receive adequate compensation for these services). It is argued that safety conditions of Swiss air transport have decreased over time (NLR, 2004).

The Federal Aviation Act also defines the possibility of providing support to the three large airports and allows the Confederation to participate in the operations of airports and air transport companies, mentioning a general interest requirement, but without precisely definition. At technical level, international standards dominate the regulatory framework (OECD, 2006).

Airports represent significant economic actors in Switzerland. They have tried to maintain their profits with higher charges and taxes, considering that the traffic has decreased, especially in the case of Zurich. The flights leaving from Swiss airports to Europe are mainly provided by foreign carriers (57% in 2003). For intercontinental flights the percentage was even 66% (Federal Council (2004). There are three main national airports: Zurich, Geneva and Basel-Mulhouse. Zurich is considered the major airport on a European scale. Airports are publicly owned, with cantons being the majority (Zurich) if not exclusive owner (Geneva, Bern, Lugano). Charges are defined by each airport according to the ICAO guidelines. FOCA is allowed to intervene under the terms of the Federal Price Monitoring Act. Leasing of slots is prohibited and only swaps are allowed.

Common rules for slot allocation are defined by EU Regulation 95/93 of 1999, which requires that slots be obtained in order to land or take off at airports experiencing problems of congestion. These slots must be allocated on the basis of neutral, transparent and non-discriminatory rules by an authority ("co-ordinator"). For certain times of the day, all available slots are allocated. However, mainly in winter, there are problems of capacity with charter flights in Geneva. Since April 2004, the association Slot Co-ordination Switzerland has been responsible for slot allocation. The association substitutes Swiss International Airlines and unique airport Zurich as previous coordinators. It is a non-profit organization and is financed by the charges collected.

In general, the powers of Swiss regulators are more limited and divided between a larger number of authorities compared with other countries. In the air transport sector, the Swiss regulatory activities are organized in a similar way to the French model in the sense that FOCA's role is relatively wide-

ranging. However, in Switzerland, the regulator is structurally less well integrated (air navigation control is not included in FOCA's responsibilities. It is delegated to Skyguide). Compared with other OECD member countries, the situation in Switzerland is on the whole satisfactory, as assessed by a recent OECD report (2006). Neverheless, the analysis of the powers of the regulatory authorities, not only in the air transport sector, reveals the partially incomplete nature of the liberalisation process in Switzerland.

4.3. Air transport liberalization and performance in Switzerland

To recall, our model foresees an intermediary step between institutions (and institutional change for that matter, liberalization being before all an institutional change) and performance, and this intermediary step is the four system relevant technical functions. Let us therefore first look where and how these functions are being performed in Switzerland.

- Interoperability is, as we have seen, mainly assumed at the global level by international organizations, professional standard harmonization bodies, and the supplier industry. This is no different in Switzerland, and interoperability standards are simply taken over from the international arena. The Swiss Federal Office of Civil Aviation serves as the institutional guarantor of these interoperability standards.
- Interconnection remains, as we have seen, mainly a national task, guaranteed as it is by bilateral agreements. Also, liberalization has, so far, mainly affected interconnection, as it has opened up liberties, and in the case of Europe led to the 8th liberty or cabotage. However, Switzerland is not part of the European Union and bilateral agreement that grants Switzerland the 8th liberty in the European Union has only been recently signed. Also, Switzerland does have an Open Sky agreement with the US, but without much consequences. As for airspace, the Swiss ATC operator Skyguide does control German and French airspace, and Switzerland is a full member of Eurocontrol and thus part of all the harmonization efforts of air space management. Switzerland also strives to play an active role in the European Single Sky efforts, as Skyguide is hoping to be able to bid, one day for functional blocks of airspace.
- Capacity management, as we have seen, remains at a local level for airport slots, but there is a now a national slot coordinator, whose power to oversee airport slot allocation is however limited. As for routes, capacity management is handled by Skyguide, the ATC operator, which is overseen by the Swiss Federal Office of Civil Aviation. Skyguide works very closely with Eurocontrol and obeys Eurocontrol rules. But one must also mention the fact that Skyguide is not yet fully integrated, there remain two separate blocks of airspace and two control centers.
- System management is fragmented in Switzerland. There has been an effort to integrate civil and military aviation into the same ATC operator, making Switzerland one of the first countries in the world to do. However, this integration is far from perfect from an organizational point of view, and at the supervising level there remain two separate bodies, i.e., the Swiss Federal Office of Civil Aviation for civil aviation and the Ministry of Defense for military aviation. Also, airports and corresponding slot allocation remain largely outside of the scope of control of the Federal Office.

In short, the Swiss institutional system remains not only highly fragmented, as in most countries, but is moreover characterized by weak national (federal) institutions, as well as by the absence of air transport regulatory authority, which could have brought more coherence into this institutional

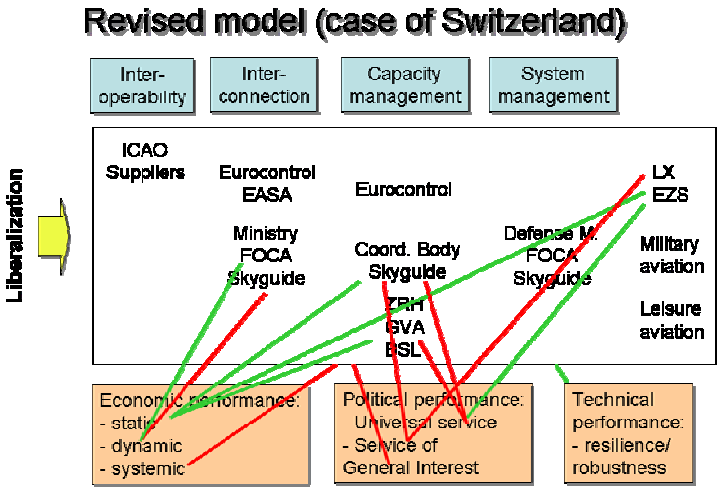
framework. In all fairness, one must say that this need for a regulatory authority has been recognized (as a result of significant safety performance problems) and a corresponding transformation of the Swiss Federal Office of Civil Aviation into an Air Transport Regulator is under way.

In terms of performance, there is regrettably little research for the case of Switzerland, with the exception of the 2003 NLR study, which focused exclusively on safety performance. We can nevertheless attempt to make a subjective assessment of how performance in the Swiss air transport sector has evolved over the past 15 years and try to link eventual changes either directly or indirectly to liberalization.

- In terms of economic performance first criterion, i.e., static or productive efficiency, there has without doubt been significant progress. Not only have the airlines – and before all the Swiss flag carrier – become more efficient, but so have airports, and Skyguide. Also without doubt, this progress is more or less directly attributable to growing competition, i.e., the replacement of hiarcical coordination by market coordination to speak new institutional econmics terms. However, things are already less clear when it comes to dynamic efficiency. To recall, Swissair was always considered, in the past a quite innovative airline (e.g., safety, environmental sustainability, service), but its innovation capacity seems to have considerably diminished as a result of competitive pressure. EasyJet, the second biggest national carrier is of course a highly innovative company, but its innovation is less due to the Swiss situation than it is to its mother company. As for airports, dynamic efficiency is difficult to assess, and in the case of Zürich Unique Airport and Geneva International Airtport probably rather doubtful. And many observers have questioned whether Skyguide, the ATC operator, is indeed an innovative company. As for systemic efficiency, this is even more difficult to asses, but it is likely that the Swiss air transport system has been further fragmented by liberalization and that corresponding transaction, coordination, and supervision costs have significantly increased as a result of it. Also, Swissair has gone bankrupt, more or less as an indirect result of liberalization (and of not being able, for political reasons to take part in European liberalization), and the Swiss government had injected over 2 billion USD to re-float the company, which is clearly a cost that has to be taken into account when assessing overall systemic efficiency.
- In terms of political performance we have distinguished above between criteria of Universal Service (quality, accessibility, and price) and Services of General Interest. We have already seen with Gonenc and Nicoletti that prices for air transport services have gone down and this is also the case in Switzerland. However, prices have gone significantly up in Switzerland for airport and air navigation services, while quality and accessibility improvements are difficult to assess. As for Services of General Interest, the NLR study (2003) has shown that – as an indirect effect of liberalization – there were serious safety problems (LX, Skyguide), and environmental sustainability has certainly decreased as a result of air transport liberalization
- Technical performance is certainly difficult to assess. However, one can probably say that, as a result of liberalization, overall robsutsness and reliability of the air transport systemn has improvement, which in turn is attributable to technical progress in turn resulting from pressures on technical harmonization.

Though it is difficult to establish a clear causal link between liberalization, one can nevertheless say that liberalization does have effects on performance, though not necessarily only positive ones. In a first step, such relationships will have to be assessed by means of concrete and empirical case studies

before becoming econometrically verifiable. This is what we have tried to do in our exploratory case study of Switzerland, which can be summarized as follows graphically:

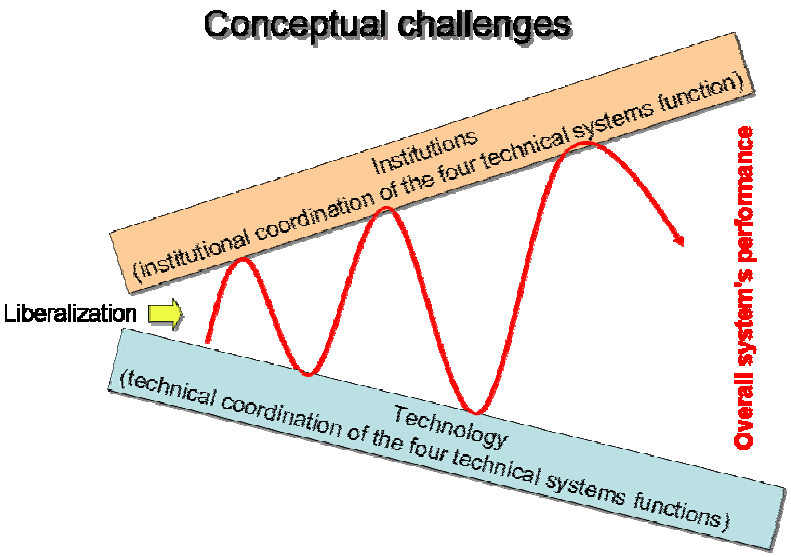


5. FUTURE CHALLENGES FOR RESEARCH

What we have come up here, so far, is a purely static model that tries to linke the institutional arrangements of a given industry to performance indicators. We have argued, that in the air transport sector – as in all other network industries – is mediated by the way four technical functions are assumed both technically and institutionally. To recall, the functions of interoperability, interconnection, capacity management, and system management are essential conditions for a network industry (and for the air transport industry for that matter) to function. In terms of research, we see two main challenges, one empirical and the other conceptual:

- At an empirical level, it is important to obtain a more solid picture of the relationships between liberalization – i.e., the introduction of market coordination replacing hierarchical coordination – and performance. In order to do so, one will have to work with case studies at first, highlighting how exactly liberalization affects the various actors behaviors not only vis-à-vis the custoimers but also vis-à-vis the other actors (e.g., strategic behavior), as such overall actor behavior will ultimately determine overall systemic efficiency (e.g., transaction costs, coordination costs, information costs, supervision costs) and overall systemic performance. In other words, more case studies using this or an even more refined conceptual framework are needed.
- But there is also a significant need for conceptual development, which can, at least in part, be furthered by more empirical case work. As said above, our approach so far is static. In other words, we are trying to establish a relationship between institutions and performance at a certain level of technological development (which determines the way the four technical system functions are technically coordinated), as well as at a certain level of institutional development (which determines the way the four technical functions are institutionally coordinated). While in the past there as been some correspondence between the state of technical and the state of institutional

coordination, liberalization has introduced a certain dynamics. In other words, liberalization, as we can see in the case of the EU, has clearly triggered institutional developments and innovations (e.g., EASA), but it has also triggered technological innovations (e.g., satellite navigation systems). And both institutional and technological innovations in turn affect the performance of the industry. In other words, our static model needs to be made more dynamic, as at any given state of institutional and technological development the effect of liberalization on performance will be different. The following graphic constitute a first attempt for such a conceptualization:



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