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Conference Paper

Regional innovation networks evolution and firm performance: one or two way causality?

44th Congress of the European Regional Science Association: "Regions and Fiscal Federalism", 25th - 29th August 2004, Porto, Portugal

Provided in Cooperation with:

European Regional Science Association (ERSA)

Suggested Citation: Almodovar, Joana; Teixeira, Aurora Amélia Castro (2004) : Regional innovation networks evolution and firm performance: one or two way causality?, 44th Congress of the European Regional Science Association: "Regions and Fiscal Federalism", 25th - 29th August 2004, Porto, Portugal, European Regional Science Association (ERSA), Louvain-la-Neuve

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**REGIONAL INNOVATION NETWORKS EVOLUTION AND FIRM PERFORMANCE:
ONE OR TWO WAY CASUALITY?**

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Abstract

Current research has revealed the existence of a relationship between networks and firm growth (Jarillo, 1989; Huggins, 2000). Nevertheless, network content and specificity and how these networks influence firm economic and financial performance has been little investigated. In addition, the influence of regions in relation to the spatial proximity on inter-firm networks should be an additional dimension taken into account if the determinants of firm performance are to be adequately understood. The most important linkages tend to be characterised by territorial closeness and have relevant effects over firm performance (Oerlemans and Meeus, 2002; Lechner and Dowling, 2003).

Since automobile industry can be regarded as a worldwide cluster, where the evolution tendency on constructor’s behalf has been to gradually delegate technological competencies into industry suppliers, the regional networks acquire a renewed importance beyond the recognized benefits of sharing, interaction and reciprocity. Given that networks “do not happen in a virtual space where spatial proximity does not matter” (Lechner and Dowling, 2003: 9), the Portuguese inter-firm cooperation within the automotive industry can be regarded as a possible source of regional advantage for responding to globalisation competitive challenges.

Thus, in this paper we explore how firms grow through the use of external linkages and become competitive, using case study material based on a Portuguese inter-firm network of the auto-parts industry (ACECIA) and one of its founding members, Simoldes. Using a set of performance indicators, we concluded that its positive evolution was contemporaneous and last beyond ACECIA’s constitution date. Moreover, evidence of possible leverage effects from the combined collaboration emerged indicating that the relation between networks and firm performance implies a *two-way causality* association.

[^] CEMPRE - Centro de Estudos Macroeconómicos e Previsão - is supported by the Fundação para a Ciência e a Tecnologia, Portugal, through the Programa Operacional Ciência, Tecnologia e Inovação (POCTI) of the Quadro Comunitário de Apoio III.

1. Introduction

In recent years a growing body of regional and organisational studies has focused on inter-firm networks, innovation and spatial proximity (Oerlemans and Meeus, 2002). Talking about networks implies the existence of a structure rich in resources, knowledge, as a result of complex interactions, adaptations and investment (Dimara *et al.*, 2003). Through these types of inter-organisational relationships firms can overcome some constraints and assumed internal barriers (caused by limited size) and access external resources (Havnes and Senneseth, 2001).

In this context of theoretical considerations, we intend to give an empirical contribution, by investigating the relation between inter-firm networking and firm performance in the Portuguese auto-parts industry. Talking about inter-firm networks in this industry implies a broader insertion related with the automotive cluster. In fact, the automobile constructor's behalf, the auto-parts consumers, has followed an outsourcing tendency in terms of R&D and technological competencies, favourably to networking (Almodovar *et al.*, 2003; Ramos and Ribeiro, 1999). Also the global nature of automotive cluster, as a complex and complementary set of institutions (Steiner and Hartmann, 1998), seems to stimulate dense networks and, therefore, new productivity dynamics in specific regions like Portugal (Selada and Felizardo, 2002).

The case study focused in the present paper relates to an inter-firm network, ACECIA (Agrupamento Complementar de Empresas de Componentes Integrados da Indústria Automóvel), which emerged in 1997 within the auto-parts Portuguese industry. Presently includes seven partners, five firms – Simoldes, Ipetex, Plasfil, Sunviauto and Tavol - and two technological organisations related with the auto industry – CATIM (Centro de Apoio Tecnológico à Indústria Metalomecânica) and INEGI (Instituto de Engenharia Mecânica e Gestão Industrial).

The methodology approach comprises two kinds of analysis: one, more qualitative, related to the specific content of ACECIA; and other, quantitative, aiming at exploring the effects of networking on firm outcomes, based on the study of an ACECIA partner, Simoldes.

The paper is structured in five sections: beyond the initial contextualization (section 1), there is a section devoted to synthesize the main theoretical contributes related with networking activity, regions and innovation (section 2); the following sections describe

the content and functioning of ACECIA's network (section 3) and present the case of Simoldes so as to evaluate the potential effects of network involvement at the level of individual firm performance (section 4); finally, section 5 summarises the main conclusions and uncovers future exploration avenues.

2. Regional Networks and Firm Performance

Many scholars have stressed the relevance of industrial innovation for economic growth and performance (Oerlemans and Meeus, 2002). Indeed, the long-term growth strategies, not only for firms but also at a macro level (regions and nations), depend on their capability to continuously promote innovation (Sternberg, 2000).

In a context of uncertainty (resulting from the fast-changing technologies) and global competition, Oerlemans and Meeus (2002) point out the disintegration of value chains and also the labour and competencies division as rational trends of firm's strategic policies. In fact, organisations are encouraged to concentrate on their core competencies, which force them to rely more heavily on several types of external contacts and relations, involving transactions, transfers and inter-firm collaborations. These relations are based upon trust and reciprocity.

Authors like Saxenian (1990), Maillat (1991) and Fisher (1999) stress out the benefits of collaborating and interacting with external actors for the innovative capacity of firms. Others, like Venkataraman and Van de Ven (1998), see in the maintenance and development of network relationships the capability of firm survival and growth. Some relevant ideas that came up with Lechner and Dowling's investigation (2003) about firm networks demonstrated that firms shift their relational mix over time and its development phases, not only in terms of network types¹ but also in relationships types (weak or strong ties)² and number. In this line of reasoning, these authors argue that firms are aware of their limited relational capability. In this sense, their strategy of overcoming growth barriers by accessing networks requires alternative and variable paths by different combinations between those relations that allow them to deep knowledge (strong ties) and others that diverse knowledge (weak ties), stressing the association between firm development and network size. Still according to Lechner and

¹ Social; reputational; co-opetition; marketing, and knowledge, innovation and technology (KIT) networks.

² While strong ties comprise intense relations, offering a great depth of knowledge the weak ties allow reaching information diversity (Granovetter, 1973).

Dowling, when the social networks appear as the entrance passport for inter-firm relations the reputational and other kinds of networks open up future options and kinds of collaborations.

One relevant type of network for the present paper, mentioned in Lechner and Dowling's study, is the co-opetition which implies co-operating with a competitor and, as Dei Otati (1994) refers, is a common feature in many mature clusters, since it involves the development of complex relations that take time. Lechner and Dowling (2003) refer the regional dimension as relevant to the co-opetition networks for several reasons such as the fact that successful agglomeration of firms attracts business and this building of trust requires time and interaction; in such cases, proximity can be crucial to limit energy and time constraints.

Also revealing the importance of territorial closeness, Oerlemans and Meeus (2002), design a modelling approach to the proximity effect in firm (innovative and economic) performance and seek to optimise the allocation between an internal and external mix of resources. One point of general agreement is that no firm may work efficiently as an island (Freel, 2001). So, to the extent to which the innovation process is related to external actors, it is useful to distinguish between unintentional and intentional external knowledge inputs. While the former respects to the knowledge that circulates within the economy as result of a spillover effect, the later relates to intended and voluntary contributions of several types of actors to the innovation processes of local firms (Hur and Watanabe, 2001).

Using a theoretical set of firm-specific, embeddedness, proximity and sectoral factors accounting for innovative and economic outcomes, Oerlemans and Meeus (2002) stressed out the relevance of proximity, mainly in innovative performance, by its facilitating role involving transfer of innovation related knowledge. Testing some hypotheses with data about 365 manufacturing and services firms, the authors confirm the spatial proximity relevance to network firms for its contribution to more positive innovative outcomes. In fact, the more possibilities a firm gets to use those intended and unintended regional knowledge flows, the higher their performance. Oerlemans and Meeus (2002) also conclude that sectoral R&D spillovers are related with higher performance levels, finding less importance in firm-specific resources.

In a similar approach, but more related with peripheral regions, Dimara et al. (2003) use a survey of 100 firms to explore the effects of spatial features of the business networks in firm performance. Their main conclusion suggests that in the remote area a high proportion of success business access both vertical and horizontal networks while in the less remote areas this happens mainly with vertical networks. While the vertical networks respect to relationships that a firm maintains with other located in a different area, the horizontal networks refer to relationships of firms located in the same region.

This aspect is highly relevant in the context of ACECIA because this inter-firm network is a clear example of a vertical network in a less remote region like Portugal, at least in terms of development.

3. Regional networks in the Portuguese auto-parts industry: the case of ACECIA

During the eighties the automotive industry went through a set of transformations which were translated into the simplification and permanent application of a set of techniques in terms of global management, production and quality (Selada *et al.*, 1998). This new approach to management on the automotive industry behalf, which includes techniques like lean production, just-in-time or total quality, had considerable influences in the auto-parts industry. Moreover, the general trend followed by constructors was to develop a concentration process of their core resources and competences, granting firm critical domains with higher strategic content (engineering development, final assembly, trade management) and outsourcing the remaining, mainly in what relates to the components (Selada *et al.*, 1998). Consequently, the average rates of outsourcing increased dramatically and stabilised in a value ranging between 60 and 80%.

The structural changes that took place in the auto-parts industry involved a drastic decrease in the number of automotive suppliers, large requirements in terms of economic and financial capacity and risk and cost sharing with constructors of components development (Ramos and Ribeiro, 1999). Indeed, the major challenges of the auto-parts industry appear as a result from constructor's behaviour for which the relevance of innovation and technological competencies of the auto-parts producers emerges as crucial (Selada *et al.*, 1998).

These trends on automotive industry promoted both a concentration process of component suppliers (Ramos and Ribeiro, 1999) and room for creating some important collaborations and alliances among suppliers and supplier-constructor. Such general

tendencies were also felt within Portuguese auto-parts industry, perhaps even more strongly given its external dependence.

In Portugal the auto-parts industry comprises, approximately, 150 firms. In the last decade this industry suffered a huge development, reflected in exports and investment values (Rolo, 1998). Taking 1986 as a reference period, the author concludes that exports evidenced an average annual growth of 12,5% and that the auto-parts industry is in at the forefront regarding the trade account. Moreover, the gross part of the auto-parts production goes to EU market, where Germany, Spain, France and the U.K. are the most relevant destinations.

In her study aiming to determine the critical factors to inter-firm cooperation, Rolo (1998) points out the necessity of implementing new forms of inter-firm networking so that Portuguese auto-part firms may overcome some of their handicaps and efficiently respond to the actual challenges of the automotive industry.

In this context of trends and challenges, it emerged in March 1997, a kind of network, ACECIA, gathering five auto-part firms – *Ipetex*, *Plasfil*, *Simoldes*, *Sunviauto* and *Tavol* - and two technological supporting institutions – *CATIM* and *INEGI*.

ACECIA can be defined as a network in the auto-parts industry, involving the direct, intense and coordinated cooperation of those seven entities that, maintaining their total independence, work together in order to offer a “complete bundle of industrial services”.

The relative territorial proximity of all the five firms involved and their main goal of performance improvement in terms of innovative outcomes turn pertinent the conclusions of Oerlemans and Meeus (2002) that spatial proximity and innovation performance are closely connected.

The main goals of ACECIA are related with strong cooperation among firms; interaction with automotive constructors in what concerns the components development and engineering and, finally, to make use of the market benefits that eventually result from this combined supply (Selada *et al.*, 1998).

Each of ACECIA members contributes with its own resources and competences to the network's activity development: *Tavol* with stamping, *Sunviauto* with seats full production, *Plasfil* with interiors plastics, *Simoldes* with several types of moulds and plastics and, finally, *Ipetex* with coverings. This global service has the component

conception upstream and downstream the module (set of components) delivery to the constructor-client (Selada *et. al.*, 1998).

This allocation of resources among the intervenient firms meets the theoretical considerations of Lechner and Dowling (2003) who, referring to co-opetition networks, suggest that firms could gain in flexibility and concentrate in their core competences. They also considered as function of networking activity the response to costumers needs by presenting total system solutions, as it happens with the automotive industry.

Regarding the major benefits that ACECIA's members may recognise, Rolo (1998) pointed out the information and knowledge sharing; new product and techniques development; cost reduction and scale economies; sales and market share increases, etc. These sharing possibilities (in terms of resources and competences) also find echo in the theoretical aspects early mentioned by Lechner and Dowling (2003), which pointed them out as a major benefit of networking activity and firm performance. In fact, bringing together capacities and market experience from these five firms, ACECIA seems to present a new approach to the automotive market by offering an integrated product that works out as an isolating mechanism to other firms. In fact once ACECIA was formed other firms in the auto-parts business felt increased difficulties in offering their products to automotive constructors. This is one of the main reasons for other types of networks, such as Comportest (Companhia de Estampagem Portuguesa), which joined three firms from metal work industry, had emerged in meantime (Lobo and Melo, 2002).

4. Regional networks and firm performance: the case-study of Simoldes

Once mentioned the theoretical background related to networks and described the specific case of a Portuguese network of the auto-parts industry (ACECIA), we now test whether that network evidences some kind of effects at firm performance level. So, in the present section, we investigate whether the entrance of a firm into a type of coordinated activity like a network influences that firm outcomes. We specifically analyse the case of *Simoldes*.

Looking back to Simoldes evolution, its activity started in 1959 with mould production in the Portuguese market. Soon Simoldes decided to open up its production to the international market by exporting. In 1980 Simoldes extended the business to plastic

injection and rapidly focused on the automotive industry as the main market. In a first stage, Simoldes produced indirectly to automotive constructors through sub-contracting but the settling in Portugal of some relevant worldwide constructors allowed the firm to directly supply the automotive industry. Responding to management requirements such as *just in time* or total quality, Simoldes increased its set of competencies and resources, which jointly with a strong investment policy gave the firm wide market recognition (Almodovar *et al.*, 2003). Another feature of Simoldes that often it is considered one of its strategic strength is the proximity to potential clients, the automotive constructors (Cardoso, 2000).

In order to assess potential network effects at firm performance level, we define a set of indicators that are likely to translate several aspects of firm performance: innovative, economic, financial, and human resources.

The methodological procedure undertaken here is of comparing Simoldes performance *before* and *after* its entrance in ACECIA network. More specifically, we seek to evaluate whether the entrance in ACECIA produced visible outcomes in terms of Simoldes technological competencies and economic results and also whether existing and ongoing performance outcomes of Simoldes conditioned and influenced ACECIA's progress. In short, to investigate whether regional networks evolution is one critical factor influencing firm performance or whether the causality may be on both ways, that is, firm performance leveraging out the evolution of regional networks imposing a kind of cumulative development path at regional level.

Innovative performance

The innovative performance is measured by Simoldes capacity to innovate, using the R&D effort. This indicator is computed as the ratio between de R&D expenditures and Sales. Despite being an *input* ratio that reveals the deliberate investment in the R&D activity, and not the outcome of it (as the case of patents), due to data availability the R&D effort might be considered as a reasonable indicator to evaluate this type of performance. The most relevant aspect that comes out from the analysis of R&D intensity is that Simoldes is clearly above the national average (3,2% against 2,6%, according to OCT estimations for 2000).³

³ <http://www.oces.mces.pt/docs//doc36/lang1/1.xls> [accessed on 28.05.03].

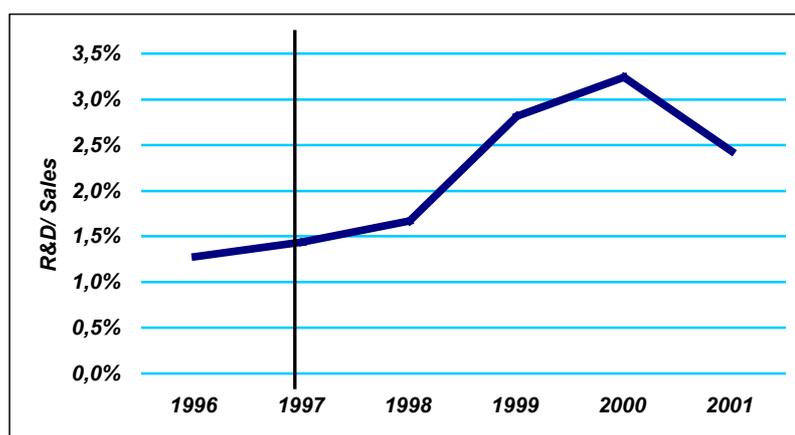


Figure 1: Innovative Performance, *Simoldes*, 1996-2001

Source: Authors computation based on *Simoldes* data

According to figure 1 it is possible to see that from 1997 onwards the R&D effort has increased which could take us to considerer that *Simoldes* entrance in ACECIA was positive. Nevertheless, given the long range and lasting effects of network involvement, we should stress that the participation effects in a network of this kind cannot be assessed based only on the above evidence. In fact, an inter-firm network involves large expenses in terms of time, coordination and economic resources. The structural benefits from this joining may take time and so the expected benefits in performance indicators at firm level. In order to minimise this pitfall and the scantiness of available data, we present further ahead complementary evidence, which taken together, tend to enforce the theoretical expected positive effects of network involvement.

Economic performance

At the economic level we consider pertinent to know how the entrance in a network, which implies sharing of resources, interferes with *Simoldes* productivity. As it was early mentioned, the integration in networks allows firms to share resources, knowledge and experiences that can positively impact not only in the network activity but also in that of each intervenient, like *Simoldes* (Selada *et al*, 1998).

Due to some constraints of data availability we only computed *Simoldes* productivity from 1994 onwards. Productivity is computed here as the ratio of real value added to employment.⁴

⁴ For deflating value added data we used the consumers' price index to tradable goods whose reference year is 1996 (Portugal, Ministério das Finanças, 2002).

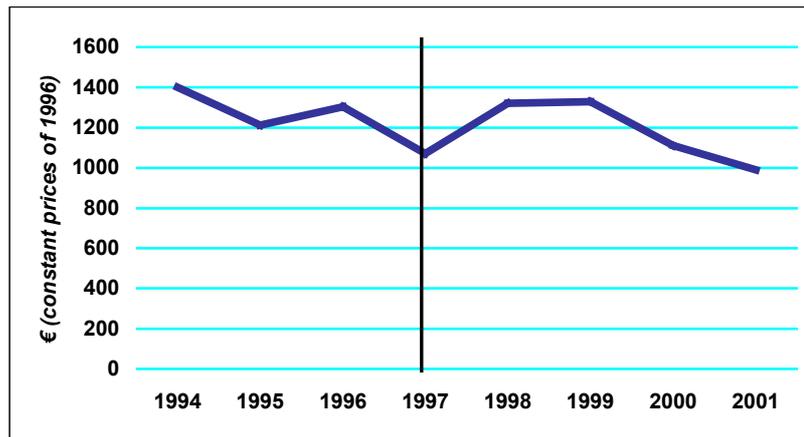


Figure 2: Real Productivity Evolution, *Simoldes*, 1994-2001

Source: Authors computation based on *Simoldes* data and DGEP – Ministério das Finanças (2002)

Beyond all potential considerations that may explain the evolution of *Simoldes* productivity, including its own specific firm resources and competences, from the figure one can observe an increase in real productivity in the period immediately followed to ACECIA's constitution, notwithstanding a decreasing tendency from 1999 onwards in large part explained by macroeconomic business cycle considerations.

Another reason for this more recent downturn in productivity was also uncovered in Almodovar *et al.* (2003) who associate it to an aggressive hiring policy in the period in question.⁵

Financial performance

To evaluate the influence of the network relationships at the financial level we choose a well-accepted indicator, the return on equity (ROE). ROE allows knowing the results that, after considering all costs and taxes, will reward equity. Desagregating, i.e. using the *Dupont* analysis, we can evaluate ROE as being determined by both economic and financial conditions (Moreira, 1997).

From the observation of figure 3 we note that, in the period 1991-2001, ROE present large variations. The negative variations are related with investment cycles and specific activity features of *Simoldes*. *Simoldes* does not have its own products, working in specific projects constrained by the needs of each of its costumers. Accordingly, the end of a component/module supply, although implying the start of other projects, has inherent some gaps during which large investment is made and production decreases.

⁵ The number of employees within an eight-year period more than trebled.

Therefore, given Simoldes characteristics it is reasonable to observe this recurrence pattern of investments, which is reflected in ROE values and thus in financial performance.

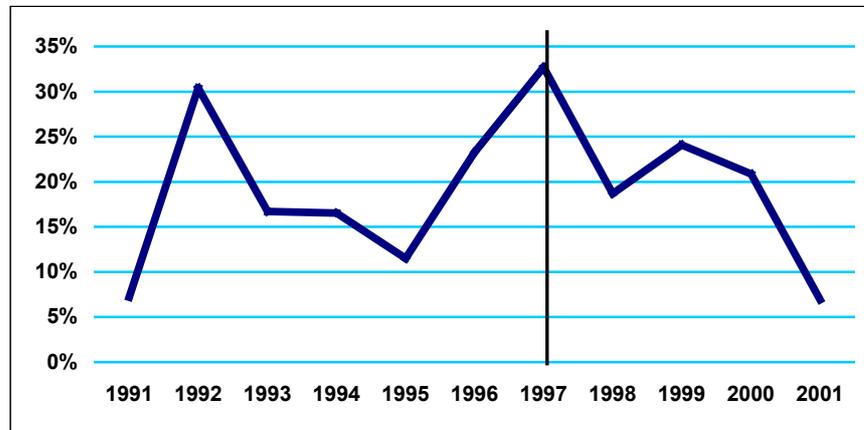


Figure 3: Return on Equity, Simoldes, 1991-2001

Source Authors computation based on *Simoldes* data

Considering the division of investments between intangible assets (which mainly respects to R&D expenditures) and fixed assets (which basically corresponds to equipment) we draw figures 4 e 5.

In figure 4 it is possible to highlight the exponential increase of intangible assets from 1998 onward. This trend is in large extent explained by accounting formalization issues. In fact, Simoldes only at the end of the nineties initiated the formal consideration of R&D expenditures in accounting terms. The evolution of intangible assets seems very peculiar due to the fact of starting with very small levels increasing exponentially after 1998.

It should not be rejected the hypothesis that the entrance into a ‘type of coordinated activity’, i.e., ACECIA, required a higher degree of organization formalization, namely at accounting level. In this sense, network adhesion may be saw as positively associated with high levels of firm organization and therefore as contributor to firms technological competencies in a broader sense.

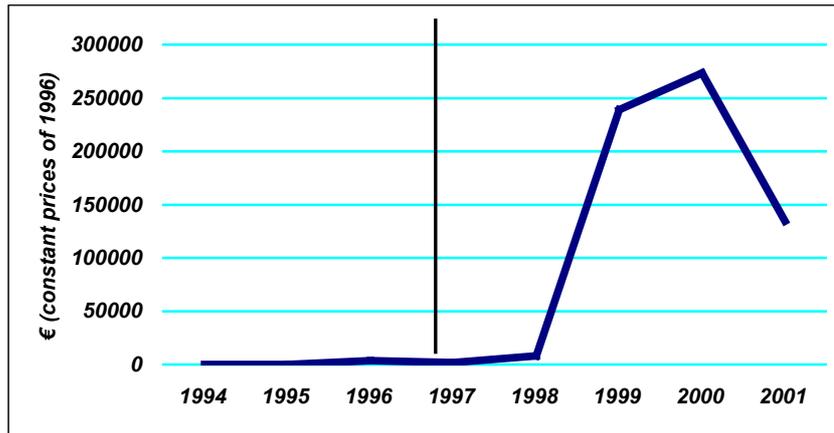


Figure 4: Real Intangible assets evolution, *Simoldes*, 1994-2001

Source: Authors computation based on *Simoldes* data and DGEP – Ministério das Finanças (2002)

The evolution of fixed assets reveals a distinct path, influenced by investment cycles and fluctuations, with a recurrence time of about three years.

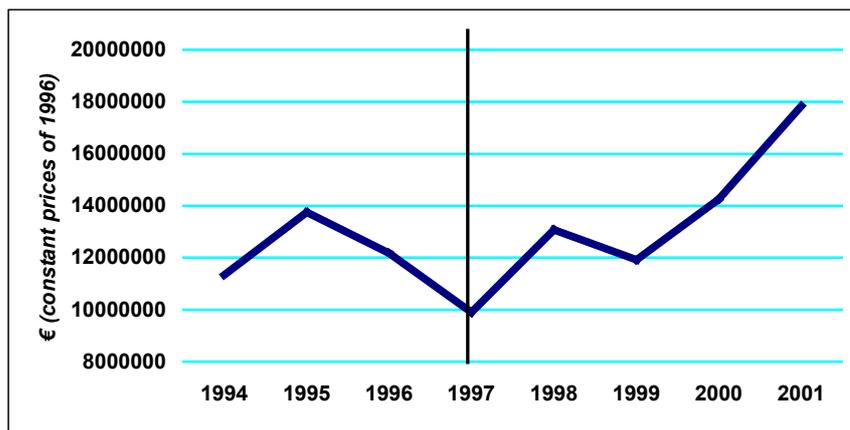


Figure 5: Real fixed assets evolution, *Simoldes*, 1994-2001

Source: Authors computation based on *Simoldes* data and DGEP – Ministério das Finanças (2002)

In general, financial performance of *Simoldes* seems to be positively influenced by its participation in ACECIA. One important aspect that investment data confirms is the periodicity in which investments are made, corresponding to mass development and engineering components processes.

Human resources performance

In what human resources performance is concerned our goal is to evaluate whether the participation in ACECIA network had some kind of implications in terms of competencies of firm's labour force. In fact, linking, in a single entity, resources,

competencies, knowledge and experiences of several firms allows each of the participants not only to contribute to a good team result but also to acquire and improve their own results. In this sense one may refer the importance of learning-by-interacting.

To evaluate this level of performance we use a ratio of the number of engineers in total employment. The option by engineers is intentional and related with the sector specificity where Simoldes is included - the importance of engineers in this sector is recognised both at the conception, R&D project development and production levels. Therefore, this professional category may be considered the one that better reflects the firm's concern in developing technological competencies, both technical and organisational.

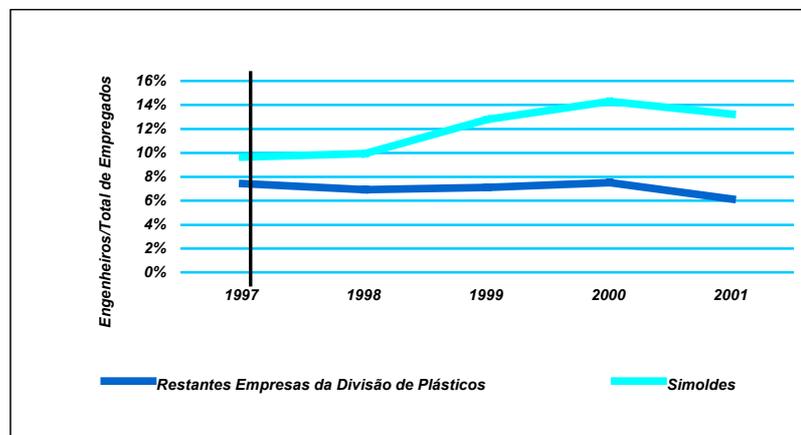


Figure 6: Human resources qualification, Simoldes vs. Plastic Division of Group Simoldes, 1997-2001

Source: Authors computation based on *Simoldes* data (Almodovar *et al.*, 2003)

According to figure 6 it is noticeable that the ratio of engineers in the total employment has strongly increased after 1997, being a further aspect associated with the potential positive effect of being involved in a network (ACECIA).

It seems plausible to argue that participation in a network like ACECIA together with Simoldes clear strategic orientations towards permanent competences acquisition stimulate the hiring of engineers, explaining therefore the increase in the above-mentioned ratio.

5. Main Conclusions

The main objective of this paper was to evaluate whether inter-firm networks and their regional proximity influenced the corresponding performance. This was pursued by using case study material of a Portuguese inter-firm network in the auto-parts industry, ACECIA, and the specific case of Simoldes, one of the founding firms.

Authors like Oerlemans and Meeus (2002) or Lechner and Dowling (2003) show that the most important linkages are characterised by territorial closeness and that these components have relevant effects over firm performance.

The specific trends in auto-parts customer's behalf (the automotive constructors) promoted both a concentration process of component suppliers and room for creating important collaborations among suppliers and supplier-constructor. In the particular case of Portugal, several authors (e.g., Rolo, 1998) pointed out the necessity of implementing new forms of inter-firm networking so as to overcome some of firm handicaps and efficiently respond to the actual challenges of the automotive industry.

We have found echo in most of the theoretical considerations early mentioned, mainly regarding to benefits and goals recognised by network members. In fact, ACECIA seems to have allowed the sharing of resources and competences, which in turn made possible to grant a combined supply, more flexible to customer's needs.

However, even if these general benefits are widely attributed to ACECIA, evidence concerning its effects at firm performance level tends to be scant or inexistent. Using a set of indicators, which measure several perspective of firm performance, we concluded for Simoldes case that often its positive evolution was contemporaneous and last beyond ACECIA's constitution date.

Recalling Freel's (2001) words any firm may work efficiently as an island. Therefore, it is through the combination of resources that a firm attains best results. This recurrence to external resources implies different levels of linkages, including networks. As a more articulated, strong and continuous type of collaboration, participation in a network requires some kind of internal organization and some level of outcomes. This is due to the possible leverage effect that a combined collaboration may have to the continuous firm growth strategy. Hence, one may say that this relation between network and firm performance implies a *two-way causality* association.

It is important to note nevertheless, that a network like ACECIA involves large resource investment, both in terms of time, coordination and economic resources. As a result, not only the main network goals acquire a strategic and long-run dimension but also the specific firm effects turn to be more perceptible and attainable in a long run perspective. Given the relative short period span analysed, we cannot reject that the selected indicators evolution may be highly influenced by other aspects, such as the macroeconomic background, the specific features of business and markets where firm acts or its own set of internal resources and competences. It is highly probable therefore that performance effects from Simoldes participation in ACECIA may not be clearly distinguished due to the whole set of co-mixed reasons that are also likely to explain indicators evolution.

In future developments of investigation it would be useful to undertake a more qualitative research involving detailed analysis of ACECIA's content, namely in terms of network performance indicators. Moreover, data about other members of the network would also enrich and would be pertinent to add to the present analysis.

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