

# **The interaction between FIAT and local enterprises in Minas Gerais: a case of Regional Innovation System \***

**This version: September 13th 2004**

By: Alberto Brugnoli \*  
Rubens R. Sawaya ♦

---

\* This paper is part of the project “The interaction between FDIs and local SMEs in Latin America and the Caribbean: a look at Regional Innovation Systems”, financed by the IADB and carried out by ISLA.

• Alberto Brugnoli is project coordinator and senior researcher at ISLA, Bocconi University, Milan, Italy, Email: alberto.brugnoli@unibocconi.it

♦ Rubens R. Sawaya is local project consultant from Catholic University of São Paulo-PUCSP

The authors would like to thank Alessandro Barattieri for the excellent research assistance he provided during all the phases of the present study and for his very useful comments.

## Contents

<b>1. Introduction</b>	<b>3</b>
<b>2. The auto-vehicles and auto-parts industries in Brazil</b>	<b>4</b>
2.1 <i>The '70s and '80s</i>	4
2.2 <i>The '90s to the present</i>	5
2.2 <i>The change in the supply chain structure</i>	7
<b>3. Minas Gerais and its institutional framework</b>	<b>9</b>
3.1 <i>The industrial development institute (INDI)</i>	9
3.2 <i>The Minas Gerais Development Bank (BDMG)</i>	10
3.3 <i>Universities</i>	11
3.4 <i>The National Service of Industrial Learning (SENAI)</i>	12
3.5 <i>CETEC</i>	12
3.6 <i>SEBRAE</i>	13
3.7 <i>Sindipeças</i>	14
3.8 <i>Other Institutions</i>	14
<b>4. Fiat's experience in Minas Gerais</b>	<b>16</b>
4.1 <i>The establishment and success of Fiat in Minas Gerais</i>	16
4.2 <i>The mineirização program and the formation of a suppliers' cluster</i>	18
4.2 <i>The relation between Fiat and its suppliers</i>	20
<b>5. Research's results</b>	<b>22</b>
5.1 <i>Features of the sample</i>	22
5.2 <i>The MNEs</i>	23
5.3 <i>Firms performance</i>	25
5.4 <i>Human Capital and innovation potential</i>	28
5.5 <i>Innovation performance of domestic firms</i>	29
5.6 <i>Interactions between domestic and foreign firms and their effects</i>	33
5.7 <i>Interactions among foreign firms and their effects</i>	37
5.7 <i>Interactions among domestic firms and their effects</i>	38
5.7 <i>Interactions between firms and institutions and their effects</i>	40
5.7.1 <i>Educational and research institutions</i>	40
5.7.2 <i>Business associations</i>	41
5.7.3 <i>Development institutions</i>	42
<b>6. Conclusions and policy suggestions</b>	<b>44</b>
<b>7. References</b>	<b>48</b>

## **1. Introduction**

It is well known the relevance of the interactions between foreign and local firms in developing countries. In theory, there is a widespread consensus on the positive effects MNEs may have on domestic firms in host countries. However, the evidence provided by empirical investigation is mixed, depending on the countries, the periods of time, the industries and methodologies considered. This is an issue even more relevant to Latin American countries, due to the large FDI inflows that reached the region in the second half of the '90s.

Moreover, an increasing attention has been paid to the role of institutions and their relations with the private firms in the context of the so-called Regional Innovation Systems (RIS). These are systems in which industrial clusters are supported by an appropriate infrastructure made up of universities, colleges and technical institutions: all these provide for an appropriate level of human capabilities, research institutes and agencies, and meso-institutions (chambers, associations, consultancy systems), which represent appropriate communication channels between firms and between firms and the public sector.

This paper presents the case study of Fiat suppliers' cluster in Betim, in the Brazilian State of Minas Gerais. It aims to study both the interactions between Fiat, other foreign firms and local SMEs, and those between the Italian car manufacturer and Minas Gerais institutional framework, also as potential RIS.

The paper is structured as follows: Paragraphs two and three discuss the development of the auto-vehicles and auto-parts industries in Minas Gerais and Minas Gerais institutional framework. This part is mainly made up of direct interviews to several officers working in the institutions considered. Paragraph four contains the description of how Fiat settled its activities in Minas Gerais and of the relations with its suppliers (information given by Fiat executives during interviews) while Paragraph five shows the most important results given by a field research carried out among a sample of Fiat suppliers. Paragraph six provides for some conclusions and policy suggestions.

## 2. The auto-vehicles and auto-parts industries in Brazil

### 2.1 The '70s and '80s

Auto-vehicles industry started its operations in Brazil in the second half of '50s; during the '20s, however, Ford had already set up a small assembly plant for imported parts. The size of the Brazilian market is one of the main reasons that led MNEs to invest in this industry, together with government policies, which have been very efficient in attracting big cars manufactures to make them set up their business in the country. These policies followed the import substitution strategy and were aimed at introducing in Brazil dynamic sectors whose target was to boost forward and backward industrial upgrading. As a matter of fact, although MNEs were stimulated to come to Brazil, the main target of these policies was to promote domestic firms' development. In other words, they aimed at attracting foreign capital which could help the introduction of high technology systems; therefore, thanks to this presence in the country, domestic firms could start a catching-up process via technology-spillovers.

Table 2.1 shows how the model was quite successful in terms of industrialization. Brazil experienced the creation of a great auto-vehicles industrial park focused on MNEs (Volkswagen, Ford, Fiat etc.) and also the birth of a number of local auto-parts producers, which could benefit from technology spillovers that would probably derive from car assemblers. São Paulo's region became the center of automotive industry in Brazil.

Table 2.1 – Scale of the auto-vehicle sector production in Brazil, 1976-1990

Year	Cars	Commercial vehicles	Trucks	Busses	Total
1976	765,291	125,370	83,891	12,059	<b>986,611</b>
1980	933,152	115,540	102,017	14,465	<b>1,165,174</b>
1985	759,141	134,411	64,769	8,385	<b>966,706</b>
1990	663,084	184,754	51,597	15,031	<b>914,466</b>

Source: ANFAVEA (2003)

However, despite the success of the policies mentioned above, the measures taken were not sufficient to maintain Brazilian industry competitive in time. As Suzigan and Vilella (1997) point out, in the period between 1930-70 industrial policies and the corresponding effort of the institutional building was successful in pushing automotive industry into a convergence process to meet international industrial and technological standards; but during the '80s, the same policies were not able to promote new processes using the new technologies acquired, as Table 1 clearly shows.

As a matter of fact, in the '80s auto-vehicles industry in Brazil started losing competitiveness. Although a modern production pattern had been achieved in the '70s, the technological progress of the whole industry had been created by MNEs and there was no sign of innovation in domestic firms. As a consequence, technological dependence was still very high. Furthermore, firms continued to purchase new machinery abroad as this was regarded as a strategic source of new technologies and a way to ensure an increasing development of local industry.

In addition to the difficulties in importing new machinery in the '80s, a key for the modernization of the industry, new difficulties arose due to the crisis suffered by the Balance of Payment. The shortfall in imports made both the local automotive and auto-

parts industries lose their competitiveness. Even MNEs ceased to develop new technologies inside their auto-vehicles assembly plants.

## 2.2 The '90s to the present

In early '90s, Brazilian government rearranged its industrial policy. Surveys had made clear that the general loss of competitiveness suffered by Brazilian automotive industry was due to the protectionist trade policies followed in the past. Therefore, there was a shift towards liberalization in trade policy, which was achieved by lowering tariffs and other barriers, and appreciating the Brazilian currency (Suzigan and Villela, 1997).

This resulted in an immediate increase in imports of complete vehicles: car manufacturers began to import vehicles from their parents firms because of the lack of technology available at a local level, as they wanted to compete with other manufacturers, which had already begun to sell their cars on the Brazilian market. As an example, in 1994, vehicle assemblers owning production plants in Brazil bought abroad almost 120,227 vehicles – i.e. 10% of the locally produced stock. This increase in import opportunities led to a modernization process carried forward both by assemblers and by auto-parts producers. However, this process was mainly driven by the technology imported from abroad while imported vehicles, sourced by global players, replaced most of the auto-parts production, which usually was an internal process.

Following this, automotive industry faced a huge imbalance in its external accounts; when this happened, the Brazilian government decided to impose restrictions on the liberalization policy previously adopted in order to favor local production. In the beginning, tariffs were raised and the government tried to establish import quotas on vehicles without success as WTO forced it to withdraw this measure. Finally, in 1995, the “Automotive Regime” was introduced, aiming at promoting production and trade in the automotive and auto-parts industries by means of special tax incentives.

This new policy, together with the fear for a failure of the stable and overvalued exchange rate, significantly contributed to the attraction of new FDI, leading to a significant upsurge in output, as shown in Table 2.2.

Table 2.2 – Automotive industry production in Brazil 1992-2002

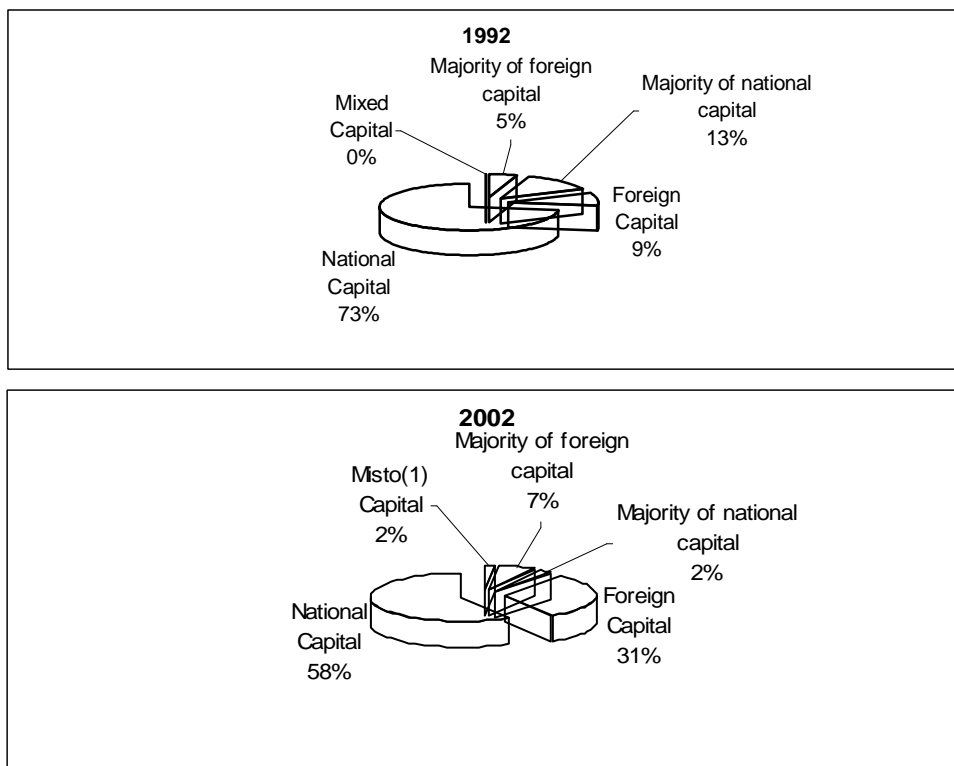
Year	Cars	Commercial vehicles	Trucks	Busses	Total
1992	815,959	201,591	32,025	24,286	<b>1,073,861</b>
1993	1,100,278	224,387	47,876	18,894	<b>1,391,435</b>
1994	1,248,773	251,044	64,137	17,435	<b>1,581,389</b>
1995	1,297,467	239,399	70,495	21,647	<b>1,629,008</b>
1996	1,458,576	279,697	48,712	17,343	<b>1,804,328</b>
1997	1,677,858	306,545	63,744	21,556	<b>2,069,703</b>
1998	1,254,016	247,044	63,773	21,458	<b>1,586,291</b>
1999	1,109,509	176,994	55,277	14,934	<b>1,356,714</b>
2000	1,361,721	235,161	71,686	22,672	<b>1,691,240</b>
2001	1,501,506	214,936	77,431	23,163	<b>1,862,373</b>
2002	1,521,431	180,030	68,500	22,699	<b>1,792,660</b>

Source: Sindipeças, 2003 Annual report

Car assemblers already established in Brazil (Fiat, GM and Volkswagen) as well as new assemblers that entered the market (Honda, Mercedes, Peugeot/Citroen, Toyota and Renault, just to name a few) began to build new production facilities. The resulting increase in investment and production is impressive: between 1996 and 1998, the motor vehicle industry invested more than 2 billion of dollars per year in the industry and in 1997 it reached a peak of 1.68 million of units produced. Then, in 1998-1999, production fell to almost 1.1 million of units; in 1999 it began again to grow, reaching a new peak of 1.52 million of units produced in 2002 (Sindipeças, 2003).

During the '90s, Brazilian auto-parts industry followed more or less a similar path. During early '90s it was characterized by a sharp rise in sales, which reached their peak in 1996; in 1997, however, sales index started to fall to the levels of early '90s (Sindipeças, 2003). Auto-parts industry was also deeply influenced by the "Automotive Regime" of 1995. Auto-parts producers were obliged to face a fierce international competition and this caused the need for larger investments, followed by lower level of increase in revenues due to the fall in prices. These conditions favored global suppliers, which started to invest in Brazil, often acquiring existing firms. Foreign buyers were mainly favored by the financial fragility of target domestic firms, a friendly legal framework and the increasing presence of global assemblers. According to the 2003 annual report by Sindipeças (the auto-parts producers' business association), till 1992 almost 72% of auto-parts companies was local and only 9% was completely foreign owned. In 2002, the percentage of local capital companies fell to 58%, while the percentage of foreign owned companies reached 31%.

Chart 2.1 – Auto parts industry, ownership of firms 1992 and 2002



Source: Sindipeças, 2003 Annual report

As Table 2.3 shows, if we consider these proportions in terms of book value, we can see that the importance of foreign firms rose from 48.1% in 1994 to 78.4% in 2002.

Furthermore, looking at the total sales figures, these show an increase in foreign sales from 47.6% in 1994 to 75.6% in 2002. Things are even more dramatic if we consider investments: in this field, foreign firms accounted for 85,9% of the total investments in the industry in 2002.

Table 2.3 – Companies according to their ownership 1994-2002

Year	%		
	Capital Value	Sales	Investment value
1994	51,9 <sup>(1)</sup>	52,4 <sup>(1)</sup>	52,0 <sup>(1)</sup>
	<b>48,1<sup>(2)</sup></b>	<b>47,6<sup>(2)</sup></b>	<b>48,0<sup>(2)</sup></b>
2002	21,6 <sup>(1)</sup>	24,4 <sup>(1)</sup>	14,1 <sup>(1)</sup>
<b>a</b>	<b>78,4<sup>(2)</sup></b>	<b>75,6<sup>(2)</sup></b>	<b>85,9<sup>(2)</sup></b>

(1) National capital (2) Foreign capital

Source: Sindipeças, 2003 Annual report

These data make clear that the second cycle of Brazilian auto-parts industry modernization was not boosted by the development of local capabilities, but by a wave of new imported technologies, which is nowadays probably causing a new technology flow. However, the role of domestic firms within the industry has been seriously questioned by these new investment flows.

Table 4 shows the percentages relevant to several different countries where parent firms to foreign firms today operating in the Brazilian auto-parts industry are based. US have been the most important source of investment in the sector, followed by Germany (even though the share of the latter fell during the '90s), France and Japan. It is interesting to see how Italy is ranked: this country was almost absent in 1992, but in 2002 it registered a share of 5.9%. This figure was certainly deeply influenced by the suppliers' programs introduced by Fiat, which will be illustrated in the following sections.

Table 2.4 – Home country of foreign firms operating in auto-parts industry (%), 1992 and 2002

	Germany	US	UK	Japan	France	Spain	<b>Italy</b>	Others	Total
1992	34.7	36.3	5.8	8.3	5.0	..	..	9.9	100
2002	24.8	31.1	2.8	4.6	6.3	5.2	<b>5.9</b>	19.2	100

Source: Sindipeças, 2003 Annual report

### 2.3 The change in the supply chain structure

Since the '90s, a great change in the supply chain has affected the automotive industry in Brazil. In the beginning, vehicles production was managed by car manufacturers, which maintained all the most important functions (such as design, R&D, etc.) inside their plants. They only used to require some components to auto-parts companies thus fixing given standards of quality and price. At this stage, auto-parts companies were composed mainly of local firms, which could benefit from the product and process technology transfers from the central assembler; in this way they could achieve a certain level of quality. Assemblers, however, used to produce almost all their vehicles inside their own facilities.

In the '90s, the production structure of assembly companies changed and this had a huge impact on Brazilian industry. The main assembly companies began to organize their production according to a modular sourcing system as they bought from their suppliers whole parts of vehicles. The system was organized as a pyramid: some auto-parts plants provided complete systems (so-called 1<sup>st</sup> Tier supplier) and bought on their turn parts and components from other suppliers (2<sup>nd</sup> Tier). It is evident how this kind of system could affect the supplier's market structure according to an increasing concentration process.

This new structure required auto-parts producers to begin to play a new role as global players. They started working close to assembly companies on different kinds of activities, including R&D, also suggesting new solutions about the construction of complete modules for the assemblers' production lines. Some companies became even stronger than their clients and started to develop their own technologies inside their facilities.

This dramatic change in the automotive industry way of working had a big impact on Brazilian industry structure. The number of auto-parts companies dropped from 1500 in 1990 to 800 in 2003 (Sindipeças and BNDES). Foreign companies bought many local companies, as it was explained in the previous paragraph, and a huge modernization and internationalization of the sector took place. Moreover, when auto-parts companies became part of a global sourcing system, also the relationship between vehicle assemblers and auto-parts producers developed affecting the organization of the industry.



### **3. Minas Gerais and its institutional framework**

A presentation of Minas Gerais State institutional framework is relevant to the aims of the present work because, as it was suggested before, a Regional Innovation System is made up of the interactions between firms and the institutions present in a certain geographic area. A brief presentation of this framework, like the one given here, allows pointing out the interaction between the institutions considered in this paper and all the economic sectors involved; an example of this can be the case of Fiat's suppliers. Moreover, we needed to pay a special attention to the specific industry studied in this case study as some of the institutions presented here are strictly linked to Fiat and to auto-parts industry.

Broadly speaking, Minas Gerais presents a very rich institutional framework: 16 Universities, many research centers, vocational training centers and public institutions whose specific aim is to promote economic development and innovation, as the industrial development institute (INDI – Instituto de Desenvolvimento Industrial) or the Minas Gerais Development Bank (BDMG – Banco de Desenvolvimento de Minas Gerais). Many of these institutions were set up in the '70s and gave a significant contribution to State development in the '70s and '80s. During the '90s many institutions found themselves limited in their activity as there was a general consensus about the need for public presence to be limited as much as possible in the economic system. However, unlike in many other Brazilian States, first of all São Paulo, in Minas Gerais these institutions survived during the '90s and can now show a good potential in terms of support to the economic system.

Moreover, as interviews made clear, these institutions are linked each other through a close network of relations that provides for a great potential in coordination and efficiency of the policies adopted.

The following presentation is mainly based on the interviews made during the project to the representatives of the institutions considered. In those cases in which the interview could not be arranged, information have been derived from secondary sources.

#### *3.1 The industrial development institute (INDI)*

INDI is a State agency created in 1968 with the aim to promote State industry development by attracting investment both from other Brazilian States and from abroad (FDI). Operations carried out by this institution have always been supported both by the State energy company (CEMIG – Companhia Energética de Minas Gerais) and by the State development bank (BDMG), which accounted respectively for the 75% and the 25% of the budget. In the beginning, therefore, CEMIG was INDI majority shareholder and this was because INDI served as client-hunter for CEMIG.

INDI does not develop its own programs, as its task is only to assist potential investors in all their needs, above all providing them with all sort of information about legal framework, economic environment and public programs carried out by other institutions, like the State Economic Council or BDMG.

The governance of this institute is linked to that of other institutions. INDI's President is directly appointed by the State governor while its executive board is composed of

representatives from the Development Council, CEMIG, BDMG and FIEMG (Federação das Indústrias do Estado de Minas Gerais), which is the Federation of Industries of Minas Gerais. This organization allows a joint management that helps coordination and efficiency.

INDI does not have specific targets for its action. All investments are welcomed and encouraged in the same way. This is due to a deliberate strategy aimed at promoting horizontal investment, a strategy derived from the assumption that investments are valuable above all for their contribution to employment and fiscal revenues increase. Other possible externalities regarded as important are technology transfers to local firms (which would probably require more targeted policies), but they are certainly far less important than the other two factors mentioned.

From 1974 to 2004 INDI supported 1564 investment projects, 894 of which were Greenfield investments and 669 production capacity expansions. In particular, INDI played a pivotal role both in the Fiat's establishing in Betim and in the Fiat's project of *mineirização* of its suppliers, (details of both operations will be explained in the following sections). These efforts made INDI win WAIPA 2003 prize for efficiency in investments attraction.

Among its most recent interesting actions, INDI has become partner in the European program AL-Invest on behalf of Minas Gerais State, a program aimed at promoting investment flows and business opportunities between European and Latin American firms. Moreover, INDI has an active role in the intermediation between several actors involved in a BID-financed project on cluster development, in which, however, auto-parts industry is not included.

### *3.2 The Minas Gerais Development Bank (BDMG)*

BDMG is a State bank created in 1962 as a part of the institutional system whose aim is to promote local economic development. When the bank was founded, the structure it was given by the Brazilian Federal Government was aimed at financing private investments. It was composed of BNDES and of local development banks: the former is the National Bank for Economic and Social Development (created in 1950s), which had the responsibility to support big national projects and companies in their industrial investments, and the latter belonged to the single States and had the responsibility to finance local projects and support local state development policy. During the '80s, several development banks crashed because of the economic crisis, fiscal constraints, and in some cases because of mismanagement. During the '90s, most development banks were incorporated with local state banks and in many cases privatized. BDMG is one of the few exceptions.

Today, BDMG is linked to the Secretariat for Development of Minas Gerais as for its administration. 60% of its resources is provided by Minas Gerais State and by its own cash flow; the other 40% are resources from BNDES. Its main responsibilities are to support private industrial investments, public infrastructure and rural activities in behalf of state social and economic development.

BDMG has always supported local development and private investments. As Table 3.1 shows, in 2003 BDMG assisted 4691 clients, approving loan operations for a total of

US \$230 million and generating 11.700 jobs. Within these loans, transport materials and auto-parts industry are the items with the highest figures, totaling more than US \$71 million (BDMG, 2003). However, even though operations approved were 192, the clients served were only 22 and this means that probably there were opportunities only for large firms.

Table 3.1: Basic data BDMG – 2003

Number of clients	4,691
Approved operations	US\$ 230 million
Liberate resources	US\$ 203 million
Total investments	US\$ 234 million
Employment generated	11,700

Source: BDMG, 2003 Annual report

In addition to this, through BDMG the State government offers a lot of public programs aimed at boosting economic development. These programs will be presented later in the study, but it is important to point out how some of them are specifically designed for SMEs (such as “The competitive company in Minas Gerais”, “Estrada Real”, “Jaiba fund”, or “Technological Base”). Other programs have as target both SMEs and large companies. This is the case of Fundiest, PROIM, PRO-Industria and BNDES export program.

### 3.3 Universities

Minas Gerais has 16 Universities and is the state with the highest concentration of federal universities in Brazil. These institutions offer almost 650 different degree programs and in 2001 more than 145,000 new students enrolled there. Unfortunately, quite all universities were closed when we carried out the interviews, therefore all the information given here has been provided by opinion asked to other institutional actors interviewed.

The most important university is certainly the Federal University of Minas Gerais (UFMG – Universidade Federal de Minas Gerais), which accounted for 72% of the published papers and for 12% of the total patents registered in the State over the period 1990-2000. However, most of these patents were related to medical or biological issues, while only 10% of them regarded engineering topics or related subjects. Despite of this, the engineering department of UFMG sometimes cooperates with the vehicles and auto-parts industry with regard to research and flows of students sent to the companies to attend internship programs.

UFMG has been recently involved in a project for the creation of a “Technological Park” in Belo Horizonte, a project promoted by the Science and Technology Council, which also includes the participation of IEL, FIEMG and Sebrae. The university is in charge for the Park development executive committee and gave the location area for the pilot project. The “Technological Park” aims at strengthening the relations between the University and partner industries. The university usually produces knowledge and does not develop technology, but thanks to the creation of the Park these relations could be transformed by exploiting the proximity of university to industries, located in the same area, in order to produce R&D for technology development.

The Catholic University of Minas Gerais (PUCMG – Pontifícia Universidade Católica de Minas Gerais) is another important institution that offers an engineering course in its Betim campus. The offer of this kind of education has been clearly influenced by the local presence of Fiat. It has to be said that many Fiat engineers studied there.

### *3.4 The National Service of Industrial Learning (SENAI)*

SENAI (Serviço Nacional de Aprendizagem Industrial) is one of the most important vocational training service companies in Brazil. It belongs to the national confederation of industry (CNI - Confederação Nacional da Indústria) and it is part of the local Federation of Industries (FIEMG). Its financial resources partly derive from mandatory contributions paid by all firms (1% of their total sales) and partly from the revenues earned through the courses offered. This institution has a good reputation of financial solidity in the country. In Minas Gerais, SENAI has more than 40 centers; we visited one of them, drawing from this visit very useful information about the organization of the institution.

SENAI centers usually offer three types of services. The first is a group of vocational training courses, which can be classified in planned programs (fixed and paid by participants) or special programs purpose-designed to meet the requests of a particular firm. The second type of service is the use of labs that firms can have access to when they cannot run particular activities into their own plants. The third type of activity is a sort of consultancy service, provided mainly in the fields of technological evolution, environment and design.

With regard to its relation with auto-parts industry, SENAI has been deeply involved in the organization of taylor-made courses for Fiat's suppliers and is now involved in a program named "Cooperation network on metal-mechanics", which includes public authorities, firms and business associations as well as other supporting institutions. Partnership seems to be a very widespread concept, since SENAI collaborates with some universities (PUC and UFMG above all), but also with other similar institutions in other Latin-American countries (mainly in Mercosur countries).

### *3.5 CETEC*

CETEC (Centro Tecnológico) is a public technology foundation founded in 1972. Its history is not different from that of many other institutions in the region: it was founded after an important policy arrangement in order to foster regional development, and according to the arrangement it was in charge for technological development. 600 researchers began to work in this center and because of the particular economy which had always characterized the State, its research was originally focused on mining and metallurgy industries.

CETEC's importance has decreased over years. Now it aggregates 54 labs, whose estimated value is around US\$ 70 million and there are about 120 researchers working for it. Its main activity is applied technological research, mainly focused on the following areas: minerals, metallurgy, food, environment, metrology. The governance of the center is connected to the Science and Technology Council, and the State provides for about 60% of the entire budget. The remaining 40% is drawn from service provision to private firms, which total almost US\$ 2 million per year, with an average of

400 new customers served every year. Sales are very concentrated as almost 10 clients total US\$ 1 million of the total services sales. CETEC's most important clients are Fiat, CVRD (mining), Cemig (Energy), Copasa (sanitation), Acesita (steel). Some of the centre research projects are funded by federal research funding institutes (Finep and CNPq) and Fapemig.

CETEC also provides a consultancy service for industrial projects and new inventions. However, there are few examples of technological development carried forward together with the leading companies of the region. According to Campolina and Lemos (1996) "a major difficulty is its inability to establish partnership with business enterprises that results in excess capacity of the laboratories".

As for its relations with vehicles and auto-parts companies, the interviews clarified the important role CETEC played when Fiat started its business in Minas Gerais. The center was in charge as Fiat's State advisor for technological issues. Then, in 1979 CETEC developed an automotive technology program, through which it was carried out the construction of the "Engine Test Lab" funded by Fiat and specialized in vehicles security inspection, engine tests, fuel and oil tests, and gas emission tests. Vehicles assemblers usually use this Lab, but because of its location Fiat is its most important client. The Lab, however, is not aimed at resolving the problems found on vehicles: specialized engineers carry out tests and send results direct to Fiat engineering department to make them be analyzed by Fiat engineers. In this way, it does not seem that the Lab provides for a significant partnership in the problem solving process between CETEC and Fiat. Finally, Fiat suppliers rarely ask to CETEC for technology consultancies.

CETEC's relations with other institutions are mainly informal. It has relations with SEBRAE due to ProgEx, while there is no direct relation with local Universities, except for some research cooperation agreements and some CETEC's researchers who teach in local universities.

CETEC also acts as the government arm with regard to some of its technology policies, as it controls the Science and Technology Council. One of the most recent support programs to firms is ProgEx, a national program promoted by CETEC on behalf of Minas Gerais government, whose aim is to help SMEs to upgrade their products in order to meet international standards and become competitive on the international market. However, no report is now available about the results of this program.

### *3.6 SEBRAE*

SEBRAE (Serviço Brasileiro de Apoio às Micro E Pequenas Empresas) is a national institution which provides support service to small and medium firms. It has local offices in each Brazilian state. SEBRAE-MG is a private institution focused on the development of micro and small enterprises. Its main task is to provide entrepreneurs with knowledge and skills mainly related to management issues. It promotes several events in order to make suppliers meet customers and viceversa, and to foster new business opportunities, partnerships and product or technology exchange. Furthermore, SEBRAE provides a consultancy service on management, finance, costs, production techniques etc.

SEBRAE MG governance is characterized by a close network of relations with other institutions. In fact, its board is composed of representatives of the MG development council, FIEMG, CETEC, some Universities, etc. Moreover, SEBRAE is financially supported by a mandatory percentage (it varies between 0.3% and 0.6%) that all firms have to pay according to their payroll.

In terms of technology spillovers, SEBRAE has developed a special program to make micro and small firms acquire new technologies. The program is called Sebraetec. It is a consultancy program which aims at spreading to the micro and small firms the technology and knowledge already developed in research centers. This program can cover up to the 70% of the costs for the technology consultancies for which a firm contracted one of the accredited institutions. Some of them are CETEC, Senac, SENAI, UFMG and many other universities. Over the period 2002-2004, the program registered 700 projects regarding 7,643 clients and raised an amount of US\$ 2.5 million. Sebraetec is a very interesting program that can help to build relations between firms and universities/research centers. SEBRAE acts only as a bridge between the research carried out inside university and entrepreneurs, turning the inventions made by universities into commercial opportunities. For example, SEBRAE signed an agreement with UFMG in order to promote university inventions to small and medium businessmen, with the aim of creating new business opportunities.

SEBRAE helps small and micro firms in improving their products also thanks to its metrology program, which allows firms to access labs specialized in metrology. It also provides them with financial support.

Another SEBRAE's interesting program is its incubator program. This aims at promoting the development of technological incubators in Minas Gerais State. Funds allocated to this program are increasing, from US\$ 300,000 in 2003 to US\$ 500,000 in 2004.

### *3.7 Sindipeças*

There are many business associations in Minas Gerais. Sindipeças is certainly the most interesting to this study as it aggregates 95% of auto-parts Brazilian companies. This business association is part of FIEMG, which in its turn aggregates all Minas Gerais business industry associations. Sindipeças central office is located in São Paulo but it also has a local office in Belo Horizonte.

Its main association activities are:

1. signing international technological cooperation agreements with other similar associations;
2. organizing training courses;
3. organizing seminars and workshops;
4. participating in negotiations of international trade agreements related to the industry;
5. preparing an annual statistics book, carrying out further studies and market analysis;
6. providing legal assistance and other forms of consultancy to its associates.

Its office in Minas Gerais is almost new and works in close connection with its central office in São Paulo. It does not perform any special activity at a local level and some of the associated companies have more relations with its central office in São Paulo.

### *3.8 Other Institutions*

This paragraph contains a brief review of some other institutions that do not play a very important role with regard to auto-vehicles and auto-parts industries in Minas Gerais. This helps to understand better the many resources of Minas Gerais institutional framework.

IEL (Institute Euvaldo Lodi) was founded in 1969 and is a national institute connected to CNI and FIEMG. Its mission is “to promote industrial development by means of business capacity building programs and support to technological research and innovation”. It has been founded according to the innovative and widespread concept that partnership between universities and industry is the key to sustain economic development. In the IEL office based in Minas Gerais, 8 researchers work to study and analyze different economic sectors. This institute is now working on the development of some local production arrangements (49 arrangements in total).

The model followed by IEL is closely related to that of the Regional Innovation System introduced in the background paper. In fact, the fundamental concept implied by the model is that the cluster should be governed by a committee in which many different actors should be represented, such as federal, state and municipal institutions working on behalf of the government, universities and other technical training centers, research centers, business associations, financial institutions and, of course, private firms. With regard to IEL’s relations with Fiat, this company asked IEL to work in order to facilitate its relations with universities, research institutes and other companies as it can increase its R&D and improve its products’ development in Brazil. In particular, this was the case occurred in 2002, when Fiat invested money in the creation of 4 new labs in Brazil (optics, acoustics, electromagnetics and electronics). The greatest problems to be faced in this kind of relations are due to confidentiality, intellectual property of joint actions’ results and researchers’ salary.

FAPEMIG (Fundação de Amparo à Pesquisa do Estado de Minas Gerais) was founded in 1986 and is a research funding agency. It was set up to fund basic and applied research in institutes and universities, and to promote joint efforts of institutions and enterprises as to develop technology further (Campolina Diniz and Lemos, 1996). The foundation is funded by a fixed ratio of the state’s budget and is a state institution controlled by Science and Technology Council.

Just to give an idea of its importance, FAPEMIG was in charge for financial support to 1,113 research papers published in 1999, which accounted for the 77,5% of the total scientific literature produced in that year (Albuquerque, 2001). The new challenge that FAPEMIG has now to face is to stimulate scientific production in new and more advanced fields, not only related to the traditional research fields in MG (like mining and metallurgy).

The João Pinheiro foundation (FJP), established in 1969, is a socio-economic research center and a statistical institute for the processing of state social and economic data. During 1970s, FJP had “an active role in Minas Gerais’ economic planning. After a long period of crisis in 1980s it has focused on supply of basic statistics and on training of

civil servants as a “government school”. His area on Planning never recovered” (Campolina Diniz and Lemos, 1996).



## 4. Fiat's experience in Minas Gerais

### 4.1 Establishment and success of Fiat in Minas Gerais

Minas Gerais' economy has always been characterized by the predominance of low-tech scale-intensive sectors such as mining and metallurgy. During the '70s, these sectors accounted for almost the 60% of total added value and they still are very important. In 2001, Minas Gerais produced the 57.5% (15,792 thousand tons) of Brazil pig iron, and the 38% (9,765 thousand tons) of rolled steel.

After Fiat had built its plants in 1976, the added value produced by automobile industry increased from 1.2% to 6.7%. By the end of the '80s and during the '90s, thanks to the local government policy aimed at attracting auto-parts companies in the region, the added value of the industry rose to 12.1%.

Fiat established its operation in Betim, a municipality located about 30 minutes from Belo Horizonte. Its choice had no relation with market needs or with a local automotive tradition (as it was pointed out above, Minas Gerais economic expertise was mining and metallurgy); in fact, São Paulo had been the traditional center of car manufacturing since 1950s. However, Minas Gerais strategic position, in the middle of Brazil, on the routes leading to the North and to Rio de Janeiro, and not too far from São Paulo, increased its attractiveness as a location to Fiat's plants.

The reason why Fiat decided to establish its operation there can be fully explained when taking into account the role played by local institutions; in particular, it has to be analyzed the role played by the Government that provided Fiat with a huge package of fiscal incentives, credit, land and infrastructure. Besides this, the State itself became a Fiat Company partner, owning a share of 46% in Fiat capital (Lemos, 2000) until 1988.

Fiat's success over the years can be seen in the figures in Table 5, which show the company's aggregate production from 1976 to 2003.

Table 4.1 – Fiat production, 1976-2002

Year	Cars	Commercial vehicles	Trucks	Total
1976	8,350	nc	nc	<b>8,350</b>
1980	145,199	15,018	nc	<b>160,217</b>
1985	114,370	36,611	nc	<b>150,981</b>
1990	162,577	61,091	nc	<b>223,668</b>
1995	396,517	67,152	nc	<b>463,669</b>
2000	362,419	71,274	88	<b>433,781</b>
2003	309,520	48,446	240	<b>358,206</b>

Source: ANFAVEA (2003)

From 1976 levels, when Fiat produced about 8000 cars in a year, in 2003 the company reached a production of more than 300,000 cars. The agreement of the "Sector Chamber", signed in 1992 by the government and vehicles assembly companies, spurred Fiat on the national market. The key point of the agreement was the tax reduction for the so-called "popular car" (engine up to 1000cc). In 1994, Fiat reached a share close to 29% in the light vehicles market and was ranked second, coming after Volkswagen, the market leader, which had a share of 33.3%. Fiat's "popular" car was

the second most sold car that year. In 2003, Fiat produced 309,520 cars in Betim, a figure equivalent to a bit more than 20% of total motor vehicles of Brazil. Fiat is now Brazil market leader and employs 7,800 people locally while the whole sector is estimated to employ almost 16,300 people in the region (Fiat interview).

With regard to one of the issues discussed above, i.e. the effective level of technology transfers to local affiliates, usually large MNEs like Fiat are accused for not to transfer the relevant knowledge outside their headquarters. However, when Fiat's case is compared to other automotive companies in Brazil, it is possible to say that the Italian manufacturer is (with GM) the company which carries out the most decentralized strategy with regard to its relation with its parent firm. This can be easily explained as its Brazilian plant is the biggest after Fiat Italia. Before the macroeconomic liberalization program carried out in the '90s, Fiat had about 400 peoples working in its engineering department. During the '90s, the number of people working there fell to no more than 100 (Lemos, 2000). However, after changes have been made to the macro policy, incentives to companies like Fiat and GM are growing again and both Fiat and GM are now investing in local engineering in order to carry out more than the simple traditional "tropicalization". Since 2001, the Fiat engineering team in Brazil has joined the Italian engineering team in order to work together on co-design, to carry on market research and to build project vehicles for local markets (Quadro & Consoni, 2004 and Fiat interview). Nowadays, the Brazilian engineering office has increased to 200 people, who are working on the stylization of some new models for the local market and have already worked on the development of the Palio platform.

Finally, an important issue to be mentioned is Fiat's contribution to local innovation. According to Campolina and Lemos (1996), its contribution to R&D investment was \$186.2 million in 1996, equivalent to the 66.8% of the total private business expenditure in R&D under the special federal program 8861. Moreover, Table 4.2 reports the main *demandeur* of patents in Minas Gerais over the period 1988-1996.

As the Table shows, between 1988-96 Fiat registered 33 patents and is ranked sixth on the list of the twenty biggest patent demanders in Minas Gerais. On the top of the list, the other five companies listed belong to the mining-metallurgic sector. Vehicles and auto-parts companies have asked for 60 patents in Minas Gerais, almost the 5% of the total number of patents demanded in the State. It is interesting to observe how Fiat registered 10 out of the 14 patent related to industrial design. This information confirms that in automotive industry design is certainly a field in which there is much room for local innovation.

Table 4.2 – Patent registered by firms according to their ownership, 1988-1996

Firm	Ownership	DI	MI	M U	PI	TOTAL	%
Usiminas	FOP	0	0	11	117	128	10.14
Cia Vale Rio Doce	STA	0	0	33	59	92	7.29
Alcoa	FOR	0	48	11	17	76	6.02
Mendes Jr Sid.	DOM	0	0	9	66	75	5.94
Açominas	FOP	0	0	18	26	44	3.49
<b>Fiat Automóveis</b>	<b>FOR</b>	<b>10</b>	<b>16</b>	<b>3</b>	<b>4</b>	<b>33</b>	<b>2.61</b>
Odous Indl Coml Ltda	DOM	0	10	18	0	28	2.22
Acesita	FOP	0	0	11	12	23	1.51
Muller Plásticos e Metais	DOM	0	6	12	1	19	1.27
Hammer Ind Autopeças	DOM	0	7	5	4	16	1.11
Vibração Pronta Entrega Roupas	DOM	0	14	0	0	14	1.03
Belgo-Mineira	DOM	0	0	5	8	13	1.03
Itatiaia Móveis	DOM	2	9	2	0	12	0.95
Tacom Ltda	DOM	0	0	7	5	12	0.87
Copasa (saneamento)	STA	1	0	4	6	11	0.63
Protec eletromec	DOM	0	0	2	6	8	0.63
Telemig	STA	0	4	2	2	8	0.55
Dacoralita ind com	DOM	0	4	1	2	7	0.55
Enduro ind com	DOM	1	0	0	6	7	0.55
Fanape fáb nac perfumes	DOM	0	7	0	0	7	0.55
Nansen	DOM	0	1	1	5	7	0.55
Ritz do Brasil	DOM	0	0	4	3	7	0.55
Mendes Jr Sid.	DOM	0	0	3	4	7	0.55
Subtotal		<b>14</b>	<b>250</b>	<b>162</b>	<b>353</b>	<b>655</b>	<b>51.90</b>
<b>Total do Estado</b>		<b>28</b>	<b>125</b>	<b>397</b>	<b>587</b>	<b>1,262</b>	<b>100</b>
<i>DOM – Majority Nacional</i>		<i>DI – Industrial design patent</i>					
<i>FOP – minority participation of foreign capital</i>		<i>MI – Industrial model patent</i>					
<i>FOR – Majority participation of foreign capital</i>		<i>MU – Utility model patent</i>					
<i>STA – State owned enterprises</i>		<i>PI - Inventino patent</i>					

Source: Base de Dados INPI e RAIZ

#### 4.2 The mineirização program and the formation of a suppliers' clusters

When Fiat started its production in Betim, it began producing complete vehicles, like any other automotive assembly plant; it used to buy a number of components from suppliers mainly located in São Paulo and to control the complete assembly process. Only 15 suppliers were located near Fiat. During the 70s, as it was pointed out above, the macroeconomic and incentives policy was oriented towards production internalization on national territory; this is why Fiat imports were not very consistent.

Things changed in 1989, when Fiat launched its “total quality program”, which involved new decision processes (less centralization) and an “integrated logistics of material flows, production and commercialization planning”. The aim of the company was to set up “just in time” and “zero inventories” systems. In 1992 Fiat was the first assembly company in Brazil to introduce these concepts on production systems (Neves, 1999). The final goal was to promote competitiveness and increase its national market share.

There were two very important things that affected the success of this new strategy: a good and close relation with its suppliers and the attraction of key suppliers close to its facilities in Betim. This was because Fiat strategy aimed at transferring some of the car production stages to some key suppliers, in order to create a “modular sourcing” system. This could reduce inventories and the number of suppliers to deal with as well as increase Fiat production flexibility.

The mineirização program has been the core of this new strategy, which later helped to increase the number of suppliers located near Fiat and also their quality. This program was developed by Fiat together with some public institutions (like INDI) and with the government support.

An important element that characterized the mineirização program is the fact that Fiat spurred its international providers to build their plants near its own ones in order to provide modular systems according to a just-in-time deliver. In some cases, Fiat provided technical and managerial support to companies which decided to establish there, while to others it even gave financial support. These elements help to explain the great flows of FDI to the region. “One of the reasons to the raise of the participation of MNEs was the priority given by Fiat to global providers that stimulate the suppliers that belongs to Fiat Group to locate in to the region” (Carneiro, Toyshima and Barreto, 2000). However, also new vehicles assemblers that established their operations in the State, as it was mentioned before, played an important role in the attraction of auto-parts producers to Minas Gerais.

The role played by public authorities was also important to the success of the mineirização program. In particular, the development of two programs helped the process: the Fundo Fiat program and the Federal Program for industrial and technological development, which reduced income tax for R&D expenditures. The Fundo Fiat program was developed thanks to a tax credit Fiat could benefit from: this credit was assigned by the State to BDMG in order to finance the mineirização program. At the beginning money was provided by Fiat, and this is the reason why return payments go back straight to the Company. The Development Bank provided funds for investments to those companies interested in building their plants in Minas Gerais State, but Fiat had the right to decide which company should have been funded by the Fundo Fiat as this company provided the necessary financial resources. However, BDMG was in charge to analyze the payment capacity of each company.

Over the years, the mineirização program attracted auto-parts companies that now account for more than the 70% of total Fiat purchases. According to the group officers interviewed, today Fiat has 223 suppliers in Brazil, 82 of them are located in Minas Gerais and 40 located within a 10Km radius from Betim. Some of them built their plants between Great Belo Horizonte and Great SP, supplying both markets. Others are located close new car factories in Minas Gerais (Mercedes and Volkswagen), or between Great BH and Rio de Janeiro.

Mineirização was certainly a very important process for Fiat competitiveness as it helped the company to reach an important place within the Brazilian automotive industry. It made possible to Fiat to decrease its production costs and to introduce new and more efficient production processes. By using modular sourcing systems the company has been able to expand its car production without the need of increasing its

production facilities. Similarly, after the mineirização and the internationalization processes of the '90s, thanks to which many foreign companies came into the region, modular sourcing systems also gave as result industry technological up-grading and modernization, and spread of innovation.

However, this modernization was not driven by technology transfers to Brazilian companies, but rather by new investments and by global sourcing companies establishing in the region from abroad. These companies either bought Brazilian auto-parts companies or invested in new facilities near Fiat, therefore replacing other suppliers located in São Paulo. In any case, for Minas Gerais State the mineirização process was very important in terms of job creation, State economy diversification and fiscal revenues.

#### *4.3 The relation between Fiat and its suppliers*

The relation between Fiat and its providers can be classified in different ways. These relations depend on the kind of product or system companies provide, which also says whether one supplier must have its facilities (or some production stage) close to Fiat:

- Modular sourcing system suppliers usually should be close to Fiat (or 100 km maximum) in order to deliver the product “just in time” or to lower inventories.
- Other modular systems suppliers or those who are responsible for one stage of the assembly process on the Fiat assembly line (like plastic glue) have their production structure or provide some kind of assistance inside Fiat facilities, supplying their services on a so-called “shopping center” system.
- Some suppliers are not close to Fiat and supply their products from other States like São Paulo. Usually these companies produce large scale components (like glass) or have other important clients in others geographic areas where vehicle assembly companies are based.
- A few companies that work according to the modular sourcing system were born first inside Fiat and later became an independent company. Even their executives came from Fiat sometimes. Some of them have Fiat as their exclusive client (9 of the suppliers considered in our research sell between 75-100% of their production to Fiat) but most of them have others clients.
- Others work as so-called “contra-trabalho”. These companies sell to Fiat only services: Fiat buys raw-materials to give them to have them processed and then delivered, paying just for the service.

According to the managers interviewed, relations between Fiat and its suppliers are driven according to a kind of “intention agreement”. For example, when Fiat works on a project for a new vehicle, it may ask its suppliers to design a component, after it has fixed its quality and price. The provider uses its own technology and specific knowledge to develop and build the component, but it also discuss its details with Fiat. In other cases, Fiat just asks its supplier to produce some kind of existing components: providers can negotiate prices only if they are open to discuss their costs, as they are forced by Fiat to lower their own prices, but to raise production quality every year.

Moreover, Fiat’s orders or agreement are not guaranteed as they usually are not formal agreements. However, when Fiat cannot find any other supplier for a special component or wants to have one particular provider, it helps its supplier when it is in difficulties,

providing it with quality guarantee or funding (this is more unusual). During the years in which the “mineirização” was applied, Fiat and local institutions worked together to help local suppliers to develop themselves and to attract foreign ones as to make the former solve their problems and to increase product quality together with Fiat global competitiveness.

Finally, Fiat’s managers explained the system the company has developed to check and improve the quality of its suppliers. This system works according to several different indicators. If any problem about the quality of a component arises, Fiat asks its supplier to start a quality program to solve the problem. Therefore, the supplier has to examine the quality of its products and investigate the cause of the fault and whether the problem derives from its own supply system. If this is the case, it has the responsibility to solve the problem. When the problem persists, Fiat starts its own quality program on the component and tries to solve it collaborating with the supplier. In most cases, suppliers are charged for guaranteeing quality controls backward along the chain (information derived from interviews). This is an extremely important feature of the relation between Fiat and its suppliers, at least at a potential level. It can increase the possibilities of knowledge transfers between Fiat and its suppliers and between first tier and second tier suppliers. Research results contained in the next sections will clarify whether this potential has been exploited by local firms in the last years.

## 5. Research results

The aim of this section is to illustrate the main results obtained by interviews to Fiat's suppliers. Fiat managers contributed to the research by providing a list of 36 first tier suppliers and sending them a presentation e-mail in order to avoid difficulty in data collection. INDI and first tier suppliers contributed on their turn to provide a list of second tier suppliers. 67 firms were contacted, 28 belonging to the first tier, 35 to the second tier and 4 to both first and second tiers. 33 firms accepted to answer the questionnaire, but unfortunately 3 of them have not been of use to the research because of incompleteness in their answer. Therefore, the final sample is made up by 30 firms.

### 5.1 Features of the sample

Table 5.1 shows the firms classified according to the source of their capital.

Table 5.1: Source of capital

<b>National</b>	<b>12</b>
of which national share >75%	12
<b>Foreign Owned</b>	<b>18</b>
of which foreign share >75%	17
of which 75%> foreign share >50%	1
<b>Total</b>	<b>30</b>

Source: interviews

In the sample considered there are 12 domestic firms and 18 foreign firms. This quite well reflects the present situation of the industry in Brazil where, as it was explained in section 1, MNEs almost dominate. Another important information that can be drawn from the table is that only in 1 case the foreign share of capital is less than 75% (indeed in most of the cases it is 100%). This means that the "joint-venture" model is not certainly among the most used entry mode to this market; foreign investors do prefer to keep a high control on their assets, probably due to the necessity to retain some specific knowledge or advantage at managerial level or also because of the gap some potential partners may suffer in terms of technology or skills.

As for the type of product provided, Fiat classifies its suppliers according to three main categories, namely providers of metal, chemical and electric products. As Table 5.2 shows, in the sample there are 17 providers supplying metal products, 4 supplying chemical and 9 for electric products.

Table 5.2: Products provided

	Total	Foreign	National
Metal	17	8	9
Chemical	4	2	2
Electric	9	8	1
Total	30	18	12

Source: interviews

It is worth noting that when considering metal and chemical products supply, the presence of foreign companies is almost equivalent to that of domestic firms. Foreign companies are instead the main suppliers of electric products (this reflects the proportions contained in the list provided by Fiat).

Another important feature is the location of the firms. As it is shown in Table 5.3, firms are mainly concentrated in Betim, followed by Contagem, Sete Lagoas and Mateus Leme, towns very near to Betim (within 30 minutes).

Table 5.3: Location

	Total	Foreign	National
Betim	12	7	5
Contagem	4	3	1
Sete Lagoas	3	1	2
Mateus leme	3	2	1
Other	8	5	3
Total	30	18	12

Source: interviews

The last feature to be analyzed is the size of the firms considered in the sample and this can be derived from their number of employees. As Table 5.4 clearly shows, the majority of the companies included in our sample are medium-sized firms. In 2003, in fact, 18 firms counted less than 500 employees. The sample also includes large firms (12), which is not surprising when the scale-intensive nature typical of world auto-parts industry is considered.

Table 5.4: Size of firms

	Total	Foreign	National
<100	2	0	2
100-200	9	7	2
200-300	2	2	0
300-400	2	1	1
400-500	3	1	2
>500	12	7	5
Total	30	18	12

Source: interviews

## 5.2 The MNEs

As many firms of the sample are MNEs, it is also interesting to analyze some of their features before analyzing other issues.

The first feature that needs to be considered is MNEs' home country. Table 5.2 shows the results of our research and makes clear how it is important to bear in mind that this study focuses on an important Italian MNE. In fact, 10 firms out of 18 are Italian, while the others are from US, Japan, Germany and Luxembourg.

Table 5.5: Origin of foreign firms

Germany	1
US	4
Italy	10
Japan	2
Luxembourg	1
<b>Total</b>	<b>18</b>

Source: interviews



A second important feature is the reason that led MNEs to locate their operations in Minas Gerais. Again, the subject of this study, i.e. Fiat suppliers, and the attention given to them are confirmed by the answers given by the companies of the sample: 83.3% of the firms stated they decided to establish their business in Minas Gerais in order to follow an important customer that had previously invested in that area. The fact that 50% of the firms come from Italy confirms the importance of the minerizacao program, which has helped the development the whole Minas Gerais auto-parts industry. This process has been also called “follow – the client”

Table 5.6: Reason for locating in MG

	Region	Country
Natural resources presence	11.1%	5.6%
Cheap labor force presence	16.7%	5.6%
New market opportunities	11.1%	22.2%
Following an important customer that previously invested in the area	83.3%	61.1%

Source: interviews

A third interesting feature is MNEs entry mode. According to the interviews, half of the firms undertook a Greenfield investment, while 7 acquired pre-existing private firms and only two of them chose the joint-venture model.

A fourth element that has to be considered is the dimension of the parent group. Firms were asked to answer both in how many countries their group operates and how many subsidiaries the parent group owns. The answers clearly confirm the hypothesis that most of the foreign firms of the sample belong to larger groups: in the 50% of the cases the parent group operates in more than 10 countries with more than 10 subsidiaries, as it is shown in Table 5.7.

Table 5.7: groups size

<b>7. How many subsidiaries has your parent firm?</b>	
1. Only this one	27.8%
2. 2-5	11.1%
3. 5-10	5.6%
4. >10	50.0%
5. Unknown	5.6%
Total	100.0%
<b>8. In how many countries does your group operate?</b>	
1. Only here and in the headquarters country	5.6%
2. 3-5	22.2%
3. 5-10	22.2%
4. >10	50.0%
5. Unknown	0.0%
Total	100.0%

Source: interviews

Finally, autonomy of the subsidiaries is another main issue to be considered. In order to check their level of autonomy, firms were asked to answer where the main decision makers centers were located compared to some key areas. Table 5.8 contains the results drawn from the answers: as it was expected, subsidiaries show a high level of autonomy about certain operations, such as input and service procurement, production planning

and relation with public institutions. It is interesting to note that they have a certain autonomy also with regard to product development (55.6% of the cases). In other fields however, it can be seen that it is the parent firm to act as decision making body. This is the case of new investments, R&D and innovation. Finally, strategic planning and executive personnel management present a somehow more heterogeneous scenario.

Table 5.8 Main makers location in certain key areas

	Within the company	Regional headquarters	Parent firm	Shared parent firm-company	Total
Input procurement	88.9%	5.6%	5.6%	0.0%	100.0%
R&D and innovation	22.2%	11.1%	44.4%	22.2%	100.0%
Marketing and advertising	55.6%	22.2%	22.2%	0.0%	100.0%
Product development	55.6%	11.1%	16.7%	16.7%	100.0%
Production processes planning	77.8%	11.1%	5.6%	5.6%	100.0%
Strategic planning	27.8%	16.7%	27.8%	27.8%	100.0%
New investment decisions	22.2%	5.6%	50.0%	22.2%	100.0%
Services procurement (consultancies, legal advises,...)	72.2%	11.1%	5.6%	11.1%	100.0%
Executive personnel management	38.9%	16.7%	33.3%	11.1%	100.0%
Relation with public institutions (authorities, universities, associations...)	72.2%	16.7%	5.6%	5.6%	100.0%

Source: interviews

### 5.3 Firms' performance

Firms' performance is always one of the most delicate subject to be analyzed. Companies are usually reserved about sensible data. Only 20 firms answered the question on the value of their sales over the years; nevertheless, it is possible to draw interesting conclusions from Table 5.9, which summarizes the results. The table shows the averages of the total sales for the firms that answered the question and the averages of the two sub-sample of domestic and foreign firms. The proportion of answers is the same of the entire sample (60% of foreign firms and 40% of domestic ones). The figures reported are weighted averages in which the weights are the share of the firm's single shares. These are calculated on the total sales of the firm according to its category (foreign or domestic) and for each year considered. The results show that the domestic firms of the sample grew more than foreign ones. Their average sales have increased to 25.8%, while foreign firms registered only a 19.3% increase. These results, however, might have been distorted by the presence of Usiminas among the domestic firms.

Table 5.9: Sales growth – weighted averages

	Total (20)	Foreign (12)	Domestic (8)
2001	23.2%	21.1%	26.3%
2002	22.7%	22.8%	22.6%
2003	19.8%	14.1%	28.4%
Average	21.9%	19.3%	25.8%

Source: interviews

Employment dynamics can provide other indications about firms' performance and is summarized in Table 5.10 together with the relevant weighted averages. In this case there were only two missing answers. It is interesting to note that over the years the situation has completely changed: in 2001, employment increased while in 2002 and

2003 it suffered a fall, which made firms be back to 2000 employment levels. Beyond the international market trend, this might be the effect of the restructuring processes firms undertook when it became evident that the sales and production forecasts made for the Brazilian car market during the second half of the '90s had been disappointed and could not be achieved.

Table 5.10: employment growth, weighted averages

	Total (28)	Foreign (17)	Domestic (11)
2001	1.3%	1.8%	0.9%
2002	-2.6%	-4.0%	-1.9%
2003	-0.7%	0.2%	-1.3%

Source: interviews

However, it is obvious that these figures cannot be considered completely exact as they can be subject to bias due to the presence of outliers and to possible distortions introduced by the number of firms which did not answer.

Therefore, it is necessary to find out other ways to measure their performance. In a more qualitative way, the firms were questioned about the acquisition of new customers and suppliers, which might be seen as a proxy for an increase in their economic activity. The answers to these questions are shown in Table 5.11.

Table 5.11: a proxy for the performance (and perceived relevance for the company)

<b>All sample</b>	<b>Yes</b>	<b>No</b>	<b>High</b>	<b>Low</b>	<b>Irrelevant</b>
New national customers were acquired	73.3%	26.7%	90.9%	9.1%	0.0%
New foreign customers were acquired	60.0%	40.0%	88.9%	11.1%	0.0%
New national suppliers were employed	83.3%	16.7%	84.0%	12.0%	4.0%
New foreign suppliers were employed	53.3%	43.3%	68.8%	18.8%	18.8%
<b>Domestic</b>	<b>Yes</b>	<b>No</b>	<b>High</b>	<b>Low</b>	<b>Irrelevant</b>
New national customers were acquired	83.3%	16.7%	100.0%	0.0%	0.0%
New foreign customers were acquired	75.0%	25.0%	88.9%	11.1%	0.0%
New national suppliers were employed	75.0%	25.0%	88.9%	11.1%	0.0%
New foreign suppliers were employed	33.3%	66.7%	75.0%	25.0%	25.0%
<b>Foreign</b>	<b>Yes</b>	<b>No</b>	<b>High</b>	<b>Low</b>	<b>Irrelevant</b>
New national customers were acquired	66.7%	33.3%	83.3%	16.7%	0.0%
New foreign customers were acquired	50.0%	50.0%	88.9%	11.1%	0.0%
New national suppliers were employed	88.9%	11.1%	81.3%	12.5%	6.3%
New foreign suppliers were employed	66.7%	27.8%	66.7%	16.7%	16.7%

Source: interviews

Answers given show a certain dynamics: 73% of the firms acquired new national customers and 90.9% of the companies regarded these acquisitions very important to the company. In particular, domestic firms were more active in acquiring new customers and this could explain the higher sales growth rate. It is worth noting that foreign firms show a greater inclination to employ new suppliers, which might lead to expand their production, but also to a greater turnover in the providers employed.

The share of local sales and purchases and the concentration of sales are other key aspects when analyzing firms' performance and therefore relevant to the purposes of this research. Table 5.12 reports the answers to the question about which geographical

areas sales they have as targets. The table clearly shows that exports are very limited (7.2%), and it is no surprise that, in this case, foreign firms registered a slightly higher share (9.2%). In general, we can say that the majority of the sales are within the State (60%). Here, again, foreign firms registered a higher percentage (63.4%), which is probably due to the fact that they located in Minas Gerais mainly to serve customers located in the same area, while national firms, which have a longer history, might have more customers in other Brazilian States. Foreign firms are more export-oriented than domestic firms and this happens because MNEs deal mainly in intermediate inputs within their group at an international level, producing not only intra-industry trade, but mainly intra-firm trade.

Table 5.12: Geographical areas targeted by sales (simple averages – cumulated values)

	Total	Foreign	Nationals
Local (within your city)	36.9%	38.2%	35.2%
Regional (within the State)	60.0%	63.4%	55.3%
National	92.8%	90.8%	95.6%
Abroad	7.2%	9.2%	4.4%

Source: interviews

Table 5.13 shows the shares of inputs according to their source. Again, the share of inputs import is very low, even though it is higher than exports'. Moreover, foreign firms still import a certain amount of inputs from abroad (18.7%). However, the nature of the data (simple averages) could hide problems related to possible outliers. The percentage of inputs purchased within the State is 55.6% for national enterprises and 42.8% for foreign ones. The values assumed for local inputs purchased by national firms are very strange and could be due to misunderstandings occurred during the interviews.

Table 5.13: Origin of inputs (simple averages – cumulated values)

	Total	Foreign	Nationals
Locally	10.8%	16.2%	2.8%
Regionally (within the State)	47.9%	42.8%	55.6%
Nationally	86.7%	81.3%	94.8%
Abroad	13.3%	18.7%	5.2%

Source: interviews

Finally, another key aspect of firms' performance is their level of dependence from customers. For this reason, firms were asked to answer which had been their sales share to their three most important customers out of their total amount of sales and which had been Fiat's share out of the total amount of sales. The answers reported in Table 5.14 show that Fiat is much more important to foreign firms (58.7% of average weight over total sales) than to national ones (39.7%).

Table 5.14: Level of dependence

%...	Total	Foreign	National
Of products and services sold to FIAT	50.9%	58.7%	39.7%
Of sales to the three most important customers over total sales	67.4%	67.5%	67.3%
Of purchases from the three most important suppliers over total inputs purchases	39.7%	38.5%	41.6%

Source: interviews

This might be explained by the fact that many foreign firms are Fiat's first tier suppliers, while in the case of national firms, many of them just supply Fiat's suppliers. However, a certain level of dependence seems to be the common trend, as it is shown by an impressive 67.4% of average weight registered by the three most important customers over the total amount of sales. Looking at input purchases, the average percentage of the three most important suppliers is 39.7%. In this case, national firms registered a higher percentage (41.6%) than that shown by foreign ones.

#### 5.4 Human Capital and innovation potential

The first interesting thing to consider is where the personnel employed by firms come from. Table 5.15 clearly shows how the majority of the people employed by the firms considered in the sample come from the town in which the firm is located. Surprisingly, this percentage is higher in foreign firms (54.1%), while national firms show a higher number of employees coming from other Brazilian States (15.3%). These results can be explained when we consider that domestic auto-parts firms often have their central office in São Paulo and many of their employees come from there. As it was expected, the percentage of foreign personnel is higher in foreign firms, but it is very low in absolute terms (0.6%).

Table 5.15: origin of personnel 1

	Total	Foreign	National
City	53.0%	54.1%	51.7%
Region	33.0%	33.2%	32.9%
Country	13.5%	12.1%	15.3%
Abroad	0.4%	0.6%	0.1%
Total	100.0%	100.0%	100.0%

Source: interviews

Table 5.16 enables us to see that in 10 out of 18 foreign enterprises, there is at least a small percentage of people who studied abroad; this percentage is much lower in national firms (20%). Moreover, in 13 out of 14 multinational companies employing foreign people, these come from the headquarters' country.

Table 5.16: origin of personnel 2

FOREIGN	0%	<10%
Your employees that studied abroad	8	10
Foreign employees	4	14
People coming from the headquarters	5	13
NATIONAL	0%	<10%
Your employees that studied abroad	10	2
Foreign employees	8	4

Source: interviews

Once understood the geographical origin of the personnel employed in the firms, it is also essential to assess the educational level of this workforce in order to assess the level of human capital. Table 5.17 shows the answers given with regard to this point: it can be clearly seen that national firms can benefit from higher levels of human capital than foreign firms can. Indeed, the percentage of graduates working in domestic firms is sensibly higher than foreign firms'. Moreover, in domestic firms there is a higher

number of employees who attended secondary school, while the percentage of people who received a technical education is almost the same in the two cases.

Table 5.17: Education level

	Total	National	Foreign
University	10.4%	11.9%	8.5%
Technical education	17.7%	18.0%	17.3%
Secondary (non technical) School	31.6%	36.5%	25.4%
Primary School or less	40.3%	33.5%	48.8%

Source: interviews

This data need to be handled with the usual care and we also have to accept a definition of human capital based on education, which might be questionable.

As for innovation potential, firms were asked to answer how many people were involved in R&D or more in general in innovation activities. In both cases the relative majority of the firms answered that more than 10 people are involved in this kind of activities. The number of domestic firms that answered to this question is slightly higher than foreign corporations number. However, by comparison, in a higher number of national firms there are no people specifically involved in innovation activities.

Table 5.18: People involved in R&D or innovation activities

	Total	Foreign	National
0	6.7%	5.6%	8.3%
1 a 5	23.3%	27.8%	16.7%
5 a 10	23.3%	22.2%	25.0%
>10	46.7%	44.4%	50.0%
Totale	100.0%	100.0%	100.0%

Source: interviews

The same situation might be the result of a great research vitality or of a decline in the innovative capability of the firm. For this reason, firms were also asked to answer which had been the dynamics in this field in the last 4 years.

Table 5.19: Dynamics of people involved in R&D or innovation activities

	Total	Foreign	National
Increased	60.0%	66.7%	50.0%
Remained the same	33.3%	27.8%	41.7%
Decreased	6.7%	5.6%	8.3%
Total	100.0%	100.0%	100.0%

Source: interviews

The results show how in foreign firms R&D and innovation dynamics development has been fairly more intense than in the national firms of the sample. However, this does not mean that there was no innovation process within national firms, as the following paragraph will confirm.

### 5.5 Innovation performance of domestic firms

As this study is focusing its attention on the effects of the interactions between domestic and foreign firms and between them and institutions, it appeared necessary to introduce

a specific section about innovation performance in domestic companies. This is to understand which could be the possible benefits national firms can derive in terms of productivity and innovation. These firms were asked about all the changes occurred in the last 4 years related to the many aspects that can suggest “innovation”. Moreover, for all the changes introduced by innovation, firms were asked to assess their importance with regard to productivity innovation.

Beginning with enterprise’s governance, in 8.3% of the cases new stakeholders entered or the legal form of the enterprise changed, but the firm in which this happened assessed it as highly important. However, in the 58.3% of the cases, the organization structure underwent a significant change and where it happened all the firms again regarded it as an highly important innovation.

Table 5.20.1 Governance innovations

	Yes	NO	High	Low	Irrelevant
New stakeholders entered or the legal form changed	8.3%	91.7%	100.0%	0.0%	0.0%
The organizational structure was significantly modified	58.3%	41.7%	100.0%	0.0%	0.0%

Source: interviews

Turning the attention on product innovations, we can see that 83.3% of the firms introduced new products on the national market, with an high impact in 80% of the cases; only the 58.3% introduced new products on international markets, but here there was a high impact in 100% of the cases. 91.7% of the firms stated they improved their old products in a significant way, but only 50% seem to have replaced them. 66.7% of the firms carried out significant up-upgrades of their packaging or their products design, but only 16.7% of the firms registered a patent.

Table 5.20.2 Product innovations

	Yes	NO	High	Low	Irrelevant
New products were introduced...					
...for the national market	83.3%	16.7%	80.0%	20.0%	0.0%
...for the international market	58.3%	41.7%	100.0%	0.0%	0.0%
Old products were significantly up-graded	91.7%	8.3%	90.9%	9.1%	0.0%
Design or packaging were significantly up-graded	66.7%	33.3%	75.0%	12.5%	12.5%
Obsolete products have been replaced	50.0%	50.0%	83.3%	16.7%	0.0%
Product variety has been enlarged	75.0%	25.0%	88.9%	0.0%	11.1%
A new patent has been registered	16.7%	83.3%	100.0%	0.0%	0.0%

Source: interviews

Turning to process innovations, which firms unanimously regard as very important, 91.7% of firms introduced new stages in their production process, and the same percentage was awarded international Standards certificates like ISO. 58.3% of the firms bought new machineries from MNEs, while 83.3% bought new equipments from national firms and 50% from abroad. Again, only 16.7% of firms registered a patent related to their production process.

Table 5.20.3 Process innovations

	Yes	NO	High	Low	Irrelevant
New stages were introduced in production processes	91.7%	8.3%	100.0%	0.0%	0.0%
Stages of production process were outsourced	33.3%	66.7%	75.0%	0.0%	25.0%
Introduction of International Standard certificates (like ISO)	91.7%	8.3%	100.0%	0.0%	0.0%

New machineries and equipment were bought...					
...from MNEs operating in the country	58.3%	41.7%	100.0%	0.0%	0.0%
...from a national firm	83.3%	16.7%	90.0%	10.0%	0.0%
...from abroad	50.0%	50.0%	100.0%	0.0%	0.0%
A new patent has been registered	16.7%	75.0%	100.0%	0.0%	0.0%

Source: interviews

When considering administrative and planning innovations, also regarded as very important by enterprises, it can be seen that all firms improved their administration procedures; 58.3% of the firms introduced new strategic planning instruments and financial planning skills were improved in 83.3% of the cases. 91.7% of the firms changed its inventory management system and improved fund raising ability. In 75% of the cases the ability to identify new targets was also increased.

Table 5.20.4 Administrative and planning innovations

	Yes	NO	High	Low	Irrelevant
Administrative procedures improved	100.0%	0.0%	91.7%	8.3%	0.0%
Ability to identify medium-long run targets increased	75.0%	25.0%	100.0%	0.0%	0.0%
New strategic planning instruments were introduced	58.3%	41.7%	100.0%	0.0%	0.0%
Financial planning skills improved	83.3%	16.7%	100.0%	0.0%	0.0%
Fund raising ability improved	66.7%	33.3%	87.5%	12.5%	0.0%
Inventory management changed	91.7%	8.3%	100.0%	0.0%	0.0%

Source: interviews

Acquisition of new available technologies is another important dimension of innovation. Basically, in all the cases, new computers were purchased and new software introduced: both are regarded as very important innovations to the company and 58.3% of the firms opened a website in the last 4 years.

Table 5.20.5 New technologies

	Yes	NO	High	Low	Irrelevant
New computers were purchased	91.7%	8.3%	100.0%	0.0%	0.0%
A new software has been introduced	83.3%	16.7%	90.0%	10.0%	0.0%
A website has been opened	58.3%	41.7%	85.7%	14.3%	0.0%

Source: interviews

Finally, even though it might not be strictly considered an innovation, the development of human resources can certainly be considered a key aspect to innovation performance. In this field, almost all the firms provided training to their employees (of all levels) and 83.3% of firms introduced programs for assessing personnel training needs. However, this last activity is the one which has been regarded in a different way compared to all the other activities mentioned, which firms have regarded almost all as highly important. 30% of the firms introduced training assessing programs, but the companies did not considering them very important.

Table 5.20.6 Human Resources

	Yes	NO	High	Low	Irrelevant
The operatives received training	91.7%	8.3%	100.0%	0.0%	0.0%
The administrative personnel received training	100.0%	0.0%	100.0%	0.0%	0.0%
The executives received training	91.7%	8.3%	90.9%	9.1%	0.0%
Personnel training needs were assessed	83.3%	16.7%	70.0%	30.0%	0.0%
Particular incentive schemes were introduced	75.0%	25.0%	100.0%	0.0%	0.0%



Working conditions improved	91.7%	8.3%	100.0%	0.0%	0.0%
-----------------------------	-------	------	--------	------	------

Source: interviews

In conclusion, we can notice a certain level of innovation performance in domestic firms if the concept of innovation adopted is the broad one explained in the background paper. Obviously, when this concept is restricted to the number of patent or technological inventions registered, the rate of innovation in this Fiat's domestic suppliers sample would turn to be very low.

Another important issue related to innovation performance and also connected to interactions between different actors regards the main sources of information used for innovation activities.

Table 5.21: Source of information relevant to innovation

<b>Internal</b>	High	Low	Irrelevant
R&D department	72.7%	9.1%	18.2%
Production area personnel	81.8%	9.1%	9.1%
Marketing and customer satisfaction area personnel	90.9%	9.1%	0.0%
<b>External</b>	High	Low	Irrelevant
Suppliers	72.7%	18.2%	9.1%
Customer	90.9%	9.1%	0.0%
Competitors	54.5%	18.2%	27.3%
Consultancy firms	54.5%	18.2%	27.3%
<b>Institutional</b>	High	Low	Irrelevant
Universities	18.2%	36.4%	45.5%
Research centres	27.3%	18.2%	54.5%
Technical schools	27.3%	18.2%	54.5%
Business Associations	18.2%	27.3%	54.5%
Public development institutions	18.2%	18.2%	63.6%
International organizations	18.2%	18.2%	63.6%
<b>Other</b>	High	Low	Irrelevant
Conferences	18.2%	54.5%	27.3%
Fairs & exhibitions	54.5%	27.3%	18.2%
Informal relations (Clubs, relatives,...)	27.3%	18.2%	54.5%
Internet	45.5%	27.3%	27.3%

Source: interviews

Among internal sources, the R&D department is regarded as highly important by 72.7% of firms and it is worth noting that it is even higher (81.8% and 90.9%, respectively) the percentage of firms that regard as very important other areas like production or customer satisfaction. Among external sources, 72.7% of firms considers its suppliers very important, while customers are considered highly important by the 90.9%. Competitors and consultancy firms seem to be less important, since 27.3% of the sample consider them irrelevant. When turning to institutional sources, figures change completely. The firms considered in the sample regard institutions as not very important as a source of information relevant to innovation. The percentage of firms which answered "irrelevant" ranges from 45.5% (universities) to 63.6% (public institutions

and international organizations). Among other sources, fairs exhibitions and internet are regarded as important source of information (their percentage of “high relevance” is respectively 54.5% and 45.5%).

### 5.6 Interactions between domestic and foreign firms and their effects

This is in a way the central point of our analysis. It is almost certain the existence of interactions between foreign and domestic firms as all domestic firms stated they have some kind of interaction with MNEs present in the area and all MNEs stated they have relations with domestic firms.

The second point that needs to be assessed is related to the frequency of these contacts. Among domestic firms, 66.7% of them said they have daily contacts with MNEs, while 25% has contacts with them once or twice a week. However, the 61.1% of foreign firms described their contacts with domestic firms as daily based, while the 22.2% said they come in contact with them once or twice a month. In any case, the conclusion that can be drawn from the answers given is that contacts are generally frequent.

As for the mode in which relations developed, personal contacts are without doubt the first channel of communication between firms, mentioned by the 91.7% of domestic firms and by the 77.8% of foreign firms. This channel is followed by business associations, whose share represents only the 16.7% of the answers given by domestic and the 38.9% given by foreign firms. This are interesting data because business associations can certainly be a channel foreign firms can exploit to come in contact with national ones. Fairs and new employees seem to be somehow important to national firms (8.3%) while foreign firms mentioned them according to a share of 33.3% and 22.2%, respectively. Institutional programs and advertising are simply regarded as irrelevant in the answers given by domestic firms and as of very limited importance in those given by foreign firms (11.1%).

Another important issue is what kind of contact has been established between firms. In its first column, Table 5.22 shows the answers given by domestic firms (this means that the rows must be read with reference to domestic firms): it can be clearly seen that domestic firms are mainly suppliers to foreign firms (94.4%). However, in the 55.6% of the cases MNEs have to face the competition of national firms and in the 50% of the cases they also act as their suppliers.

Table 5.22: Kind of contact between domestic and foreign firms

	Foreign firms' answers	National firms' answers
Customers	50.0%	100.0%
Suppliers	94.4%	75.0%
Competitors	55.6%	41.7%
Partner in joint-ventures	0.0%	16.7%
Partners in distribution network	0.0%	16.7%

Source: interviews

The answers given by national firms confirm that MNEs are mainly customers, but in this case 75% of the firms have also foreign firms among their suppliers and 41.7% faces MNEs competition.

As for the backward linkages established by MNEs, we asked foreign firms to specify which kind of activities domestic suppliers carry out for them in order to give a more detailed analysis. Table 5.23 shows how in all the cases domestic firms are components suppliers. However, domestic firms are also mentioned as suppliers of general services (88.2% of the cases), of specialized services (70.6%) of assembling services (64.7%) and even as responsible for distribution (only 29.4%). Moreover, we asked if there were any kind of subcontract agreement existing between firms and it is worth noting that general services is the form of supply which is more subject to subcontract (73.3% of the cases), followed by assembling and specialized services. Components supply is characterized by subcontract agreement only in 35.3% of the cases, which might indicate a certain turnover in the “suppliers park”, as also Table 5.11 suggests.

Table 5.23: kind of product or services supplied by national to foreign firms

	Yes	Subcontract?	
		Yes	No
Provision of inputs and part	100.0%	35.3%	64.7%
Provision of assembling or other production phases	64.7%	63.6%	36.4%
Provision of specialized services	70.6%	58.3%	41.7%
Commercialization/distribution	29.4%	40.0%	60.0%
Provision of general services (transport, cleaning...)	88.2%	73.3%	26.7%

Source: interviews

Now, when we investigate the backward linkages existing in many cases between MNEs and domestic firms, another issue that arises is the possibility of some kind of spillover effect due to these relations. Therefore, our questionnaire tried to understand this. Table 5.24 shows MNEs’ answers to which action they took towards their domestic suppliers.

Table 5.24: Actions undertaken by MNEs with their domestic suppliers and relevance for the company

	Yes	NO	High	Low	Irrelevant
Ask to increase product quality	100.0%	0.0%	100.0%	0.0%	0.0%
Visit to suppliers facilities	94.4%	5.6%	76.5%	23.5%	0.0%
Ask to adopt new production process technologies	83.3%	16.7%	100.0%	0.0%	0.0%
Ask to introduce new inventory management practices	72.2%	27.8%	84.6%	15.4%	0.0%
Ask to introduce new administrative practices	44.4%	55.6%	75.0%	25.0%	0.0%
Ask to increase the strategic planning capabilities	61.1%	38.9%	90.9%	9.1%	0.0%

Source: interviews

The first thing to point to out is the way in which all MNEs asked their suppliers to increase their product quality. In 94.4% of cases, MNEs visited their suppliers’ facilities in order to help this process of improvement, but 23.5% of the firms that carried out the visit regarded it as not very important. MNEs frequently asked to adopt new process technologies (83.3%), to introduce new inventory management practices (72.2%) or to increase strategic planning capabilities (61.1%). Suppliers were asked to introduce new administration practices only in the 44.4% of the cases. Therefore, it can be said that MNEs made a certain effort to help their suppliers to develop. How much these efforts have been efficacious it can be verified through the answers given by national

enterprises when they were questioned about the benefits they derived from their relations with multinational customers.

The question asked to domestic firms follows the pattern of possible spillover effects in terms of technology transfers due to backward linkages, a pattern created by UNCTAD in the World Investment Report 2001 (UNCTAD, 2001). Therefore, we asked the firms how in the last four years their linkages with multinational customers had helped them to deal with the many different aspects of technological up-grading. These have been classified into product technologies, process technologies, managerial know-how, human resources, information and financial support.

Starting with product technologies, in 91.7% of the cases, linkages with multinational customers helped the firms to introduce new products and to improve their quality (this confirms the answers given above by foreign firms). These two aspect have been regarded as very important by 90.9% of the firms.

Table 5.25.1 Product technologies up-grading

	Yes	No	High	Low	Irrelevant
Introduction of new products	91.7%	8.3%	90.9%	9.1%	0.0%
Improving quality	91.7%	8.3%	90.9%	9.1%	0.0%
Investing in R&D	50.0%	50.0%	83.3%	0.0%	16.7%

Source: interviews

However, only 50% of firms said that MNEs helped them in investing in R&D, even though 83.3% of those that answered “yes” regarded it as very important to the company.

Turning to process technologies, in 91.7% of the cases MNEs helped the introduction of new machinery and equipment and to monitor production planning and quality control. In all the cases, new production processes were developed with the help of MNEs and in the 83.3% of the cases domestic firms plants were visited by foreign customers.

Table 5.25.2 Process technologies up-grading

	Yes	No	High	Low	Irrelevant
Introducing new machinery and equipment	91.7%	8.3%	90.9%	9.1%	0.0%
Monitoring production planning, quality control and testing	91.7%	8.3%	100.0%	0.0%	0.0%
Improving layout, operations and quality through visits to reciprocal facilities	83.3%	16.7%	80.0%	10.0%	10.0%
Developing new production processes	100.0%	0.0%	83.3%	8.3%	8.3%

Source: interviews

As for managerial know-how, 91.3% of the firms were helped in improving their quality assurance systems, 66.7% in managing inventories and 58.3% in introducing new marketing or organizational practices.

Table 5.25.3 Managerial Know how up-grading

	Yes	No	High	Low	Irrelevant
Managing inventories	66.7%	33.3%	87.5%	0.0%	12.5%
Implementing quality assurance systems	91.7%	8.3%	100.0%	0.0%	0.0%
Introducing new marketing or organizational practices	58.3%	41.7%	85.7%	14.3%	0.0%

Source: interviews

Human resources is another important field in which MNEs seem to have helped domestic companies up-grading.

Table 5.25.4 Human resource up-grading

	Yes	No	High	Low	Irrelevant
Improving company's personnel skills	100.0%	0.0%	91.7%	0.0%	8.3%
Access for Your employees to MNEs internal training	66.7%	33.3%	75.0%	0.0%	25.0%
Hiring of employees previously employed by MNEs	50.0%	50.0%	83.3%	0.0%	16.7%

Source: interviews

In all the cases national firms personnel skills were improved with the help of foreign customers. In 66.7% of the cases employees coming from domestic firms were given access to internal training programs organized by their customers and in 50% of the cases employees previously employed in foreign firms were hired by national companies.

Furthermore, also information is a possible channel through which national firms can benefit from significant upgrading. In 91.7% of the cases, MNEs helped national companies to collect information about future orders, a very important aspect for production and financial planning. Moreover, in 66.7% of the cases the relations national firms had established with foreign customers helped them to obtain information about international markets; this is another essential element for strategic planning. Finally, in the 58.3% of the cases, representatives of national firms who were interviewed said MNEs provided them with information about international trends, which is necessary to maintain competitiveness.

Table 5.25.5 Information up-grading

	Yes	No	High	Low	Irrelevant
Collecting information about future business requirements	91.7%	8.3%	90.9%	9.1%	0.0%
International markets information provision	66.7%	33.3%	87.5%	12.5%	0.0%
International trends informations	58.3%	41.7%	100.0%	0.0%	0.0%

Source: interviews

Financial support is the last aspect to be examined. As it was expected, in this case the share of help coming from relations with foreign firms is lower than in the other fields already examined. Only in 41.7% of the cases, the relations helped to improve medium and long term financing and within those cases this help was not always delivered in a manner which could have an important impact on the company. However, in 66.7% of cases, the setting of minimum prices and above all prompt payments can be considered a little help to firms in order to improve their financial stability.

In conclusion, we can state that a certain level of technology transfers can be regarded as an interaction between foreign and local firms, carried out through backward linkages.

Table 5.25.6 Financial support

	Yes	No	High	Low	Irrelevant
Setting minimum pricing and quantities agreements practices	66.7%	33.3%	100.0%	0.0%	0.0%
Prompt payments	66.7%	33.3%	100.0%	0.0%	0.0%
Improving medium and long term financing	41.7%	58.3%	80.0%	20.0%	0.0%

Source: interviews

Other kind of relations that need to be assessed are the forward linkages established by MNEs with their domestic customers. First of all, it has to be analyzed which kind of supply MNEs provided to local domestic firms. Thanks to the answers given by national firms, it is possible to see that in all the cases foreign firms provide parts and components, even if in some cases they also provide specialized services or general services.

As usual in literature, there is limited information available about the way in which interactions with foreign suppliers affected national firms. However, in the 55% of the cases, intermediate products showed an increase in their quality. In the 44.4% of the cases, relations with foreign suppliers helped domestic firms to adopt new technologies and even though this can be regarded as a flimsy evidence, it also might indicate a certain level of technology transfer, also due to MNEs forward linkages.

Spillovers derived from competition (i.e. a competition effect) are certainly a stronger evidence of how interactions affected domestic firms. In fact, 73.3% of the firms mentioned the increase in internal efficiency as an effect of their interaction with competitors because of their need to face competition with foreign/domestic firms. It is worth noting that the percentage of foreign firms increasing their efficiency is considerably higher than domestic ones'. In the 60% of the cases a fall in prices was also mentioned as a competition effect. However, no domestic firms mentioned the exit of foreign competitors from the market as an effect, while 50% of foreign firms said domestic competitors left the market. Even though this also is likely to be a flimsy evidence, it could also be a sort of crowding out effect evidence.

Table 5.26 Competition effects

	Total		Foreign		National	
	Yes	High	Yes	High	Yes	High
Some of your competitors left the market	33.3%	80.0%	50.0%	80.0%	0.0%	
Decrease of the prices of the goods you produce	60.0%	100.0%	60.0%	100.0%	60.0%	100.0%
Increase in wages	26.7%	75.0%	10.0%	100.0%	60.0%	66.7%
Increase of the prices of input you buy locally	13.3%	100.0%	20.0%	100.0%	0.0%	
Increase in internal efficiency to stay in the market	73.3%	90.9%	80.0%	87.5%	60.0%	100.0%
Increased variety of products in the market	40.0%	100.0%	40.0%	100.0%	40.0%	100.0%

Source: interviews

Therefore, if national companies seem to have benefited in some ways from an increased efficiency, pushed by competition with foreign firms, a crowding out effect is also another possible consequence.

### 5.7 Interactions among foreign firms and their effects

The aim of this section is to analyze interactions between the foreign firms considered in the sample in order to compare them with interactions between domestic firms. In all the cases it has been verified the existence of interactions with other foreign firms. 61.1% of them described these relations as very frequent (daily basis); personal contacts (72.2% of cases), business associations (44.4%) and fairs (38.9%) are among the most mentioned channels thanks to which interactions are established.

With regard to the kind of the relation established among firms, Table 5.27 shows the answers given. In 88.9% of the cases, other foreign firms are customers and in 77.8% they are suppliers. In 44.4% of the cases there is a competition relation between the firms, while only in 5.6% of the cases other foreign firms are partners in joint-ventures.

Table 5.28 Form of relation with other Foreign firms

They are customers	88.9%
They are suppliers	77.8%
They are competitors	44.4%
They are partner in joint-ventures	5.6%
Partners in distribution network	11.1%
Subcontractors	5.6%

Source: interviews

The level of interaction among firms does not automatically imply a real mutual involvement. This is the reason why we also tried to check which was the degree of these interactions by measuring the joint actions carried out by firms in the last four years. 77.7% of the firms collaborated with other foreign firms. Table 5.29 shows the main answers given about what kind of actions was developed by foreign firms: product development and design are the most common joint actions (64.3% of the relevant cases). Training of human resources is another activity considered a joint action (35.7%), while financing, sales and purchases are hardly a matter of joint actions.

Table 5.29: Main joined actions

Design of products	64.3%
Product and process joint development	64.3%
Training of human resources	35.7%
Financing of some projects	21.4%
Joint Input purchases	21.4%
Joint product sales	21.4%
Joint participations to fairs and exhibitions	14.3%

Source: interviews

After the existence of joined actions and their nature have been verified, we can now consider which have been the main effects they had on firms. In the 85.7% of the cases firms said they experienced an effective development of new products or processes, while in 78.6% of the cases their product quality increased. Exploitation of business opportunities shows this same percentage. Mutual trust is reported to have been increased in 57.1% of the cases, human resource quality to have been improved in 50% of the cases as well as the promotion of the brand on the local market.

Table 5.30: Effects of joined actions

	Yes	No	High	Low	Irrelevant
Developed new products or processes	85.7%	14.3%	100.0%	0.0%	0.0%
Increased the product quality	78.6%	21.4%	100.0%	0.0%	0.0%
Exploited business opportunities	78.6%	21.4%	81.8%	18.2%	0.0%
Increased reciprocal trust in other agents	57.1%	42.9%	87.5%	0.0%	0.0%
Improved the quality of human resources	50.0%	50.0%	100.0%	0.0%	0.0%
Promoted better its brand in the local market	50.0%	50.0%	100.0%	0.0%	0.0%
Improved commercialization	42.9%	57.1%	100.0%	0.0%	0.0%

Introduced organizational innovations	35.7%	64.3%	100.0%	20.0%	0.0%
Achieved a better insertion in the external market	28.6%	71.4%	100.0%	0.0%	0.0%
Improved its input procurement	21.4%	78.6%	100.0%	0.0%	0.0%

Source: interviews

Less frequent effects were actions aimed at improving commercialization and input procurement, at introducing organizational innovation and at better integrating the firm on the external market.

### 5.7 Interactions among domestic firms and their effects

As it was noticed in the case of foreign firms, also domestic firms, almost all the ones considered in the sample, interacted with other national firms (with one exception due to the lack of opportunity for interaction). Here again, there is a high percentage (72.2%) of firms that describe their interaction with other domestic firms as daily basis relations. Finally, as for the way in which relations have been established, personal contacts are the most cited channel (100%), followed by fair and exhibitions (72.7%), and business associations (63.6%). In this case, also advertising is regarded as important (27.3%).

Relations among domestic firms have different features from the ones established with foreign companies. As Table 5.31 shows, in all the cases domestic firms described their relation with other domestic firms as supplier-customer one; in the 63.6% of the cases they are also customers, in the 54.5% competitors, in the 27.3% subcontractors while nobody seems to be involved in joint ventures.

Table 5.31 Form of relation with other domestic firms

They are suppliers	100.0%
They are customers	63.6%
They are competitors	54.5%
They are subcontractors	27.3%
Partners in distribution network	18.2%
They are partner in joint-ventures	0.0%

Source: interviews

The low percentage of firms that undertook joint actions in the last 4 years (33.3%) confirms the low degree of close relations among domestic firms.

Table 5.32 Main joint actions

Product and process joint development	3
Joint Input purchases	2
Training of human resources	2
Joint product sales	1
Design of product s	1
Financing of some projects	1
Joint participations to fairs and exhibitions	1

Source: interviews

Only three firms developed products or processes in collaboration with other national firms. Input purchases and human resources training occurred as joint actions in two cases. Joint product sale, product design, financing and participation to fairs and exhibitions could be found only in one case.



Table 5.32 Effects of joint actions

	Yes	No	High	Low	Irrelevant
Increased the product quality	100.0%	0.0%	100.0%	0.0%	0.0%
Developed new products or processes	100.0%	0.0%	100.0%	0.0%	0.0%
Improved its input procurement	75.0%	25.0%	66.7%	33.3%	0.0%
Improved commercialization	75.0%	25.0%	66.7%	33.3%	0.0%
Increased reciprocal trust in other agents	75.0%	25.0%	100.0%	0.0%	0.0%
Improved the quality of human resources	50.0%	50.0%	100.0%	0.0%	0.0%
Introduced organizational innovations	50.0%	50.0%	50.0%	0.0%	50.0%
Exploited business opportunities	50.0%	50.0%	100.0%	0.0%	0.0%
Promoted better its brand in the local market	25.0%	75.0%	100.0%	0.0%	0.0%
Achieved a better insertion in the external market	0.0%	100.0%			

Source: interviews

Joint actions seemed to have produced very positive effects. In all the cases, firms increased their product quality and developed new processes. In the 75% of the cases, reciprocal trust, input procurement conditions and commercialization were improved. However, even when these actions brought several benefits to the firms which undertook them, it is very important to point out the lack of joint activities between domestic firms, compared to what happened within foreign companies.

### 5.7 Interactions between firms and institutions and their effects

This paragraph contains the results drawn from the answers given to the section of the questionnaire dedicated to the institutional framework. It is divided into subsections concerning educational institutions, business associations and public development institutions in this order.

#### 5.7.1 Educational and research institutions

Table 5.33 shows the percentage of firms that have relations with the educational institutions introduced in section 3. Senai is the most cited institution (82.8%), and it is worth noting that this percentage is even higher among foreign firms (88.2%). UFMG follows with an average percentage of 51.7%, higher than that of PUC-MG (41.4%). 20.7% of the firms said they have relations with CETEC and again the percentage of foreign firms is higher than that of national companies.

Table 5.33: Interactions with educational and research institutions

	Total	Foreign	National
1. Universidade Federal de Minas Gerais	51.7%	52.9%	50.0%
2. Pontifícia Universidade Católica de Minas Gerais	41.4%	47.1%	33.3%
3. Cetec - Fundação Centro Tecnológico de Minas Gerais	20.7%	23.5%	16.7%
4. Fundação João Pinheiro	0.0%	0.0%	0.0%
5. Sistema Sesc-Senai	82.8%	88.2%	75.0%

Source: interviews

There are several main reasons that led firms not have relations with educational institutions. Table 5.34 shows the most important ones. Lack of information is the most mentioned reason (46.7% of the cases), followed by lack of suitable research programs (40%). Firms also mentioned the limited availability of funds (33.3%) and geographical distance (26.7%). Lack of trust does not seem to be a very relevant reason.

Table 5.33: Obstacles to relations with educational and research institutions

Lack of information	46.7%
Lack of suitable research programmes	40.0%
Scarce fund availability	33.3%
Geographical distance	26.7%
Lack of trust	6.7%

Source: interviews

When considering the firms that do have relations with educational and research institutions, our main interest was to understand which kind of relations have been established and which have been their effects on the firms. Table 5.34 clearly shows that training courses have been the most widespread form of relations (84.0%) between firms and these institutions. In 90.5% of the cases firms regarded these courses as very important to them. In many cases, firms allow students to make apprenticeship training for short periods inside their plants (68%), but only in the 28% of the cases there have been technical research projects. However, it is interesting to note that 100% of those firms which undertook such projects regarded them as very important. Consultancy projects are mentioned in the 32% of the cases, conference and seminars in the 36%, but only 55.6% of the firms consider them very important.

Table 5.34: Kinds of the relations with educational and research institutions

	Yes	High	Low	Irrelevant
Training courses	84.0%	90.5%	4.8%	4.8%
Stages	68.0%	82.4%	11.8%	5.9%
Conference and seminars	36.0%	55.6%	33.3%	11.1%
Consultancy projects	32.0%	75.0%	25.0%	0.0%
Technical research projects	28.0%	100.0%	0.0%	0.0%
Research projects to identify new markets	16.0%	100.0%	0.0%	0.0%

Source: interviews

The effects produced by these interactions are summarized in Table 5.35. It is no surprise that firms mentioned as first effect of interactions with educational institutions the improvement of human resources skills, regarding it as very important. It is indeed more surprising that firms mentioned the improvement of product quality as the second most immediate effect, which is regarded as even more important than improvement of human resources skills (87.5%).

Table 5.35: effects of interactions with educational and research institutions

	Yes	High
Improving human resources skills	72.0%	83.3%
Increasing the product quality	64.0%	87.5%
Developing new production processes	40.0%	90.0%
Introducing organizational innovations	40.0%	80.0%
Strengthening contacts with other domestic firms	36.0%	66.7%
Developing new product	36.0%	77.8%
Increasing trust in other agents	20.0%	80.0%
Strengthening contacts with foreign firms	12.0%	100.0%

Source: interviews

Other possible minor effects mentioned by the firms are, for example, the development of new process (40%) or products (36%), introduction of organization innovations

(40%), increase in trust in other agent (20%) or strengthening of contacts with domestic firms (36%) or foreign ones (12%)

### 5.7.2 Business associations

Table 5.36 shows the answers given to the question about participation to business associations. Generally speaking, the firms included in the sample show a high level of participation, near to 84%. However, when the answers are broken down under different headings according to the firm's capital ownership, foreign firms show a total rate of participation (88.9%) higher than that of the domestic firms (75%). Sindipeças is the most important business association, and 60% of firms are registered as its members. There are no useful information that can explain the absence of relations with local business associations. In the 60% of the cases, it is said that there just was no occasion to establish relations with them and in the 40% nobody proposed to the firm to join the association. More real obstacles, like lack of common interests to be pursued, were mentioned only in the 20% of the cases.

Table 5.36: Participation to business associations

	Total	Foreign	National
Yes, Sindepéças	40.0%	44.4%	33.3%
Yes, Sindepéças and other associations	20.0%	16.7%	25.0%
Yes, other associations	23.3%	27.8%	16.7%
No	16.7%	11.1%	25.0%
Total	100.0%	100.0%	100.0%

Source: interviews

As for the benefits given by participations, organization of seminars is the most frequently mentioned (80% of the cases); however, this is considered very important only by the 65% of the firms. Also organization of training courses is considered a benefit (76%), but again it is regarded as important only in 57.9% of the cases. Among the benefits listed, information about technologies is the most appreciated by firms, but only the 52% mentioned it. Another important benefit is the possibility to create new business opportunities, while the third most appreciated benefit (very important for 80% of the firms) is the increase in mutual trust, mentioned by 60% of the firms.

Table 5.37: benefits from participation to business associations

		Very important
Organization of conferences and seminars	80.0%	65.0%
Specific training courses	76.0%	57.9%
Increase in reciprocal trust	60.0%	80.0%
New business opportunities	56.0%	85.7%
Contacts with other domestic firms	56.0%	64.3%
Information about technology	52.0%	92.3%
Information about "best practices"	48.0%	66.7%
Joint participations to fairs and exhibitions	48.0%	50.0%
Joint promotional initiatives	40.0%	60.0%
Contacts with foreign firms	32.0%	50.0%

Source: interviews

Information about “best practices”, joint participation to fair and exhibitions and joint promotional initiatives is regarded as a minor benefit derived from associations. Finally, only in 32% of the cases contact with foreign firms is regarded as a benefit.

### 5.7.3 Development institutions

Interactions between firms and public development institutions can be better understood when considering the way in which firms are effectively involved in the programs proposed by these institutions. This is the reason why firms were more asked about programs than about the institutions they have relation with.

Looking at their general degree of involvement, Table 5.37 summarizes firms’ total participation rate, which is quite low (40%). In this case, national firms seem to be more active (41.7%) than foreign firms (38.9%). The main reasons given to explain the absence of participation are lack of interest in the programs proposed by institutions (33%), excessive bureaucracy (22%); lack of funding, information and trust were mentioned as minor reasons while corruption was mentioned only by the 6% of the firms.

Table 5.37: Participation to institutional programs

	Total	Foreign	National
Yes	40.0%	38.9%	41.7%
No	60.0%	61.1%	58.3%
Total	100.0%	100.0%	100.0%

Source: interviews

We then investigated about specific programs proposed by the institutions listed in section 3. Firms were asked about their participation or knowledge of several programs now under way.

Among these programs, “*Empresa mineradora competitiva*” was developed to increase existing investments and to create new companies in Minas Gerais. This program includes a special credit line at BDMG, set up for SMEs so that they can carry out their projects and actions aimed to technological and managerial modernization. This program aims at increasing the competitiveness both on national and international markets. The “*Geraminas*” program aims at helping micro and small firms to access external credit, which requires a 12% interest rate. Proe-Industria, Proe-Eletronica y Proe-estruturação are also credit lines, but their requirements make them more suitable to large companies. Proim is a credit program purpose-developed for modernization processes while Pro-Industria is an incentive program whose target are both SMEs and larger firms.

The scenario presented by Table 5.39 is clear and it is quite obvious that lack of information is likely to be one of the most serious obstacles to participation.

Table 5.39: Participation in development programs

	Known and joined	Known but not joined	Unknown
1. Empresa mineradora competitiva	3.6%	17.9%	78.6%
2. Geraminas	3.6%	28.6%	67.9%

3. Pró-indústria - programa de integração e diversificação industrial e	14.3%	42.9%	42.9%
4. Proim – programa de indução à modernização industrial	17.9%	42.9%	39.3%
5. Proe-indústria- programa de apoio à implantação de empreendimentos	3.6%	35.7%	60.7%
6. Proe-estruturação- programa de estruturação comercial de	0.0%	21.4%	78.6%
7. Proe-eletrônica – programa de apoio às empresas de eletrônica,	3.6%	17.9%	78.6%
8. Apoio à exportação - bndes - exim	14.3%	57.1%	28.6%

Source: interviews

The benefits derived to the firms that joined the programs are summarized in table 5.40. It is no surprise that increase in credit availability is regarded as the first benefit, mentioned by the 41.7% of the firms. This is followed by new process and product development, improvements in human resource skills and trust (33.3%). 25% of the firms were helped in improving product quality and could exploit new business opportunities. Contact with foreign or domestic firms, introduction of organization innovations, brand promotion on the local market and improvement in input procurement condition or commercialization are regarded as minor benefits derived from participation.

Table 5.40: benefits from participation

	Yes	High
Increase in credit availability	41.7%	80.0%
New product development	33.3%	100.0%
New process development	33.3%	100.0%
Improvement of human resources skills	33.3%	75.0%
Increase of trust in other agents	33.3%	50.0%
Increase in the product quality	25.0%	100.0%
New business opportunities	25.0%	100.0%
Improvement of inputs procurement conditions	16.7%	50.0%
Improvement of commercialization	16.7%	50.0%
Introduction of organizational innovations	16.7%	50.0%
Brand promotion on the local market	16.7%	100.0%
Contacts with foreign firms	16.7%	0.0%
Contacts with other domestic firms	16.7%	0.0%
Better insertion in the external market	8.3%	100.0%

Source: interviews

## 6. Conclusions and policy suggestions

Previous results can give an idea about the degree of backward spillovers and technological re-organization occurred between Fiat as foreign company and local manufacturers:

1. Fiat brought new technologies and introduced a new competition system, thus fostering new opportunities for technology transfers. The new competition scenario even affected others MNEs, already operating in the country.
2. The Italian company created a new chain of providers on the national territory, which, however, did not need to establish near its plants;
3. Fiat promoted the creation of a network of new local suppliers, which provided for some kind of components. State incentives and market protection boosted auto-parts manufacturers nationalization;

4. During this stage, the Italian MNE provided backward vertical technology transfers in order to increase local companies' capacity;
5. In most of the cases, technology transfers to local firms were not related to research and product development, but rather to quality improvements and price reductions, carried out in order to achieve a higher level of competitiveness.
6. At the beginning, domestic firms benefited from all this. When the macroeconomic policy changed towards market liberalization (for example, by lowering tariffs for imported inputs) and incentives were reduced to domestic companies, new foreign companies, global suppliers, invested in the area replacing some local companies.
7. New providers entered the domestic market after the acquisition of local companies and some of them brought their own technology.
8. Technology spillovers to local firms were then considered less important. To some extent, relations with multinational customers certainly did help firms to introduce what can be called soft innovations, but there were no actual technology transfers.
9. All this would mean that there were significant technology spillovers to local domestic firms and this occurred when the state policy and institutions were involved in some way. .

Fiat's investment in Betim had some knowledge spillovers and important linkages effects as it led to the development of a total new dynamic sector in that region. This was the result of the fundamental role played by local institutions over the years.

The production arrangement in Betim had change from vertically integrated to network integration. This change resulted from the modifications carried out in auto-vehicles industry on all the production system as the system focused much more on sourcing arrangements. However, also globalization was among the causes that brought global providers to Brazil. Vertical integration was prevalent in backward linkages when domestic companies dominated the sector.

This means that during the first phase (1976-1990), when domestic companies dominated the auto-parts industry, there was a "positive linkage effect" due to Fiat FDI. However, the situation changed when most of the domestic companies were replaced by foreign ones and no institutional policy was implemented in order to help them to be competitive on the market. On the contrary, all the policies implemented during those years aimed at promoting FDI rather than making domestic firms be able to catch-up. One of the main reasons why this happened can be the importance given to FDI as employment and fiscal revenues sources rather than considering them as a source of technology up-grading opportunity.

If FDI are well coordinated by local institutions, they will be able to become useful instruments to create a new sector focused on dynamic technology. Technology transfers usually occur somehow mechanically, through natural transmission from central companies (Fiat and some first tier firms) to their providers because of quality and price programs; but transfers seem to stop when R&D programs are carried out, and modernization usually takes place thanks to new technologies import. As for foreign companies, decisions on innovation and new investments mainly depend on their parent firms.

FDI coordination and supporting policies to local company are usually the main reasons able to promote technology spillovers derived from FDI. This was very important for Minas Gerais development after Fiat had established in Betim. In the case of auto-parts industry, the ability of domestic companies to survive and to start playing an important role within the production system was related to institutional support and national macroeconomic policies. However, innovation resulted from the ability of firms for buying new technologies from abroad or reproducing those developed by foreign firms.

Companies do not often ask the support of local institutions when they are interested in increasing their own performance. Some research institutes suffered from public fiscal restraints and as a consequence did not developed further in terms of people and equipment. For this reason, companies do not consider them as a source of solutions to improve their own technologies and competitiveness.

Today, the institutional framework does not seem to have been very useful in the innovation process; in fact, technology spillovers took place mainly thanks to the quality control programs led by Fiat. Information exchange between companies, related to these programs, and cost restraints are the main factors that helped to improve products and processes from a technological point of view, both forward and backward on the value chain. Large foreign companies generated innovation through their parent firms. Some of them have developed a “tropicalization” laboratory in Brazil, while others developed solutions for local car models. Some domestic firms operating in the first tier have some R&D inside their facilities.

The institutional framework is very useful in terms of training centers. As companies pointed out, there is no lack of trained people either for administration or production jobs. Even Fiat employs local engineers who graduated in local universities. The region has a good trained workforce and a very small part of it comes from other states, while it is even smaller the number of employees coming from abroad.

### **Proposals and policy implications**

Domestic firms need institutional support in order to be given the chance to compete with foreign firms at the same level. Foreign firms can usually benefit from international support, like financing and technology from their parent firms and scale gains when their production is located in more than one place. Therefore, the role of institutions has to be emphasized as to fill those gaps in efficiency revealed by the interviews: institutions need to help knowledge spreading and to promote cooperation among local firms, thus providing the ground for the creation of a domestic manufacturers network that would eventually be able to develop without depending on the market core business – Fiat.

Furthermore, some components can be easily produced locally: this means that import substitution should be promoted in order to develop local firms’ abilities to produce car components. In order to make it possible, technical research centers and universities need to play a major role, which means that they need to help local firms to use and develop high-tech intensive products. However, import substitution strategies have to be carefully designed when WTO standards need to be met; trade policy should be fine-tuned to the needs of young districts but avoiding unfair domestic protection.

These proposals can become real actions only if the government, in collaboration with foreign or domestic firms, invests on research centers and universities. These investments would help domestic companies to improve their technological capacity, working on innovation processes. Also modernization could be affected by these processes so that companies may try to develop new technologies inside their plants, whenever there will be the need for modernization.

The active role of institutions, which should work to offer local companies technological solutions, can also change the relation between institutions and companies. Public institutions became increasingly weaker during the 80s and 90s and this process should be now reversed. Technology has to be developed locally in order to make firms competitive in a sustainable way. However, when developing cooperation or training projects, the government will need to have as its target domestic as well as foreign firms, otherwise its actions could be regarded as state intervention aimed at distorting competition. Therefore, an approach that takes into account both kind of firms would be regarded as more politically correct.

This means that technical institutes and universities need to play a major role as to make joint private companies search their own technological solutions. This will be possible by supporting the creation of new labs and increasing the number of scholarships to those students who are carrying out any research related to the needs of the company.

Existing local institutions such as BDMG, INDI, UFMG, CETEC and PUCMG also need to be supported. The role of these institutions has been weakened by lack of money and public support and students does not want to work there because of low wages and lack of opportunities. The structure of these institutions needs therefore to be revised and they need to be provided with new equipment and researchers in order to develop new local planning capability and local skills to plan new strategies.

It is also very important to increase public services quality: this can be done by lowering bureaucracy and simplifying the decision-making process. Local governments should start working on this issue as to lower transaction costs for companies in order to make investments easier and cheaper in Minas Gerais. This policy can be regarded as a good instrument to attract new investments to dynamic sectors and it can have a strong impact both on forward and backward sectors of the value chain (regardless of firms' ownership); however, it should also be integrated with the efforts made by institutions whose aim is to increase domestic and local companies' participation to this strategy.

Many actions can be carried out also in terms of production arrangement. Fiat facilities in the region have created a total new dynamic industry in Minas Gerais. This new structure requires a new kind of trained workforce, new facilities, new technologies etc. All these elements can therefore be used as necessary background to attract new companies to Minas Gerais and to spread the knowledge acquired thanks to those new sectors.



## 7. References

- Albuquerque, E.M. (2001) “Sistema de Inovação de Minas Gerais: um balanço introdutório e uma discussão do papel da FAPEMIG para sua construção”, Belo Horizonte.
- ANFAVEA (2003) “Autoparts industry Performance” , Sindipeças – São Paulo-SP
- BNDES (1997) “Desempenho do Setor de Autopeças” nº12, set/97, Área de Operações Industriais.
- Campolina Diniz, C. and Lemos, M.B. (1996) “Technology and Economic Development: Suitability of the institutional system of Minas Gerais”, in Gazzinelli, R. Moreira, R.L. and Rodrigues, W.N. “Physics and Industrial Development: Bridging the Gap”, World Scientific, Singapore, New Jersey, London, Hong Kong.
- Carneiro, P.T., Toyshima, S.H. and Barreto, R.S. (2000) “Inovações Organizacionais e Tecnológicas da Indústria de Autopeças Mineira e suas Relações com a Fiat Automóveis S.A”. <http://www.ufop.br/ichs/conifes/ac7.htm>.
- Lemos, M.B. et alli (2000) “O Arranjo Produtivo da Rede Fiat de Fornecedores”, Instituto de Economia da Universidade Federal do Rio de Janeiro – IE-UFRJ, Rio de Janeiro.
- Neves, M.A. (1999) “Impactos da Reestruturação Produtiva Sobre as Relações Capital/Trabalho: o caso Fiat-MG”, in Oliveira, F. and Comin, A.A. “Os Cavaleiros do Antiapocalipse: Trabalho e Política na indústria automobilística”, Entrelinhas, São Paulo-SP.
- Quadro, R. & Consoni, F. (2004) “As Estratégias de Produto das Subsidiárias das Montadoras no Brasil: Adaptação ou desenvolvimento local?”, in Kon, A. “Pesquisas em Economia Industrial, Trabalho e Tecnologia”, EITT-Economia Industrial, Trabalho e Tecnologia do Programa de Estudos de Pós-Graduados em Economia Política-PUCSP, São Paulo-SP
- Suzigan, W. and Villella, A. (1997) “Industrial Policy in Brazil”, Universidade Estadual de Campinas - Unicamp, Instituto de Economia – IE, Campinas.