4th International Conference on Technology Policy and Innovation

Curitiba, Brazil, 28th –31st August 2000

CAN SMALL FIRMS LEVERAGE GLOBAL COMPETITION? EVIDENCE FROM THE PORTUGUESE AND BRAZILIAN AUTOMOTIVE SUPPLIER INDUSTRIES

FRANCISCO VELOSO(1)(2)
fveloso@mit.edu

CHRIS HENRY(3)
cphenry@mit.edu

RICHARD ROTH(2)
rroth@mit.edu

77 Massachusetts Av., Room E40 – 242A
Cambridge, MA 02139 Tel: (617) 253-6467

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ABSTRACT

Automotive assemblers' global sourcing strategy is pushing their suppliers to have an equally global presence. Until recently this trend was confined to large companies, which expanded their presence to new locations through the exploitation of unique knowledge assets. This movement has a good fit with existing theories of foreign investment. More recently, some of the smaller and often local suppliers are trying to use this trend as a growth opportunity, aiming to gain new business and critical dimension through the establishment of new plants in some of the industry fast growing areas. Unlike the reaction of the large players, the behavior of these smaller firms does not fit well with existing theory. This paper uses a detailed microanalysis of manufacturing cost to explore how the market characteristics of the home base and the new areas condition the investment possibilities of small

automotive suppliers. The context analyzed is the decision of stamping and injection molding companies located in Portugal to invest in Eastern Europe or in Brazil.

(1) Technology, Management and Policy Program; (2) Materials System Laboratory; (3) Department of Materials Science and Engineering

INTRODUCTION

During the past decade, the automotive sector evolved to become a true global industry. Until the end of the eighties, competition between the major international automakers would be mostly within regional automakers, with American automakers dominating the US market or Japanese the Asian market. During the nineties, an important growth in the number of transplants changed this picture dramatically. Nowadays, virtually all original equipment manufacturers (OEMs) are present in every corner of the globe, both in developed areas, as well as in emerging regions. Moreover, OEMs are organizing operations at a world scale, planning and deploying identical vehicles in several regions simultaneously, or running supply bids for suppliers around the globe.

Global operations and similar vehicles led OEMs to demand their direct suppliers to also have a strong international presence. They are increasingly expected to have substantial responsibility in the design and engineering of complex systems and to coordinate the supply chain necessary for their manufacturing and assembly across multiple locations. Traditional suppliers were not equipped to respond to this new set of challenges. Even more than the OEMs, they were mostly regional, focusing on particular components, and had limited financial resources to withstand strong financial outlays on product development. This led to an important restructuring of the auto supply chain across the world. Firms faced three alternatives: become a multinational firm; sell the operation to an international firm aiming to expand; or become a small process-focused company that works as a second or third tier supplier of components in a local market.

The first wave of restructuring took place among the US, Europe and Japan, areas where the auto industry is more developed. One of its key characteristics was an important flux of capital across these regions, either through greenfield investments, mergers or acquisitions. Larger firms like Magna, Bosch or Valeo did the initial rounds of foreign investment. These suppliers already had unique knowledge and technology in particular components and systems and their decision to invest in new areas of the globe aimed at the exploitation of this knowledge. The response of these firms to the new market configuration fits the well-established theory of foreign investment. This theory states that, in light of a foreign market opportunity, a firm that owns imperfectly tradable assets that give it a competitive edge over its local competitors will decide to enter the market, using the unique capability to offset potential disadvantages of doing business in a foreign region. Another important trend observed over the last years are firms with expertise in particular components wanting to capture the supply of complete systems, that decide to merge with or acquire companies that are experts in the remainder aspects of the system. Again, this seems to be according to recent expansions of the same theory, that sustain that that firms may also invest to internalize unique technologies that can’t be traded in the market.

Recently, another wave of foreign investment has been taking place in the auto supply industry. This time it is not the large firms with strong technological capabilities, but rather the typical one plant small firm that is deciding to move across the border and head into new regions. Moreover, the investment has not been directed at developed regions and it is not aiming at acquiring firms with complementary assets. On the contrary, it has targeted intermediate or developing areas and, when the objective is acquisition, it is often of a plant with equivalent size and characteristics of the original investor. Unlike the trends described in the previous paragraph, the established theory of foreign investment does not provide much insight on why may we observe these facts.

This paper aims to provide a better understanding of the opportunities these small suppliers may be pursuing through foreign investment and gain insights on how to further expand these theories. It uses a detailed microanalysis of manufacturing cost to explore the current situation of these firms in their home market and assess the conditions they may face when they decide to invest in a new region. The analysis is based on case studies of small stamping and injection molding manufacturing in Portugal, evaluating their expansion opportunities for other regions of Europe and South America. The paper has five additional sections. The first describes the overall trends in the automotive industry and how they are affecting the supply chain, in particular the smaller players. The second section describes the major theories of foreign investment and their fit to the observed trends in the auto sector. The third presents the methodology used to assess the competitive position of the firms and the internationalization options they are facing. The fourth section details the manufacturing case study for the particular context of the Portuguese autoparts industry and the final section presents conclusions.

AN EVOLVING AUTO SUPPLY CHAIN

Until the end of the eighties, despite some overseas presence of OEMs, competition would still be mostly within regional brands. American automakers dominated the US market, Japanese the Asian market and European automakers their regional market. During the nineties, this picture changed completely. A growth of transplants in the beginning of the decade led to a presence of all competitors in virtually every corner of the globe (Sturgeon and Florida, 1999), particularly in emerging regions where OEMs are fiercely disputing market shares as demand picks up. As a result, automakers are now planning operations on a global scale, having similar models launched at the same time in different locations with similar standards. They are also trying to replicate supply chain structures across locations, demanding suppliers to be present in the regions where they are present, often near their plant. Auto suppliers have seen OEM globalization as an opportunity to improve market presence and expand sales volume. Therefore, they have mostly tried to follow the automakers' expansion. Nevertheless, suppliers are still far behind any of the OEMs as true global players, having sales and capacity of less than 50% outside their home markets (Group, 1998).

Global competition generated brand proliferation and pressures for continuous restyling of models. As a result, sales per model have declined, preventing automakers and suppliers alike from reaching economies of scale in manufacturing, with important adverse impact on cost. The solution automakers have been exploring is to share components and systems among cars and models (Lung, et al., 1999). This involves the development of standard platforms that homogenize basic structures of the car (like the Golf/A3 VW platform), while allowing adaptations of the interior and exterior through modules that can be configured to particular vehicles. Suppliers have been active participants in this process, aiming to market and modules systems as diverse as an ABS or a seat frame across car models and even different OEMs. This possibility yields better returns, not only due to scale efficiency, but also because the important costs associated with the development of innovative solutions can be split among several automakers and a much larger number of manufactured units. The standardization effort was coupled by increasing outsourcing (Clark and Veloso, 2000). The OEMs are focusing their attention on designing, assembling and marketing vehicles, as well as servicing the customer, leaving the design and manufacturing of most of the systems and components to their suppliers. From 1985 to 2000, the share of the car value that is outsourced went from 50% to over 75% (EIU).

The requirement to be present all over the world, the increasing regulatory and consumer demands and the need to continuously tackle new technologies, all of this at low cost, has created a tremendous financial pressure in the industry. As a result, a swarm of consolidation is now taking place at all levels of the supply chain. It is estimated that, within the next 5 years, less than 10 independent automakers may survive (EIU, 1999). As OEMs integrate and shed their involvement in manufacturing, they also concentrate their efforts on working with a smaller number of players. Their objective is to reduce asset intensity, improve assembly productivity and lower supply chain management costs. They are demanding their direct suppliers to be present around the globe. Moreover, they are expected to have a substantial responsibility in the design and engineering of complex systems and to coordinate the supply chain necessary for their manufacturing and assembly around the world. Traditional suppliers were not equipped to respond to this new set of challenges. They were mostly regional, focusing on particular components, and had limited financial resources to withstand financial outlays on product development for up to 3 years before receiving returns on investment. As a result, a wave of consolidation is also taking place in the supplier industry. In 1992 there were only 28 US suppliers with sales between US$1bn and US$5bn dollars and 5 companies with sales higher than US$5bn. In 1998 these numbers were, 47 and 13 companies, respectively (calculations from Wards, several years).

The trends described in the previous paragraphs led to an important restructuring of the auto supply chain across the world. The first wave of restructuring took place the US, Europe and Japan, the areas where the industry is more developed. One of its key characteristics was a large flux of capital across these regions, either through investment, mergers or acquisitions. Larger firms like Magna, Delphi, Bosch or Valeo have led this important round of foreign investment. Moreover, it is estimated that, since 1992, more than over 200 mergers and acquisitions took place between European and American suppliers (EIU, 1999). Simultaneously, while investment and consolidation was taking place in the Triad, increasing car demand in emerging regions such as South America, Eastern Europe or Asia was creating additional investment pressures on OEMs and suppliers. In Brazil, assembly capacity went from 2 million vehicles in 1994 to 3 million in 1999, a 50% increase (Group, 1998). In Eastern Europe, during the same period, installed capacity doubled, reaching 1.3 million vehicles (Wards,). Because of growing standardization in the cars, this often meant that the same components manufactured in Europe or North America were now needed in regions as South America or Asia.

Major suppliers initially considered OEM investments in emerging areas as the generation of important business growth opportunities. They reasoned that, because of their previous experience in Europe or the US, those that would decide to set up a plant near one of these new OEM operations would be well prepared to supply the same components to the new plant. In particular, it would give them a potential edge in the supply bidding process. As a result, some firms quickly followed the automakers paths. Nevertheless, despite the important growth of OEM assembly capacity in regions such as Brazil and Eastern Europe, their absolute size is still rather small when compared with more than 15 million vehicles assembled in Western Europe or the US. Moreover, a multitude of assemblers is present in these regions. Therefore, component production volumes in these regions are often small, often below economical scale. This situation was further aggravated by the financial crisis that has swept most of the developing world in 1997 and made the car sales slump. As losses for supplier plants in emerging areas mounted (for example, the autoparts net profit margin in Brazil went from 3% in 1994 to –4% in 1996. Sindipeças, 1998), investment decisions became more conservative. Suppliers realized that the economic return of investments in some of these regions could be negative, or at least below the one that a firm may get through investment in another region in the Triad. This led some large international firms to decide to be out of some of these regions, or at least have a limited presence there, preferring instead to concentrate resources in Europe, the US or Japan.

This situation opened a new field of opportunities for smaller local players in the Triad, which were increasingly feeling trapped in their own market. Faced with component standardization and demands for more development responsibility and presence abroad, firms traditionally installed in a single location and supplying one or two OEMs realized that they would be given less and less responsibility if they were to remain in a local market. They faced three alternatives: either become a small process-focused company that works as a second or third tier supplier of small parts, sell the operation to an international firm aiming to expand capacity or become themselves a multinational firm. While the two first options are found in a number of cases, more ambitious firms soon became aware of the market gap that the auto supply industry restructuring was generating in emerging regions. Automakers in these regions often did not trust local firms and were not being able to interest the larger suppliers to enter the market at the pace they required. The smaller companies used their limited experience to leverage this opportunity. In a small region like Portugal, for example, one in every eight local firms has embraced some form of international investment, most towards emerging markets. The smaller production scales in emerging regions demanded fewer resources from investing firms, which set up operations with scales that were similar to those they operated in the home market, either through greenfield investment or by acquisitions. By tackling this OEM supply need, they not only became multinational firms, but they often were given further responsibilities in development through the adaptation of components to plant particular conditions.

Given the trends described in the previous paragraphs, the interesting question is whether the existing economic and management models can help us understand the observed behavior. As it will be argued below, existing theories are able to explain the movement of the large players, but do not provide good insights regarding the international investment of the smaller firms. The following section details how the empirical fact fit the theory.

PERSPECTIVES ON FOREIGN DIRECT INVESTMENT

As Markusen (1995) writes in a review often quoted in the literature, "if foreign multinationals are exactly like domestic firms, they will not find it profitable to enter the domestic market. After all, there are added costs of doing business in another country". In this article, the author reviews the evolution of the theories explaining the growing phenomena of having companies from one area investing directly in another region of the globe. The key ideas sustaining this empirical observation are what Dunning (1981) summarized as Ownership, Location and Internalization (OLI) advantages.

In first place, firms may own a particular product, technology, reputation or secret that gives them a competitive edge over their competitors. This idea of ownership advantage, initially proposed by Hymer (1976) and further developed by Caves (1976), can be used to offset the disadvantages of doing business in a foreign region. Second, there must be advantageous to having operations locally, rather than producing in its home market and exporting the product to the foreign destination. These advantages are often related to logistics costs, tariffs or preferential access to production factors, although other intangible aspects such as proximity to knowledge centers and clients are increasingly playing a role. Finally, the foreign company should have a perceived advantage of keeping the new investment internal to the company rather than licensing its ownership advantage, or finding solutions such as contract manufacturing. According to Rugman (1980; 1986), the preference for an internal investment solution is the result of the inexistence of a market for the ownership advantage, e.g. intangible assets such as reputation can't be contracted on; or the foreign firm may not be able to exclude its licensee from the knowledge it transfers and may well prefer to invest abroad and protect their rights over technology.

The OLI framework has been the basis for most of the empirical work in the literature over the last decades. In fact both anecdotal evidence and empirical studies have associated multinational enterprises with industries where intangible firm-specific assets such as R&D and brands are crucial parts of their business (among many others see, for example the recent survey by Blomstrom and Kokko, 1998; or Buckley and Casson, 1976; Teece, 1986). Therefore, there has been a rather good historical fit between theory and empirics. Markusen (1995) summarizes four key characteristics of multinationals that have been sorted out by a number of studies: high levels of R&D relative to sales; a large share of professional and technical workers in their workforce; products that are new or technically complex; and high levels of product differentiation and advertising.

Recent papers have proposed an extension of the theory beyond the core described above. This new research suggests that firms may also decide to invest abroad not so much to exploit advantages they already possess, but rather to acquire new knowledge or technology sourcing objectives. Kogut and Chang (1991), for example, show how US R&D intensity had a positive and significant effect in the entry of Japanese firms during the eighties. Braunerhjelm (1996) presents evidence that Swedish multinationals in high tech industries choose international locations near knowledge centers. Neven and Siotis (1996) reach similar conclusion for foreign (US and Japanese) firms investing in the European market. Fosfuri and Motta (1999) describe a formal model that attempts at explaining why firms may decide to invest abroad to source technology.

Given these perspectives on foreign direct investment, a substantial part of the empirical facts on the auto supply sector discussed in the previous section seems to be well aligned with theory predictions. Investment happened mostly through firms like Magna, Bosch or Valeo, which had unique expertise in particular components and systems in one of the regions of the world. Moreover, it pertained components like the ABS or the control unit of the car, products with a high degree of differentiation. The suppliers' decision to invest in other parts of the globe was the exploitation of their OLI advantages, where the issues of location stem from client requirement. Conversely, firms with expertise in particular components wanting to capture the supply of complete systems merged with or acquired companies that were experts in the remainder aspects of the system. Once again, theory and facts have a good match.

What does not seem to fit the theory is the investment decision of the small players. These firms did not have a clear source of competitive advantage to support the internationalization decision and they were not looking to access new technology. This assertion is aligned with the results of a previous study by Mascarenhas (1997), where he concludes that small international specialists tend to invest in markets with small adaptation costs. This is mounting evidence that seems to challenge the existing configuration of the OLI framework, suggesting that some extensions might be needed to accommodate new empirical results

This paper aims at exploring how small local firms in low-tech sectors, where the traditional advantages that support the internationalization decision are not present, can use particular market conditions and location advantages to internalize new activities and gain competitive capabilities. Moreover, it asserts that their foreign investment decision is not motivated by access to technology, as the previous papers have indicated, but rather as a means to build a stronger market position. The analysis will be based in case studies of Portuguese automotive suppliers in stamping and injection molding. Firms in these segments have been local competitors for several decades, but increasing pressure in the automotive supply chain is forcing them to either stagnate or move beyond local borders.

METHODOLOGY

The stamping and injection molding industries form the backbone of the modern autoparts industry. Both manufacturing processes are mature and prevalent worldwide. Though stamping and injection molding are worldwide industries, several reasons contribute to the existence of cost differences between the same part when produced in different countries. First, countries do not have the same uniform levels of infrastructure. The disparity between the quality of roads, the power-grid, the suitability of real estate, the human resources, in part, accounts for cost differences among countries. Second, government regulations relating to the trade of steel and stamping equipment into or out of a country may prevent companies from obtaining the world prices for these goods. The policy of government tariffs, quotas, value-added taxes, and local content requirements on these goods limit the cost competitiveness of companies due to the increased prices that these regulations cause. Fourth, national factor conditions contribute to differences in manufacturing cost. These factor conditions are macroeconomic indicators such as energy cost interest rate and social indicators of wage, work ethic, and skill level.

In addition to country differences, several reasons exist for finding cost differences between the same parts made in different companies of the same country. First, companies do not have the equal access to raw material and equipment in the world marketplace as others do. Second, factors relating to internal company organization and management structure affect the way the business are run and, therefore, their productivity. The manner in which managers implement planning decisions and utilize human resources can dramatically alter manufacturing costs. Third, companies are limited by the amount and type of manufacturing resources that they have on hand. The adequacy of the particular equipment can affect manufacturing efficiency. Thus, systematic cost differences between different companies can be difficult to ascertain because of qualitative business decisions within companies.

This case study intends to investigate actual Portuguese production operations for both stamping and injection molding processes. Both these processes are established to the point where they are very economical. The investigation entails comparing manufacturing condition in several countries and evaluating expansion opportunities for local companies. In analyzing manufacturing operations between countries, key questions emerge concerning the level of competitiveness Portugal has in the industry. This initial section of the study will focus on the differences that contribute to cost-variations between countries. It investigates the reasons for cost differences between plants and the effects on manufacturing cost due to the existing national factor conditions. The second part of the study entails an analysis of expansion possibilities for these firms, evaluating conditions that may lead to potential competitive advantages to these firms.

A firm’s decision to expand depends both on internal and external factors. Market circumstances and business climate generate multiple opportunities and possibilities for expansion into other countries. The difficulty is to determine the best locations to achieve a competitive advantage. On the other hand, internationalization is also based upon many internal factors that range from manufacturing or financial capabilities, management ability and vision, or logistic considerations. All these aspects are difficult to capture, making it hard to understand the complete set of factors determining the decisions, particularly when the firms do not have a clear set to internal proprietary advantages. Given the standard characteristics of the technologies used in these small firms, our choice was to focus the analysis on manufacturing and logistics cost. Addressing these issues provides limited information regarding more intangible company factors but, as seen below, they provide an interesting first order approximation for the economic feasibility of an internationalization decision. Moreover, focusing on industry average conditions and the evaluation is striping out the idiosyncratic characteristics of an individual company, enabling a good understanding of an industry trend rather than an individual firm decision.

A Cost model to analyze each of these manufacturing processes and estimate the cost drivers was developed based upon standard practice regressions and engineering principles (see Veloso, et al., 2000 chapter 6 and 7 for a full description of the models developed). These models are used to analyze the sources of cost differences between companies and between nations. Technical cost modeling is a powerful tool for analyzing cost elements in manufacturing, with a wide use. TCM considers a wide range of factor inputs for a process technology to understand aggregate costs. A seemingly complex calculation with uncertain engineering and economic decisions is reduced to a single, comprehensive process model in which each input is controllable. Other cost estimation techniques do not adequately cover all factor inputs and production-floor trial and error has been the usual way of implementing improvements and proceeding down the learning curve. In addition to being an intelligent approach for analyzing alternative processes, TCM is an excellent tool for comparing a broad range of manufacturing choices. Complex processes simplify to a series of calculations. TCM places a monetary value on every contributing element in the process. By summing the estimated values of each step, TCM gives manufacturing costs for a specific product. Allocation decisions in such a model include fixed versus variable costs, and dedicated versus non-dedicated investments. Variable costs include, material, energy, and direct labor costs. Labor costs must include wages and benefits and must account for downtimes. Fixed costs are directly associated with the processing of a part. Allocation is thus straightforward upon deciding on an allocation rule. Fixed costs include, among others, tooling, machinery, indirect labor overhead, and engineering personnel. Further, building costs and capital costs are treated as having an opportunity cost associated with them and are discounted according to its age. These cost elements are considered fixed costs.

TCM models are flexible and adapt easily to cost allocation decisions. However, because of the uncertain data for some of the fixed cost variables, such as overhead and maintenance, TCM is better used for estimations of cost trends and comparisons than as an absolute costing instrument. Nevertheless, it does single out limiting process parameters. Further, it emphasizes the relative importance of factor inputs. TCM attempts to give an accurate description of costs and incorporates a number of engineering concepts into calculations of parts costs. Line balancing and the number of parallel production streams have significant impact on costs, but the models assume that it is optimal. The more streamlined operations have little downtime and therefore optimize run time. Again, this is not an obvious approach as there will more often than not be rate-limiting steps that may hinder optimal use of all the machines. Nevertheless, using TCM to estimate optimal combinations of machines is far more productive that engaging in production-floor trial and error experiments.

Given the level of detail necessary for an appropriate implementation of these models, detailed operations conditions for companies in the relevant locations were collected through questionnaires. This included firms in Portugal, as well as in the regions of potential investment or competing production like Brazil. This information was used in the model to evaluate manufacturing cost.

CASE STUDY ANALYSIS

During the last decade, the Portuguese automotive industry has been one of the centerpieces in the general path towards industrialization and development that the country has been following (see Veloso, et al., 2000 for a full description of the evolution and existing conditions of the Portuguese auto industry) From 1987 to 1997, sales of the autoparts industry grew sevenfold. Together with the assembly industry, it leads the stock of FDI in Portugal as well as the volume of exports for the country, representing almost 7% of GDP. The export capacity of the Portuguese firms, with over 60% of the total production being sent abroad, demonstrates the important level of competitiveness the Portuguese firms have achieved. Despite the recent success, there are a set of important challenges for both companies and government. A high atomization of firms, each with small capacity, and limited investment in research and development, has kept the suppliers working mostly at second and third tier levels. Moreover, the environment they are now facing is one of increased concentration in the supplier industry, and higher collaboration of the assemblers with their first tier suppliers. This relationship demands several capabilities beyond production, including design and logistics. It also requires that some of the critical suppliers be physically close to the OEMs. Therefore, local autoparts firms that want to continue to grow must consider presence beyond Portugal's borders.

To fully address the questions at stake, the study includes three major parts. First, it will analyze the manufacturing conditions for stampings and injection molded parts in several countries. These results will provide cost benchmarks to evaluate the competitive threat that Portuguese firms face from other regions, as well as suggest some of the challenges that they will face when deciding to invest in the regions considered. Portugal faces competition from many regions in Europe, as well as from local firms in emerging regions. To simplify the analysis and still consider some of the more important challenges identified by local industry leaders, France will represent the European countries with a strong economic base and the Czech Republic will represent countries in Eastern Europe that have been starting to improve economically and have been receiving many foreign investments. Brazil was chosen for a final comparison because the national firms have looked at it as a potential expansion market for Portugal. The second part of the study builds on the initial one, exploring expansion opportunities for Portuguese firms. Using the stamping example, the costs of having Portuguese companies expand production to the different European countries that represent typical economic conditions in Europe is considered. The case of injection molded component is then used to assess the investment vs. export decision to Brazil.

The scenarios considered analyze the changes in total cost as manufacturing, assembly, and logistics conditions change due to location of the operations. For each of them, manufacturing operations were modeled after best practice information gathered for the particular parts considered in the analysis. One set of inputs that affect manufacturing cost are factor conditions in the country of production. These factors include wage, working days per year, interest rate, energy cost and building costs. The baseline assumptions for these countries, shown below in Table 1 are based upon typical costs and conditions found in each country through extensive interviews with industry leaders. As the table shows, Brazil has two critical differences in the factor conditions. The first is the level of interest rate, which has been severely affected by the region's financial turmoil. The second is material cost. According to industry leaders interviewed, market power from the local raw material supplier generates material cost 20% higher than world prices, generating a substantial cost penalty. The other major gap difference is France to the remaining areas. As one would expect, beyond interest rates, factor costs are much higher in France than in any of the remaining nations.

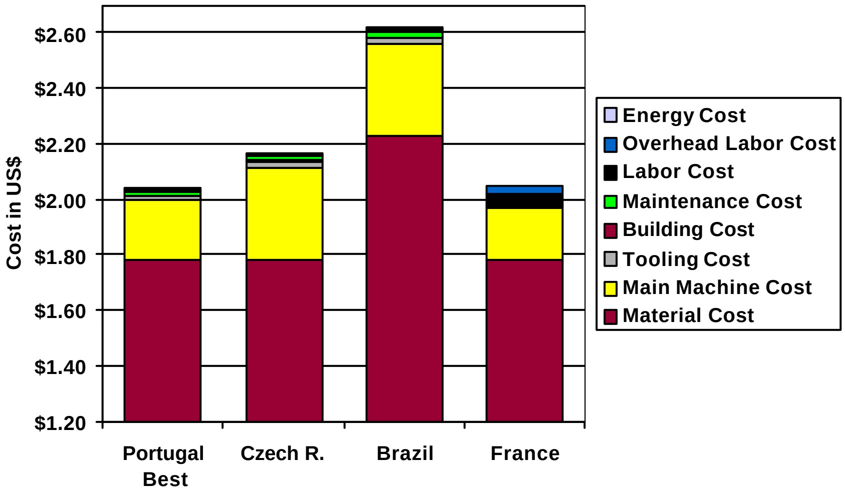
Table 1: National factor conditions

	Portugal	France	Brazil	Czech Republic
Days / year	230	240	260	260
Wage (US$/h)	$ 6	$ 25	$ 6	$ 3
Energy Cost (US$/kwh)	$ 0.05	$ 0.08	$ 0.08	$ 0.05
Interest Rate	10 %	7 %	30 %	10 %
Building Cost (US$/m^2)	$ 300	$ 1500	$ 500	$ 500
Material Cost	100 %	100 %	120 %	100 %

METAL STAMPING

The stamping case study was done for a typical simple part used in all cats. The part, described in detail in annex, weighs 2Kg and a production volume of 400.000 parts per year, typical for the automotive industry, was considered. The results of the cost estimate are shown in Figure 1. Portugal, France and the Czech Republic have very similar cost levels, while an important cost difference exists in Brazil. The main source of cost difference for Brazil is material cost. Between the other countries, the main machine cost provides most of the cost differences. Two aspects drive this cost difference: efficiency and interest rate. The advantage of Portugal over the Czech republic is driven by better machine utilization and process control. But the gap between these two countries and France is driven more by difference in the interest rate. The press hourly expense is determined by the opportunity cost of the investment in presses amortized over their lifetime. Therefore, high interest rates increase the opportunity cost and increase the main machine cost attributable to this part, generating some of the cost difference. This aspect is also quite important in the cost penalty for manufacturing in Brazil.

Figure 1: Country Cost Estimates by Country for the Stamping

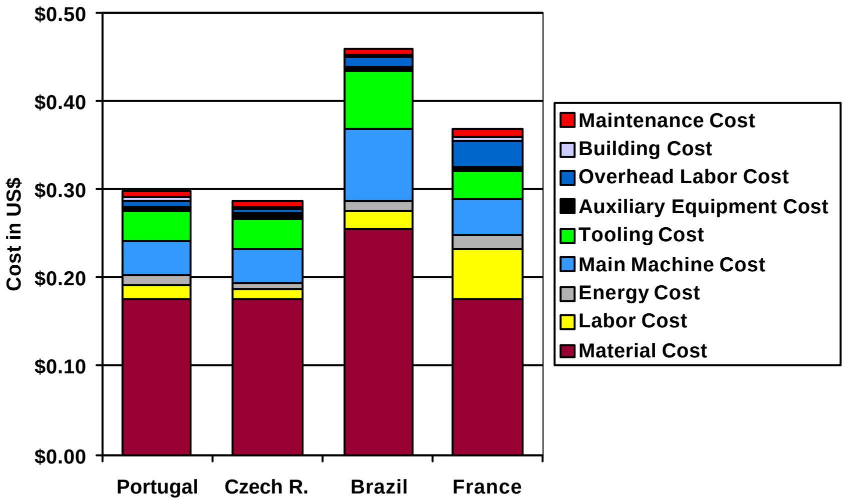


Despite the differences in wages, labor does not usually contribute significantly to the capital-intensive stamping process. Nevertheless, it is sufficient to balance the capital cost when comparing Portugal and France. Surprisingly, the energy cost, maintenance cost, and building costs are not the predominant sources of cost or cost differences. These are factors that are used in the decision-making process about where to locate, but they may not be as important as the proximity to the market. These results show that Portugal's advantages in manufacturing may not be sustainable, particularly if one considers that there will be additional costs of shipping the parts, which are explored below. As a result, provided that an expansion facility can achieve full equipment utilization, this result supports the trend to expand abroad where the market is located, particularly in other regions of Europe.

INJECTION MOLDING

Like the stampings, operations of Portuguese companies and other companies worldwide were used to provide a cost estimate for a representative injection molded part described in detail in annex. For this case an individual part as well as an assembly that includes three identical parts that are fit and fastened together was considered. This assembly represents a typical assembly that the Portuguese companies manufacture.

Figure 2: Cost estimates by country for the injection molded part



Cost estimates calculated for the generic injection molded part are presented in Figure 2. As in stamping, the main source of cost difference for Brazil is the higher material cost. For France, labor cost is the main source of cost difference. The Portugal, Czech Republic and France all have nearly the same interest rate for assessing the opportunity cost of the tooling and machinery. While Brazil contributes a larger tooling and machine cost due to a higher interest rate. As before, the energy cost, maintenance cost, and building costs are minor sources of cost or cost differences. Therefore the main sources of cost difference include the material cost, labor wage, tooling and machine cost. In particular, because the efficiency of equipment use is identical for Portugal and the Czech Republic, lower wages and energy costs create a disadvantage for Portuguese firms. These cost drivers can be used in the decision-making process about where to locate, but they may not be as important as other factors, such as the proximity to the market.

These results show that production of a simple stamped or injection molded part can be performed relatively inexpensively with good manufacturing performance across Europe, with almost insignificant differences in cost. Nevertheless, these economical components can only be sold for a small profit. Profit growth is usually achieved though assembled components that perform particular functions. The production of subsystems is becoming ubiquitous with the described trend towards modularization in the automotive industry. With Portugal's relatively low wage, there is little reason to ship simple components to higher wage locations to assemble them.

Figure 3: Injection molding assembly costs by country

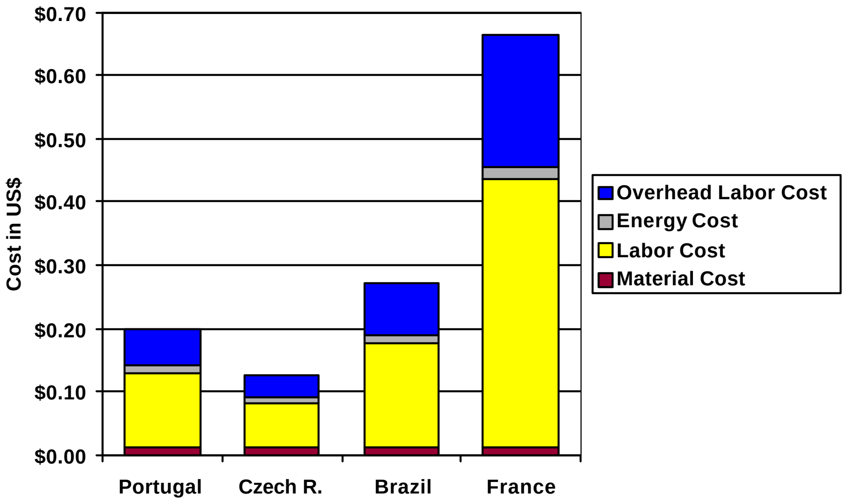
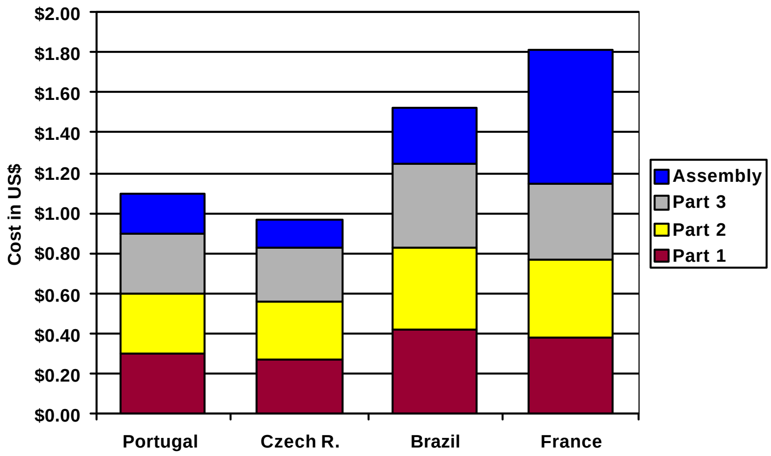


Figure 3 shows the cost breakdown for the assembly of the three part injection molded components. Labor cost and the overhead burden associated with labor form the overwhelming majority of the assembly costs. Therefore, the cost in Portugal is ranked closely to other emerging markets in the Czech Republic and Brazil. This seems to indicate that having the assembly performed locally in these regions is much more cost effective than shipping the individual injection molded components to be assembled in France, as these manual tasks cost much more to perform in these advanced economies.

Figure 4: Total assembly costs by country



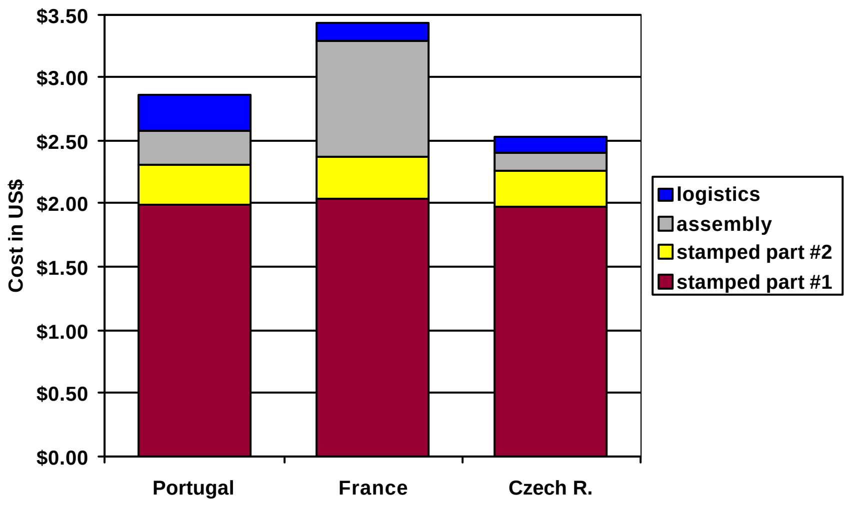
Given these results, instead of the individual component manufacturing, an assembly of three components is now considered in the analysis. Figure 4 shows the total cost breakdown of the injection molded assembly described in annex. The figure shows the three individual component manufacturing costs plus the associated assembly cost. This result illustrates what is now the prevailing view among Portuguese automotive suppliers. Portugal still maintains the cost advantage over countries such as France and Germany where the labor costs are several times higher. However, local firms are losing ground in terms of cost to emerging East European countries such as the Czech Republic. Increasing openness and restructuring of the Eastern Europe automotive industry is prompting efficiency to levels that threaten the low wage leadership that Portuguese firms have used to compete in the western European market. Furthermore, Eastern Europe is closer to central European customers than Portugal, which implies reduced logistics costs.

As a result, Portuguese firms are expecting to lose business in France and Germany to suppliers located in emerging areas over the next years. They face three alternatives: either shrink operations and become a small process-focused company that works as a second or third tier supplier to the Iberian peninsula and possibly France; or sell the firm to an foreign company aiming to expand capacity; or become themselves a multinational firm, using their existing expertise in these technologies to enter in regions where the industry is growing but local suppliers have weak capabilities and some of the largest firms do not find it interesting to invest because of the small absolute scale of the market. In fact, a substantial share of the companies is aiming at the third option. In a recent survey more than 40% of the Portuguese autoparts firms interviewed considered foreign investment a company top priority. Moreover, 15% of the firms owned by national capital have already embraced some form of internationalization, either through the establishment of green-field plants or mergers and acquisitions (Veloso, et al., 2000). The next section discusses the strategies these firms are considering to tackle these opportunities.

INTERNATIONALIZATION STRATEGIES

Internationalization decisions are based upon many factors that cannot be completely captured simply by estimating the cost of production and shipping. However, the cost models used in this analysis can give a first order approximation for the economic feasibility of a decision. As explained above, the research considers the costs of producing from several different countries that are representative of typical economic conditions that currently exist. In this section the analysis considers that, besides the direct manufacturing cost, there are also logistics costs associated with shipping the manufactured components to a particular site geographically associated with an OEM customer. Logistics costs are also calculated using a cost model developed to evaluate shipping scenarios for the parts, volumes and distances considered (see Veloso, et al., 2000 ch. 7 for a full description of the logistics model).

Figure 5: Cost breakdown for a stamped assembly delivered to a German customer.

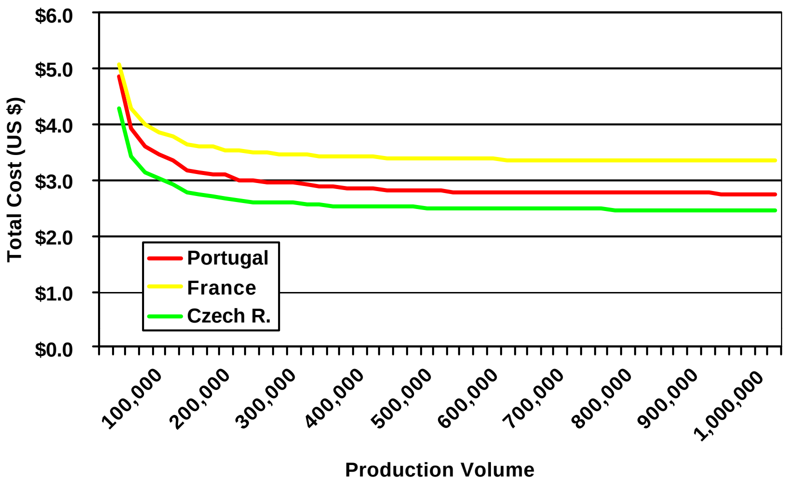


The first scenario looks at investment decisions in a European context. It compares the cost of manufacturing a stamped assembly in plants located either in Portugal, the Czech republic or France and shipping it a to a client located in Germany. The component is now an assembly that joins the part described in the previous section with a smaller one through spot welding (see annex). The calculated cost breakdown for the three countries is shown in Figure 5. The primary cause of cost difference is assembly not stamping cost. This is not surprising given the large disparity in wages between the countries, $17/h in France, $5/h in Portugal and $2.50/h in the Czech Republic. This is why assembly is typically performed in Taiwan and in Singapore where an educated, motivate workforce is inexpensive. Logistics shipping results in secondary cost differences. The close proximity of France to the

German customer cannot make up for the assembly cost difference with Portugal and the Czech Republic. The Czech Republic gains these advantages due the factor conditions despite a stamping cost that is slightly higher than the other countries.

The relative costs differences between them persist, regardless of the production volume as shown in Figure 6. Therefore, expansion into countries similar to the Czech Republic makes the best economic sense. These eastern countries represent the new low-cost leaders in Europe. Additionally, the close proximity to a higher tier customer makes the Czech Republic and other comparable countries ideal candidates for expansion. A Portuguese firm entering the Eastern European market could even have a marginal cost advantage when compared to local firms due to greater efficiency in manufacturing. Nevertheless, the most important factor driving a potential investment in this location is access to a market that is likely to be lost if manufacturing remains in Portugal.

Figure 6: Total cost for the stamped assembly as a function of volume

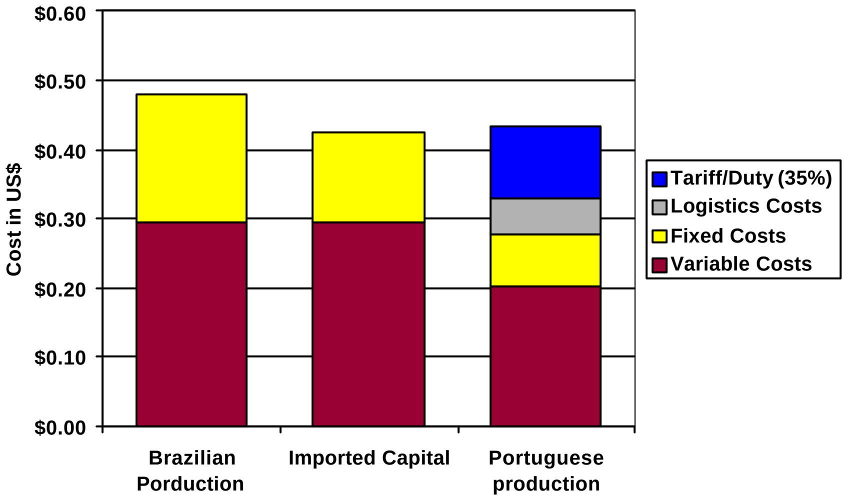


The second scenario looks at expansion to Brazil. This possibility is more complex than the European scenario considered above because multiple aspects with conflicting effects in component cost affect the decision. One the one hand, the government has enacted a number of protectionist measures to help promote Brazilian business growth within the country. Therefore, exports from Europe must consider, besides manufacturing and logistics costs, tariffs and duties equivalent of 35% of the product f.o.b. cost. This additional cost generates a strong disincentive for imports. On the other hand, higher factor prices, local manufacturing inefficiency and small scale all negatively affect the cost of manufacturing in Brazil. In this context, making the decision of whether or not to invest locally becomes extremely difficult.

To evaluate potential decision trade-offs, the cost of manufacturing and shipping the injection molding described in the previous section to a client OEM in Brazil was calculated. Three situations were considered more relevant for the problem under analysis. The first is to have local Brazilian production by local capitalists. The second is local Brazilian production by Portuguese investors. The key assumption of this scenario is the fact that the Portuguese investor is able to borrow capital at Portuguese interest rates, diminishing the equipment opportunity cost penalty. The third situation is direct exports of the component from Portugal to Brazil. For this option to be attractive, it assumes that the supplier already has a supplying contract of 400.000 units of the same component in Europe, enabling it to export at lower marginal cost the smaller scale demanded by the Brazilian OEM.

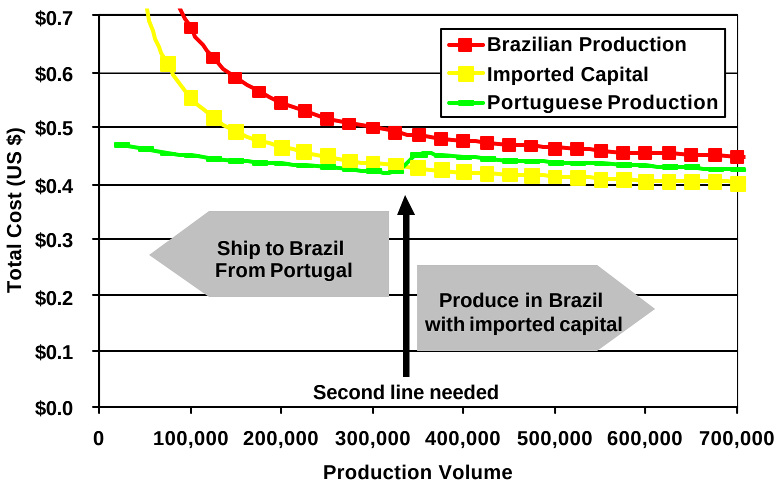
As it had been perceived from the analysis of the previous section, Figure 7 demonstrates how Brazilian production can be very costly. Without the strong industrial policies of Brazil, in particular the local content regulation, Portugal and undoubtedly many other countries would export even more to Brazil. Despite the logistics costs and tariff associated with shipping 400,000 components per year to Brazil, Portuguese production is still below the cost of Brazilian production with local capital. Because the Portuguese operation is already producing the same components for another customer outside of Brazil, it will gain economies of scale, reducing the cost of shipping low production volumes to Brazil. Despite this advantage of imports over local manufacturers, the figure indicates that the use of capital raised in Portugal for the installation of a subsidiary in Brazil is actually yielding a lower cost than the imports. Nevertheless, this advantage is very small. Moreover, it depends on the ability of the plant located in Portugal to reap the necessary economies of scale.

Figure 7: Cost breakdown of the injection molded assembly delivered to a Brazilian customer.



As shown in Figure 8, for low production volumes, it is more economically suitable to ship the injection-molded assemblies to Brazil and pay the high tariff than it is to expand into a facility immediately. However, once the production volume fills capacity, an additional machine and die must be bought in order to continue production. When the new equipment and die are bought, the average cost increases above the cost of producing in Brazil with inexpensive capital. Thus, it now makes sense to expand the new machine and die set into a Brazilian facility and stop shipping from Portugal. The costing of a product helps determine when it is best to expand abroad. This example demonstrates the cost tradeoffs that occur and how the cost can inform the decision.

Figure 8: Affect of shipping components from Portugal versus importing capital for Brazilian operations.



The two scenarios demonstrate how new emerging regions such as Eastern Europe and South America have become interesting investment targets for smaller manufacturers of standardized parts like injection moldings and stampings. Nevertheless, they have different characteristics. The Eastern European market is a direct threat to Portuguese manufacturers. Despite some inefficiency gap to the Portuguese manufacturers, their overall cost of manufacturing and shipping to customers in central and northern Europe is already smaller than the Portuguese cost. As a result, loss of sales to these producers is to be expected in the next years. In the short run, the opportunity for foreign investment in this region is greater because most local suppliers are still aiming to join with other firms that may provide them manufacturing experience in these technologies. Over the next years, as the knowledge gap to Portuguese producers disappears, investment may become more difficult. The Brazilian scenario is increasingly seen as a direct extension of the Portuguese market. Early market penetration by exports is a better alternative until the appropriate production scale is evident. This is an important step because it gives the Portuguese companies a first exposure to the local conditions before deciding to expand operations to a local facility when scale grows. In fact, this has been the observed trend for the Portuguese companies that have decided to invest in Brazil.

CONCLUSIONS

Global operations and similar vehicles led OEMs to demand their direct suppliers to also have a strong international presence. As a response to this change in market configuration, large firms like Magna, Bosch or Valeo led an important flux of capital across the Triad. These suppliers had unique knowledge and technology in particular components and systems and their decision to invest in new areas of the globe aimed at the exploitation of this knowledge. Simultaneously, some of these firms with expertise in particular components wanting to capture the supply of complete systems, decided to merge with or acquire others that were experts in the remainder aspects of the system. The strategic investment of suppliers in new market conditions fits the well-established theory of foreign investment, which sustains that firms will use imperfectly tradable unique assets to offset potential disadvantages of doing business in a foreign region. Likewise, the mergers and acquisitions trend seems to follow recent expansions of the same theory, pertaining that that firms may also invest to internalize unique technologies that can't be traded in the market.

Recently, another wave of foreign investment has been taking place in the auto supply industry. This time it is not the large firms with strong technological capabilities, but rather the typical one plant small firm that is deciding to move across the border and head into new regions. Moreover, the investment has not been directed at developed regions and it is not aiming at acquiring firms with complementary assets. On the contrary, it has targeted intermediate or developing areas and, when the objective is acquisition, it is often of a plant with equivalent size and characteristics of the original investor. Unlike the trends described in the previous paragraph, the established theory of foreign investment does not provide much insight on why may we observe these facts. In fact, it was uncertain why would one find these small players and not the large suppliers taking over international operations. In addition, it was not clear what could be the advantages of a small supplier of commodity parts in one region of the globe over another, so that it would eventually lead to foreign investment.

The reason why some of the smaller suppliers were being able to tackle some of the emerging market business opportunities is related to the sudden and dramatic evolution of the supply chain across the world. Because of smaller scale and large fluctuations, large suppliers realized that the economic return of some of the investments in emerging regions could be negative, or at least below the one that a firm may get through investment in the Triad. This led some large international firms to decide to be out of some of these regions, or at least have a limited presence there, preferring instead to concentrate resources in Europe, the US or Japan. The detailed microanalysis of stamping and injection molding manufacturing cost enabled an exploration of the current situation of these firms in their home market and an assessment of the conditions they may face when they decide to invest in a new region. The results provided a baseline for understanding the investment options of these small suppliers. The analysis shows that small companies do not possess strong knowledge assets that grant them competitive advantages in the international investment are extremely influenced by market conditions, either locally or abroad. Therefore, their responses are mostly determined by the context rather than by particular capabilities.

The Portuguese companies analyzed in the case study are facing an important threat from Eastern European producers. Despite some inefficiency gap to the Portuguese manufacturers, their overall cost of manufacturing and shipping to customers in central and northern Europe is already smaller than the Portuguese cost. As a result, loss of sales to these producers is to be expected in the next years. The local producers have become aware of this danger and their foreign investment decisions are what could be called a front leap for survival. Internationalization to other areas is seen as the only way to expand, sometimes maintain, an anticipated shrinking market at home. The choice of emerging areas like Eastern Europe or Brazil results from the combination of two purely external factors: On one hand some neglect from larger players that have established other investment priorities; on the other hand industrial structures and macroeconomic contexts that provide Portuguese firms a temporary cost advantage. In a country like the Czech republic, the difference is mostly due to efficiency and of a marginal significance. This has refrained investment, as Portuguese companies are not sure of what to expect when competing with local firms. Some are establishing joint ventures as a way to minimize risk. On the contrary, the cost advantage to Brazilian producers is significant, mostly because of the difference in access to cheap capital. As a result, it is not surprising that Portuguese suppliers have found in Brazil the preferential investment target.

The overall study shows that the national conditions and policy play an important role in internationalization and detail how expansion decisions need to be informed by the tradeoffs between manufacturing costs, logistics costs, and country policies. Moreover, it presents mounting evidence suggesting that existing theory of foreign direct investment ought to be expanded to incorporate smaller players without unique assets, whose investment decisions are mostly determined by particular market configuration and the strive for survival.

ACKNOWLEDGEMENTS

The authors would like to thank IAPMEI and 15 Portuguese autoparts manufactures for sponsoring the project 'Global Strategies for the development of the Portuguese Autoparts Industry', that provided the grounds for this paper. We would also like to thank the Portuguese institution INTELI for gathering the data and the contributing to the analysis. Francisco Veloso acknowledges a fellowship from Praxis XXI for his studies at MIT (BD/9457/96).

APPENDIX: STAMPING AND INJECTION MOLDING CHARACTERISTICS

Table 2: Stamping assembly data for cost estimation

	Medium Stamping	**Small Stamping**
Mass	2 kg	0.1 kg
Max Part Length	500 mm	100 mm
Max Part Width	400 mm	200 mm
Thickness	1.5 mm	0.9 mm
Production Volume	400,000	400,000

	Assembly
Mass	2.1 kg
Size	0.5m x 0.4m x 30mm
Welds	10 spot-welds
Cycle time	20 seconds

Figure 9: Injection molding assembly data for cost estimation

	Injection Molded Part
Mass	200 g
Dimensions	200 x 100 x 50 mm
Wall Thickness	2 mm
Cost	$1.00 / kg
Cycle time	35 seconds
Setup time	100 minutes
Production Vol.	400,000 parts

3 similar parts fastened together

	Assembly
Parts	**3**
Mass	600 g
Dimensions	200 x 120 x 100 mm
Fasteners	20
Cycle time	40 seconds

REFERENCES

Blomstrom, Magnus, and Kokko, Ari. "Multinational Corporations and Spillovers." *Journal of Economic Surveys* 12, no. 3 (1998): p 247-77.

Braunerhjelm, Pontus, and Svensson, Roger. "Host Country Characteristics and Agglomeration in Foreign Direct Investment." *Applied Economics* 28, no. 7 (1996): p 833-40.

Buckley, Peter, and Casson, Mark. *The Future of the Multinational Enterprise*. London: MacMillan, 1976.

Caves, Richard. *Multinational Enterprise and Economic Analysis*. London: Cambridge University Press, 1976.

Clark, Joel P., and Veloso, F. "The vertical integration of the component supplier chains and its impact on multi-tier supplier relations." In *The automotive industry: Component suppliers; current and prospective regulatory approaches.* Sta Maria da Feira, Portugal, 2000.

Dunning, J. *International Production and the Multinational Enterprise*. London: Georoge, Allen and Unwin, 1981.

EIU - The Economist Intelligence Unit, Automotive Components Europe. Several Issues

Fosfuri, Andrea, and Motta, Massimo. "Multinationals without Advantages." *Scandinavian Journal of Economics* 101, no. 4 (1999): p 617-30.

Group, Global Interest. "The Globalization of the Automobile industry." Connecticut: Mckinsey & Co., 1998.

Hymer, S. *The International Operations of National Firms. 1959 PhD diss*. Cambridge, MA: MIT Press, 1976.

Kogut, Bruce, and Chang, Sea Jin. "Technological Capabilities and Japanese Foreign Direct Investment in the United States." *Review of Economics & Statistics* 73, no. 3 (1991): p 401-13.

Lung, Yannick, Chanaron, Jean-Jacques, Fujimoto, Takahiro, and Raff, Daniel, eds. *Coping with Variety: Flexible Production Systems for Product Variety in the Auto Industry*. Abingdon, Oxon: Ashgate, 1999.

Markusen, James R. "The Boundaries of Multinational Enterprises and the Theory of International Trade." *Journal of Economic Perspectives* 9, no. 2 (1995): p 169-89.

Mascarenhas, B. "Small International Specialists." *Journal of International Management* 3, no. 3 (1997): 160-186.

Neven, Damien J., and Siotis, G. "Technology Sourcing and FDI in the EC: An Empirical Evaluation." *International Journal of Industrial Organization* 14, no. 5 (1996): p 543-60.

Rugman, Alan M. "Internalization Theory and Corporate International Finance." *California Management Review* 23, no. 2 (1980): p 73-79.

Rugman, Alan M. "New Theories of the Multinational Enterprise: An Assessment of Internalization Theory." *Bulletin of Economic Research* 38, no. 2 (1986): p 101-18.

Sindipeças. "Desempenho do Setor de Autopeças - 1997." , 33. São Paulo: Sindipeças - Sindicato Nacional da Indústria de Componentes para Veículos Automóveis, 1998.

Sturgeon, Tim, and Florida, R. "Globalization and Jobs in the Automotive Industry." . Cambridge: IMVP, 1999.

Teece, David J. "Transactions Cost Economics and the Multinational Enterprise: An Assessment." *Journal of Economic Behavior & Organization* 7, no. 1 (1986): p 21-45.

Veloso, Francisco, Henry, Chris, Roth, Richard, and Clark, Joel. *Global Strategies for the Development of the Portuguese Autoparts Industry*. Lisboa: IAPMEI, 2000.

Wards. "Wards Automotive Yearbook."., several years