Supply-led Technology Adoption in Maranhao, Brazil: a Case of Developmental Trade in the Small-scale Furniture Sector

by

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ABSTRACT

In the pre-Amazon region of Western Maranhao, in Northeast Brazil, small-scale furniture firms have proliferated and grown in size in the last 6 to 8 years. This sector offers an alternative for economic development, to the simple exploitation of wood resources on which the economy of the region is currently based. Relative to this activity, furniture-making is less environmentally destructive and more easily accessible for the lower strata of the population. In a region where wealth is unequally distributed, furniture firms have been successfully started and are still controlled by low and middle class entrepreneurs.

Much of this growth depended on new production techniques. Two main actors have jointly contributed to disseminate this new technology: a private firm supplying inputs to the furniture sector, and the quasi-public agency in charge of vocational training. From the analysis of this cooperative agreement, the paper draws some lessons concerning the conditions under which similar public-private partnerships can produce positive outcomes and private developers of technology can be successfully involved in public technology policy.

Demand-side agents have not contributed in the same way to the growth of small-scale firms, because they didn't have a direct impact on technological change. A comparison between the cases analyzed in different towns suggests that representative agents have been more helpful for larger firms producing furniture in series, than for the smaller enterprises, due to their insufficient production turnover. The role of demand-side agents was also more conservative in the sense that it tended to reproduce the existing specialization of the region in low cost and low value added productions.

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SECTION 1

INTRODUCTION

In this study I analyze the process of economic development promoted by small-scale manufacturing enterprises in a recently colonized region of Brazil characterized by poverty, income inequality, and high dependency on the exploitation of natural resources. On the basis of this concrete experience I try to draw more general lessons about the first stages of industrial development in regions that lack economic resources and experience in manufacturing. My findings are organized around three main areas:

- *The nature of the manufacturing activity.* I argue that low-technology manufacturing industries like furniture possess some nice properties that make them suitable to a development strategy aimed at widening the entrpreneurial base, reducing income inequality, and increasing employment. Furniture-making in particular is also compatible with a sustainable use of environmental resources.
- *Training and technical assistance.* Private suppliers of inputs can, in the process of pursuing their economic interest, effectively promote the technological upgrade of small manufacturing firms. In the cases I studied, a supplier has been involved in a successful public-private partnership with a vocational training authority. Under certain conditions, well designed agreements of this nature can produce spectacular results in the dissemination of new manufacturing practices.
- *Demand side actors* like buyers and representative agents can help reduce the uncertainty that characterizes production on demand, without taking any active part in the learning process of small firms. In the cases I review, they have created opportunities for some of the firms to reduce costs and expand production, but they haven't contributed to their technological upgrade as much as suppliers have.

I base these observations on field research I have conducted in Brazil, where I spent three months in the summer of 1996 studying small-scale furniture

enterprises in three different towns of the interior of the state of Maranhao. In the small-scale segment of this industry I discovered and analyzed a lively entrepreneurial reality, that contrasts with more traditional patterns of economic development that prevail in the state and in the Northeast of Brazil more in general. However, indigenous firms producing furniture on a small-scale are tightly linked to the larger wood-processing sector on which the economy of this state is highly dependent.

One could see these small production units as pre-modern forms of manufacturing that survive on the side of larger plants for the purpose of serving the lowest end of the market, or of enhancing the flexibility of the sector at large. The position I develop in the next pages is that they represent a viable and desirable option for the industrial organization of a region that struggles to reduce its dependency on the exploitation of natural resources. The forward linkages from large sawmills to small-scale furniture enterprises offer a unique opportunity for improving the equity and long term sustainability of this process of growth.

There is today a vast literature looking at the role of small firms in under-developed regions and at the policies that support them. These studies often apply to developing countries concepts like industrial districts, collective efficiency and flexible specialization, derived from the empirical observation of successful cases of industrial clusters of small firms in Western Europe (Sabel 1986; Humphrey and Schmitz 1995; Poon 1990, Verschoor 1996, IDS Bulletin 1992). In this work I will try to avoid the mistake of evaluating the progress of small firms against the industrial district /flexible specialization formula for industrial development. For this reason I am not focusing on issues of cooperative behavior, firms' clustering, or any of the other elements of that framework. Rather, with the case studies of small enterprise development in the furniture industry presented here, I am trying to shed light on the process by which firms have contributed to the region's welfare by expanding output and improving skills and competitiveness, without making any clear assumption about the path to be followed.

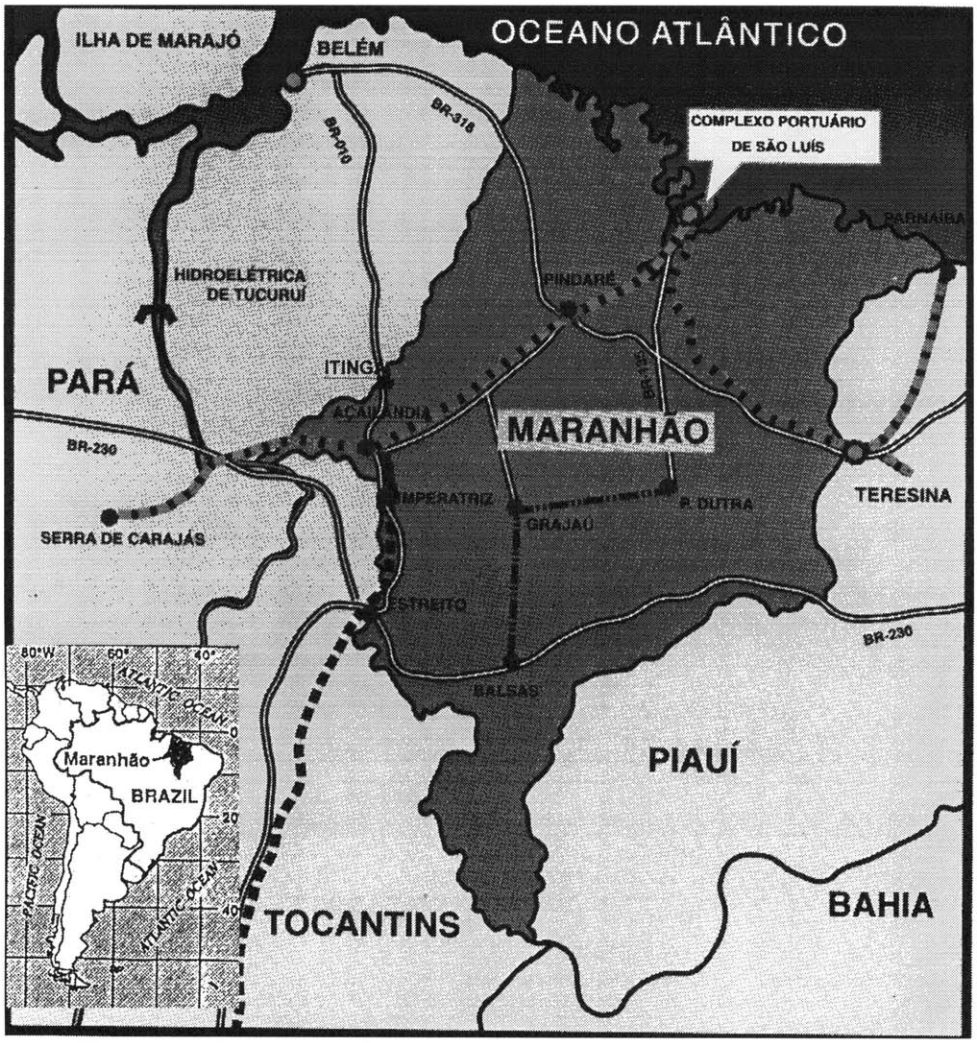
My sources of information have been direct interviews with entrepreneurs (about 35) and workers of the industry, visits to firms, interviews with other key informants in government agencies, local governments, supplier and buying firms, trade unions and industrial organizations. I have also consulted some of the available data describing the economic trends of this region.

This introductory section continues with a synthetic description of the particular municipalities I have studied in the state of Maranhao and of the recent economic trends in this region of Brazil. The remaining of the paper is organized in three sections that address the three main points I made at the beginning, and is followed by the conclusions. Section 2 presents the desirable aspects of furniture-making and argues that this low-technology manufacturing activity offers an equitable and sustainable development strategy for the region. The following section looks at the main technical innovations introduced in this industry and describes the partnership between a supplier of inputs and the Brazilian public training agency as the main force promoting this learning process. Section 4 generalizes this analysis, comparing the firms' commercial relationships with suppliers and buyers, and explains the different role of these external agents in promoting the firms' growth.

1.1 The West of Maranhao

Maranhao is the second poorest state in the underdeveloped Northeast of Brazil - a region that has been targeted for decades by economic policies aimed at reducing the economic differential that separated it from the more industrialized South. In 1994, with a Gross per capita Product of $1628, Maranhao showed levels of wealth by 26% lower than overall Northeast[1]. Within the Northeast, Maranhao represents a scarcely populated state, whose economy is heavily based on the extraction and simple processing of natural resources of wood and iron ore. Other important productions are aluminum and a few agricultural cash crops like soy and cashew nut.

[1] This gap in the per capita product relatively to the larger Northeastern region has reduced in the last decades. The ratio between GDP per capita in Maranhao and in the whole Northeast was 59% in 1970, 57% in 1980, 92% in 1990 and 73% in 1994.



In my research I have studied the small furniture firms operating in the three towns of Itinga, Acailandia and Imperatriz in the west of Maranhao, at the frontier with the states of Para' and Tocantins. As we can see in the map represented above, the towns are lined from North to South along one of Brazil' s main arteries, the federal road BR010 (the white continuous line) connecting Belem, the capital of the northern state of Para', to the federal capital Brasilia, and are about 60 kilometers from one another. The colonization of this area occurred in recent times - after this road was paved in 1973 - driven by the exploitation of timber and other natural resources. In the past decades, thousands of people migrated here from all over Brazil with the prospect of a

better life in the "garimpos", or gold-mines and the region experienced a very fast process of transformation.

Today the economic picture looks different: timber is in crisis, the extraction of minerals cannot absorb the growing employment needs of the population, and the region is struggling to diversify its economic base to develop new and more sophisticated productions. The following aspects of the economy of this region characterize all the three urban centers, and create growth potential for small-scale productive units.

- The area has the fastest rate of population growth in the state excluding the capital city. The administrative districts I have studied have increased their population between 1980 and 1991 at a rate of about 4.45 % annually, much higher than the state figure of 1.91% (Estado do Maranhao 1994). High immigration means growing expected local demand for consumer durables, construction inputs, and furniture.
- The region is better connected by road transportation to the South of the country than all the rest of the state. Acailandia and Imperatriz are also linked to the state capital, S. Luis, by the only railway continuously operating in Maranhao (the striped line in the map). Easier transportation means that locally based firms don't have to look only at the local market in their strategies for expansion.
- The local supply of labor in all the three towns is influenced by the continuous expulsion of low-skill manual workers from sawmills and mining activities. Just in the municipality of Acailandia the local labor union estimates the timber industry has lost in the last 8 years more than 9,000 jobs. Although the labor dismissed by sawmills is largely unskilled, it has some familiarity with woodworking that makes the transition to furniture-making easier. Labor in general is abundant and cheap, but firms have some problems filling some skilled positions.

The economic trends of the logging and sawing industries form also the basis of the main differences in the economic conditions faced by furniture firms in the three towns. In particular, what differs is the response of the local economy to a growing scarcity of the other major input of the sawmill industry: wood. The three towns have started exploring their wood resources at different moments in time, and thus their wood-related industry has been hit differently by the raising cost of inputs related to deforestation. These costs and their change over time determine where the sawing industry finds it convenient to localize its plants. In the Amazon "frontier", in fact, this industry is said to have a short economic life or a "migrant" character because it constantly moves, abandoning the areas where natural resources have already been exploited and moving towards the virgin forest.

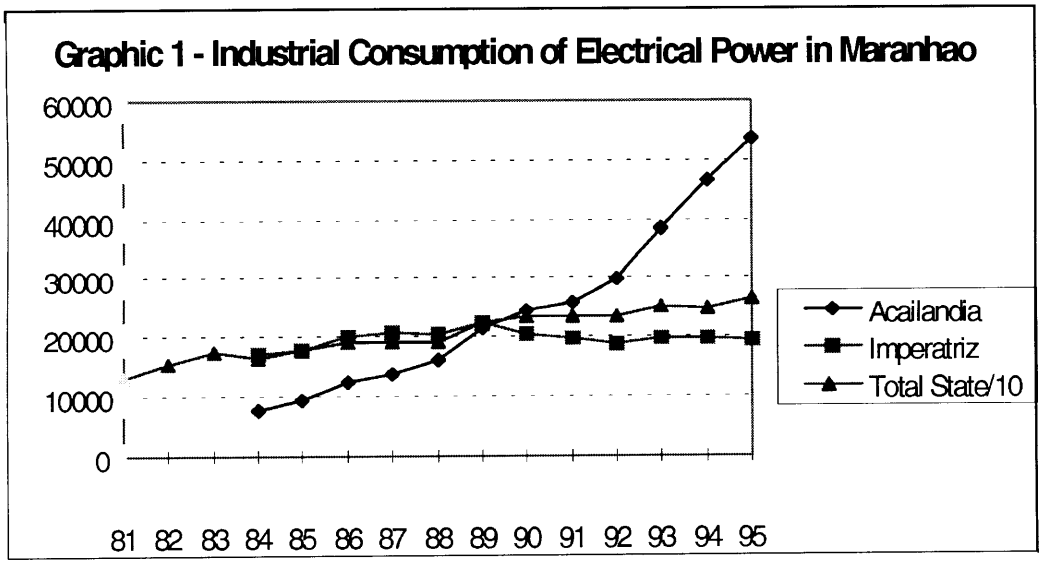
Sawing is usually located close to the source of its inputs. But, when the resources of the forest become scarce around them - as it is now happening in the west of Maranhao - loggers have to travel farther and farther from the sawmills in search of unexplored wood sources. Wood logs have to be transported from the sites of their extraction for hundreds of kilometers on dirt roads opened in the forest. Fuel, manpower and truck deterioration correspondingly increase their cost for sawmills, eroding their profits.

The three towns occupy a different position on the life-cycle curve of the sawing industry, but are united by the same pressure to diversify their economic activities. Imperatriz - the older center - has already dismissed a large share of its capacity in wood sawing accumulated in the 70's; Acailandia is facing the problem of restructuring now as the areas surrounding it in a 100 kilometer radium have been largely spoiled of their wood, while Itinga is still close enough to the virgin forest to still base its economy almost exclusively on wood-related manufactures and will probably be hit by this problem in the next decade.

The economic base in Imperatriz is, thus, broader: the city has already restructured its economy moving into other manufacturing activities like garment and furniture production, and has also discovered a service vocation; with its large chain shops, hotels and hospitals Imperatriz is nowadays mainly a trade,

service and recreational center serving the vast areas of the states of Tocantins, Maranhao and Para'. Acailandia remains still more dependent on wood sawing, but has also diversified its economy in the manufacturing sector, with the opening of large factories refining iron ore, the transformation of wood in coal, and the growth of a smaller furniture sector. Finally, Itinga still bases its economy on the production of simple derivatives of wood: mainly particle board, veneer, sawed and laminated wood.

These trends are confirmed by the available data. The best statistics on industrial production at the local level are represented by indirect indicators like the collection of taxes and electrical power consumption in the manufacturing sector. This latter indicator, reported in Graphic 1, clearly shows a steady growth in manufacturing activities in Acailandia and Itinga (here grouped under the heading "Acailandia") in the period 1980-1995, while in Imperatriz energy consumption remains almost unchanged. While from 1985 to 1995 industrial energy use has increased by 50% at the state level, and 10% in Imperatriz, in Acailandia this indicator has increased more than five times.



Source: Compagnia Electrica do Maranhao (CEMAR)

Of course, most of this growth has little to do with small firms. Four large plants refining iron ore for the steel industry and about 70 medium scale sawmills are mostly responsible for the industrial consumption of electrical power in the area of Acailandia. A quick look at the same indicator - industrial consumption of energy - divided by the number of users, supports the story I was telling: in the period 1985-95 average consumption per industrial client decreased in Imperatriz from 37.8 to 25.2 Mwh per year (- 50%), and increased in Acailandia from 52 to 171 Mwh (328%). The impressive growth in average consumption in Acailandia and Itinga depends heavily on the growing needs of large, heavy industry, while the reduction in Imperatriz results from the process of industrial restructuring and the diversification into less energy intensive sectors like services.

TABLE 1 - BASIC FACTS ABOUT THE THREE TOWNS AND THEIR FURNITURE SECTOR

	IMPERATRIZ	**ACAILANDIA**	**ITINGA**
How old is the town?	145 years (but developed mostly after 1958)	20 years old	<15 years
Town size, population	300,000	80,000	? - smaller than the others
Number of sawmills in town	42	32	34
Number of furniture firms	40	22	14
What is the furniture firms' typical size?	From 20 to 70 employees each	most employ ~ 5, 4 of them > 20	all employ 5 to 10 workers
Are they physically close to each others?	No, they are scattered all over the urban area	Yes. Most have been relocated in an area donated by the city government.	Yes, they have spontaneously clustered along the road to South Brazil
What do they produce?	the larger are specialized in just one or few items (ex. beds or wardrobes)	all produce all kind of furniture	full-wood, unfinished furniture; tables made of one single piece of wood
Average monthly sales	- Large ~ $100,000; - Small ~ $5 -20,000	$5 to 20,000	$5 to 15,000
Do they produce in series or on request?	larger firms: in series ; smaller firms: on request	on request (only two firms in series)	on request

SOURCES: FIEMA, *Cadastro Industrial do Maranhao 1994/95*; FIEMA, *Diagnostico Tecnologico do setor Moveleiro,* Abril 1996; and personal field research[2].

[2] Given the limited number of the productive units in the three towns, in the course of my field research I had the unusual opportunity to compare the data reported in the official statistics

Table 1 - largely based on information collected directly during my field research - offers a synthetic picture of the sector of wood and its derivatives in 1996, without capturing the transformations that are still at work. Currently, the area still hosts, according to the 1994 industrial cadaster (FIEMA 1994), 114 wood-processing plants[3] producing for the Southern Brazilian markets a varied range of wood products: sawed wood, particle board and veneer. This situation is in many ways favorable to the growth of a locally based furniture sector because of the importance in these intermediary products for furniture-making.

1.2 The Success of Furniture-making

The structure of the local timber sector, and the trends that are forcing its transformation, contribute to explain the strong economic performance of a manufacturing activity like furniture in such a remote area of Brazil. First of all, the output of sawmilling is the typical input of furniture and it is cheaper at the site of production than in other regions of Brazil, because of the virtual absence of transportation costs. In addition, the sawmill entrepreneurs are aware that, even after increasing the efficiency of their process by introducing higher value added product lines like wooden floors and frames, they can increase their revenues by selling the residual, an item that cannot be shipped, but that can find uses in furniture-making locally.

Under the current cost increases generated by growing wood scarcity, the sawmills face two options: to leave the area, moving in the direction of the forest, or to fight the profit decline by starting collateral activities. Both the phenomena

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provided by the state industrial association (FIEMA) with the actual numbers I have estimated with the help of local experts of the field (which, on their turn, are not by any means exempt from the possibility of measurement error). My information indicates that FIEMA underestimates the number of firms by 10% in Imperatriz and by 220% in the case of Acailandia and Itinga. This error depends on two elements: on the creation of numerous new firms in the time elapsed after the last industrial census, and on the absence from the data of the smallest productive units.

[3] This number does not exactly match with my findings reported in the table, as it results from a survey conducted two years before my research. Nevertheless, because of the average larger size of the sawmills I would expect it to be more reliable than that referring to furniture firms. Cf. note 2.

are currently happening. According to local experts, in Acailandia the largest business groups have reduced their capacity by about 50% after 1988; both employment and the number of firms also have experienced cutbacks of the same order of magnitude. Most of the sawmills that have not left have already introduced more sophisticated lines of production like laminated wood, veneer, and door and window frames, all characterized by higher value added. To oppose the raising input costs, the sawmills have also initiated reforestation projects in large areas close to the towns, and started to sell part of the wood residual of their production processes, instead of burning it as they used to do when the industry was more profitable. For this reason, rich industrialists are strongly in favor of the growth of a small-scale furniture sector.

Building on the competitive advantages and on the forward linkages quickly described above, furniture-making has experienced a fast growth process. To have a realistic picture of the dynamics of this sector one has to rely again on indirect indicators of economic activity and to integrate them with information gathered from local witnesses. Table 2 shows that the share of tax revenues collected in the furniture sector in the two municipalities considered (Itinga is again included under "Acailandia") was 2% of the total state revenue in the sector in 1991, 25% in 1993 and 61% in 1995. If this indicator approximates the level of manufacturing activity, then the share of state furniture production generated in this region has increased impressively in the last 5 years.

Table 2 - State of Maranhao: Tax revenue collected in the furniture sector. Contribution of the two municipalities

	1991	1993	1995
Acailandia	0.1%	1.9%	10.0%
Imperatriz	2.5%	23.7%	51.2%
All Other	97.4%	74.4%	38.8%

Source: *Secretaria da Fazenda do Maranhao, my elaboration.*

And this growth was not due to stagnant output in the sector at the state level: furniture production seems to have performed better than industry in general in Maranhao according to power consumption data. Consumption of electrical power in the furniture sector has increased by 50% from 1991 to 1995, while in industry in general consumption has grown only by 13%.

As for the future of this activity, the local demand for furniture in the next years will probably depend critically on overall economic growth in the region and on the distribution of the additional wealth. In fact, given their nature of "normal" goods - whose demand increases in proportion more than income - one could expect the local demand for furniture to grow steadily, if the region is to continue on its trend of economic development[4]. The high rates of population growth indicated before also reinforce the view that these favorable results could be sustained in the medium run.

To occupy the growing local market, and possibly to export its production to other Brazilian markets, the furniture sector of Maranhao has to be competitive on price and quality with the well-established manufacturers from the South/ Southeast. For this reason the recent process of technological update is so critical for the small firms' development. After a discussion of the advantages of furniture-making relative to other activities, I thus turn to analyzing example of a successful and instructive example of technology transfer.

[4] In his study of the furniture sector in Egypt, Mead reports estimates of income elasticity of demand for furniture that range from 2 to 3. In urban areas the estimates were higher (around 3) for lower income levels, while in rural areas were higher for the higher income groups (Mead 1982).

SECTION 2

FURNITURE-MAKING: A DOORWAY INTO MANUFACTURING

Small-scale furniture-making represents the most remarkable recent development in the local economy. This activity is particularly suitable for the economic development of a region like the west of Maranhao, where power and resources are highly concentrated, and the work-force lacks experience in manufacturing. In this economic context, furniture-making offers much better opportunities relative to other economic activities for social mobility, the acquisition of skills, and poverty alleviation. At the same time, furniture need not maintain the character of an "industry for beginners" forever. In the long run, if a sufficient stock of skills and knowledge is produced and accumulated locally, it could evolve into something more sophisticated, by increasing the value added of the process and moving into higher price-quality niches.

Using the evidence collected in my field research, in the following pages I underscore the nice effects furniture-making produces on the distribution of resources, and the opportunities it opens up for further technological upgrade, to make a case in favor of this form of industrial development for the region. Then I try to challenge the criticism that associates furniture-making to logging and sawmilling, defining them as environmentally destructive activities. Given the existing industrial structure in large scale sawmilling, furniture-making can expand without imposing any additional environmental costs.

I hope by the end of this section to be able to persuade the reader that the beneficial effects created by the furniture sector in this poor region teach something more general about the developmental role of low-technology manufacturing activities. In fact, it is possible to think of other manufacturing activities that - like shoe-making or garment - have similar properties and could offer similar opportunities for economic and social progress at the early stages of industrial development.

2.1 Easy Entry

A number of different factors contribute to making the furniture industry specially suitable for low and middle class individuals with a predisposition for self-employment. The most immediate reason is that it is possible to enter the sector with a very low initial investment because there is room for firms of very different sizes. Economies of scale exist in furniture, but only in the standardized sub-sector working in series. Micro-enterprises working on request for the local market do not actually compete with large scale firms selling standardized goods on a wider regional level. They represent a different sub-sector of the industry, where entry is easier, and that will always exist as long as there will be rooms of unusual size to furnish, unusual tastes, needs for repair, etc.

But the division between the two sub-sectors can also be crossed in a reasonable time-span; from very small operations producing for the local demand firms can gradually grow through small, incremental investment. At the entry level, production technology is also relatively easy to learn. Most of the operations performed by dedicated machinery is substituted with human work employing very simple hand tools. For this reason it is possible for people without strong previous experience in the sector to start at the bottom of the technology scale and then, in a few years, gradually upgrade their production. This has in fact happened to some of the most successful firms that were started by former traders of wood or garment 3 to 5 years ago, and whose production is now appreciated for its quality in faraway Brazilian cities.

2.2 Employment

Especially at the entry-level, where technology is relatively simple, the production process is also relatively labor-intensive, so that the growth of the small-scale end of the sector absorbs significant numbers of workers and thus contributes to reducing the unemployment resulting from reducing saw-mill capacity. The high employment potential of furniture manufacturing relative to other economic activities has been described in the Latin American context both

in terms of ratio of workers employed on output value (Meller and Marfan 1981, 204) and of employment-production elasticity (Amadeo and Camargo, 1992,103)[5].

2.3 Upward Mobility and reduced Income Inequality

The artisan nature of small-scale furniture manufacturing and the critical importance of economizing the use of non-standardized inputs make the small-scale segment of this industry unattractive for wealthy industrialists. This makes of the customized segment of this sector a sort of business reserve for the middle and lower classes. This happens because large part of the economic viability of a furniture workshop depends on the continuous effort to reduce waste to the minimum, making the most out of every piece of wood. A skillful and dedicated artisan can find the way to employ small chunks where others need first class wood, and knows how to saw each piece in order to increase its yield. Of course the full exploitation of these craft abilities depends a lot on the continuous presence of the owner at the shop-floor level. The need for close monitoring of the workers and the non-repetitive, artisan character of this production activity makes this sector unattractive for large industrialists.

The fact that rich land-owners or sawmill businessman don't usually invest in furniture seems to confirm this argument. In this region, their diversified corporations usually include livestock farms, sawmills, the production of coal, reforestation projects, rubber trees, and sometimes bus companies and gas stations, *but not* furniture. Many have successfully entered the sector of simple wood products for the construction industry like wood frames for doors and windows, and boards for floors and walls, because of their standardization. Still, in general they stay out of furniture because it usually requires a lot of non-standardized work and requires a much higher percentage of skilled labor than

[5] Meller and Marfan, working on data on the Chilean manufacturing sector, rank furniture as the industry with highest direct employment effects per unit of output, followed by metal products and clothing. When they limit the same analysis only to small firms, furniture comes third after transportation equipment and clothing (Meller and Marfan 1981). Amadeo and Camargo estimate an employment-production elasticity of .68 for a sector including wood, furniture, leather and others; this is the third highest elasticity coefficient after mechanic and food products (Amadeo and Camargo, 1992).

the repetitive and simple processes of transformation of the raw materials they are used to. Local elites in this area have typically based their wealth and power on the land and on the resources it provides, so their preference for simple production processes is not surprising.

Although it is difficult to explain this phenomenon only on economic grounds, by and large furniture has remained the economic arena for low and middle classes. The medium sized firms currently operating in the area have been started in most of the cases with very small investments and have subsequently grown larger. Cases in which furniture firms are owned and managed by the local landed elite are rare and their performance not impressive. In one case, one medium size plant was created mainly to serve public demand for school-desks, but is currently operating below half of its productive capacity. In another, a small-scale firms was started by a former sawmill owner spurred by the possibility to have access to a subsidized loan, but is currently not producing at all according to its owner because of the economic recession. A third small firm was started with public incentives by a person strictly related to large real estate owners, but was then leased to a different person to be operated.

I don't want to appear naive about the chances I give to poor unskilled workers to start their successful furniture business. These cases of economic upward mobility are possible but rare in such a poor economy. But if the chances for self-employment don't improve immensely for workers in small-scale furniture-making relative to sawmills, working conditions and opportunities for advancement within the firms do improve. In the furniture workshops senior employees are given the status of artisans and are paid per production. This payment system rewards their productivity and skills and, arguably, promotes an entrepreneurial mentality. In many cases they are also involved in the design of the pieces, and this gives them a unitary view of all the phases of the production process that is an important step towards higher responsibilities.

2.4 Reduced Depletion of Natural Resources

Unlike sawmilling, the furniture industry could expand its output without increasing deforestation. This can happen - and is indeed happening - because the small furniture producers in most of the cases utilize as their main inputs the waste and the by-products of the sawing process, and require little additional raw materials. Therefore, the development of furniture firms on the side of sawmills reduce the environmental costs of the sector of "wood and derivatives" by allowing a larger share of the inputs to be processed.

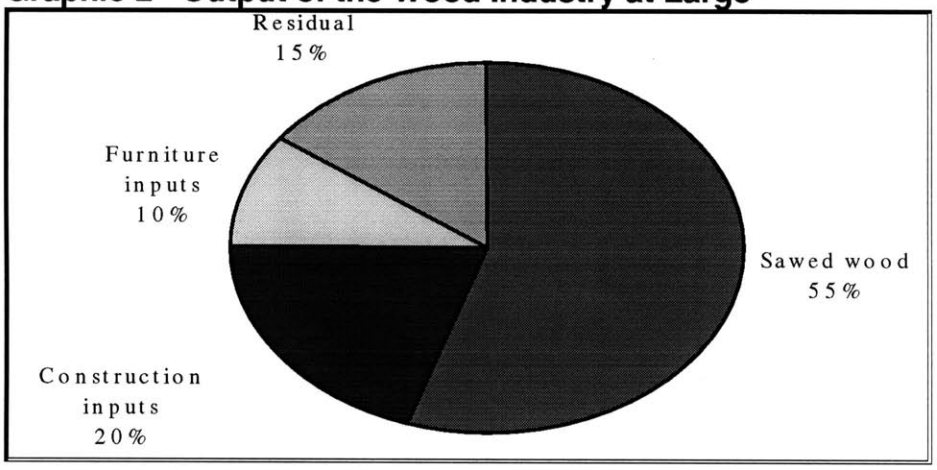
The simple processing of wood by sawmills has had devastating effects on the local natural environment in a very short period of time. As anticipated before, this process of intense exploitation of natural resources is now running into its limits. Two environmental constraints are imposing new burdens on the sawmilling activity: one is represented by the exhaustion of the non-renewable resources of the forest, the other is an increasing effort on the part of government agencies to enforce regulations aimed at preserving the bio-diversity of the local ecosystem. Both these forces impose additional costs on the local timber industry and, by making simple sawing less profitable, have contributed to the development of higher value-added productions in the region. In economic terms it thus makes perfect sense for the furniture segment of woodworking to introduce more environmentally sustainable production practices, as this sub-sector developed in response to the increase in the relative cost of the scarce environmental input.

In concrete terms, the process works as follows. The technique of sawing is such that, along with the primary output, it makes available a large quantity of wood material that, being non-standard in its size and quality, heavy and cheap, cannot be sold to far-away clients. In the case of a typical saw-mill, for example, out of 1.8 tons of wood in trunks, just 1 ton of sawed wood is obtained. The remaining 0.8 is a residual consisting in chops of wood of uneven size and shape. In the case of the factories producing laminated wood, instead, this residual consists in cylindrical poles made of high quality wood - the very heart of the trunk - of the size of a telegraph post.

Under the pressure of raising costs due to growing transportation needs or to the need to comply with environmental regulation, sawmills can introduce more sophisticated lines of production within their plants (mainly construction materials like doors, window frames and floors). This can increase the yield of wood of about 20%, bringing the ratio of the weight of the final product to that of the input from about 50-55 to 70-75%. Still, factory production cannot make use of at least 25% of the wood material that enters the production plants because it would need a case by case treatment to recuperate it to productive use. For the large sawmills this residual is more a problem than a source of income, and many of them still dispose of it in the worst possible way: burning it.

But, the increased price of wood makes it economic to transform also part of this residual 25% into natural coal or to sell parts of it to small-scale furniture enterprises that adopt artisan systems of production.

Graphic 2 - Output of the Wood Industry at Large



Graphic 2 shows what the output of the wood industry looks like after an additional part of the sawmill residual is recuperated for productive uses. Trough furniture-making another 10% of the original weight of the wood logs can find a productive application. This quantity of residual is not negligible given the size of the sawmills relatively to that of the small-scale furniture enterprises. The largest sawmills produce about 250 m^3 of this wood residual per month. One of the largest furniture manufacturers in Imperatriz uses about 100 m^3 per month of

this wood and employs 68 workers, while a cluster of 16 micro-enterprises in Acailandia employs around 60 and uses about 70 m^3 per month. Of course, the furniture sector doesn't use only residual: production in series requires some intermediate products like veneer and particle board, while customized, craft production, sometimes makes use of first class, noble wood. Still, comparing the size of the residual of sawing with the input needs of furniture gives a sense of the waste implied in trashing or burning this residual.

One could argue that the lower environmental costs of furniture-making are conditional on the existence of a sawing industry which, in itself, is environmentally devastating. My argument, which is not based on precise estimates of the effects of each possible productive activity, doesn't indicate which of them would be more environmental-friendly, but looks at different ways out of the current not sustainable economic structure of the region. From this point of view, the growth of a small-scale furniture sector in the surroundings of sawmills, by allowing a larger share of the wood to be transformed, represents an improvement in the efficiency of the wood industry at large.

SECTION 3
TECHNICAL ASSISTANCE AND TRAINING

The main technological innovations introduced in the furniture industry in the past few years have resulted from the initiative of a private supplier of inputs, and from the cooperative agreement that this firm has initiated with a semi-public training agency. These technical improvements have been limited to the finishing stage of the production process, but they have had a dramatic impact on the small firms' ability to compete at the national level. The positive social outcomes produced by this experience suggest that, under certain conditions, private, profit-seeking firms can successfully be involved in cooperative agreements aimed at disseminating new technology and creating new skills.

The technological advancement in furniture finishing, of course, was not the only determinant of the sector's rapid expansion. Regional economic trends and competitive advantages also played an important role in the process of local industrial development described before. The reason why I am focusing on this part of the explanation instead of any of the others is that the role of external agents on the firms' learning process is more interesting for policy purposes than the study of environmental conditions. In fact, this story represents a successful case of external intervention on the infant industrial sector from which other similar programs could learn.

3.1 Furniture Finishing: Cost-effective Technological Upgrading

The main technological innovations introduced in furniture-making in the west of Maranhao, as well as the major quality improvements in the furniture produced, have to do with the finishing part of the production process, which indicates all the treatments of the product' s surface following the assembly of the product - sanding, staining, sealing and varnishing. This point emerged from many interviews with entrepreneurs and other experts of the sector who stressed the critical importance of these operations on the final appearance of the piece of furniture. A wood of poor quality can be easily concealed at the eyes of most

customers by proper sanding, staining and varnishing and the shine and smoothness of the product largely depend on proper finishing as well. Finishing allows firms to partially diversify their range of products in order to meet different market tastes, without any hard change in the basics of their production line. Most of the final consumers don't even know that often a piece of furniture that looks dark brown or reddish is made of wood whose natural color is bright yellow.

By changing the appearance and the durability of the furniture, finishing has a great impact on its commercial attractiveness. Three more points qualify the importance of technical innovations in the finishing stage in the industrial development in this sector:

- Finishing innovations are cheap relatively to the ones relating to the production line narrowly defined, that require the purchase of new sophisticated machinery. In the case of finishing the only equipment required is a spraying device and a dry and clean painting room. The indivisible nature of this investment can make it too expensive for some of the smallest firms and perfectly feasible for the larger ones. But the installation of this basic equipment widens the range of products in a way that no other investment in machinery does. A minimum firm size that allows entrepreneurs to buy up-to date painting equipment is around 30 employees, but I have visited smaller ones that were applying the techniques they had been taught with more rustic and self-made devices, like a spraying pistol that worked with gravity force instead of compressed air. Once the room has the necessary equipment, basically every further investment in finishing is represented by the improvement of the skills of the painter.
- Small firms need to refine these techniques as much as the larger ones. Only, the large firms working on long production runs usually employ a more limited number of finishing styles to gain in efficiency from economies of specialization and standardization. The smaller ones who work on request have to be capable to use a wider range of finishing products and techniques, some of which can be pretty sophisticated, in

order to meet the potential demand for different styles and colors from the buyers. Therefore, their commercial success depends to a higher degree on the number of finishing styles they are able to master.

- In the last decade supplier firms have made available to firms in this region finishing techniques that revolutionize the content and the purpose of this stage of production. The new techniques not only can change the appearance of the wood employed, but also can simulate other, totally different materials like marble or granite. These "stone effects" are used in particular for kitchens, when the client cannot afford the more expensive real stone. Many other effects can be obtained with the help of properly applied and specialized chemicals: some imitate ceramics, others cover the wood with a layer of patina that makes the piece look old and valuable, others again look like old white stucco on *Luis XVI* furniture. Some of the new finishing possibilities invade the field of decorators: new poliuretan varnishes allow experienced craftsmen to place painted fabrics between the varnish and the wood or other decorations that, at the inexperienced eye, look like the product of artistic intaglio.

Until ten years ago even the most elementary finishing styles were basically unknown in the Amazon region of Maranhao. Very simple and natural products like shellac or wax were spread on the unfinished furniture to give some protection and shine to the wood. This rough finishing made it impossible for the furniture of this region to compete on the same markets with the more sophisticated products coming from the South of Brazil. This explains why in 1990 Maranhao, despite its richness in wood resources, still imported most of the furniture it consumed[6]. The little existing capacity was concentrated in the lowest segments of quality and price.

This situation has been changing in the last 8 years or so: almost all the furniture firms - even the smallest - possess some knowledge of the basic

[6] This dependency was common to the entire Northeast, that represented in 1990 about 18% of the national furniture market, but produced only 3% of the total supply. In the region North, the

techniques. Many of the larger firms have already installed up-to-date finishing cabins equipped with modern water filtered anti-pollution cowls, and drying stoves to be able to control the timing of varnish drying even in the most humid climate. Many of the furniture show-rooms in the towns of the region display samples of local production intended to exemplify some of the dozens finishing styles available to potential buyers. And it is not uncommon in Imperatriz to see craftsmen working in informal micro-enterprises employing just 5 people, mastering sophisticated finishing techniques like the marble effect and applying it to the working surfaces of middle class kitchens.

What has made possible this remarkable diffusion of manufacturing techniques in the last 6 to 8 years? One of the answers lies in the work of two different organizations that have been operating in the region after 1988. The first is SENAI the parastatal agency in charge of vocational training for the industrial sector, the other is SAYERLACK - a private producer and supplier of finishing inputs for the furniture sector. The two organizations have in different ways promoted the major technological changes I have briefly described above through the production of a considerable stock of human capital in the form of productive skills. Dozens of firm employees that have been trained by these organizations in the use of finishing techniques contribute to disseminate this knowledge among the firms by changing jobs. This human capital is thus available to the industry and traded among the firms like other commodities, representing a true competitive asset for the region.

In the following paragraphs I describe in more detail the two organizations, the roles they played at the local level in the process of building production skills, and the different models they offer for approaching the problem of workers' training and technology dissemination.

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imports of furniture from other regions occupied about 80% of the market. (personal interview with a representative of the association of wood manufacturers, Acailandia)

3.2 SENAI and SAYERLACK

3.2.1 The Problem of Responsiveness

Servicio Nacional de Aprendizagem Industrial (SENAI) is a quasi-public institution funded by the business community through mandatory contributions proportional to the book value of the wages paid by each firm. According to Brazilian law, all the firms hiring employees "on the books" have to contribute 1% of the total value of the wages paid to a fund supporting the national training system represented by SENAI. Each territorial office of SENAI receives then financing in proportion to the number and size of the firms contributing to the fund in that region and is managed by representatives of the business community. Although SENAI is in charge of workers' training for the need of formal industrial firms - the only ones who pay for it - it embraces broader public goals, like the professional training of minors, whose skills are not always employed in the industry or in the same area.

Critics of the excessive burden of social costs (the so called *custo Brasil*) imposed on employers advocate a reform of the current system of mandatory contributions, claiming that it imposes excessive rigidities in the labor markets, causing unemployment, and that it reduces the competitiveness of Brazilian firms *vis a vis* their foreign counterparts.

The system of mandatory contributions supporting SENAI, though increasingly opposed in Brazil, finds supporters among scholars and development specialists in other countries. Analyzing the experience of the United States, Osterman and Batt insist on the importance of considering the firms and not the individuals as the clients of the training programs, but warn the policy-makers that "too often, employer-centered programs are project-based and pay inadequate attention to system building" (Osterman and Batt, 1993, 463). As a result, the Authors seem to endorse the view that the private sector should support training programs on a continuous basis through industrial consortia, and that this support could enhance and not hinder the firms' competitiveness.

Another, more direct support to SENAI comes out of an effort to defend it from the attacks of neoliberal policy agendas that propose cuts to the agency's budget to increase the competitiveness of Brazilian manufacturing. This view points at the strengths of its teaching methods and at the model of business ownership it embodies as one that creates incentives to meet the training demand of its financial supporters. Similarly to what has been argued for the employer-centered programs of the US, the organization would allegedly be under pressure from its contributors to deliver useful services to the industrial sector. The tight linkage with the private business sector would guarantee that the training curriculum remains responsive to the practice of manufacturing and to its needs for skills. The same sources identify the main limits of SENAI in the inability or unwillingness to serve the high and low ends of the industry: to keep pace with cutting edge technology and to cater informal enterprises, who don't contribute to its budget through labor taxes (Castro 1996, Middleton et al. 1993).

My field research partially confirms the strengths and weaknesses of SENAI as described above, but also offers an example of how this institution, by cooperating with SAYERLACK, a private and efficient supplier of industrial inputs, was able to gradually improve the content of its courses and to reach a larger number of beneficiaries. In the pre-Amazon of Maranhao, although SENAI was trying hard to offer valuable services to the furniture sector - a growing economic force in the region - it could not by itself meet the needs of the private sector in terms of the technological content of its courses. It was indeed the private sector that spurred SENAI to serve better the needs of the industry, but not through the demand of the firms that fund it, as expected from reading the literature. It was a private supplier of paint and varnish that took initiative in this sense and helped upgrade the content of the training courses and their responsiveness to the local economy. The input supplier did not intend to keep SENAI accountable for the funds received, but saw in SENAI a potential partner that could promote its products.

The story of these two developmental agents and of their impact on the furniture industry can be read either as the case of an efficient private firm

promoting the institutional reform of a rigid and bureaucratic public agency, or as a case in which public and private resources were pooled in a fruitful synergy and ultimately improved the pace and intensity of technology dissemination. After describing the structure of the two organizations in this region Maranhao and their interaction in the local supply of services, I try to discuss in more detail the partnership developed between them and what it teaches to training and technology dissemination programs.

3.2.2 SENAI: Struggling to Serve the Industrial Sector

In the western region of Maranhao the courses for adults offered by SENAI have responded only in part to the needs of the growing furniture sector. Some of them are too long, others technologically unfit to the needs of furniture firms. These problems indicate that the mechanism linking firm financing and control to the agency's accountability, does not work as expected.

In furniture-making strictly defined, for example, where no private firm like SAYERLACK had any external influence, the content of the SENAI's courses is still based on a craft organization of production: every trainee is still taught the generalist skills of the "*marceneiro*", the professional artisan who follows all the phases of the production of a piece of furniture, from the choice of the wood chunks to work on, to the final assembly. Far from being biased towards the needs of larger formal enterprises, in this case the course offerings of SENAI inadvertently favor the smallest, i.e. the ones that still follow those techniques. Larger firms, as mentioned above, produce furniture in series and need more specialized skills like those of operators of dedicated machinery. If SENAI trains *marceneiros* instead of blue collars it is not because it receives no pressure at all to provide the skills needed by larger firms, but, maybe, because its technological rigidities win over those pressures. In the case of its office in Imperatriz SENAI cannot be blamed for neglecting the smallest and marginal productive units, but this indicates that the system of business financing and demand-driven training is not working as expected, because the major supporters of the local office don't get served properly.

In the case of finishing, SENAI finds similar problems to attend to the necessities of the business community, but has found a powerful ally outside the public sector. In its training center in Imperatriz SENAI offers every year a 300 hours' long night course in the finishing of furniture, meeting 5 days a week, intended for firms' employees. Unfortunately, very few workers of furniture firms have actually attended these courses, notwithstanding their negligible cost of $10. The participants end up being woodworking amateurs from the surrounding urban community and unemployed individuals looking for a potential profession. These courses, that have been offered since 1988 have also trained few people, about 12 every six months. This limited enrollment and long duration of the courses are part of SENAI' s style and ideology, that give priority to quality of education over class size and graduation rates.

But the excessive length of the courses is also one of the reasons why its courses had so little success in the industrial world. Such a voluminous education package is for an entrepreneur a serious investment in his/her business and one whose payoff is uncertain. From the manual workers' point of view attending night courses for 12 hours a week after their 8 hours of day work is a also big commitment. They would probably make it if employers gave them incentives in the form of pay raises. But, employers have very seldom encouraged their workers to take advantage of SENAI' s courses to upgrade their skills maybe because they are afraid of losing them as a result of better work opportunities they could be offered in virtue of the new skills they get. In sum, SENAI is offering a training package that doesn't fit with the needs of the business community and not just of the informal enterprises.

3.2.3 SAYERLACK: When Private Interests Coincide with Technology Dissemination

What would be a training model more in line with the firms' needs? An example of such a model comes from the more effective approach taken by SAYERLACK, the multinational manufacturer of varnish, stain, sealer and other inputs for the finishing of furniture that has been very effective in promoting the

adoption of its technology among furniture firms. The firm, based in Cajamar in the state of Sao Paulo, is the market leader in this sector with 65% of the national and 85% of the Northern Brazilian markets, and is expanding in foreign countries like Chile and Argentina. Its marketing strategy is highly based on short training courses in which new finishing techniques made possible by the products it supplies are demonstrated to firms' workers, and on professional technical assistance and problem-shooting offered to all its clients at the plant level. The commercial strategy of SAYERLACK deserves attention because it has resulted in widespread adoption of modern production techniques in a relatively new and unsophisticated industrial sector. Of course, the firm was motivated by its economic interest to promote the sale of its inputs; nevertheless, some aspects of its strategy could be incorporated within other technological extension programs to improve their effectiveness.

The firm offers courses in Imperatriz, the main center of the region, in a small but modern painting cabin installed in the back of its warehouse. They are much shorter than the ones offered at SENAI, just three days (for total 24 hours) long, but offer to the participants a hands-on experience with finishing: the techniques taught are experimented directly by the class on wood samples that, after being finished in different styles, are eventually brought back to the firms to be shown to potential clients. The courses are free and have been offered on week-ends every other month for the last four years to classes of 12 students, all coming from manufacturing firms.

Obviously, the material covered in these courses is much more limited and applied than that of the longer ones given at SENAI and assumes the previous knowledge of the basics of finishing. Entrepreneurs know and admit that SENAI offers a better education and that SAYERLACK' s courses are little more than demonstrations offered with the objective of promoting finishing products among the participants. Nonetheless, their employees are numerous at SAYERLACK whenever there's a training session, but until very recently they have not taken advantage of the course offerings at SENAI.

The firm' s organization in the Imperatriz office is very basic, but also highly professional. It consists in only two full-time employees: a highly experienced finishing technician and an administrative clerk. The technician is in charge of both training and technical assistance at the client factory-level; he has worked both in a furniture firm as a painter and as a technician for SENAI, but he has left this job because he is paid more at SAYERLACK (about 3 times what a technician at SENAI receives). The only other real resources of the firm at the local level are the products themselves and the technical bulletins that illustrate how to use them. SAYERLACK tries to make the most out of these very limited resources and to amplify their effectiveness by pooling them in many occasions with those of SENAI, the other supply-side developmental agent in the industry. With this partnership with a public agency, SAYERLACK is trying to improve the effectiveness of one of its two marketing areas: training. The other main area, technical assistance, is so critical for its client development function, that it has to be kept completely under its direct control.

3.2.4 Technical Assistance

SAYERLACK technicians proudly declare to offer broad-based technical support and advice free of charge to all their clients, regardless of their size. This assistance is offered on request at the plant-level and covers all the problems related to finishing, ranging from tips on the proper use of sand paper (a product the firm doesn't sell), to the design and detailed planning of painting cabins. The broadness and customization of this assistance is clearly a deliberate strategy for SAYERLACK, and one that its technicians underscore with pride. They cite colorful anecdotes in which SAYERLACK' s technician substituted a client's painter for two days in order to make sure that she could deliver a stock of furniture that had to be exposed at an important fair. In another case, they devoted several weeks of work to solve a problem with a client firm that was using a the varnish improperly, to paint bicycles. In sum, the firm is investing a lot of resources in its reputation for a dedicated post-sale technical service. The client firms value these assistance service they receive probably more than

anything else about the varnish supplier and are inclined to do what they can to perpetuate this relationship.

Like training, technical assistance is used by SAYERLACK to make it costly for its clients to change their supplier. These costs allow SAYERLACK to price its products higher than the competitors', because they incorporate the right to services for the buyer. Furniture entrepreneurs are perfectly aware of what they are really buying with the products, and declare that they are willing to pay more not only because they believe in the higher quality of SAYERLACK' s products, but also because of the possibility of receiving technical assistance when needed. In my visits to the firms I was always surprised when *all* the entrepreneurs either declared to use just products from SAYERLACK, or that they had tried different products, but they didn't work as well. Now I make sense of this behavior, thinking that they might be afraid of being given less timely and careful attention if they were found to be using the competitors' products.

On the cohesive power of this relationship, SAYERLACK has built the fidelity of its clientele, which explains at least in part its commercial success. Another part of it - the acquisition of new clients - depends more on the training activity and on the partnerships with SENAI in this area.

3.2.5 Cooperation and Emulation

The partnership between the two organizations was developed gradually after SAYERLACK decided to intensify its commercial presence in the region. Before installing a permanent office in Imperatriz four years ago, SAYERLACK offered three-day training modules of the kind it offers now for at least 3 times in SENAI' s teaching lab on the basis of an informal agreement with the local head of the agency. SAYERLACK didn't' t have any training facility of its own at that time, and organized these sessions as one-time events for larger groups of 30 to 40 firms' employees. In the following years, SAYERLACK has repeated these larger courses using SENAI' s facilities on an irregular basis. But the use of SENAI' s equipment is only part of a larger cooperation agreement by which SAYERLACK offers technical and material support to SENAI for the diffusion of

finishing techniques in exchange for an indirect promotion of its products. This is done in different ways:

1. The teaching material for SENAI' s courses is largely represented (for a rough 3/4) by the technical bulletins that accompany SAYERLACK' s products and explain how to use them. Through these SAYERLACK tries to make its product indivisible from the processes taught at SENAI, to make sure that workers learn the name and characteristics of the products along with the techniques.
2. SAYERLACK offers for free the finishing products required for the practice classes of SENAI, creating costs of re-adaptation for those who wanted to apply the same techniques with the competitors' products. The techniques described in SAYERLACK' s manuals and demonstrated at SENAI' s courses make use of products identified with names and codes that are firm specific. Even a painter with little experience, though, can learn how to obtain similar results substituting SAYERLACK' s products with the equivalent produced by its competitors. In other words, the costs of re-adaptation exist but are by no means insurmountable; this technology does not bind the firms that learn it to SAYERLACK, and thus represents for them the acquisition of a true competitive asset.
3. SAYERLACK has recently undertaken an effort to train SENAI' s instructors at its own expenses with the overt purpose of having them disseminate information about innovative finishing techniques and the products that make them possible. Based on the model of similar experiences made in the states of Minas Gerais, Mato Grosso and Goias, the firm has signed a contract with SENAI by which it agrees to supply a week of free training in its main production plant in the state of S. Paulo to 12 of SENAI' s furniture technicians working in 8 different Northern states. In exchange for this training SENAI will offer joint courses with SAYERLACK in each of the states at the end of the training period, to which SAYERLACK will contribute products for practical classes and teaching material. The firm wants SENAI to

be bound by a contract, to teach the new techniques as part of the curriculum of its regular, 300 hour, night courses.

The practice of cooperating with SENAI - it must be clear by now - is by no means accidental. Rather, it has become a nation-wide deliberate strategy that has proved to be cost-effective for SAYERLACK. Through SENAI the firms acquires:

a) *An institutional coverage and a reputation of seriousness for its marketing initiatives*;
b) *Access to a pre-existing organization of human and physical resources that can help the firm to reach more potential clients*; for example, in Imperatriz SENAI offers the possibility to use its larger painting cabin, that allows in a much larger class; in the state of Para', where transportation is very bad, SENAI offers finishing courses on a mobile laboratory installed on a boat. On this floating training center, at their return from the courses at SAYERLACK in Sao Paulo, SENAI instructors will teach the new techniques and demonstrate the firm' s products in the small towns along the Amazon river. Because of their being distant and dispersed, these centers would have been completely out of reach for the ordinary courses offered by SAYERLACK.
c) *The tacit promotion of its products described before* that takes place whenever SENAI uses them as teaching material in their courses. One could see the whole agreement as an effort by SAYERLACK to contract out to the public sector the training component of its marketing function, for which SENAI is better equipped and has dedicated personnel. SAYERLACK can thus concentrate its efforts on technical assistance, that is more critical for its success.

If this strategy indeed pays off for SAYERLACK, this means that all the costs incurred in terms of free supplies of products, free training offered to firm employees and SENAI instructors, free teaching material and, mainly, free technical assistance, have to be smaller than the beneficial effects generated. Part of these costs are charged on the client firms: as mentioned, SAYERLACK'

s products cost more than the competitors' ones. But my hypothesis is that SAYERLACK expects to recover large part of them from increased profits accruing from an increasing number of clients, rather than from higher products' prices. I am arguing this on the basis of an analysis of the types of services offered, more than on cost and price estimates, that I was not able to conduct. SENAI' s instructors' training, professional training courses, the provision of teaching material and product samples for training purposes are, in fact, all aimed at developing new markets and creating new users. Technical assistance at the plant level is the only other service offered by SAYERLACK that is not directed at developing new customers, but at retaining the existing ones.

The firm expects to open up new markets represented by furniture enterprises currently adopting outdated finishing techniques, or that ignore some of the possibilities offered by the new materials. To win these new clients SAYERLACK doesn't have to outbid any competitors, but just has to teach the new techniques, to generate needs that did not exist. And the rate of expansion of the firm in recent years seems consistent with the firm's strategy. The quantity of varnish sold by the office in Imperatriz has grown by 2.5 times in the last 2 years: a growth dynamic that could probably be explained more by an increase in the size of the market, than in the firm 's competitiveness *vis a vis* the other manufacturers.

If SAYERLACK really sees the adoption of modern technology as its goal, then the cooperation agreement between the two institutions is no transitory accident; SAYERLACK is not exploiting SENAI for its own goals, but has joined its efforts with the public agency because its objectives are really coincident with the "public interest" promoted by SENAI to have firms upgrade their finishing technology. One might wonder why SAYERLACK is not afraid that other firms reap part of the returns of its investment, by capturing part of the market for varnish that the firm has contributed to develop. A first answer to this question is that SAYERLACK is afraid of precisely this, and that is therefore teaching the new techniques in a somewhat firm-specific way. The other answer is that the firm uses the other of its services - technical assistance - to try to retain a

considerable part of the newly acquired customers. If they don't use the product (and pay the price premium) the furniture firms are denied the right to receive technical help, which is so important especially to those who have little manufacturing experience. Under these circumstances the two organizations are working together because they have *the same interest* to widespread adoption of new technology.

3.3 Reflecting on the Case

Reading with policy in mind this story of two external agents trying to influence the use of inputs in the furniture industry, we could make sense of it in two different ways. We could stress the comparison between the "good" private firm and the "inefficient" public agency and make the case that the latter has benefited from the methods and the motivation of the first. Alternatively, one could decide to highlight the cooperation part of the story, and show how this creative arrangement has brought about change in a way that none of the two actors could have by itself. In this case, one could try to draw some useful lesson from the design and implementation of this partnership and try to study how it could be replicated elsewhere. The remaining of the section addresses these two points separately.

The Private Model of Training. One could give the entire credit for the success of this story to the private supplier, arguing that its profit maximization goals are the driving force that has indirectly influenced the performance of SENAI, and that guarantee, more in general, the responsiveness of the two partners to the needs of industry. One cannot deny that SAYERLACK offers an excellent example of how to bridge the differences with the furniture manufacturers, and of how to define the relationship in terms that don't make the clients-beneficiaries uncomfortable, but that they can understand and trust. Concretely, the elements of this strategy consist in the following.

1. SAYERLACK defines the relationship up-front as a *commercial exchange*, a category that sounds familiar to the client firms. The deal implies paying higher prices for the finishing products and receiving back the right to

professional and reliable technical advice when needed and a periodical update on the latest innovation in the finishing techniques. This economic exchange sounds familiar to the firms, because it's something they do all the times; they are not concerned or skeptical in entering this relationship as they would be with an unclear one in which they are offered free services and asked for a big time commitment. On the other hand, SENAI offers training services that are nominally free, but whose implicit costs and expected returns are unclear and have to be assessed by the firms.

2. This relationship is less problematic for the clients also because it's *built incrementally* and allows them to experiment the services they receive and to price them. The first contact is established when the entrepreneurs are asked the small effort to invest few hours in their workers' training. Further costs are paid in the form of higher prices of the inputs, that bring with them the right to free technical assistance. At any moment, then, the firms can pull out of the relationship or reduce its intensity simply by stopping or reducing the purchase of inputs. SENAI, on the contrary, asks for a big time commitment up-front, without the trainees being able to estimate the returns that such an investment would generate, or to attach a value to this free service. In sum, winning strategies for SAYERLACK are represented by the low costs of entering the relationship, associated to the choice to charge overtly, even if indirectly, the beneficiaries of technical assistance. The products' higher prices and the demonstration sessions help the firms develop expectations about the advantages they will receive by entering the relationship with a technological extension service[7].
3. Having the same person - a qualified technician - doing both the technical assistance and the training for SAYERLACK also contributes to making the courses attractive. This way, clients can experiment the technician's ability to solve practical problems in their very production process and develop

7 This seems to me a practical application of the idea that prices, like systems of communication, convey information collateral to the transaction. In this case, rather than reflecting the value of the service, the product surcharge contributed to inform customers about the value of the package of services offered by SAYERLACK. The more general, theoretical point is laid out in a recent interview to M. Piore (Precis 1996).

informed expectations about the usefulness of the training courses he or she teaches.

Contrasting SENAI' s approach with SAYERLACK' s success, its weaknesses don't seem to lie in the fact that it offers services for free; after all the excessive time commitment that it requires from course participants it's an implicit price. Rather, it seems to me that SENAI is charging too much, in an unclear way and in lumpy, indivisible installments.

I have detected some initial signs of SENAI becoming a more flexible and responsive institution, although it is not clear to what extent they can be traced back to the work or the example of SAYERLACK. First, the class enrolled in the finishing course for adults in the fall of 1996 in Imperatriz for the first time was largely composed by firm employees (10 out of 12 already work in furniture firms) rather than by members of the community in search of a profession, as it was common in the years before. It is reasonable to believe that the pervasive ramifications developed by SAYERLACK in the industrial sector have affected the firms' demand for the services of SENAI, making them aware of their value. The higher attractiveness of SENAI' s courses could be also explained by its recent technological upgrade, for which, again, SAYERLACK is in part responsible.

Second, looking at different types of courses offered by SENAI in the state of Maranhao and at their attendance, one notices a shift towards the use of short courses and away from traditional modules of vocational training. From 1991 to 1995 the shorter - about 50 hours long - courses have increased their enrollment by 11%, while the total variation in enrollment (in courses of all lengths) has been a 2.8% reduction. The students-per-hour measure, that allows comparisons between long and short courses, indicates a 3.1% increase in the short courses mentioned, in contrast with a 43% reduction in the Apprenticeship courses (that last on average about 700 hours) and with a 18% reduction in the Professional courses for adults (about 270 hours long) (SENAI 1995). These data indicate that SENAI has understood that the industrial sector shows little interest in the long and comprehensive training curricula (i.e. Professional

Courses) and is trying to fix its training offer in consequence. At least in Maranhao, SENAI seems to be in part moving away from its rigid schooling standards, and towards more flexible and demand-driven training. This downsizing of training duration could be the result of its exposure to the private model of technology extension represented by SAYERLACK and to its higher ability to meet the training needs perceived in the private sector[8].

Private-Public Cooperation - The cooperative agreement stipulated between SENAI and SAYERLACK can be taken as a model in itself. The input supplier, in essence, helped SENAI to upgrade the content of its courses and to establish stronger ties with the industrial sector and its needs - objectives that the agency already considered part of its agenda, but that was not able to pursue by itself. Only through SAYERLACK and its deeper entrenchment in the industrial milieu, could SENAI reach many of the firms. Because of its nature of business-owned agency, industrial firms were supposed to be demanding services and driving it toward excellence, but this mechanism was not enough to spur SENAI to action. For example, a program aimed at training SENAI instructors in the furniture sector had been started under the pressure of furniture entrepreneurs even before the cooperation with SAYERLACK. Sending SENAI technicians to Canada to study in modern woodworking schools, this program had been successful at improving their skills but had produced little change in the courses offered. SENAI was paralyzed by conflicting goals: serving the industry, providing good standards of teaching, and choosing the technology that would have been more appropriate in the long run. It took the stimulus of SAYERLACK, and the injection of its direct economic interest for the adoption of the new techniques, to drive SENAI towards more effective training.

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[8] These could be different from the firms' actual needs for training. The whole argument in favor of the subsidization of training and technical assistance is based on the claim that firms, taken individually, would under-invest in training relative to what would be collectively in their interest. The problem rests in the nature of a public goods of workers' skills, and in the consequent free-ride dilemma faced by firms that invest in their production. For an overview of these issues see Lynch (ed.), 1994. On the basis of the public good nature of skills, Streeck also makes a strong case for public intervention in setting the curriculum of training courses, and for unions to prevent firms from pursuing short-sighted, opportunistic goals in this area (Streeck ,1989, 16).

Seen from the opposite point of view, also the contrary is true: SENAI has been essential for SAYERLACK to meet its goals. Without the well-established organization of SENAI already in place, SAYERLACK could never have influenced the firms' production processes in the way it has in just four years. SENAI has learned and applied the new techniques to its courses, spending more time and its better equipment in the activity that it knows better how to do: teaching. Through the new contractual agreement stipulated by the two agencies in Imperatriz, SAYERLACK basically delegates training to SENAI and keeps for itself the function of contacting new customers and cultivating the relations with the existing ones. In this successful story, SENAI acts as a facilitator in this forward transfer of technology to furniture firms from their modernizing supplier.

The successful results of this model of intervention seem consistent with the recommendations advanced by a recent study of technology policy in the United States. On the basis of a survey of 35 programs for technology transfer and of 7 original manufacturing technology centers established by the National Institute for Standards and Technology, Kelley and Arora have argued in favor of a model of intervention limited to bringing together developers and users of new technology. They call this an "Institution Building" approach as opposite to a "Service Provider" approach in which the public agency directly provides advice or training to firms (Kelley and Arora 1996). "Service provider" programs are found in this study to be costly for the public purse and often under-utilized by the potential beneficiaries, in comparison with policies aimed at creating or strengthening private institutions that mediate technology transfer and diffusion processes.

Building on these ideas, the contribution of the material evidence presented in this paper is to provide an example of how successful institutions of technological transfer can practically be built. The first difference with the US case is that here the institution builder is the private firm and not the public agency, as the initiative has been started by SAYERLACK. If we assume that similar partnerships can be started effectively by the public sector, this case

gives a good example of how the two parties can divide among themselves the effort. Public agencies can contribute to such institutions their infrastructure, their reputation and, when needed, classroom teaching hours. Private suppliers of technology can contribute - apart from the technology itself - their more pervasive connections with the business milieu and their ability to customize their services to the needs perceived by the firms.

This case also suggests that there could be a specialization among the between technical assistance and training. In a broad-based, industry-level partnership, the public agency could more successfully provide the training services, with some external help from product developers in keeping technology up-to-date and publicizing the courses among firms. Technical assistance could be taken on entirely by privates, in order to keep their business connections alive and strong.

A clear understanding of the private partner' s contribution, and of its motivation in entering the agreement can also help identify the conditions under which product developers can represent reliable partners. In this case, one of the reasons for the success of the partnership lay in SAYERLACK' s strategy of increasing the number of clients. This strategy, on its turn, was chosen because the region was largely underdeveloped and its manufacturing potential largely unexplored. The fact of facing an industrial *tabula rasa,* added to the valuable post-sale technical service, allowed SAYERLACK to focus on expanding the market, rather than on outcompeting other suppliers.

Is this a necessary condition for the economic goals of technology developers to coincide with the public interest? Maybe not. In well developed industrial sectors, similarly "public minded" suppliers of technology could be found among true innovators, whose technology brings real advancement to the firms adopting it. One can imagine, for example, that if their technology is protected by patent, their economic goals could be more in line with those of public extension and training programs. Further research in different social and economic contexts should help to illuminate these issues further.

SECTION 4

THE ROLE OF MARKETING INTERMEDIARIES IN THE FIRMS' DEVELOPMENT

Marketing intermediaries have played an important developmental role in the cases I have studied, but, unlike suppliers of inputs, were not directly involved in the transfer of new technology. The impact on the organization of production was only indirect; namely, they facilitated the further expansion of the already larger firms in the low-quality-and-price segment of the market. Some of the firms that were able to reach large enough volumes of output to start production in series, by hooking up with representative agents or other informal intermediaries were offered the chance to expand their output further, and thereby reduce unit costs. These cost reductions were achieved exploiting the well-known relationship that links division of labor with the size of the market.

Neither the larger nor the smaller enterprises, in essence, directly received pressures from intermediaries to upgrade production quality or technology. The main changes in the production technology promoted by agents depended on their demand for larger volumes of production relatively to what was required by the local market.

4.1 Market Intermediaries: Opening up an Avenue to Mass-production

Isolating the role of buyers and representative agents on the firms' development is a somewhat artificial exercise, because the choice of marketing intermediaries, of the markets of destination for the products, and the decision whether to organize production in series or on demand are strictly linked to each other in the growth strategy of furniture firms. With respect to such choices firms have taken two broad and different paths:

- Some operate mainly in local markets, rely mainly on their own direct marketing efforts, and are producing customized products in response to the specificity of each order;

- Others that have expanded in markets outside the urban areas of the region, are selling through professional middlemen, and are producing standardized items in series.

These two strategies are the only available because of the absence of small-scale intermediaries. The only agents specialized in furniture operate at a state-level, and are not accessible to firms unless they reach a certain production threshold. The firms producing on request are thus forced into the local markets and into the uncertainty that this brings about.

Local markets in the interior of Maranhao are still largely based on personal and direct relationships between manufacturers and buyers. In the towns I have visited furniture are sold either in showrooms belonging to local manufacturers, or in large retail shops, sometimes affiliated to nation-wide chains. None of these larger stores, that could theoretically offer a way into the local market for smaller firms, individually absorbs and sells substantial amounts of furniture, but, rather, they all trade also in a variety of other house-ware items like electrical appliances, lamps, curtains, carpets and towels. These shops usually cover the low-cost-and-quality end of the market and are served by the state-level representative agents.

Unless local manufacturers can meet the low wholesale prices of the standardized furniture offered by the agents, their products will not be considered by the local retailers. Local furniture firms would probably be competitive with these costs only if they reach sufficient volumes of production (say beyond 1000 pieces per month). No single local retailer or group of retailers can guarantee an outlet of this size and so the options for local firms remain limited to the two extremes of marketing directly to customers, or through state-level agents.

The absence of local level middlemen dealing with volumes commensurate to the size of the local market, forces the small firms of the region who are not considering the low-quality, long production runs option, to pursue alternative ways into the local markets. Their strategy has to rely on production on request, more artisan techniques based on case by case design and direct marketing to the final customers. Most of the smaller firms are still stuck at this

stage: they don't have standardized products, but realize pieces of furniture of any kind, adapting them to the tastes and to the necessities of the buyer. They have occasionally received orders from faraway states like Rio or Sao Paulo, or from the cities of the Northeast through networks of friends and relatives, but they have not been able to establish a reliable clientele only by word of mouth. As a result their monthly sales are subject to huge variations around their average levels[9].

TABLE 3 - TWO ALTERNATIVE GROWTH PATHS: BASIC DIFFERENCES		
Market of Destination	Local Demand	Capital cities in Northeast Brazil
Marketing Intermediaries	None. Direct Sales to Customers, or Opening Furniture Shop	Representative Agents
Organization of Production	Production on Demand Customized products	Production in Series Few standardized Items
Workers' Pay System	Craftsmen are Paid per Production, apprentices a fixed Salary	All Receive a fixed Salary

Because of unreliable demand, their productive capacity has to be very flexible and their concerns for this market uncertainty undermine their ability to plan on reasonably long time horizons. Consequently, these firms don't hire permanently anyone: they pay their carpenters per production and the other

[9] Firms serving local demand and producing on request have reported variations in their monthly sales of the same size of their average value. For example, firms would indicate their average monthly sales in $15,000, but also recall having reached $30,000 in months of peak demand. Although I'm not using the absolute numbers I collected, because they are probably biased by incentives to under-report sales, I still think that the information about the strong variability of sales can be considered reliable. The whole argument that follows is based on the fact that only entrepreneurs selling on demand for local markets have reported to me this phenomenon of high volatility in sales. The other firms producing cheaper and standardized goods like beds or wardrobes had totally different concerns. Their focus was on reducing costs, optimizing times, being on time for the deliveries and increasing workers' productivity, because their sales were stable and constantly growing.

employees a fixed salary, but can dismiss them at any moment with very short notice and they try to avoid making any long term indivisible investment. Their growth path is made of small, incremental investment and occasional reductions of capacity. The basic elements of these two alternative growth paths for industrial firms have been summarized in Table 3.

When the firms described in the column on the left of the table face increasing turnovers of sales and their stock of capital exceeds a critical threshold, two reasons induce them to think about moving into production in series. One is that they realize how time-consuming and costly is the effort to meet the ever different needs of the clients. Each of them asks for some changes in the design, color or dimension of the furniture. This requires visits to the client's house, continuous learning of techniques and the purchase of some different input in almost every case. The other reason is that, once the productive capacity has increased after some investment in machinery, reducing or stopping production becomes much more costly: the opportunity cost of the equipment grows to the extent that the factory has to be constantly producing or otherwise has to close.

A typical firm employing some 20 people and selling some $15,000 worth of furniture monthly for the local market faces two main alternatives to stabilize its outlet and start producing in series. One is to create its own sales channels in different markets, that is opening sales points or show-rooms in different urban areas. The other is to market its products through representative agents. The first choice gives firms more freedom to characterize their production in terms of quality and style, and implies a more gradual approach to production in series. The other option is to shift to the right column of Table 3, by contacting intermediaries in the furniture markets. This strategy requires a discontinuity in the firms' production by starting from scratch with long enough production runs to allow cost competitiveness. The first choice implies continuity in the strategy of incremental growth, the other calls for a leap in the volumes of production and, probably, in the quality standards.

Among the firms that I have visited, the ones that have been able to enter markets in other states through representative agents have, in fact, grown faster and larger. But their higher growth in sheer size does not by itself make of this option a more desirable form of industrial organization for the region. First of all, their growth in sales has often coincided with a reduction in the price and quality of their production. Low-cost production in larger volumes is not necessarily more profitable than high quality production on demand: as a matter of fact, my rough estimates indicate that the high quality segment of production on request yields higher returns, although on much smaller scale. In complex, the wealth created in the region and the spill-over effects to other sectors are hard to compare in the different sub-sectors of furniture-making.

As for the sustainability of mass production factories in the long run, they seem highly vulnerable to increases in the price of inputs because they compete mainly on costs. The cost of timber in particular seems likely to be growing in the future due to resource depletion, increased distance from the areas of extraction and more strict regulation on logging. Finally, labor conditions and the diffusion of workers' skills are lower in the firms producing in series, but these disadvantages have to be traded off with the lower employment generated by production on demand. In my research I couldn't conduct a serious evaluation of the social and economic effects of the two alternative growth strategies.

Why do the firms working with agents compete mainly on price and operate in low-quality, popular furniture markets? I'm not sure if agents don't deal in more intermediate quality, standardized furniture at all, or if they expect from the firms from Maranhao to fill only the low-end segment of the market, assuming that they wouldn't be able to compete in other classes of products. In the second case one could expect in the future some of the manufacturers to move upwards to market segments characterized by higher value added, while in former, firms should think of other marketing solutions if they wanted to produce higher quality furniture on a larger scale. In any case, in Maranhao agents have given growth opportunities only to cost-efficient manufacturers and strong

incentives for them to increase capacity and rationalize process. Their developmental role has consisted in allowing firms to concentrate on cost-saving investments and improvements, by giving more confidence to entrepreneurs about the stability of their markets. They have not been demanding in terms of quality standards or forced technological innovations, an area that has been influenced exclusively by supply-side agents.

4.2 Truck Drivers-Driven Economic Development: the Case of Itinga

I have found that marketing intermediaries have had a neutral role with respect to production technology even in one exceptional case in which they were responsible for driving the economic growth of a whole cluster of small furniture firms. Sturdy demand coming from an atypical form of intermediaries - truck drivers (or *camioneiros*) - resulted in the mushrooming of successful furniture micro-enterprises started by relatively inexperienced people.

This case of grass-roots manufacturing development is taking place in Itinga, at the frontier with the state of Para', where 10 small furniture firms have agglomerated on the side of the road BR010 to Southern Brazil. Starting from scratch, in the past 3-4 years they have experienced a rapid process of growth, and have consolidated their business position.

The first entrepreneur opened a furniture shop here 17 years ago to serve the local community, but after a while started to sell some of his products to truck drivers stopping at the local gas station on their long way from North to the South and *viceversa*, transporting their load of sawed wood or other merchandises. Then, one by one, other micro-enterprises opened on the side of the first work-shop, attracted by the business represented by the truck drivers. Some of the firms have been started by former employees of the first-comers that had originally come to this community attracted by gold mining or logging; others engaged in trade. As a result the entrepreneurs are all socially bound by common, humble origins and by common experiences with the start-up of similar businesses.

The products manufactured in Itinga distinguish this cluster from all the other firms I have studied in the region. They consist in pieces of heavy furniture, sometimes of unusual size, made of full wood like big tables, two to three meters long, whose top is made out of one single trunk[10]. These heavy tables or chairs are considered uncommon, fancy items in the South of Brazil and the truck drivers sell them easily in the states of S. Catarina, Rio or S. Paulo. Often the buyers in the South do their own finishing on the pieces of furniture before re-selling and sometimes eventually exporting them to first world countries like Japan.

Although these micro-enterprises have also received training from SENAI and with SAYERLACK products, finishing is clearly not the reason for success in this case. What is making the Itinga tables, chairs and beds so attractive for these business-oriented transportation workers, is their low price, their being unusually wood-rich and their convenient location along the road on which they are traveling for different business purposes[11].

The truck drivers are not professional intermediaries. Sometimes they are employees of transportation firms, but more often they are petty traders that work on their own account or contracted by large firms. Their business with furniture is doing so well that some have started an doing it on a continuous basis, collecting orders for what are considered exotic goods from networks of friends and acquaintance in their home towns. In other cases they can be considered economic actors who have identified opportunities for arbitrage in the significant price differential between pieces of furniture in different regions of the country. In this case the truck-drivers re-sell to other intermediaries - large stores and exporters - earning on the positive difference between this price differential

[10] Clearly the argument about low environmental costs of furniture-making does not apply to this particular case, in which the wood input does not consist in a by-product of wood sawing.

[11] The convenience of the firms' location has other dimensions that could be easily neglected as practical details. All the firms are actually located on a dirt road which is parallel to the federal road BR010 for a mile or two in the center of Itinga. Although the firms are clearly visible from the main, paved road, the truck drivers don't have to stop along the BR010, but can take the parallel and park in front of the firms. This makes shopping, negotiating and loading easier and safer, without requiring from the truck-drivers annoying deviations from their way. The furniture entrepreneurs know how critical their location is and don't want to move even if some of them have hardly enough room to work. For the future some of them are thinking of keeping the space alongside the road as a show-room and manufacture in some other place.

and transportation costs. Full-wood tables are sold in Itinga at $350 each, but I would expect their price to rise from 5 to 10 times at their retail destination. This differential, on its turn, depends on cultural differences between the two regions of Brazil, that make the same item - say an unfinished long and heavy table - a luxury unique piece in the South and an impractical and old-fashioned item in Maranhao.

In the start-up of their business the furniture entrepreneurs in Itinga have found allies in the low technology of the goods and the initial small size of the market. Truck drivers have not bought furniture in bulk quantities from the beginning. They have started buying occasionally for themselves or for faraway retailers individual pieces of furniture that were exposed in the small work-shops along the road. The success of the first sales has induced them to increase the number of pieces traded and has attracted more truck drivers into the business. The drivers would stop their truck in front of the firms and ask every firm owner for the piece or pieces they need. For orders larger than two or three pieces usually the manufacturers are accorded a week or two to deliver the furniture: the *camioneiros* sometimes order on their way to their destination and pick-up the pieces on their way back. Only recently have the *camioneiros* started to order furniture in larger batches that the small furniture-firms can hardly produce in short periods. When they place larger orders, the firms still have a hard time delivering because of lack of working capital and resort to sharing of the order. The intermediaries have, thus, been able to pull up the size of production in a community that had no productive capacity because their business has grown with that of their suppliers. This more gradual pressure on the firms in Itinga to increase their volume of production also distinguishes this case from that of the firms in Imperatriz that sold through marketing agents. Having to deal with non-professional intermediaries allowed the micro-enterprises in Itinga to enter manufacturing with very small production volumes, to learn the basic techniques in the industry, and to grow incrementally under the pressure of increasing demand. This option represented by semi-professional, small-size intermediaries

was not available to firms in Imperatriz and Acailandia, that could not hook up with distribution networks unless they reached a sizable productive capacity.

Similarly to what happens with conventional representative agents in the other towns, though, truck drivers are not promoting any kind of production upgrading in the firms in Itinga. They are just asking for certain kinds of productions that are particularly requested in Southern Brazil. But such productions are technically very basic, mostly based on manual work and on simple tools and equipment. Their success is based mainly on the large availability in the region of varieties and sizes of wood that in the South have become very rare. The most successful item and the typical production of Itinga' s micro-enterprises is a model of table offered in different sizes, that can be easily disassembled in four, full-wood pieces: the top plus a three-piece base.

The absence of any finishing indicates how little value is added locally to the cost of raw materials; similar to what is happening in the case of production in large series, the absence of any firm-specific and knowledge-based competitive asset in Itinga makes this kind of production vulnerable to shifts in factor supply in the industry. For this reason, even though truck drivers are playing a fundamental role in spurring this startling process of economic development in a remote locality of Maranhao and offering an entry point into manufacturing to poor and unskilled people, they cannot be counted upon for the next steps of such process: the upgrading of technology and quality. The *camioneiros* are happy with unfinished tables whose price is still largely influenced by wood costs. As in the case of the larger furniture firms in Imperatriz and Acailandia, the stimulus for product upgrading and learning of new skills has to come from different sources.

4.3 Marketing Intermediaries and Industrial Development

Generalizing from the experience of small-scale furniture firms in all the three towns studied, one realizes that the contribution of marketing intermediaries has not consisted in promoting the adoption of new technology. The role of marketing intermediaries has been narrower and more traditional.

They have allowed firms to adopt a longer time horizon in their development plans, by guaranteeing an outlet for the firms' products if certain price and quality standards were met. They have reduced the uncertainty linked to the volatile character of local demand and offered a way out of the ills of production on request to the larger firms willing to standardize and rationalize their production.

This absence of backward technological transfers to the furniture firms from buyers or retailers seems surprising in the light of the recent literature that describes this as a common phenomenon in the modernization of industry in developing economies (Dussel et. Al. 1996). This literature, that analyzes production and distribution in each industry as "commodity chains", tries to assess which stage of the chain exerts leadership over the others and influences their practice and organization. The theory of commodity chains classifies as "buyer-driven chains" the industries in which marketing intermediaries directly influence technological change in the production process of firms (Gereffi and Korzeniewicz 1994). Due to its nature of a labor-intensive consumer good, furniture is expected to fall in the realm of buyer-driven chains and correspondingly its technology and quality to be dictated by brand-named merchandisers and trading companies (ibid.: 97).

But furniture, in the case of Maranhao, doesn't fall in the other category envisaged by that theory either: that of supply-driven commodities. Those are, in fact, defined as industries - like for example the manufacture of cars - in which the producers themselves are powerful enough to impose standards of technology and quality forward in the chain to buyers and consumers. In this case, as shown above, traders certainly didn't push through innovations in the line of production and the main technical improvements were promoted by the action of supplier-side agents.

To be fair to the theory of commodity chains, one should make it clear that it has been developed to describe the workings of global production and trade. This could explain why the industrial organization of furniture-making in Maranhao is not well captured in the taxonomy of commodity chains: the local production of furniture is not directly exported outside Brazil and is not connected

to developed international trade networks. The low tradability of these products depends probably on high transportation cost of unsophisticated furniture resulting from their big volume and heavy weight. Moreover, and probably more important, the organization of production is still at its first stages and buyers from other Brazilian states have discovered only recently the new suppliers of this region. As a result of these still underdeveloped commercial relationships, producers from internal Maranhao are by and large free to organize the details of production independently from the influence of traders.

Does this evidence from Maranhao suggest the existence of a third category of commodity chains, in which the production standards are influenced principally by input suppliers and technology developers, instead of producers or buyers? Given the infant stage of development of this industry and of its market connections, it is probably incorrect to consider this case even comparable with those of world traded commodities. One could instead use this case material to underscore the importance that supply-side agents have in the technological upgrade of local industrial systems at their first stages of development. In a backward industrial context like the interior of Maranhao, national level input suppliers like SAYERLACK are probably the only firms in their industry that are large and powerful enough not to take the industrial structure as a given. It's them and not the marketing intermediaries who think strategically about the sector's future, and who perceive a clearer economic interest in the growth of a cost-effective manufacturing sector. In this view, vendors and technology developers can be considered the last resort for updating technology, when dense industrial agglomerations or connections to world markets - two well studied enabling conditions for innovation - are absent[12].

[12] A recent study by Glasmeier on the small-scale manufacturing enterprises of the Appalachian region of the United States reports similar findings with respect to the importance of technology suppliers and vendors in the learning process of firms. In the context of a relatively underdeveloped region, small firms are reported to operate outside densely-knit commercial networks and to receive most of the information on the available technology from personal visits of suppliers of technology and from magazines. In her study based on interviews with entrepreneurs, supply-side agents are ranked among the most important sources promoting the adoption of new technology. The findings of this study were presented by Amy Glasmeier in a seminar offered at MIT on the 17th of October 1996.

A role for marketing intermediaries more consistent with my findings is described in other empirical studies of local economic development in Brazil.

The intermediaries' contribution to the firms' development was similar in my case to that described by Finan in his account of the relationships between farmers and traders in the state of Ceara' (Finan 1988). In the case of Ceara's Ibiapaba plateau, an agricultural region about 650 km east of the west of Maranhao, intermediaries were found to have developed preferential relationships with some suppliers that served the purpose of shielding the latter from the uncertainties of free market forces. By matching-up with one or few traders, producers behaved differently from what a short-term profit-maximization theory would predict. In order to be protected from the future risks of cheating by their commercial partners', and from losses caused by falls in prices, they were willing to give up part of their short-term profit margins (ibid. p. 702). Without developing equally "protected" commercial relationships, the furniture-makers of this region of Maranhao who take the growth path involving the use of agents, receive similar coverage against the unstable character of local demand.

Another successful case of industrial development in a low-technology industry also offers an interesting comparison with respect to agents and buyers. In the history of the formidable growth of the shoe-making cluster of the Sinos Valley in the state of Rio Grande do Sul, marketing intermediaries seem to have performed a wide range of tasks, but their impact on the industrial organization of the region looks somewhat similar to what is now happening in Maranhao.

Under this system the industry expanded rapidly during the 1970s and the first half of the 1980s. Product development and marketing was taken care of by the export agents; they also enforced adherence to basic quality and delivery standards. Export manufacturers concentrated on increasing scale and competing on price. The factories expanded so fast that workers had to be bussed in from outlying regions. Several manufacturers relocated their factories closer to where the workers lived. Production was organized along conveyors, work was fragmented, training times could be kept short and wages low (Ruas 1989). Profit were re-invested for capacity expansion rather than innovation. Fordism seemed to reign supreme in the valley. (Schmitz 1995, 14-15)

The role of buyers in the transfer of technology looks more similar in this case to what a commodity chain approach would predict. At the same time, the incentives offered to the standardization of production resemble what is happening now in Maranhao in the furniture sector.

Two differences could account for the richer role of buyers in Rio Grande do Sul. First, the Sinos Valley has a longer manufacturing history than the developing west of Maranhao - at the end of the 1960s more than 400 shoe enterprises already worked in the region. In addition, the marketing agents that drove the expansion process described by Schmitz were initially buyers from international retail chains, and not domestic distributors. These differences could explain why in Rio Grande do Sul and not in Maranhao agents were active in designing the products to be purchased from the local firms and in assisting them to achieve the required standards of quality and price: because they had in front of them an already established industrial base, that they could compare in terms of quality and cost to other international manufacturing centers. Nevertheless, traders didn't pull the firms into more sophisticated lines of production, but, as it's now happening in Maranhao gave opportunity for expansion only to larger firms interested in large scale, standardized manufacturing.

SECTION 5

CONCLUSIONS

This paper has analyzed the economic growth of small-scale furniture enterprises in a region of the state of Maranhao that is struggling to convert its economic base to more sustainable activities. The small-scale furniture sector, in this process of economic diversification, possesses desirable characteristics relative to other activities that could be developed: it imposes lower environmental costs on the region (relatively to saw-milling), and it could help reduce poverty by generating opportunities for self-employment and salaried work.

The low technological level of furniture-making at the entry level makes this activity particularly suited to the economic development of a region in which economic resources and manufacturing experience are scarce and highly concentrated. The easy entry in the furniture sector, and the low start-up investment make furniture relatively accessible to low and middle class people; while the artisan, non-repetitive nature of this activity make it unattractive to the local industrial elite. Easy entry at the low end of furniture-making doesn't exclude the possibility for small firms to subsequently move up in the sector's internal ladder, to technically more sophisticated sub-sectors.

With respect to the environmental aspects of economic development, that were not here studied with the attention they deserve, this analysis suggests that the output of certain segments of the furniture industry could be increased without any significant change in the rate of deforestation, just by improving the efficiency in the use of the wood inputs in the industry largely defined.

This analysis has also tried to understand the role of the firms' commercial partners - their suppliers and buyers - in shaping the set of opportunities and constraints they face on their development path. Particular attention was dedicated to the impact of such external agents on the acquisition of new techniques and on the organization of production in series or on demand. The main findings of the paper with respect to these issues are summarized in the following points.

Public-private partnerships: Coincidence of Interests

A successful case of adoption of new production techniques resulted from the joint efforts of a private manufacturer of inputs and of a quasi-public agency in charge of vocational training. This case indicates that publicly sponsored training programs can make use of the resources of private suppliers of technology whenever their economic goals are found to be coincident with the public interest to the diffusion of new technology. In this case, the private supplier of varnish shared the public interest to the technological upgrade of the furniture sector, because it pursued a strategy based on increasing the size of the market. This, on its turn, depended on the large share of the market it occupied, the valuable technical assistance service it offered to its clients, and on the backwardness of the furniture sector more in general. The value that furniture firms attach to the relationship with the supplier of inputs and to the services it incorporates, reduced the risk for the supplier of loosing its clients after having invested in their upgrade.

Public-private partnerships: Division of Labor

This sort of cooperative agreements can also benefit from a division of responsibilities between the private and the public partner, that assigns to each the tasks that it can perform better. In the case of the successful partnership studied here, aimed at the dissemination of finishing techniques in the furniture sector, the public agency was assigned teaching responsibilities, and contributed physical facilities and personnel. The private firm - according to this experience - can be most useful in opening up and cultivating the relationships with the clients, and in supplying the technology itself.

Supply-led technology adoption

In contrast with recent empirical findings coming from sectors in which global sourcing is the rule (Gereffi and Korzeniewicz 1994), marketing intermediaries didn't exert any influence on production technology or contribute to upgrading it.

This role was taken on by supply-side agents. In the cases I reviewed, marketing intermediaries tended to reproduce the existing pattern of geographical specialization in the industry, whereby the western region of Maranhao engages in unsophisticated, low value added manufacturing activities. The suppliers, and not the buyers, have perceived the potential economic returns that the upgrade of the small-scale firms of the region could have generated for them, and have invested to see them materialize.

The demand side

Marketing intermediaries have enhanced the firms' growth in more traditional ways, by connecting them with larger markets characterized by different tastes and that would have been out of reach otherwise. The formal representative agents have thus allowed firms to reap economies of scale and specialization, by giving them the opportunity to increase output and to reduce the volatility of their sales. The problem is that in most of the cases the size of these intermediaries is too large relatively to that of most of the manufacturing units of the region and so the investment required to enter this system is out of reach for the furniture entrepreneurs. The exception to this rule is the case of Itinga where intermediaries have been able to help the firms' with their start-up and in their very first stages of production. This could happen because the intermediaries were themselves beginners (their primary job was of transportation workers) and their business turnover has grown in size along with that of their furniture suppliers.

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