Transforming the Construction Industry to Solve the Housing Deficit in Argentina.

by

Gustavo Bottan
and
Julian Eguren

Submitted to the Sloan School of Management
in Partial Fulfillment of
the Requirement for the Degree of

Master of Science in Management
at the

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May 1996

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Signature of Author:

Sloan School of Management
May, 1996

Certified by:

Professor Donald Lessard
Professor of International Management
Thesis Supervisor

Accepted by:

Susan C. Lowance
Director Sloan Fellows Program

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Abstract

This work will focus on the housing deficit problem of Argentina. The thesis objective is to create an awareness in the international business community, Argentine private sector and Government, of the significant possibilities that exist to overcome this deficit, transform the construction industry, and to contribute in bringing Argentina towards a more modern economy.

We are proposing the transformation of the housing construction industry from an artisan-based brick and mortar system to an industrial-like process, by revamping the whole value-chain basing it on wood technology.

Our work quantifies the housing deficit, compares the advantages and disadvantages of wood-based construction and highlights the existing and future potential of regional wood resources as the springboard for a new industry. The existing cultural, political and legislative environment is also covered, as it is significant in determining the feasibility of transferring technology and gaining acceptance of this construction method.

Thesis Supervisor: Donald Lessard

Title: Professor of International Management
# Table of Contents

**Introduction**  
Page 4 to 5

**I. Importance of the Housing Sector**  
Page 6 to 14

**II. Assessment of the Argentine Housing Construction Industry**  
Page 15 to 34

**III. Suitability of Wood-based technology**  
Page 35 to 57

**IV. Low Income Housing**  
Page 58 to 65

**V. Conclusions**  
Page 66 to 86

## Appendix List

**Appendix 1: Understanding How the Housing Sector Works**  
Page 87 to 91

**Appendix 2: Why Now in Argentina**  
Page 92 to 99

**Appendix 3: Wood construction in Developed Economies**  
Page 100 to 122

**Appendix 4: How Wood-based construction affects the Argentine Housing industry**  
Page 123 to 127

**Appendix 5: Availability of Raw Materials**  
Page 128 to 136

**Appendix 6: Primary Converting Industry**  
Page 137 to 150

**Appendix 7: Building Materials Comparison**  
Page 151 to 169

**Appendix 8: Financial Considerations**  
Page 170 to 177

**Appendix 9: Low Income Housing**  
Page 178 to 186

**Appendix 10: Low Income Housing Programs in the Region**  
Page 187 to 227
Introduction

The concept for this thesis came about when discussing the potential of Argentina to rejoin the ranks of the developed economies of the world, enjoying increased economic growth and raising standards of living. Through the 1930’s, Argentina was among the highest income countries in the world but had since declined significantly, becoming marginally important to the world’s markets. We realized that such a change back to prosperity could never be accomplished without first transforming its construction industry as the vehicle to increase economic activity, improve income levels, lower unemployment, and resolve its chronic housing deficit problem.

Thus the objective of our work is to put forward a message of possibilities to the Argentine government; local and foreign private businesses; developmental agencies; local unions; universities, technical institutes and research centers; as well as to think-tanks and individuals interested in pursuing this subject further.

Recent political changes in Argentina have launched an era of economical stability and the development of reform programs which affect most areas of social and economic activity. These include the modification of laws and regulations which impeded the housing construction growth, an important sector of the economy.
However, all plans, programs and expectations are still based on a conventional construction industry characterized by the use of brick and mortar technology. Our thesis is to demonstrate the importance of a transformation of the housing sector to the revival of the economy; generating higher employment, more efficient use of capital, and the fastest resolution of the housing deficit, now possible by the use of new construction technologies based on wood and derivatives.

In the following chapters we will strive to quantify the housing deficit of Argentina and the reasons which led to its present state; highlight why we believe this is the appropriate time for its reversal; describe the alternative construction technologies based on wood; show the Argentine potential for the development of its forestry resources and primary wood industry; list the potential effects on employment and decentralization of its economy; describe the main obstacles to its implementation and propose a series of recommendations for all sectors involved.
Chapter 1

Importance of the Housing Sector

The importance of the building industry to any country’s progress is based on the fact that it represents a considerable share of the economy; investment and production; it employs a large number of people; and is connected to so many other industries, some of which work almost entirely for it. Studies show that each dollar invested in the capital goods sector gives rise to more dollars of economic activity in other areas of the economy. In this respect, the housing construction industry is no exception. Proper understanding of the construction sector of an economy is important and we have included a more detailed account in Appendix 1.

Employment in the residential construction industry, which comprises between 1% to 3% of the economically active population in developing countries, is associated with employment in other industries in about the same ratio: one additional job in residential construction gives rise to about two other. Yet, this linkage is not what matters the most but the housing sector’s real side-impacts on the economy. Income and employment multipliers are not so different for the housing sector and other investment sectors; thus, in conditions of close-to-full employment, shifting of resources towards or away from the housing sector is of no particular benefit. However, housing can still influence the economy in unique ways. Its overall price level and rate of change has an impact on inflation rates, levels of personal savings and of household wealth. It can also have more pervasive and chronic effects through the creation of underlying factors affecting job
mobility and thus labor costs and unemployment levels, for example if housing availability and price differentials are significant in different parts of the country.

A vigorous housing sector contributes towards broad social and economic objectives. In summary, some of its benefits are:

- Alleviating poverty
- Controlling inflation
- Generating household savings and mobilizing household productive resources
- Generating employment and income growth
- Enabling social and spatial mobility
- Increasing productivity
- Generating investment growth
- Reducing the government budget deficit
- Developing the financial system
- Protecting the environment
While the above list may be incomplete, it does provide a broad view of the benefits of a well-functioning housing sector. Appropriate housing policies can help achieve these goals while inappropriate interventions stifle the sector, block supply and frustrate demand, reduce quality and choice, increases costs, and damages the economy as a whole.

**Defining the Problem:**

Argentina suffers from a chronic housing deficit. Affordability has been limited by many factors, primarily high costs of construction and a lack of financing mechanisms both of which have affected the country for a long time.

In a 1961 survey of the Argentine savings and loan potential for the International Cooperation Administration, an immediate need of 86 million square meters of housing it was estimated for the country. Calculated on the basis of 70 square meters per home, this meant that the housing deficit was somewhere in the vicinity of 1.23 million dwelling units.
The Construction sector in Argentina has been suffering significant fluctuations which can be visualized as a share of GDP between 1980 (8.1%) and now (6.2%).

The reasons for this are many, i.e. periods of high inflation and recession, scarce credit and the resulting impossibility of developing a real estate market according to the population’s needs.

Due to this political and economical instability, the construction industry activity did not keep up and the Argentine housing deficit increased. Between 1980 and 1990 about 190,000 new houses were built every year, but it was necessary to construct 252,000 units per year just to hold the housing deficit steady at 3.0 million units (based on 60 m2 dwellings), on the basis that almost 112,000 units became obsolete annually. The severity of the problem varies significantly within regions, so extreme cases compound the problem.

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The shortfall in Argentina has been increasing at a rate of approximately 60,000 units annually, reaching today a level of close to $60 billion dollars of required investment to cover the complete Argentinean housing deficit. Present day actual expenditure is only $1,506 billion dollars which means that at this level of expenditure it would take more than 40 years to solve the deficit problem.

Like in so many emerging economies, the growth of Argentina’s main cities was related with changes in the overall economic structure of the country. Argentina’s industrial development took place in populated areas, the only ones which offered labor possibilities. Many people from rural areas moved to the cities looking for improvements in their standards of living. The city offered better salaries and access to sanitary, educational, and housing services. This process started around 1934 and continued well into 1970. After the second world war, Argentina was in a relatively good position in the world but mismanagement and political divisions reduced its growth and industrialization. This aggravated the labor situation and more people continued to flock the cities in look of work, this time settling in surrounding areas in marginal dwellings.

Urban growth patterns vary significantly between continents. In the heavily urbanized countries of Latin America, such as Argentina, Brazil and Chile, more than 75% of the population lives in urban areas. Growth rates in these countries are expected to be around 2% per year, attributable in part to the increased number of households formed resulting
from falling household size. The future prospects for many of these people swelling the ranks of urban dwellers will be bleak, presenting a special challenge to those who provide housing and public services. In 1988, nearly 25% of developing country's urban dwellers were estimated to be poor, some 330 millions people. And despite the generally good record of urban income growth that accompanies economic development, the proportion of poor urban families is not expected to change appreciably within the next two decades. Many of these families will be housed in slum and squatter settlements, creating pressure on governments to devise solutions for housing the poor.  

The housing standards in Argentina, vary across regions, but overall is far better than in most developing countries. According to 1991 official data, 93% of total dwellings had electricity services while 92% were connected to the natural gas network or used bottled gas. Similarly, 73% of the population had safe drinking water within their own dwellings, while 69% had sanitary services (only 34% had sewerage services). Yet, overcrowding worsened compared with the early 1980s: a quarter of all dwellings were overcrowded in 1991 compared with 18.5% in 1980. The regional distribution of these figures is heterogeneous, while almost 100% of the population of the capital city have sewerage systems. This share is only 31% for those living in the Buenos Aires province and shrinks to 13% in provinces such as Santiago del Estero or Chaco or 7% in Misiones. New official information shows that 3,039,018 houses were deficient in one or more major aspects in 1995. We have identified four types of deficits or housing needs. First, those

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2 Housing, Enabling Markets to Work, a World Bank policy paper
houses whose material quality is beyond recovery and should be replaced with new units. By 1995 these represented 510,743 units. Second, units that show some inappropriate living conditions like absence of finishing or sanitary installations which are recoverable by further building or reconstruction. As of 1995 they represented 1,635,014 units. Third, units in good condition, but because of the size of the house are not appropriate for lodging. In 1995, 454,482 units were in use by more than two persons in a room, promoting promiscuity conditions. Fourth, dwellings where people are forced to share them with others. As of 1995, 438,779 units were in this category.

By ranking the deficit we can define a ‘Critical Deficit’, which is the sum of the first and second categories amounting to 2,145,757 units for the year 1995.

Overall, if we analyze all types of deficits (about 3.0 million units) we find that the number of people affected reaches 12,782,279 out of a total population of 34,180,171 in 1995. This represents 37% of the population suffering some kind of housing deficit.

Argentina must take immediate action if it is to become inserted among the industrial nations of the world. A look at the graph below, qualifies this opinion.

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3 Bases de una politica Integral de Vivienda, Subsecretaria de Vivienda, Secretaria de Desarrollo Social, Presidencia de la Nación.
Of the industrialized countries included in the graph, the United States not only has the highest GDP per capita, but also the lowest cost per unit of living surface. Its housing industry, unlike those of its European counterparts, is primarily based on wood construction. On the other extreme, among the countries in the South American Cone, Argentina has the highest GDP per person, yet has the lowest housing affordability.

In summary, Argentina is clearly lagging the industrialized nations in the housing sector. The problem arises from a combination of high ownership cost and lack of viable financing. As we will see later, some of these problems are already being addressed as a result of the new economic and political reality in Argentina. Although we will touch upon all factors, including finance availability, our thesis argues that construction costs can be significantly lowered through the modernization of its construction industry by going from
traditional artisan-like brick and mortar construction to industrial-like methods based on wood technologies.
Chapter 2

Assessment of the Argentine Housing Construction Industry:

Housing construction is a complex set of activities of crucial importance to any national economy and to the socioeconomic well-being of its inhabitants. In order to evaluate these activities, we provide a description of the industry's value-chain and a reference to the determinants of its competitive advantage using the Porter Diamond framework.

Home Building Value-Chain

<table>
<thead>
<tr>
<th>Forest &amp; Other Products</th>
<th>Primary Conversion - Building Materials</th>
<th>Engineered Products</th>
<th>Engineering &amp; Design</th>
<th>Construction</th>
<th>Financing</th>
<th>Marketing</th>
</tr>
</thead>
</table>

The construction industry in Argentina is primarily based on the southern European model. Housing is therefore primarily built with brick or cement blocks with little wood, primarily used in roof beams and parquet floors. This has given rise to a raw material sector dominated by cement companies and a primary conversion activity driven by smaller brick producing companies. Few building products have much engineering designed into them and most of the housing construction is left to the artisan (mason). House design and engineering is based on just a few types of building materials and construction is performed by small constructors (houses) and medium to large size firms (apartment buildings). The final stages of the value chain are also very important in determining affordability and actual housing demand: Financing has been quite inefficient or non-existent and house Commercialization has been performed by small realtors, operating in a very segmented fashion. All these factors have contributed to large costs to the consumer.
Home-Building Industry Analysis.

For a brief characterization of the Argentine home-building industry, we use an extension of the Porter Diamond\(^4\) analysis as suggested by other authors and shown below.

\[
\text{Expanded Porter's Diamond Model}
\]

As we can see, the industry’s competitiveness and sustainability is influenced by many factors. All contribute to its success or failure. The Argentine traditional construction industry can be characterized by looking at the following:

(1) **Demand:**

Despite the chronic housing deficit, actual demand is limited, given the high costs of construction. These derive from the high cost of land (given that construction is mainly in large cities and surroundings), excessive government fees, unreasonable construction standards, building and transport inefficiencies, high working capital required by builders

\(^4\) Michael Porter, Competitive Advantage of Nations.
(due to long time of construction), unavailable or expensive financing and poor commercialization practices. Estimates on housing distribution according to socio-economic levels are as follows:

<table>
<thead>
<tr>
<th>Socio-Economic Level</th>
<th>Number Houses</th>
<th>Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High and Middle High</td>
<td>1.146.238</td>
<td>12.4</td>
</tr>
<tr>
<td>Middle</td>
<td>3.383.252</td>
<td>36.6</td>
</tr>
<tr>
<td>Middle-Low</td>
<td>2.995.010</td>
<td>32.4</td>
</tr>
<tr>
<td>Low</td>
<td>1.719.358</td>
<td>18.6</td>
</tr>
<tr>
<td>Total</td>
<td>9.243.858</td>
<td>100</td>
</tr>
</tbody>
</table>

An analysis of the number of houses with one or more kinds of deficit problems in relation to the above housing distribution points to the fact that there are no deficits in the high-level segment of the population and at the same time, more than 90% of the middle-low and low levels have deficit problems. The next table shows the relation between socio-economic level and housing deficit:

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5 Internal forecast, Secretaria de la Vivienda
<table>
<thead>
<tr>
<th>Socio-Economic Level</th>
<th>No. Units with No Deficits Problems</th>
<th>No. Units With Deficit Problems</th>
<th>Total Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>High and Middle High</td>
<td>1.146.238</td>
<td>0</td>
<td>1.146.238</td>
</tr>
<tr>
<td>Middle</td>
<td>2.932.186</td>
<td>451.066</td>
<td>3.383.252</td>
</tr>
<tr>
<td>Middle Low</td>
<td>1.962.718</td>
<td>1.032.292</td>
<td>2.995.010</td>
</tr>
<tr>
<td>Low</td>
<td>163.698</td>
<td>1.555.660</td>
<td>1.719.358</td>
</tr>
<tr>
<td>Total</td>
<td>6.204.840</td>
<td>3.039.018</td>
<td>9.243.858(^6)</td>
</tr>
</tbody>
</table>

To estimate the growth in the number of units required in the future, we used the trends in population growth, as given by the Argentine National Statistic’s Department. According with this growth in population, we can foresee a construction level of 95,492 new houses per year between 1995 and 2005. At the same time, we can assume that this new demand will be similar to the actual distribution of units. Therefore, we can assume that the future demand, as related to the population’s socio-economic level, will be:

<table>
<thead>
<tr>
<th>Socio-Economic Level</th>
<th>New Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle High</td>
<td>10.581</td>
</tr>
<tr>
<td>Middle</td>
<td>34.451</td>
</tr>
<tr>
<td>Middle Low</td>
<td>29.139</td>
</tr>
<tr>
<td>Low</td>
<td>21.321</td>
</tr>
<tr>
<td>Total</td>
<td>95.492</td>
</tr>
</tbody>
</table>

\(^6\) Subsecretaria de Vivienda
(2) Factor Conditions:

Labor has been largely unionized and construction work very artisan-like, which brings high costs to any project. Further, materials like cement and bricks are quite heavy and increase transportation costs, also requiring more scaffolding and other on-site equipment for building requirements. The time required for completion increases the labor cost, as well as material costs due to storage needs and theft.

(3) Cluster of Related Industries:

Most constructors and associated material suppliers are located close to the large cities in Argentina. However, their interaction does not result in major synergy in R&D or product improvements. The clustering does however increase transportation costs for construction requirements away from the larger cities.

(4) Structure and Rivalry:

Like with most Argentine sectors, the construction industry has been highly protected in the past. Very little imported materials were in use until recently and the bidding practices, work inspection and certification procedures, were characterized by their lack of transparency. Its construction industry is highly concentrated, in technical and legal terms, yet residential construction is performed, in many cases, by small and medium-size companies, many of them owned by one person, that subcontracts the different
construction processes. Most builders therefore have little capacity for improving on construction efficiency and quality.

The construction sector has expanded rapidly in recent years. In 1993 its rate of growth was 10.9% while it had contracted in the previous two years by 20% annual rates. This recovery proceeded from very depressed levels of economic activity at the turn of the decade: the constant price share of construction in GDP almost reached 6% in 1993, compared with over 8% at the beginning of the 1980s.

As far as residential construction is concerned, the expansion has been the result of pent-up demand and the reappearance of mortgage credit. Initially, residential construction focused on units for high-income families. More recently, medium-priced units have become the most dynamic sector.

Construction activity in general has been stimulated in Argentina by the building of new shopping centers, hotels, the renewal of gas station networks, and activities related to the privatization in telecommunications, highways, railroads and energy. Also, macroeconomic stability and the fall in interest rates led to a switch in demand for physical assets, favorable relative prices, and effects on wealth and income generated.

The highlights for the construction industry, in Argentina, are the following:

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7 Investment Opportunities report. Ministry of Economy and Public Works and Services.
(5) Other:

Affecting the above factors we also include Government, Finance cost and availability, Firm Commodity Chains, and Historical (Sticky) Factors, as other major determinants of the industry. The Government's role has been quite negative in general, as it enforced a closed economy, maintained high transaction costs through fees and non-transparent bureaucracy and produced constant political instability and lack of stable macroeconomic conditions. Financing has been impossible given the hyperinflation and lack of transparency of our institutions which affected builders and buyers alike. Firms are not well connected locally or regionally and this insularity increases material costs. Finally, the Historical traditions and procedures of construction has prevented much innovation in the sector.

On a very positive note, the construction industry is expected to continue to grow in 1995/1996, accelerating the rate of expansion of the last two years. The additional growth will be partly due to the push provided by the housing programs financed through the mortgage loan schemes offered by the private banking system, as well as the activities of
the Banco Hipotecario Nacional and Banco de la Provincia de Buenos Aires. The availability of financing will stimulate projects for multifamily dwellings with loan installments that are competitive with rental housing.

Undoubtedly the most important development with regard to both industries is the "Agreement on Construction" signed by the representatives of the national government, business, private and public banks and workers, covering all of the sectors involved in the construction industry. The objectives of such agreement are as follows:

- Deregulation of the construction industry, lifting all existing bureaucratic impediments
- Enactment of legal instruments in order to encourage the development of real state market using mortgage securities, so foreign investors can invest buying mortgage securities or financing projects issuing such securities.

Under the same agreement, the business sector is committed to:

- construct affordable housing
- perform training programs for his workers

The Financial entities agree to:

- finance the projects initiated within this framework
- reduce administrative costs and other expenses
- publish detailed information about cost rates
- make and adequate regional distributions of funds
The Labor sector accepts to:

- introduce an insurance for accidents
- design and implement a training program

The Suppliers of materials agree to:

- keep stable prices and comply with quality standards

The Provinces and Municipalities agree to:

- eliminate red tape impediments to housing projects

and finally the Central Government has assumed a compromise to:

- submit to Congress a bill regarding the deregulation and reactivating of the sector, to reduce employers contribution
- eliminate restriction on the exercise of professional activities
- provide transparency to the market
- instrument a system of securitization trough Banco Hipotecario Nacional
- enact a law regulating the leasing system
- set up a property trust scheme
- permit tax deductibility for units under the mortgage securitization scheme and the issue of securities
- suppress some taxes and quantitative restriction or duties in some key imported materials
• adequate national standards to international ISO standards

• and improve port facilities

The expected impact of these measures on the sector is detailed below.\(^8\)

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Direct Employment</td>
<td>203.000</td>
<td>233.000</td>
<td>280.000</td>
<td>350.000</td>
<td>437.000</td>
</tr>
<tr>
<td>Indirect Employment</td>
<td>61.000</td>
<td>70.000</td>
<td>84.000</td>
<td>105.000</td>
<td>131.000</td>
</tr>
<tr>
<td>Square m. constructed (millions)</td>
<td>5.4</td>
<td>6.48</td>
<td>8.10</td>
<td>10.53</td>
<td>13.69</td>
</tr>
<tr>
<td>Units Constructed</td>
<td>108.000</td>
<td>130.000</td>
<td>162.000</td>
<td>210.000</td>
<td>274.000</td>
</tr>
<tr>
<td>Share of GDP</td>
<td>2.7%</td>
<td>3.0%</td>
<td>3.6%</td>
<td>4.5%</td>
<td>5.6%</td>
</tr>
</tbody>
</table>

**Attractiveness of Wood-Based Construction**

In our view, wood-based housing construction is a key part in solving Argentina’s housing affordability problem. Here we discuss the reasons why.

In a recent record breaking event, a full-size residential house was completed in the United States in less than 3 hours\(^9\). This seemingly trivial event underscores the power that this technology provides to modern societies. Unlike conventional single family housing of

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\(^8\) Construction and Real State, Ministry of Economy and Public Works and Services, 1994

\(^9\) Commencement address at MIT Sloan Fellows Convocation week, October 1995.
brick and mortar construction, which takes in Argentina an average of 18 months to build (standard house no less than 9 months and 24 months for important projects)$^{10}$, wood construction requires from 3 to 6 months to complete ("stick built"); one to three months to finish a componentized home; six to eight weeks to finish a panelized packaged home, and one to three weeks to finish a double section mobile home or modular housing$^{11}$. Further, latest advances in modular construction make it possible to complete a previously prepared site in a matter of days, something that even prefabricated units in other materials cannot compete with.

The implications are many. To start with, the most pressing problem affecting housing programs is its financing. Even in successful programs, private developers need to undertake the financing of a significant part of the project during construction. The tying-up of capital thus restricts the developer's capacity to produce. Wood construction and modularization would bring financial costs to a minimum.

For community-based construction programs, the lengthy construction period has been demoralizing and a matter of frustration to the people working hard to resolve their habitational problems$^{12}$. Wood construction would provide these communities with practically instant results to show for their efforts.

$^{10}$ Investment Opportunities, Real Estate Construction Sector, Argentine Ministry of Economy and Public Works and Services, 1994.
$^{12}$ De la Villa Miseria al Barrio Autoconstruido, Beatriz Cuency et. al. 1984
Wood-based construction technology is quite flexible and allows for the design of a core unit of minimum surface which can be used for low-income housing programs, while allowing its beneficiaries to expand the unit as they find it necessary. This would provide with immediate housing, potential to meet different family needs, and enough differentiation to make even the largest of projects quite diverse in nature.

Given Argentina’s housing deficit it would be impossible to resolve Argentina’s housing deficit through conventional construction techniques even if adequate financing was available at reasonable costs. The back-log deficit, plus the units required for replacement and new households every year makes it a losing race. Wood construction is fast and suitable for small and large construction companies to undertake and thus is a better choice as the technology of excellence to resolve the housing deficit problem.

The impact of construction on economic development is not only a function of the housing construction itself but on its multiplier effect due to its materials industry and ancillary products. In this respect, the versatility of wood based technology is a generator of innumerable new products that will increase the economic potential of the country. Brick and mortar technology does not have the same potential for product development or industrialization and cannot compete regarding transportation costs or ease of use. As mentioned earlier, modularization and thus creation of “continuous housing production lines” is only possible with wood based products.
Wood is a significant complex and versatile material which can be converted to high value added products and in this respect is much more valuable than clay or cement. Despite its draw back of requiring larger investments in developing and managing forests as well as the higher level of capital investment in machinery for its industrialization, it is a renewable raw material.

Wood Based Housing Construction - Cost Comparison against other materials

It is difficult to perform an exact comparison between different wood housing materials and technologies of construction. Housing is a very complex product, employing many different products, in a product mix which depends on the engineering and architectural design of the house, its size and function, regional availability of materials etc. Therefore any comparison will be subject to particular assumptions which not always may hold true.

For our purposes, we looked at comparing conventional brick and mortar construction, (the most prevailing housing type in Argentina) against the wood-frame and steel-frame housing. As mentioned above, no absolute comparison is possible, so we have limited ourselves to look at the advantages and disadvantages of each major material of construction, regarding their applicability to housing construction, their cost, and impact on the environment (life cycle analysis), as disclosed by published information. Significant benefits of using wood-based materials are (i) their renewable sources and (ii) the lower energy consumption in their production, transport and use. The details for these comparisons are included in Appendix 7.
In what follows, we have tried to evaluate the financial impact which wood-frame or brick and mortar construction have on a project, by simulating the cash flows required during a typical construction, discounted at an appropriate cost of capital. We conclude that the wood-based construction has advantages over the other materials and thus should be important to Argentina's construction industry.

**Cost Situation in Argentina**

Cost comparisons are difficult because the quality of conventional construction in Argentina is quite variable. Quality in materials, design and land costs affect any prediction of cost of construction measured in dollars per unit of area constructed.

Costs of wood frame housing in Argentina are difficult to come by due to the very few units in the market. From the information gathered however, we can conclude that the pricing difference between a conventional and a wood-frame house is not significant. Complete wood-frame houses including all accessories and appliances have been imported in to the country and it is this type of house which shows higher costs per m^2. This higher cost is due in part to transport and duties, but primarily because the imported houses come fully equipped and therefore are not comparable to local construction. Cost comparisons are also complicated by the fact that when quoting built surface, there is a 5 to 10% larger habitable area for wood-based housing, due to the smaller width of the walls, than for brick and mortar construction. None of the cost comparisons seem to take into account
the cost of capital during construction, which are different for each method of construction.

We set out therefore to try and quantify this effect and its sensitivity to different cost of capital scenarios. We've chosen low income housing as a base design, given the magnitude of these projects, being the main case affecting the overall housing deficit problem and the reluctance of builders to enter into this sector among other things due to its financial risk.

Cost basis:

In order to select an appropriate cost base, we looked at the following available data:

1. Cost of a good quality property (both in brick and mortar or wood construction) is about U$S500 to U$S590 per m2 +/- 5 to 10%\(^{13}\).

2. Cost of low income housing in Argentina\(^{14}\) based on 30m2 house is U$S12,000.

3. Cost of low income housing in Uruguay based on 30 m2 house is U$S15,000\(^{15}\).

4. Cost of Canadian Townhouse wood-frame construction (1,500 Ft2) is CND68,366\(^{16}\).

5. Cost of Canadian Bungalow wood-frame construction (2,000 Ft2) is CND126,061.

6. Cost of Canadian Two-Story wood-frame construction (2,100 Ft2) is CND106,348.

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\(^{13}\) Fax quote from Ing. Roberto Chevalier, Buenos Aires, Argentina December, 1995.


\(^{15}\) Interamerican Development Bank. Strategic Planning and Operational Policy Department. Operational Policy Division, March 1995.

Based on the above, we can observe the higher cost of construction in Argentina relative to that of neighbouring Uruguay and of wood-based housing construction in Canada. For our analysis, we are therefore assuming a cost of U$S 450 per m2 and a basic 60m2 house (as considered in the Argentine government's housing deficit estimates). Regarding the break-down of the overall cost by components is also quite variable and we decided to use the actual data of a low-income project performed in Argentina in the past for which such data is available\textsuperscript{17}. We are aware that the relative magnitude of each component is dependent on the relative prices prevailing at the time, the availability of raw materials as well as selection of the design of the house and location of the settlement. The cash flows are assumed to be required for payment at the end of the month in which delivery of material is made. Regarding the sequence of construction, we are also aware that this depends on many variables i.e. type of construction, magnitude of the project, regional availability of materials and work force as well as their productivity. etc. We have selected what we considered to be a conservative approach.

\textsuperscript{17} De la Villa Miseria al Barrio Autoconstruido, Beatriz Cuenya et. al.
The resulting breakdown and assumption of work-in-progress are shown below:

<table>
<thead>
<tr>
<th>Conventional Construction</th>
<th>Percent Cost</th>
<th>U$S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase of Land</td>
<td>17.30%</td>
<td>$4,671</td>
</tr>
<tr>
<td>Municipal Permits</td>
<td>1.20%</td>
<td>$324</td>
</tr>
<tr>
<td>Building of Tool Shed</td>
<td>3.90%</td>
<td>$1,052</td>
</tr>
<tr>
<td>Foundation</td>
<td>21.30%</td>
<td>$5,751</td>
</tr>
<tr>
<td>Erection of Walls and floors</td>
<td>8.50%</td>
<td>$2,295</td>
</tr>
<tr>
<td>Other Utilities and Sewer</td>
<td>0.30%</td>
<td>$81</td>
</tr>
<tr>
<td>Roofing</td>
<td>13.70%</td>
<td>$3,699</td>
</tr>
<tr>
<td>Doors and Window Frames</td>
<td>15.90%</td>
<td>$4,293</td>
</tr>
<tr>
<td>Glass</td>
<td>11.00%</td>
<td>$2,970</td>
</tr>
<tr>
<td>Plumbing, bathroom and electrical Installation</td>
<td>0.60%</td>
<td>$162</td>
</tr>
<tr>
<td>Paint and Clean-up</td>
<td>6.30%</td>
<td>$1,701</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
<td><strong>$27,000</strong></td>
</tr>
</tbody>
</table>
### Work in Progress

<table>
<thead>
<tr>
<th>Conventional Construction</th>
<th>Project Duration measured in months</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t=0 t=1 t=2 t=3 t=4 t=5 t=6 t=7 t=8 t=9 t=10 t=11 t=12</td>
</tr>
<tr>
<td>Purchase of Land</td>
<td>X</td>
</tr>
<tr>
<td>Municipal Permits</td>
<td>X</td>
</tr>
<tr>
<td>Building of Tool Shed</td>
<td>X</td>
</tr>
<tr>
<td>Foundation</td>
<td>X X</td>
</tr>
<tr>
<td>Erection of Walls and floors</td>
<td>X X X X</td>
</tr>
<tr>
<td>Other Utilities and Sewer</td>
<td>X X</td>
</tr>
<tr>
<td>Roofing</td>
<td>X X</td>
</tr>
<tr>
<td>Doors and Window Frames</td>
<td>X X</td>
</tr>
<tr>
<td>Glass</td>
<td>X</td>
</tr>
<tr>
<td>Plumbing, bathroom and electrical Installation</td>
<td>X X X X X</td>
</tr>
<tr>
<td>Paint and Clean-up</td>
<td>X X</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wood Frame Construction</th>
<th>Project Duration measured in months</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t=0 t=1 t=2</td>
</tr>
<tr>
<td>Purchase of Land</td>
<td>X</td>
</tr>
<tr>
<td>Municipal Permits</td>
<td>X</td>
</tr>
<tr>
<td>Building of Tool Shed</td>
<td>X</td>
</tr>
<tr>
<td>Foundation</td>
<td>X X</td>
</tr>
<tr>
<td>Erection of Walls and floors</td>
<td>X</td>
</tr>
<tr>
<td>Other Utilities and Sewer</td>
<td>X</td>
</tr>
<tr>
<td>Roofing</td>
<td>X</td>
</tr>
<tr>
<td>Doors and Window Frames</td>
<td>X</td>
</tr>
<tr>
<td>Glass</td>
<td>X</td>
</tr>
<tr>
<td>Plumbing, bathroom and electrical Installation</td>
<td>X X</td>
</tr>
<tr>
<td>Paint and Clean-up</td>
<td>X</td>
</tr>
</tbody>
</table>

The most striking differences in the construction time start after the second month. These are a product of the differences between artisan-type and industrial-type construction. The artisan brick and mortar system is built upon simple components (bricks), thus the erection of walls takes longer and with that the installation of roofing, windows, doors etc. On the other hand, the engineered products used in wood-based construction are components suited for fast assembly and require no major equipment or scaffolding. Further, when piping, plumbing and electrical wiring installation is involved, wood-based components can be either previously piped and wired at factory or be simple to install on site. Brick
and cement walls are not appropriate for fast piping and wiring and any changes or upgrades will require extensive rework and patching which delays work completion.

We assumed that the cost of housing per m² is comparable between both methods of construction if no consideration is made for cost of capital and that the relative costs of each house component is the same for both methods. We assumed a pre-tax profit indicated in the graph and assumed that the depreciation costs were the same for both methods of construction (although this is not true as the conventional construction is expected to require more capital equipment during construction phase). We then simulated different scenarios varying component costs by CPI and cost of borrowing money. The comparison can be seen in the following graph.
The above calculations assumed a typical 30% pre-tax profit for the project. Different margins can be used with relative results still remaining the same. For a given fixed sales-price of a house, profits will be higher the faster the house is completed. In this respect, the wood-frame housing has all the advantages due to time factors. For our case analysis, this is so the higher the CPI and the higher the cost of capital, but of both, the most sensitive is the cost of borrowing funds.

The above profits for a $27,000 dollar sale price show a financial advantage for the wood-frame housing. This advantage can mean higher profits for the builder and/or lower cost for the buyer. Assuming that the price-relationship between house components do not vary according to the total price (or size of the house), the above benefits will remain the same for other house comparisons.

In summary, wood-based construction in Argentina is cost attractive today, despite the weakness of the factors which determine its competitiveness. Through the learning curve effects which will naturally follow, the financial effect of its faster construction, and the development of its building materials industry, the advantages will become evident and the affordability of housing will be improved.
Chapter 3

Suitability of Wood-Based Technology

In this section we will look at the main issues which need to be resolved or addressed in order to make the transition from conventional to wood-based housing construction in Argentina and we discuss some of the positive effects we envision for the industry.

This is not an easy transition as it involves a radical change from an artisan to an industrial approach to construction. We have included, where applicable, comparisons to industrialized countries using this type of housing, pointing out to similar or adapted solutions to most of the concerns brought about by this technology.

Using the expanded Porter Diamond model as a reference, we present herewith our assessment of the factors potentially affecting the transition to wood-based construction.

1. Demand

Demand for these houses is difficult to estimate, despite concrete knowledge of the housing deficit numbers, because the general population is not used to this type of construction. Their belief is that wood housing is not permanent, secure and if anything is a reserved domain for low-income housing.

However, it is at the high income bracket level that the first marketing possibilities exist. This segment of the population has traveled abroad and experienced the convenience and
comfort of modern wood based housing. Therefore it should be easier to sell the most sophisticated housing designs.

The design of housing might require some modifications to the traditional houses in Europe or North America. For example, there is a wide concern among Argentines for proper home security. Robbery is much more common than in suburban America and this forces housing designs to incorporate bar-windows and other protective devices. It is not uncommon to find empty houses where holes were made to masonry walls in order to gain access to it. In another instance, a Latin American buyer of a prefabricated house in the United States did not purchase such house as he considered wood framing was not resistant to bullets. This underscores the difficulty in wood construction gaining wide acceptance in Argentina, when compared with brick and mortar construction. The question remains whether wood framing can provide a similar service. The United States with its predominantly wood frame housing experienced about six million attempted or completed burglaries in 1993, this being 43% less than in the past two decades. Despite the fact that this has not been an issue in the decision to purchase a wood-frame house, more and more Americans are including fences, gates, walls, surveillance systems, security guards etc. Gated communities gained in popularity in the eighties and have attracted nearly 4 million Americans. Some 28 million more live in tightly controlled condominiums and cooperatives. We believe the alternatives for Argentina are many. Like in the US,

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18 Personal conversation with US supplier, January 1996.
neighbourhoods typically built in country-clubs or closed communities, usually have their own security guards which would provide the safety required. Otherwise, houses may still be built in a conventional way where the exterior walls are built with cement blocks or bricks for protection mainly and not as bearing structures.

Security is not only reserved for the higher income brackets. In the US for example, a government subsidized 404-unit apartment complex in Wynnewood, Dallas was renovated and surrounded with wrought-iron fencing with gates in all entrances. 'Though residents must abide by restrictions that include curfews, no felony convictions, no vandalism and no littering, applicants are clamoring to get in and personal qualifications are so strict that only half make the cut'\textsuperscript{21}. Fencing and security guards are becoming status symbols in the US, and the sale and sophistication of house alarm systems will increase very much like has happened in Argentina.

The issue of fire is also quite important. Wood self-combusts at 275 degrees C when there is sufficient oxygen for the combustion to spread. It will initially be a superficial phenomena creating a crust which has lost all its mechanical properties and gases. However, if the temperature does not increase, the fire will die. W\textsubscript{co}{2}d is consumed at a rate of about 4 cm per hour which means that it is possible to design wood beams which will resist longer than most other materials without collapsing\textsuperscript{22}. Although wood beams


\textsuperscript{22} Estructuras de Madera Laminada y Encolada, Arq. Miguel Demkoff. Argentina Forestal No. 3 November-December 1994 page 12.
can withstand fire better than structural concrete and metals, it is more common for wood structures to catch fire and suffer damage and when this happens, proper firefighting equipment and manpower are necessary. Nonetheless, the insurance industry in Canada indicates that there is no lower or higher insurance rate for steel framed residences compared with wood framed construction because there is no fire-loss data that indicates superior fire performance by either one. Fire hazards however would be a problem in Argentina where its infrastructure is not developed like in North America. The recent forest fire in Bariloche highlights in the population the fragility of wood and underscores the inability of the country in dealing with such problems i.e. firefighting planes had to be requested from neighboring Chile and Brazil to help combat the forest fire.

The risk of substandard developments which potentially may occur due to lack of proper municipal controls and the use of unsuitable materials, especially during the years it will take the Argentine industry to develop, are risks to be taken into consideration, as fires could become common occurrence with devastating results due to fast fire propagation and toxic fume production. The design of new housing must include their heating system as an integral part of the construction. The opportunity to supply central heating systems based on natural gas should be an attractive alternative given its wide availability in the country. Failure to do this will lead to severe fire hazards as it is quite common for Argentines to use kerosene and electrical heaters.

As a result, it will be necessary to insure proper control and maintenance of standards, and that construction of new neighborhoods only proceed prior to investment in fire hydrant systems and local firefighting stations as well as use of smoke alarm-detectors and where necessary sprinkler systems. This of course is a penalty in capital cost investment by the country, but is a necessary cost of modernization.

Another issue of concern is the sound proofing of wood-based construction. It is common for Argentine visitors to the US to be shocked by how easy noise is transmitted between rooms and especially between upper and lower floors. Similarly, the noise produced by the heating or cooling systems, showers, toilet flushing or use of dish-washer, garbage disposal and washing machines, invades the whole house. This is not to say that such noises are not present in Argentine construction. In fact they are, in lower income housing and in high-rise apartment buildings. The few architects who have taken wood seriously as a building material in Argentina have used expensive designs of in order to achieve rigidity and acoustic isolation to upper floors probably due to lack of modern materials or lack of knowledge about the latest construction techniques in developed countries. This means that unless the building materials industry develops in Argentina and know-how is passed along to builders and professionals, housing designs will not be of acceptable standards and lose appeal. Further, proper housing designs should be followed with the use of acceptable insulation materials and proper fastening of floor surfaces and for low-income housing preference to single floor construction. In many respects, even in the United
States the subject of noise in home construction is gaining visibility. The quest for a quiet homes is strong. Neighborhoods and condominiums have been planned too close and street noises have become louder due to traffic congestion. Housing construction has become so expensive that thinner walls and cheaper materials have increased the propagation of noise and the noisier homes are also seen as of cheaper quality. For example pre-World War II housing used inch-thick plaster walls, which used to absorb more sound than today's easy-to-install gypsum boards; piping used to be cast-iron while now-a-days it is plastic, which does not reduce water flow noises as well. Even the more open designs of construction where the kitchen living and dinning rooms are open to each other exacerbate the problem. Many builders today are modifying their designs, changing ceiling heights and angles in an effort to reduce the propagation of noise; or changing the way they construct the upstairs flooring to reduce squeaks. Pressed wood is used for floor joists because it is a uniform material that does not shrink or twist like traditional lumber. Though pressed wood costs 30% more, it is being used in 20% of new floors. In some recent condominium designs concrete block walls were used for divisions between units. This is a sign that blending traditional Argentine construction with lumber may be a quite realistic alternative. Even the appliance market is undergoing product changes to minimize noise and insulation-material manufacturers are coming out with new products which offer not only thermal insulation but greater noise resistance.

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27 Owens Corning Fiberglass Corp. QuietZone.
The subject of durability has always been invoked in Argentina describing wood based housing as a temporary solution or only suited for low-income housing. As explained earlier this is not true. However, there is an important point to consider in the maintenance and replacement of various components in wood based housing. An indication of typical duration for most housing components is included as an attachment. In a way, maintenance in wood housing is simpler and faster than in brick and mortar constructions and is better suited to the do-it-yourself solutions. In Argentina though, there is no service and repair infrastructure for these materials yet, which can delay the progress towards wood housing acceptance. Despite being simple and fast repairs, they require special materials and tools not commonly sold in Argentina. On the positive side, the creation of this industry is bound to have significant multiplying effects in many others i.e. chemical, mechanical and electrical industries. The maintenance problem will be more acute in low-income housing. Although this is also a problem with conventional construction, especially when housing is subsidized in its majority, the ability of low-income households to start with a basic modular wood-house (which is easier to expand and modify), together with proper training in building techniques, lowest possible subsidies and community participation in the building project, will allow better housing than is currently available.

Neither wood, steel nor concrete will perform properly under earthquakes if they fail to meet code standards. Like steel and concrete, wood frame construction can be properly

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28 Life Expectancy of Housing Components, Gopal Ahluwalia and Angela Shackford, Housing Economics, August 1993 pages 7-9
designed to withstand earthquakes. Wood frame construction provides good resistance to lateral loads, is lightweight, and has inherent redundancy and load sharing and transfer capability. The good heating and cooling properties of wood based construction are perhaps one of the most distinguished characteristics of wood housing. This and its earthquake resistance should make it the premier mode of construction for the western provinces of Argentina.

2. Cluster of Related and Supporting Industries

The value chain picture presented earlier highlights the importance that the forest and forest products industry have on the construction industry, and more so when construction is wood-based designed. Here we will; describe the Argentine Forest Industry and the challenges facing its transformation to match an industrial-based construction industry.

**Forestry:** Wood is a renewable raw material and has substantial advantages over other construction materials, in particular when it comes to energy requirements. This highlights the importance it has to any economy. It should therefore be in any country’s best interests to develop its forest resources and forest product’s industry, as well as to increase its construction reliance on wood materials. To make this happen, the effect of all factors conditioning the economic availability and usage of the forest resource must be dealt with.

If a wood-based construction housing industry is to develop in Argentina, its forest resources and forest-products industry must develop further. The Forest Product Industry
refers to the harvesting and processing of timber for the production of many products such as lumber (softwood and hardwood), plywood (softwood and hardwood), panel products (particleboard, insulating board, and hardboard), pulp wood (logs and chips), other industrial products (posts, poles, and pilings), and fuelwood.

The Southern Cone of Latin America, has significant forest resources and potential to support a large Forest Products industry. In the case of Argentina, its abundant forestable areas of easy access and its climate, which promotes high growth rates, gives it comparative advantages which are unmatched. Yet, its forestry industry lies behind that of Chile and Brazil. Also, many plantations today have small diameters and are not pruned, which generates knots thus destroying wood value.

Argentina’s Forest Products industry could be much more productive and competitive. As can be seen by the table below, the cost of logs is lower than Brazil’s and Chile’s yet the prices of its sawn products is significantly much higher.

<table>
<thead>
<tr>
<th>Country</th>
<th>Prices for Forest Products in South America’s Southern Cone (US$/m3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Logs</td>
</tr>
<tr>
<td></td>
<td>Cost</td>
</tr>
<tr>
<td>CHILE</td>
<td>30-40</td>
</tr>
<tr>
<td>BRAZIL</td>
<td>20-22</td>
</tr>
<tr>
<td>ARGENTINA</td>
<td>19-23</td>
</tr>
</tbody>
</table>

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\[29\] Desarrollo Industrial de la industria maderera de Misiones y su posible tendencia. Ing. Agr. Gabriel A. Marangoni, AMAYADAP Misiones sent to the authors January 1996.
The future supply of wood in Misiones (the largest forest producing province in Argentina) is expected to be good up until the year 2000. From then on the supply of good diameter wood is expected to be reduced due to the lack of reforestation programs during the eighties. This is already being felt as shown by the price increases in the area of El Dorado, Misiones where in 1991 pine logs were sold for $17 dollars/ton; by 1993 at $19 and presently reaching $21 dollars/ton (about a $1 dollar increase a year\textsuperscript{30}) and can be partially explained due to the fact that the larger diameter woods are becoming more distant from the mills and is not uncommon to see 300 km. separating forest and mills\textsuperscript{31}. This also helps explain the low yield in operations when smaller diameter wood is processed.

The development of the forest Argentine forest sector is expected to continue, based on its comparative advantages:

- The abundant availability of suitable land for forest activities
- The availability of technology and its up-grading at very low cost
- The physical infrastructure required for normal activity
- The plantation and maintenance costs, which are gradually decreasing because of economies of scale and production technology
- Increasing demand of wood products, both local and for export

\textsuperscript{30} Desarrollo Industrial de la industria maderera de Misiones y su posible tendencia. Ing. Agr. Gabriel A. Marangoni, AMAYADAP Misiones sent to the authors January 1996.
\textsuperscript{31} Las Industrias de Transformación mecánica de la madera en Misiones. Ing. Forestal Carlos Ferreyra. Argentina Forestal No. 3 November-December 1994 page 14.
• The macro stability of the country and the favorable conditions available to foreign investments.

For further details on the Argentine forestry sector and its comparison with other relevant countries, please refer to Appendix 5.

**Converting Industry:** The basic primary structural materials manufactured from wood are lumber, which is sawn or shaped from the log; and rigid panels, fabricated by reducing wood to veneer, particles, flakes, strands, or fibers which are, in turn, reconstituted into thin sheets by pressing between heated plates, usually in combination with an adhesive. Sheets thus formed are broadly classified as plywood - fabricated from veneer - and building board that consists of an array of sheet products under generic classifications including particleboard, flakeboard, hardboard and insulation board.

Between 1966 and 1985 Argentina had a sustained growth in its production and consumption of native and plantation wood but has lived in a very unstable economy which affected it significantly. This meant very little investment in equipment and the impossibility to perform marketing strategies for its products. The lack of long-term planning and of sustained forestation programs has reduced the availability of larger diameter wood which are becoming more distant from the which helps explain the low yield in operations, as smaller diameter wood is processed without the benefit of latest production technologies.
The majority of plants are quite small and are still based on a mix of native and plantation wood. The native-wood sawmills use technologies more than 40 years old, which are not efficient with high fixed costs. Few have their own forest resources but those that do, usually manage them properly and are relatively vertically integrated with production of panels, furniture, and housing parts.

The sawmills and plywood mills using plantation wood have increased production in the last 5 years and are expected to do well in the foreseeable future\(^{32}\). The medium and large size producers have incorporated new machinery and are among the most modern plants in the country. Most of their production goes to primary products such as structural lumber, while the rest is for secondary industrialization products such as plywood, which has seen a significant increase recently.

Laminated-wood Plants are the highest added-value facilities and some include high technology equipment. They face supply problems due to the lack of laminable raw materials (native woods) and in particular because of the lack of planning for plantation woods in the last three decades.

On the finished and semi-finished Pine Products side, new plants have been started. By the end of 1994 about 10 such companies in the Province of Misiones alone, were producing

wood beams, furniture, clear wood (knot-free), finger-joint, moldings, housing parts etc., primarily oriented to the export market.

Argentina’s Forest Products industry could be much more productive and competitive. Its cost of logs is lower than Brazil’s and Chile’s yet the prices of its sawn products is significantly higher.

Continued investment in technology oriented towards higher added value production, increase in quality, yield and volume, are still required if Argentina wants to expand and successfully compete in the export market. Smaller mills should disappear or combine in order to achieve better production and marketing productivity.

Argentina is still lacking from an international marketing infrastructure and most producers do not know what the international market needs are. The industry must adapt its products to internationally accepted standards such as ISO and group itself as a way to coordinate its efforts for gaining international acceptance. For a more detailed analysis of Argentina’s present industry situation, please refer to Appendix 6.

Engineered Products: One of the characteristics of wood-based housing technology is the use of pre-fabricated components. This is really an industry which has evolved from artisan practices to fully industrialized processes. Its products are diverse and highly engineered with much value added, which allows ease of transportation, installation and
use, as well as high and uniform quality at lower cost due to standardization and volume production.

The use of wood in housing construction goes from the use of logs (log houses or "cabañas") to the much developed wood frame system where lumber is used as a structural material and trusses used for floors and roofs. Semi-built products are also commonly used such as panels i.e. (i) open panels (studs, plywood sheathing and windows) where insulation, piping, and cables are installed on-site or (ii) closed, where the complete panel includes insulation, piping and electrical connections all finished and assembled in the factory. Further, "automated building" can be taken all the way to modular housing where completely finished modules or "boxes" can be directly installed on previously prepared foundations or on top or side of each other. Needless to say, the completion of a house requires multiple wood and non-wood products but it is fair to say that they are well developed in modern countries for ease of use and replacement through proper standardization. These include: openings (doors, windows, skylights); carpeting and synthetic floors; insulation materials; plaster, vinyl sidings, wall papers, exterior facade materials, paints, varnishes and other protective coatings; roofing materials (tiles, shingles); piping, electrical cabling, switches, light fixtures and accessories; as well as all sorts of appliances from heating and air conditioning systems to kitchen garbage disposals and other conveniences not commonly incorporated in traditional mortar construction. The list does not pretend to be an all inclusive one, but highlights the amazing
diversification in materials for the home construction and do-it-yourself industry which would significantly impact any economy producing such items domestically.

Argentina does not have much in the area of engineered products and components as it has not been historically a forest products country. As a comparison, the housing industry in developed countries like the United States can be described as a model to pursue. It is basically segmented due to the diversification of home styles and designs and include: Conventional Frame, Prefabricated Housing, Pre-cut kits, Post-and-Beam Construction, Panelized Housing, Mobile Housing, Modular Housing, and others, described in detail in Appendix 3.

3. Structure and Rivalry of the Wood-Based Construction Industry: There are incipient moves towards establishing wood-based housing in Argentina, but so far these are very limited and restricted to the upper-income level households.

For example, according to a recent survey by Automated Builder Magazine on US exports of modular housing, about 11 houses were reported to have been sold to Argentina in 1994. Neighboring countries like Chile, who have had a vigorous growth in their forest industry are now exporting wood-housing to Argentina and even offering financing which includes the local labor costs of erection\(^3\).

\(^3\) Fundación Chile - wood housing. Fax sent by Arq. Carlos Frugoni, January 1996.
Importers of wood-based housing in Argentina are facing difficulties in promoting sales and they attribute this to cultural non-acceptance and lack of financing. They are therefore concentrating on larger constructions such as hotels in mountain resort areas, rather than in residential construction as these and other larger constructions such as churches and recreational facilities and restaurants have already been built in Argentina with satisfactory results. This is a start, but we believe that until the local construction-material industry is developed, very small inroads will be made.

4. Factor Conditions - Labor: In general, we can expect that wood housing construction would require less number of people involved in on-site direct work but have more of a multiplier effect in the economy than is today the case in Argentina. For the Construction Industry alone, we have estimated the job creation impact for both wood-based and conventional brick and mortar methods. Although the wood based construction technology would produce more indirect employment, the larger impact of its lower direct-construction job requirements gives it a lower overall job generation. On the other hand, the faster construction and flexibility it provides, should mean larger number of units built, which increases the overall economic activity of the country.

To reach the above conclusion, we used data for US housing starts in the 70's, as well as the use of lumber and plywood for residential construction at the time, to estimate the

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effect on the Argentine industry. We have preferred to use data from the 70’s to account for an industry which still did not use modular housing as much, a situation which would be prevalent in Argentina during the first several years of its potential transformation into wood construction technologies.

The US average housing unit during the decade of the 70s equates to requiring 8,855 feet of lumber and 4,918 sq. ft of plywood. Our calculation compares with the estimates of other studies, where construction needs for the early 1980’s were calculated as requiring 5,500 feet of lumber and 3,500 sq. ft. of plywood\textsuperscript{36}. Accounting for the fact that housing in Argentina is smaller in surface than in the US, we estimate then that the average wood-based housing unit in Argentina would require 3,600 feet of lumber and 2,275 sq. ft of plywood (a 65% ratio). Translating these quantities to housing demand and deficits, we have the following forest products production requirements for Argentina if all housing were based on wood.

<table>
<thead>
<tr>
<th>Production Required</th>
<th>1995 Housing Starts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>as per Governments</td>
</tr>
<tr>
<td></td>
<td>estimates 130,000</td>
</tr>
<tr>
<td>Lumber (in billion feet/yr.)</td>
<td>468,000</td>
</tr>
<tr>
<td>Plywood (in billion sq. ft./yr.)</td>
<td>295,750</td>
</tr>
<tr>
<td></td>
<td>Housing starts per year to reduce deficit in 25 years 384,000</td>
</tr>
<tr>
<td></td>
<td>1,382,400</td>
</tr>
<tr>
<td></td>
<td>873,600</td>
</tr>
</tbody>
</table>

Based also on the US employment data for the lumber and plywood sector during the 70's (average of 694,000\textsuperscript{37}) and assuming that the Argentine sector achieves similar productivity to that of the US during that decade, the above production requirements for Argentina would result in the employment of: 55,000 at the expected housing construction level or 162,000 at the higher rate necessary to eliminate the housing deficit in 25 years. These numbers compare with the government's estimates (based on traditional construction) of indirect employment of 70,000 at the 103,000 units per year and 131,000 jobs at a 274,000 units/year level. This is: our wood-based construction provides 0.42-0.53 lumber and plywood jobs/unit of housing vs. 0.48-0.54 indirect jobs/unit of traditionally constructed housing. These numbers are quite close but we assume that the government's estimates are for all indirect jobs while ours are based on only lumber and plywood producers. This being so, it means that the larger variety of Forest Products involved in wood-based housing vs. the traditional brick and mortar construction methods could provide more overall indirect jobs, in other words have a larger multiplier effect on the economy.

We know that the employment figures for the lumber and secondary Forest Product's industry in Misiones province is today about 7,000 people and that this industry is approximately 50% of the country's total. Therefore the size of today's industry (assuming availability of raw materials and services) would have to increase by a factor of

4 to 12. A more logical scenario would be that of a smaller proportion of wood-based construction in Argentina. Assuming a 25% proportion in wood (and not accounting for wood demands for other type of construction other than residential), the Argentine Forest Products industry would have to grow 100% to 300%.

To modernize the construction industry, a major change is necessary in the labor sector. As Argentina transforms its construction industry the type of skills required by workers will radically change. More factory-type workers will be needed for the building-material and engineered-products sectors, while the housing construction worker will require carpentry and assembly know-how rather than artisan brick-layering expertise.

For a more detailed perspective of the Argentine housing construction industry compared with that of industrialized countries, please refer to Appendix 3, 4, 6 & 7.

5. Government
The government’s recent impulse on deregulation, reducing bureaucratic burden, opening the economy to competition and foreign technology, promoting a national housing program, improving conditions suited for the revival of mortgage financing, and achieving a landmark agreement with the construction and material industry, banking, labor and others (as described earlier), is even more applicable to wood-housing technology than to the conventional brick and mortar industry. The effect that these policies and programs
will have on the implementation of wood-based technology in Argentina are far more reaching than the originally intended impulse designed for the existing housing sector.

6. Sticky Factors (Historical Background)

One of the common mistakes is to claim that wood is not a suitable or lasting material for construction. In Argentina for example it is believed that wood is only a material for temporary housing, or for small units. Covered stadiums, the 53-meters high Eureka tower and innumerable residential buildings are a testimony of the capabilities of wood in construction. In fact, many centuries old structures are still in good functional condition i.e. a church in Norway from the 13th. century. Many modern societies have primarily based their residential construction on wood i.e. 90% of housing in Canada, 80% in the United States (with more than a million units built each year) and high levels also in Sweden and Japan (more than 75,000 of latest technology). In these countries where forests were plentiful, people quickly developed the technology which allowed them to obtain energy, building and other daily used products from wood.

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39 Ficha Construcciones ‘95 FA.UM. Madera Primera Parte.
41 Ficha Construcciones ‘95 FA.UM. Madera Primera Parte.
42 According to data published by Fundación Chile. Fax from Arq. Carlos Frugoni in Argentina.
43 According to data published by Fundación Chile. Fax from Arq. Carlos Frugoni in Argentina.
In Argentina, the primary immigration of Spanish and Italian population brought with them the construction techniques proper to their countries where forests were not plentiful. Thus the residential construction was based on brick and mortar technology which had also the advantage of requiring little capital investment in equipment and machinery. Pockets of wood based construction were established however in circumscribed regions where German and Nordic European immigrants settled. However, even here, the brick and mortar standards imposed by central regulation from Buenos Aires, curtailed its spread.

7. Finance Cost and Availability

For many years Argentina had been in a much better position than many of its neighbors and its capacity for savings was considered high, representing 37% of the total capital available for investment in 1961\(^4\). Hopes still existed for a strong Savings and Loan System (S&L) to contribute to support housing construction.

The political instability in Argentina was always a big obstacle to develop any long-term housing policy and to achieve consensus between different sectors of the society. The internal power struggles typify this problem. In an press release dated in 1963, the US Agency for International Development (AID) announced its intention to assist Argentina in the creation of a national system of home finance. AID produced a $12.5 million loan to provide half of the initial capitalization required for a central home-loan banking facility

The inability of the interested parties in Argentina to come to grips with the type of S&L system to use (i.e. either American or German), ended up a fiasco. The German contract-savings system, where the potential saver must agree to the terms of a complex contract, (which must be observed religiously if the depositors are to realize the stipulated dividend and qualify on maturity for a mortgage loan), was still prevalent in the country. Most lending associations collected 3% commission on a “sale” of such a contract, which in most cases were open-ended on the lending side. That means that after a person deposits its savings as stipulated in the contract, the company is only obliged to lend the amount agreed-upon on the basis of funds available. They are not obliged to lend when the savings-term is completed. As a result of mismanagement and of not getting the loans

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45 Financing Latin American Housing, Sean M. Elliott
agreed upon, most savers lost confidence in the system. As a result, the number of S&L associations operating in the country was reduced to just a few dozen.

Mortgage finance is a critical factor in the generation of housing demand. Housing costs represent such a high multiple of annual income that mortgage financing is essential to a purchasing decision.

Housing finance transforms the construction industry. Professional developers become active more rapidly and the building industry becomes more efficient. Households can build or buy units they could not otherwise afford. Citizens of developing countries may then take advantage of the benefits of credit, not only by having access to their own house but also as a way to better reallocate their resources between savings, investment and consumption.

Housing finance is also important to the financial system. Properly structured housing finance policies are key to the stability of the sector and thus to the economy.

We believe that with the approval of law No. 24,441 and with the new role of the “Banco Hipotecario Nacional”, housing finance will be now available in Argentina.
Chapter 4  

Low Income Housing

Our analysis so far centered on generic issues affecting housing, yet most of the factors discussed and our proposed changes are applicable to low income housing, which is still an important subject in Argentina. If anything, the impact of wood-based housing will be substantial when it comes to low-income housing, as it attacks the problems of affordability, finance burden to builders, and increases the flexibility for self-help housing programs.

Perhaps the greatest obstacle to producing affordable housing is the limited ability that low-income households have to pay the rents that are needed to cover the development and operating costs of the new units. Income growth of this sector has never kept pace with the costs of producing new housing and in many cases the costs of operating or maintaining existing properties. Housing costs have continued to increase mainly due to increases in land costs because of the lack of availability that many times accompany the search for low-income housing project location. Also contributing, is the infrastructure burden-cost which typically is levied on a per unit basis, thus more seriously affecting the low-income households in a given municipality.

Housing programs supported by government and private sector are a powerful tool for putting local labor and materials to work, distributing income and raising standards of living. Furthermore they should have the capacity to develop complementary building-
materials industries for domestic as well as export markets and develop new skills in the construction sector.

Worldwide, government housing assistance to very-low-income households has generally taken one of three forms: (i) Direct subsidies to low-income households or developers of low-income housing; (ii) Tax incentives to Developers of low-income housing; and (iii) Mortgage insurance for low-cost owner and rental housing, below-market-interest-rate loans for the production of low-income rental housing; and to low-income home buyers through the issuance of tax-exempt mortgage revenue bonds46.

Enormous resources are dedicated to this area, with many well intended people and programs. Yet, and despite of some successes, these efforts are largely wasted due to bureaucracy and lack of transparency of the implemented programs, which end-up not reaching the sectors they were intended to reach and in many cases, as demonstrated by many inner-city high-rise-developments in developed and non-developed countries alike, have perpetuated conditions of joblessness, crime, lack of education and despair.

Low income housing programs around the world have faced many obstacles, but the ones which continue to be a problem, not resolved through pouring of more government money are:

- The lack of financial support by the private banking sector;

• The lack of wide-spread involvement of private developers;

• The concentration of low-income housing areas, which perpetuate the incorporation of low-income families into other levels of society;

• The lack of overall solutions to address not only housing but job creation, education and health;

• Lack of transparency, which inevitably ends-up providing access to housing to medium-level income households instead of low-level income families.

New construction programs in public housing have always required large amounts of money to keep them alive. It is common for them to require a longer term and deeper commitment than originally planned. Cost containment policies intended to limit initial program costs have driven costs up over the life of the projects and many have failed given that quality standards became compromised.

Low-income Housing in Argentina

We cannot say that the efforts by the government and private sector throughout recent history have been irrelevant, but they all suffered from the macroeconomic instability of the country, inflation, and mismanagement. With this environment, the Argentine National Mortgage Bank was hampered by an excess of unrealistic long-term, low-interest mortgages. By 1961 its U$S6.9 million in deposits was insufficient to underwrite
commitments totaling U$S340 million. Despite this, throughout the period of 1949 to 1958 it managed the construction of 500,611 new homes\textsuperscript{47}.

The Bureau of Personal and Real Estate-Secured Loans, a subsidiary of the Labor Ministry, was authorized to grant loans for home purchases, construction and improvements to employees and workers who had contributed to a variety of National Pension Funds (Commerce, Industry, Rural, Railway, State, Banking, etc.). The inadequate administration not only did not reach the targeted population but overextended its reach. Loans up to 40 years were not uncommon. Payment collections were behind in payments (at least 18\%) and delinquent accounts were around 50\%. Excess of applications and few funds were the result of these practices and because there were no offices developed in the provinces, most of the activity was concentrated around the city of Buenos Aires which contributed to compound the problems typical of underdeveloped economies. Furthermore, the rent control programs which were in effect for many years in Argentina helped distort the market, affecting all segments of the population and discouraging investment in housing.

One of the common denominators in underdeveloped economies has been the centralization of economic activity with the resulting emergence of mega-cities. The need for work attracted and continue to attract people to these centers and with the lack of available land and proper infrastructure in the suburbs, many substandard communities are

created. In the case of most large cities in Argentina, many such settlements known as Villas de Emergencia have emerged and then eradicated to give way to earth-filling projects for the creation of parks like the so called Cinturón Ecológico which has used trash from the city of Buenos Aires as the filling material. Many communities were forced to move as their precarious dwellings were bulldozed during past military governments. The response of some of these communities was to search for and build new housing elsewhere with the assistance of non-profit organizations. These alternative mechanisms developed as cooperatives and self-help projects, although gaining in popularity, had little effect on reducing the housing deficit.

Very low entrepreneurial development for medium and low-income housing, a constant characteristic, as well as the economic instability and high cost of the Argentine bureaucracy completed the picture of a system that could never achieve any improvement in solving the housing deficit.

Two decades later, in Argentina today, there are several government programs that target habitational needs of the poorest sectors of the population. The most important provides U$S 900 million of housing funding annually, amount that is insufficient to cover current shortages\(^4\). However, it would not be surprising if through the new programs to foster economic growth by increasing housing construction, middle income and higher income households are the first to benefit. It will be natural for builders and banks to look for

safest possible investments and concentrate on those certain not to default on their payments.

It is important then to tackle the question of housing construction cost and financing availability for the low income sector. In this respect, we have shown the benefits of wood-based housing construction in reducing housing construction costs as well as minimizing the financial load on builders. The increased economic activity due to the larger number of units built with this technology should also provide more job opportunities and better incomes, which has a direct impact on low-income housing affordability.

Solving the Housing Deficit

Latin American economies have been conspicuously incapable of providing basic housing services for the poor. The formal mechanisms of housing construction and financing do not reach all segments of the population and informal mechanisms tend to produce either inadequate housing or expensive ones. Many low-income families live in dwellings without basic sanitation, overcrowded or providing inadequate shelter. Private sector activities are geared towards the high income families while public policies are usually unable to compensate the deficiencies of private provision of housing services to the poor.

Traditional government programs used in the 60's and 70's, which were executed by centralized agencies, assigned houses with soft re-payment conditions and the targeting of
the low-income families was very poor, given the high standards of the solutions used thus placing them out of reach of many. These type of programs ended benefiting the middle income class and yet loan recovery proved to be poor, prompting the reduction in the assistance of foreign banks and agencies. Other areas where low-income housing had problems centered on the promotion of infrastructure. This is, many internationally-funded projects and local government efforts aiming to create trunk-infrastructure, caused in turn land prices to increase in value, putting them in far reach of the poor. Also, subdivision regulations set service standards whose costs became unaffordable. Regulation of the housing markets, including land use, utilities and building regulations, are still barriers of entry to the market or impose restrictions that prevent supply from efficiently meeting demand.

During the mid-eighties there was a gradual consolidation of the approaches to low-cost housing and sector financing in some countries. Demand-driven ideas replaced the supply-driven approaches of the past\(^49\). The new systems relied on the private sector as the main supplier of houses and long-term mortgage-backed loans for households. The government plays now the role of regulator and facilitator of the market. Under this arrangement, low-income households receive direct government subsidies for the purchase of market-transacted housing. The subsidies are intended to supplement the portion of the price of a minimum house, that a low-income family cannot finance with savings and loans whose repayment would take a maximum of 25% of the household’s income.

\(^{49}\) The Interamerican Development Bank in low-cost housing. The first three decades. Internal report.
Recent experiences in Uruguay and Chile on low-income housing have had relative success in solving some of the most typical shortcomings and may be taken as starting models and drawing conclusions for their adaptation to Argentina, thus avoiding any of the negatives experienced in these countries.

Both of these programs leave most of the active role to the private sector while the government remains as a facilitator. Each has been able to accomplish the most difficult task of reaching their low-income household targets as intended, through the establishment of a transparent, need-oriented and objective system of determining beneficiaries. For further information about these programs, we have included a more detailed description in Appendix 10.

Despite their success in reaching the low-income recipients, involving the private sector has been a problem, beneficiaries loose the drive to take part in the solution to their housing problem, developers get used to the low risk role of government contractors, and commercial banks find justifications for not entering these lower-income housing markets. These issues need to be addressed in Argentina is to implement a large scale low-income housing program.
Chapter 5

Conclusions

We believe that the best way to solve the housing deficit problem of Argentina is through an integrated program of industrial development of the forestry and construction industry. This should become a sustainable strategy as it provides for the creation of jobs, increase in income levels and facilitates involvement of private developers and financial institutions without excessive business risk.

Housing sector policy should be integrated into the national social and economic planning efforts and the sector's performance should be monitored regularly. The planning and implementation of the necessary programs has to be coordinated by all parties involved, namely government, private industry and financial institutions, labor unions, educational organizations, foreign developing agencies and financial organizations, and most importantly the communities themselves.

We believe that the fast introduction of wood-based housing construction techniques, together with an aggressive development of the forestry sector and materials industry, should result in more worker's income, promote economically feasible demand and more units built. This effect should increase with time as the forest product's industry and the wood-framing construction industry would be subject to significant learning curve exposures.

Effect of our Proposal
Argentina’s forest product’s industry and the Argentine government are basing their demand forecasts on the present domestic consumption and trends plus an increase in some exports. They understand that the construction industry (even with the traditional Argentine construction techniques) is the main vehicle to promote demand, but they are not aware of the tremendous potential that wood-housing construction would entail. Wood is still traditionally used for holding cement pourings, wall covers, roof beams, floor parquets, moldings, windows, doors and closets. Other domestic markets include furniture, pallets, export boxing, etc. Exports seem to be looked upon mainly for products which are non-load bearing such as fences, floors, pallets and furniture.

Therefore, both material and construction industries are not prepared yet to absorb the potential effect of changing the housing construction methods to wood. If this was taken into consideration, significant investments in these industries would be required but nonetheless be attractive.

**Recommendations**

As we discussed in the previous chapters, the way to achieve increased housing construction is by transforming the complete construction value-chain. As we can see, the industrialization of Argentina’s basically artisan-type industry is required from raw materials to the final commercialization of housing.

**Home Building Value-Chain**

<table>
<thead>
<tr>
<th>Forest &amp; Other Products</th>
<th>Primary conversion = Building Materials</th>
<th>Engineered Products</th>
<th>Engineering &amp; Design</th>
<th>Construction</th>
<th>Financing</th>
<th>Marketing</th>
</tr>
</thead>
</table>

67
Throughout all stages of the value chain, government and labor, have a tremendous influence and are responsible to remove barriers and frictions which would dramatically improve efficiency and productivity throughout the value-chain as well as attract domestic and foreign investment in the sector. Some of this is already taking place in the country so today’s outlook on the possibilities of change and improvement are good.

Because the concept of our approach is based on the time savings and flexibility that residential wood construction provides, as well as the potential for development of a new industry with a high multiplier effect on the economy, we will describe our recommendations from the initial efforts in forestry to the final construction and servicing of the housing sector.

(1) Forestry:

The recent economic stabilization of the Argentine economy and political system has brought some new investment by foreign companies, primarily German and Chilean. The government’s offer of incentives for forestation and the realization by both government and labor that the forest industry can contribute to the generation of new employment is embodied in the instrumentation of the “P.I.T. Forestales” in several provinces, where the Labor Ministry, Secretary of the President, and Argentine Forestry Association are bound together to generate permanent employment in this sector of the economy. Other signs of improvement are export oriented policies by the government like Export-Ar, Promex, credits to small and medium enterprises (PYMES), Reconversion and Industrial
Specialization program; as well as training and total quality programs. More recently, expectations have been raised by the Government’s announcement of a significant push in housing construction (Programa Nacional de Viviendas) which was created to promote jobs and the regional economies.

With this in mind and the awareness of the potential deficit in wood resources at the beginning of the next century, investments must be carefully planned. If as we propose, the Argentine wood housing industry develops in some meaningful magnitude, wood shortages would be even worse. Forest planning must include provisions for the updating of building construction technology, which is inevitable in a country who has opened its economy to the world.

As an initial step, the government could collaborate with the forestry sector in further developing technical organizations which can consult with the smaller and medium sized industries regarding foreign marketing and sales promotions, as well as in identifying the latest available technologies worldwide. Government and industry should search for ways to reduce the amount of wood used for energy which could otherwise be used for added value products and leave just those species without other uses for heating or charcoal production.

The industry must adapt its products to internationally accepted standards such as ISO and group itself as a way to coordinate its efforts for gaining international acceptance. This has
been successfully done by Chile with its Corporación Maderera (CORMA). Many times Argentine producers have claimed they are not in conditions to supply products in volumes required by foreign customers, but in our opinion it is quality and consistency in supply and prices which are the most important factors to foster trust and better customer relations.

Proper managing of plantations, with thinning and pruning, will be required if Argentina wants to increase its export potential. The industry must therefore recognize and incentivate, through proper pricing mechanisms, the forest producer of larger diameter wood and well managed plantations. Genetic improvements of forests should also be encouraged in order to maximize Argentina’s faster-growth comparative advantage (what takes 15 to 20 years in Misiones is equivalent to 40 to 80 years in the Northern countries of Canada, Sweden or Finland).

There is no opportunity to develop any forest products industry if proper and sustainable forests are not planned for, created and maintained. Argentina is barely able today to produce enough for its meager domestic demand and incipient exporting volumes. Any increase in its exports (highly desirable by government and private industry alike) is presently limited by the lack of sustained forestation programs, with its worst bottleneck expected towards the beginning of next century.
The country has significant comparative advantages with its fast growing rates on both hardwoods and softwoods, very large areas of apt soil for forestation and readily accessible terrain which should simplify forestry operations.

Argentina has already moved to correct this problem through the launching of new forestation programs and deregulation legislation. However, all plans are conceived with the expectations to increase and meet export demand. In our opinion, the exporting capacity must be coupled with a more significant internal domestic demand, only possible by the creation of wood-based residential construction.

This much larger demand will be a real driving force to justify domestic and foreign investments in plantations and converting industry, which can then balance its export and domestic markets according to their relative demands.

Undoubtedly, Argentina's exporting potential will have to come first, as the creation of a new construction industry and the removal of all legal, economical, and cultural barriers impeding the popularization of this mode of construction will take time. Therefore, all forest programs and plans must be accompanied by the necessary investments in transportation infrastructure, port facilities and most significantly overseas marketing and promotion programs. In this respect, it is imperative to develop an appropriate certification institute to insure that lumber products exported meet the necessary characteristics. Furthermore, this and other institutes should work to help develop
products from the fast growing species, so they can meet the minimum structural standards required overseas. Otherwise, wood exports will remain only for less added-value products to be used in non-structural applications such as fences, furniture and plywood. Plantations in Southern Argentina should be promoted for bearing load applications because of the potential for better strength characteristics (although with slower growth rates).

Other issues still lingering and which need to be addressed are\textsuperscript{50}:

- We must avoid Argentina's traditional forest policies which were radically changed by every new government in power negating any efforts made for advancement.
- The private sector must have larger integration into the planning of forestry resources.
- The high cost of utilities, transportation, services, social levies and labor suits must be lowered.
- Lack of financial capacity to start new plantations, as observed by the low utilization of the federal and provincial government programs, must be resolved.
- A requirement for uniform standardization and quality controls to allow the production of suitable products, must be implemented immediately.
- Lack of labor management accords to permit long-term planning needs to be implemented and kept in place.
- More attention must be given to better management, protection and utilization of the native forests.

\textsuperscript{50} Ing. Forestal Juan Carlos Ramirez, Instituto Argentino de Sanidad y Calidad Vegetal.
For further information regarding the forestry sector and recommendations, please refer to Appendix 5.

(2) **Industry of Wood and Derivatives:** This Argentine sector is small by comparison to that of industrialized countries or those with forest-based technologies. It has followed the fate of many other industries in Argentina, suffering from unstable political and economic climate and lack of exporting oriented vision, which prompted little or no investment and further, when it did invest, its primary technology came from neighboring Brazil and not from the most advanced nations. Because the domestic demand for wood products is circumscribed to a few basic products, there was never a strong need to develop new ones. This situation would revert itself by the implementation of wood-based construction technology. Here both government and private industry can work together to attract foreign firms to install modern machinery to produce more added value products to meet both domestic and foreign demand. It will be the Argentine construction industry which will prompt foreign investors to come to Argentina and provide capital and technology, as they will profit from a newly created market for their products. In this respect, sawmills, producers of boards, all the way up to modularized components should be encouraged to locate in strategic areas across the country.

The Argentine industry has significant potential as its forest resources are developed, and must still strive to:
• make better use of logs
• Work with shorter logs as well
• incorporate new machinery to increase productivity and quality
• implement more accurate drying methods
• plan for higher value added products
• improve operator’s training
• improve its marketing and selling structures

The construction materials sector should also recognize the tremendous change taking place in the developed economies of the Northern Hemisphere. Due to the environmental pressures and the reduced usage of Federal forest land, the availability of lumber has decreased and prices will continue to be at high levels. This has promoted the use of new competing products. Cement blocks and cement/wood fiber materials are being used as well as steel, aluminum and other metal-based products. Due to the decrease of old-growth forests, smaller diameter timber is being used widely, as technology has evolved to allow the fabrication and use of lumber and plywood replacements based on products reconstituted from fibers and small wood components, as well as building-up of large-dimension structural members from smaller pieces through lamination. The use of particle board in furniture manufacturing has increased and is expected to continue to do so, while hardwood continues to be used primarily in furniture and sawn mainline railroad ties, and less so in structural and architectural applications. A long-established trend towards the utilization of the “whole tree” (or whole stem) concept should increase wood’s
competitiveness as a construction material. Product mix changes and the use of a larger proportion of reconstituted products should therefore be expected.

What all of this means, is that countries like Argentina can develop their forest industry to export their lumber products at competitive prices, while their local industry (forest, cement, steel, and others) can all participate in the resurgence of its housing industry through the development of new products. The challenge therefore is to upgrade Argentina’s technological base. Even from an energy point of view, the wood-based material’s industry is in a very favorable position to become energy self-sufficient, but this can be fostered only through investment in new improved furnaces and designed to use green wood and bark residues to generate the heat required by kilns, dryers and presses.

The larger variety of products involved in wood-frame housing vs. the traditional brick and mortar construction could provide more overall indirect-jobs, in other words, have a larger multiplier effect on the economy. According to our assessment, assuming only a 25% of the Argentine Government’s forecasted new-housing units now produced in wood (and not accounting for wood demands for other type of construction other than residential), the Argentine Forest Products industry would have to grow 100% to 300% to sustain such growth. Also, assuming 100% of housing production in wood only, the employment in the production of lumber and plywood would translate to: 55,000 jobs (at the Government’s planned housing construction level) or 162,000 new positions at the higher rate necessary to eliminate the housing deficit in 25 years.
Our conclusion, therefore, is that growth can be achieved not only by increasing exports but by developing the domestic demand for forest products through wood-housing construction. This should have a more significant impact on the growth of this sector and provide a larger multiplier effect on the economy than the traditional construction material industry alone. This can be done if we strive to attract foreign firms to invest in the industry with initial plans to export products back to their home countries and slowly transferring their sales to the newly created market in Argentina. Increased Research and Development is mandatory in order to succeed in this part of the value chain and should be performed mainly by the private industry with support from universities and other institutes. Government can be of significant help by maintaining deregulation policies and coordinating research programs between forestry, material, housing-design, construction industries and universities.

(3) Other industries: The creation of a radically different way to construct will have profound implications in the construction material industry and thus it may face a lack of support or outright antagonism by other industrial groups. This needs not be so. Powerful groups such as the cement industry can benefit tremendously if they see themselves as being in the construction materials industry rather than in the cement industry. Present advances combining cement and wood products are creating new added value products which can be used in the construction and other industries. The challenge to the Argentine
industry is to realize this opportunity and partner with local and foreign forest companies as a way to promote and participate in this area.

(4) Labor Unions: One of the groups with most potential to participate in supporting the creation of new jobs is the labor union organizations. They are in an unique position to support the training and technology transfer required to develop the construction industry. Their role would be multifaceted where they can partner with overseas unions and developers, local and foreign technical schools, research centers and universities for the training of the Argentine workforce in the novel methods of construction. The shift away from masonry towards carpentry will demand training in new methods, techniques, use of new tooling, and managerial work. Even health and safety issues for wood construction will be different.

(5) Construction Industry:

The fact that very few wood-houses are imported in Argentina distorts the cost advantages which wood-framing technology has. Furthermore, the inefficiencies in the Argentine Forest Products Industry causes its prices to be above normal.

Despite having the lowest cost of raw materials, the sale price for lumber is much higher in Argentina than in neighboring countries. Limited supply, high internal transportation costs, and lack of knowledgeable constructors are barriers impeding the rationalization and competitiveness of the wood-frame housing industry. Yet the potential for savings are
enormous. We are confident that with the deregulation and open market for new technologies, training and investments, the development of a wood-housing construction sector looks bright.

The use of wood-based construction will increase the existing capabilities of the construction sector and provide a flexibility up to now unknown to this sector. As mentioned, not only is the flexibility a matter of reduced construction time, but also in the design of housing and modularization. Houses can be planned in stages in much easier ways. This allows the construction of family dwellings by big and small constructors alike. In fact, part of the advantage of promoting this type of construction resides in being able to create innumerable small to medium-size construction companies (i.e. they do not require the same capital investment in equipment as the conventional mortar construction companies). The effect on employment should be positive. Further, low-income housing projects, which many times fail due to cost overruns, delays, and lack of loan collections, can be now designed for a minimum modular-size unit to which the owners can enlarge on their own at later times. Their involvement will be helpful in developing the necessary community ties, yet their core-habitational needs may be resolved from the start, which removes the typical frustration which people in this situation usually go through.

The Argentine construction associations and private contractors should strive to align themselves with the providers of technology, namely the United States, Canada, Sweden and Japan, as well as cooperate with the labor groups, academia and government in the
training of personnel. Government’s role in insuring proper certification of all builders will be key in providing safe housing and working environments.

(6) Service Industry: Unlike developed countries, the construction service industry and the do-it-yourself segment is very small in Argentina. Given the heavy loads, dirt problems and time consuming expansion and repair work, very little is done by individuals or small contractors. The flexibility allowed by wood construction reverses this trend and creates further employment in related businesses and retail centers. It is now possible for individuals to upgrade their dwellings at their own pace by using new construction products which are lighter, easier to transport and faster to build with. This should be taken into consideration by the main international retail centers in their investment plans for the future.

(7) Government: It is clear today that the role of government in a modern economy is that of facilitator and to fiscalize in order to promote a fair game, transparency, health and safety standards, as well as environmental protection. Its coordinating role and promoter is thus extremely important. The Argentine government has initiated a deregulation process to allow for transparency and is reducing its taxes, duties and bureaucracy to facilitate increase construction levels. It has also promoted the updating of standards and improvements in the financial markets. Most of all it has lately provided the country with a stable economy with low inflation, key issues which can otherwise deter the construction industry. In particular, it has recently launched a 5-year infrastructure plan to stimulate
growth. It calls for $86.8 billion in expenditures for housing, public works, the expansion of gas and water lines, roads, hospitals, schools and other projects. Specifically regarding the wood construction industry, the government can create together with international and local industry and universities, a research center for the development of optimum construction techniques and wood-housing designs applicable to Argentina. It can promote technology exchange and training with overseas organizations together with the Argentine labor unions, universities and private industry. It should promote the construction in wood by eliminating all duties associated with the importation of these houses regardless of the income of the importer. It is foreseen that the higher income bracket will be the first to take advantage of this, given their economic advantage as well as their knowledge of the wood based housing they were exposed to in their international travels. This will be necessary to promote the desirability of wood houses to the rest of the population which still considers the mortar construction as the most appealing. The federal and provincial governments as well as municipalities must review their codes and regulations to permit the use of wood based housing. Further, they must review the issue of land availability in particular for low-income housing projects.

(8) Universities and other educational centers: There is a lack of wide-spread knowledge regarding wood construction within the educational system in Argentina. The knowledge is quite concentrated within a few individuals and very little is done to train architects, civil engineers and building technicians in the possibilities of wood construction. Furthermore, when wood materials are used, it is primarily in expensive high
cost alternatives covering high end design proposals. Plans for the dissemination of know-how must be implemented immediately. Until enough knowledge is gained by Argentine architects and engineers, little will be possible regarding the creation of suitable codes and regulations allowing for wood based construction. The University system must expand in collaboration with the private industry, government and communities into research and development programs to adapt the wood based construction materials and building techniques to suit Argentina’s needs. An interesting quote gives a vision for what can be expected: “For architects and builders, one of the most provocative changes will be in how they come to view a house - simply another consumer product, rather than an individual artistic creation. Although this may not be an easy or pleasant change for individual architects, it does not suggest the role of architects will be diminished or that creativity will be lost. Some readjustment to this new way of thinking may be necessary, but entirely new opportunities for creativity, expression, improved workmanship, and communications may evolve. For example, using advanced telecommunications devices and desktop computers, architects at almost any location will be able to create a new house design from libraries of stock modules or prefabricated components available from suppliers in their area, allowing more time for the design process itself”\textsuperscript{51}.

\textbf{(9) Communities and others:} Housing programs supported by government and the private sector are a powerful tool for putting local labor and materials to work, distributing income and raising standards of living. However, many government programs

(even with support from international financing agencies) have experienced innumerable problems. Targeting the poor is difficult and many attempts are not sustainable due to the difficulties in reaching these segments and the very high price-tag of success. These types of projects are very demanding in investment resources and institutional support, where high levels of subsidies and efficient executing agencies, that can develop good relationships with the communities, are a must.

Beyond the mechanics of collecting funds, keeping track of the transactions, servicing loans etc., the management of the risks associated with long-term lending, pose particular problems. Credit liquidity, cash flow, agency, system and political risks keep emerging as key areas of concern.

Today's recommendations emanating from international banks and agencies point out to becoming involved only where clearly demonstrated market imperfections require public intervention. The requisites they consider indispensable for success include\textsuperscript{52}:

- a clear identification of the low-income target population lacking access to credit;
- proper application of affordability and beneficiary solution criteria;
- adequate housing pricing and financing procedures;
- avoid conflicts among competitive programs; and

\textsuperscript{52} The Interamerican Development Bank in low-cost housing. The first three decades. Internal report.
• participant's preferences and needs have to be taken into consideration from the inception of any program.

The solution to the failures of the past seem to require the mobilization of significant amounts of local resources that can only be supplied by the households. Because the supply of housing is in the hands of the private sector, efficient developers backed by an efficient construction industry are essential to have a competitive housing market. This is why in our opinion, the development of a wood-based housing industry is a vehicle to provide income growth and thus savings potential to the low-income sectors.

As we have seen in this work, the Argentine housing deficit is more pronounced in the lower-income segments of its population. We also know about the main difficulty hindering success encountered in most low-income housing programs, i.e. the proper allocation of resources to their intended recipients.

Although we have explained elsewhere the past attempts of Argentina in this field and their failures, we remain confident that given the new deregulation and opening of the economy, new opportunities to implement successful programs are now possible. Because of this, we believe that the recent experiences of Uruguay and Chile on low-income housing can be taken as starting models, drawing conclusions for their adaptation to the Argentine conditions, thus avoiding any of the negatives experienced in these countries.
There are many organizations whose roles are important, in particular regarding low-income housing. As we mentioned earlier, in any self-promoted housing project, the community benefits from the interaction among its members in solving a common problem. The successful programs have been those which had an organization capable of providing leadership and trust (usually the local church), technical support (most of the time volunteer workers from universities of architecture and social affairs) as well as financing help by international good-will organizations. Although these efforts are not sufficient to cover even a minor fraction of the housing deficit problem, they should be continued and supported by government and the private sector.

(10) Financing: Although our thesis does not concentrate on the details of the revamping of the financing activity of the housing value-chain, we described its importance and problems.

The housing deficit quantified in this work, is mainly based on an average size unit of 60 m² typical for low-low-income housing projects. The highest housing demand however corresponds to the low- and medium- purchasing-power sectors (average size units of 80 m²), where the average traditional construction costs ranges from U$S509 to U$S751 per square meter and usually represent 50% of the final sale price.

The housing demand as said is not homogeneous throughout the country. The average gross income level of the industrial sector is about U$S 650 per month. Assuming for
example that a mortgage payment of U$S500 per month\textsuperscript{53} is required to gain access to an average house and that this amount should not exceed 30\% of the household income, we are talking about a net income of U$S1,667 per month. For the city of Buenos Aires and suburbs, only 20\% of the population would have such an average income to allow them access to financing. This would mean a potential of 600,000 households capable to participate in newly created financing mechanisms, but not all would become effective demand given the different needs and socioeconomic levels for each family. A recent poll in the largest urban centers of the country show for example the following average income levels: Buenos Aires city and suburbs: U$S2,500 per month; U$S1,650 in Cordoba city and suburbs; U$S2,400 in Mendoza; U$S1,900 in Paraná city, U$S2,100 in Alto Valle Rio Negro; U$S1,600 in Corrientes and U$S2,700 in Neuquén.

Therefore, it is expected that with the new programs to fostering economic growth through housing construction, middle- and higher-income households will be the first to benefit. It will be natural for builders and banks to look for safest possible investments and concentrate on those certain not to default on their payments.

Financing of housing construction for the low-income sector is thus crucial. In this respect we are convinced that wood-based housing construction can become more effective in reducing housing construction costs, provide more job opportunities and better incomes,

as well as minimize the financial load on builders (please refer to Appendix 8 for more details).

Government housing programs, although necessary, have never been sufficient and there is no reason to believe that they will be able by themselves to solve housing deficits in the future. Therefore it is important to look at all alternatives including improved access to finance to complement and enhance housing construction programs.

In January 1995 the Argentine government approver the law No. 24,441 which provides long-term financing for housing through the "Banco Hipotecario Nacional" (BHN). In this new role, the BHN will extend credit lines to individuals to finance or build new houses. Also, private construction companies can present complete plans to the Bank, including demand analysis, financing tools, the way that houses will be marketed and sold etc., which the Bank will analyze and if approved, buy 100% of the Mortgages of the houses built and sold. Mortgages will be for 15 year maturity and interest rates between 12 and 14%. The financial process is as follows:

- The commercial private bank finances a construction company to build a new set of houses;
- The commercial bank transfers the mortgages on those houses to BHN; and finally
- Mortgages from different commercial banks will be securitized through debentures by BHN.
As demonstrated earlier, the largest effect of wood-based housing will be in the advantage to any builder, large or small to construct a house with minimum working capital and in a much shorter time. This financial efficiency will be of interest in a country which traditionally has had high financial costs.

Final Remarks

Despite the aggressive goals of the Argentine government and their expectations for the housing program, it is clear that the housing deficit in Argentina will not be resolved soon. We have proposed that the fast introduction of wood-based housing construction techniques, together with an aggressive development of the forestry sector and materials industry, should result in higher quality and more economical construction, while the expediency of construction and reduced financial load will result in more units built than with traditional methods. This advantage will even be more important in the future as the new construction industry continues to learn.

The potential for transformation is significant and within reach. It is a matter of conviction and taking the first step.
Appendix 1

Understanding How the Housing Sector Works

The housing sector is connected to the broader economy through a number of different mechanisms: the real, fiscal, and financial aspects of the economy. Real effects are those associated with investment, output, employment, and prices. Financial effects are those associated with the financing of housing and related residential infrastructure through financial intermediaries. Fiscal effects are those associated with taxation and subsidizing of housing.

The building industry purchased practically the entire output of the Cement Industry and Clay products sectors; more than 90% of the sales of Metal Industries for Construction and Cement sectors; between 70 and 90% of Lime and Plasters. Industries whose output in Argentina today is absorbed to a lesser extent include: wood, furniture, paint and varnish, cork, explosive, glass, adhesives coloring matters, electrical machinery and equipment, etc. The transportation of building materials account for 21.49% of road transportation directed to production centers and 10.36% of sea transport.

In general, at the lower levels of economic development, the share of GNP attributable to housing investment is quite low, about 2%. As development proceeds, housing's share of GNP increases to as much as 8% for countries at moderate levels of development, and falls to an average of between 3 and 5% in industrial ones. This relationship is similar to,
and indeed is influenced to a considerable degree, by the relationship between housing demand and household income.

**Housing sector and the Macroeconomy**

The preoccupation of the Authorities to satisfy the housing needs of the poorer classes has been one of the main characteristics of any building policy since the beginning of the century. Since the time that the State had to intervene to prevent the exploitation by builders and speculators of low-income sectors, and for the purpose of improving the living conditions of large sections of the population (especially in industrial cities). Initially, the social-type dwelling only tended to satisfy the minimum housing requirements. Thus, the State and other public bodies managed to avoid the emergence of slums, insalubrious buildings and sub-human living districts, by the erection of a large quantity of dwelling units, which were in reality no more than a roof and walls. Although there is no doubt that this was an advance on the state-of-things, it was still a far cry from the concept that the dwelling must, in fact, be a home.

The circular nature of the relationship between macroeconomics performance and the performance of the housing sector has become increasingly evident. Macroeconomics policies that influence economic growth and national income levels, have clear impacts on the quantity and quality of housing. Inflation rates and interest rates influence householders, firms, and financial institutions in making decisions about demand, supply,
and price of housing. Taxes and subsidies have further influences on the performance of the housing sector.

The connections running from the macroeconomy to the housing sector tell only part of the story regarding the linkages between the housing sector and the broader economy.

Direct government spending on the housing sector, for example, averages only about 2% of government’s budgets in developing countries, a tiny fraction of the resources flowing into the sector. But government policies that affect housing prices and characteristics by laws, regulations, and other means, can have vast and pervasive impacts not only on the performance of the sector but on the performance of the broader economy as well.

Like we said before, financial and fiscal linkages between the housing sector and the broader economy are very important. Residential mortgage loans, as a proportion of the consolidated assets of the financial system, grows from next to nothing to more than 25% at moderate levels of economic development, and up to 40% in industrial countries. In some countries with rapid economic growth and expanding urban populations, mortgage loans are the most rapidly growing portion of the portfolios of commercial banking institutions, contributing importantly to financial sector development.

Housing subsidies sometimes constitute a significant portion of government expenditures and may lead to budget deficits and considerable inflationary pressure. On-budget housing
subsidies have been a particularly prominent feature in centrally-planned, or formerly centrally-planned economics. In Poland, for example, housing subsidies in the late 1980s comprised some 34% of all government budgetary subsidies, 13% of the government budget, and about 3% of GNP. Reduction and restructuring of subsidies in such countries is an important part of the agenda for any housing policy reform, with implications for both social equity and macroeconomics efficiency.

In Argentina, some 25% of its sometimes explosive inflation rate was estimated to be attributable to a badly functioning housing finance system. The public expenditures in social services, called "Gasto Público Social" is at a high level (the projections for 1995 and 1996 for these expenditures will be $57,375 and $63,417 millions respectively, equivalent to 18.41% and 18.80% of GDP. Of this total, the portion allocated to Housing Policy is as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>$ Millions</th>
<th>Share of GDP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>1.448</td>
<td>0.46%</td>
</tr>
<tr>
<td>1996</td>
<td>1.505</td>
<td>0.45%</td>
</tr>
</tbody>
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Experiences elsewhere, like in the United Kingdom, show that rigidities in the housing supply system, coupled with the liberalization of housing finance appears to have resulted in a major drop in the rate of household saving, higher interest and inflation rates, and a major structural increase in unemployment. Those policy failures further distort markets,

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1 Secretaria de Programación Económica
generally resulting in large benefits for a lucky few and widespread cost for everyone else. In many cases the biggest losers are exactly those groups whom housing policies were nominally intended to benefit. And frequently, these costs are amplified through the broader economic system, as they begin to affect investment in other sectors, savings rates, budgetary deficits, inflation, interest rates, labor markets and labor productivity, and even the balance of payments. The housing sector suffers dramatically when housing policies fail.²

² Housing Enabling Markets to Work, a World Bank policy paper
Appendix 2

Why Now Argentina

Argentina has seen its economy dwindle and its position among the leading countries of the world diminish to inconsequential levels. The policies implemented by the country in the last several decades, with political and economical instability certainly contributed to its debacle. However, Argentina is emerging from a turbulent past and seems on its way to stability and prosperity.

This appendix will serve to provide those readers unfamiliar with the country some basic information about it as well as recent developments.

Country Highlights:

- Location : South extreme of South America
- Area : 2,767,000 sq. Km
- Capital : Buenos Aires
- Population : 34 millions
- Literacy Rate : 95.3%
- Independence date : July 9, 1816
- Language : Spanish
- Currency : Peso (1 peso = 1 dollar)
- Political System : Democracy

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3 The Economist, Country Report, 1994
**General Overview:** The election of Peronist President Carlos Menem in July 1989, during a traumatic hyperinflation period (July inflation alone was 200%), constituted a turning point in the economic evolution of the country, with the implementation of a neo-liberal economic adjustment and structural reform program. The new government inherited weak public institutions accustomed to deficit spending and with an institutionalized reliance on inflation taxation. In addition, claims on state resources were far greater than its capacity to mobilize resources - in short, the Argentine state was insolvent. The administration undertook stabilization programs in 1989 and 1990. Neither succeeded, principally because of the intractability of the fiscal deficit. The first program ended in a new hyperinflation period (end of 1989 and early 1990). The second one lasted from March 1990 to December 1990 and culminated in a new inflationary outburst, but, unlike the previous breakdowns, the economy did not spin into hyperinflation. Instead, a new fiscal package in February 1991 was sufficient to close the remaining fiscal gap. This was followed by the April 1991 introduction of the Law of Convertibility, which guaranteed one-for-one peso-dollar conversion and effectively proscribed money creation other than through increases in net foreign reserves. The convertibility program thus disciplined monetary policy and limited the government’s power to finance its deficit through inflation. The law markedly reduced the foreign exchange rate risk to investors and the inflation risk to business and labor. This will be so as long as the fiscal fundamentals are kept in place to support it.
With this new environment, long forgotten in Argentina, the base was set for credibility and stability.

The February 1991 program was able to close the fiscal gap in large measure because of the government's sustained structural reform efforts which have progressively improved the foundations of sound public finances. The program aimed at opening up the economy, reducing the size and boosting the efficiency of government, and restructuring State activities. This restructuring included a broad and deep privatization program. The program also called for the elimination of the fiscal deficit and the liberalization of labor and capital markets. The program led to a quick economic recovery.\(^4\)

Between 1989 and 1992, inflation dropped substantially to annual one-digit rates—the CPI fell by nearly two-thirds from 1992 to present. The GDP grew 18% and 670,000 jobs were created, representing a 5% increase in full employment. Productivity increased and investment grew 25% in 1991 and 31% in 1992.

**Crucial Reforms:** Unquestionably, the principal theoretician, master architect and leading proponent of Argentina’s economic turnaround is Domingo Cavallo, its Economic Minister. One of the crucial pillars of the Cavallo Plan was tax reform and simplification. The Plan eliminated many income-distorting smaller taxes and established one broad and

\(^4\) Results Latin Finance, by The World Bank, September 1993
flat value-added tax at the federal level. Since the inception of the reform measures, the tax structure was changed several times. Although yielding positive results, these constant modifications, and their consequences, had produced a perception of uncertainty (and therefore weakness) in this area of economic policy.

Another notable achievement has been the drop in tax evasion in Argentina for the last several years. Tax reform has not only expanded the tax base, but also improved collection. To attract foreign capital to Argentina and to increase market competitiveness, the Cavallo Plan has eliminated the foreign investment law that applied discriminatory treatment to foreign investment, including cumbersome regulations. A foreign investor is now treated as a local investor in Argentina. As a result, ECLAC reported that $30 billion entered the country between 1991 and January 1994, most of which corresponded to repatriated flight-capital. In addition, Decree 146 of February 21, 1994 lifted all restrictions on foreign banks seeking to establish local branches in Argentina.

The current legal framework for foreign investment is very propitious. Not only have discriminatory regulations been eliminated, but the economy has opened up, a convertibility regime has been adopted (i.e., contracts can be written in either domestic or foreign currency), the Central Bank has been accorded increased independence, and exchange controls have been eliminated.
As a result, foreign investment has surged since the beginning of the year. A torrent of foreign acquisitions has hit the marketplace, changing the ownership of a large number of firms. Nabisco, Procter & Gamble, Nestle, and the Chilean pulp and paper group CMPC have all acquired outright or purchased significant shares in a number of leading Argentine companies during the last six months. Large Argentine firms such as YPF and Bunge & Born have also made major acquisitions of domestic and foreign companies. Additionally, joint ventures and strategic alliances, such as Alpargatas-Nike and tire CTI/GTE/Benito Roggio/AT&T partnership (to provide cellular telephone service) are increasing substantially.

The Emerging Stock Market: The Argentine stock exchange is increasingly becoming an important source of funding for local firms, as confirmed by a number of recent studies of emerging markets. Furthermore, the “Bolsa” is also attracting international interest, partly due to an increased confidence in the system, due to privatization and stable economic growth.

The Buenos Aires Stock Exchange capitalization value rose from $18.8 billion in January 1993 to $37.5 billion in mid-December. Meanwhile, the Merval index measuring the 17-most actively traded stocks rose 24% in 1993. The daily trading volume averaged $50 million in 1993; of this volume, an increasing portion corresponded to international firms.
The stock market is also expected to benefit from the private pension funds (AFJP) which are to emerge in Argentina. These, which have been modeled after Chile’s and have already been adopted by other Latin American countries, will manage around $3 billion per year; of these, 50% will be allowed to be placed in locally traded shares.

**Privatizing the State:** Privatization is another area in which Argentina has made significant progress. It is estimated that Argentina’s privatization program has brought some $9 billion in cash to the government and lowered the national debt by $4 billion. The privatization of YPF is a prime example. The country now has greater investment in oil and gas exploration and exploitation, and higher wages as a result of privatization and management improvement. Formerly state-owned companies are now making money rather than losing it as in the past. This has occurred in electricity production and transmission, telecommunications, rail transportation, ports, and commercial air services. The only two sectors still owned by the State (but scheduled for privatization) are the nuclear plants and the airports. Although facing higher prices, consumers have benefited from improved services.

Not all privatization have worked well, as is the case of Iberia’s purchase of the national airline Aerolineas Argentinas. The new owners lost money, and the Argentine government is reluctant to spend more cash, while travelers complain that the service has worsened. It should be noted, however, that the sale of Aerolinas Argentinas is not a true privatization, since the purchaser Iberia is owned by the Spanish government.
The outcome of the privatization of the Buenos Aires underground is still pending. Metrovias—the group led by Argentine construction company BenitoRoggio—won the bidding due to its offer of the lowest subsidy to run the system ($130 million) and the maintenance of low fares during the life of the concession. The group, which is also formed by 25 local bus companies and large foreign transport firms, has promised to improve the standard of service, which includes cleanliness and security at the stations.

**Globalization:** Regional and hemisphere-wide trade integration have been high priorities for the Menem government. At the Fifth Meeting of the Common Market Council held in January 1994, the presidents of the member countries—including Argentina—agreed that the moment was decisive for the consolidation of Mercosur. All of them agreed on the need to establish a common external tariff (CET), though only 85% of the 10,000 items to be included were included.

Albeit the government’s aim to pursue regional integration through Mercosur, Argentina’s leading economic situation in the group, and the largest asymmetries between member countries, create doubts about whether the country will benefit from Mercosur. It is likely that greater gains could be achieved by joining Nafta. In this regard, Economic Minister Cavallo recently announced that Argentina is willing to join Nafta with or without its Mercosur partners.
Prospects: The neo-liberal Cavallo Plan adopted by the Argentine government some years ago has produced positive economic results. Inflation has dropped to insignificant levels, the economy is growing, markets have been liberalized, and the State has been restructured. As David Rockefeller stated during his visit to Argentina in mid-March 1994: “Argentina has joined the club of important countries.” Nonetheless, serious problems persist.

• First, external imbalances are growing, as indicated by a $3.2 billion trade deficit for 1993, a 20% increase over 1992 and the highest level ever recorded. This trend is expected to continue.

• Second, the neo-liberal reforms have resulted in significant social costs, which could result in increasing social unrest if the demands of the growing number of unemployed are not channeled efficiently either through greater job creation or through state compensation mechanisms.

• Third, entrepreneurs have been hit hard by the new tax system and by an overhauled exchange rate; they are also insisting on new government policies which are more favorable to them.

These are significant challenges but for the first time in generations, the possibilities for real change and positive growth are here.
Appendix 3

Wood-based construction in Developed Economies:

As a way to further explore this industry, we will concentrate on the United States as this is the largest market in the world. Countries like Canada, Sweden and Japan also have significant and advanced wood-based home industries.

In the last 100 years, two significant events marked the evolution of wood-based construction technology in the United States. The first was the transition from balloon to platform framing and the other the advent of engineered roof and floor trusses in the 1950s\textsuperscript{4}, which helped shape today’s industry.

As early as 1905, Sears Roebuck and Co. began to sell prefabricated houses from a catalog. Pre-cut and marked building materials were shipped by train where they were met by horse’s drawn vehicles for transportation to the site. A local contractor would then erect the unit on the previously prepared area. As time went on, pre-fabrication technology followed the route of Henry Ford’s assembly line and by 1938 prefabrication companies were producing the parts as panelized, pre-engineered or pre-cut houses. Companies in New England and the Mid-West started to emerge, and since then mobile, modular, and panelized homes have grown significantly to cover 49% of the US market by 1984. This does not take into account that the majority of on-site construction (about

95%) already uses factory made roof trusses and the trend to use floor trusses, pre-hung doors, wood panels and other components is increasing.

The Great Depression of the 1930’s, the cessation of housebuilding during World War II and a high marriage and birth rate after the war caused an enormous housing deficit which by 1946 required the construction of three million houses during a 5 year period to avoid the situation from worsening. By the 1950’s the prefabrication industry had refined its building technology to produce a competitive product and eventually gained acceptance, providing America with a significant portion of its housing needs.

By the mid’ 1970’s the US prefabrication industry shifted to the vacation or second-home market and was selling what were called “kit-built” houses. The ever higher quality standards produced by the industry completed its acceptance by the marketplace and became very popular with homeowners who could save 15 to 20% of the overall cost of their homes by doing most of the erecting work themselves.

After Moshe Safdie’s “Habitat” at the 1967 Montreal World’s Fair (an arrangement of factory made modules stacked to create a large apartment complex), modular construction became well known and has since evolved in the United States and overseas.

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A study conducted by Automation in Housing & Manufactured Home Dealer magazine published in 1984 indicated that the majority of houses in the US (51%), were production built on-site. Twenty seven percent were Panelized Homes, while Mobile Homes represented 18% and Modular Homes 4%.

**Production Builders:**

US builders, concentrating in single-family homes and low-rise apartment buildings around major metropolitan areas, sold about 899,000 units. These were sold directly to consumers rather than through networks of dealers and builders, which is what distinguishes this group from the panelized home manufacturers. Because of soaring on-site labor and construction loan costs, 95% of production builders use factory-fabricated roof trusses and wall panels. Some of the bigger ones even operate their own component factories.

Component manufacturers are thus important to the construction industry. They are usually independent companies who produce for sale mostly to the production builders. By 1984 there were 1800 such companies in the US. Roof trusses are manufactured by 95% of them, 69% make floor trusses, 30% make wall panels and 32% machine and pre-hang doors. They also produce gable ends, corners, tees, stair systems, cupolas, agri-buildings, garages, metal-plate-connected rough openings for windows and doors, and other components.

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Panelized Home Manufacturers:

Under this category several types of manufacturers are grouped. They include (a) Open-panel Panelized Home Manufacturers; (b) Closed-panel Panelized Home Manufacturers, who usually ship their products with a bath or bath-kitchen core building; (c) Precut Manufacturers, who ship only pre-cut, pre-marked members rather than assembled interior and exterior panels; (d) Log Home and (e) Dome Home manufacturers who operate similar to the pre-cutters. All groups sell through networks of builders and dealers. In 1984 Panelized Home manufacturers sold about 476,000 units in the United States\textsuperscript{10}.

HUD-Code Home Manufacturers:

Since the passage in 1976 of the US Department of Housing and Urban Development (HUD) Manufactured Home Construction & Safety Standards, exterior frame construction of mobile units has been on a par with site-built homes and HUD-Code homes are now generally safer dwellings. HUD-Code homes are built in factories using similar techniques to modular methods but are generally of lighter construction and invariably with a metal chassis as part of the floor system. It is believed that double-section HUD-Code homes, which can look alike to on-site built homes will account for the majority of the low-cost housing in the future. These homes are sold through dealers from display lots or from model homes in subdivisions, where it is usually their responsibility to prepare the land, do the foundation and utility work, and supervise completion work on

\textsuperscript{10} Automation in Housing & Manufactured Home Dealer magazine, 1984.
the house after delivery. In 1984, 304,000 HUD-Code units were sold, of which 30% were double-or multi-section units.\(^{11}\)

**Modular Home Manufacturers:**

Most modular homes are factory built complete in "half-a-house sections" although multiple section and stack-on units are common. Modular are the strongest of all frame homes built given the transportation requirements and are 95% complete when leaving the factory. By 1984 about 73,000 units were produced by 187 companies in the US and sold mainly through local builders and dealerships.\(^{12}\)

**International Modular Housing Industry:**

Despite the large volume of the US industry, it is worth mentioning the achievements obtained by other industrialized nations as a way to better describe the potential for development that this basic industry has for Argentina.

In the case of Japan, Japanese home builders are producing modular housing which from start to finish can take as little as nine days with most of the time spent waiting for the concrete slab to cure. In 1975, the Japanese government and industry officials agreed to a plan called "House 55" setting the goal of factory-producing houses at 55% of the cost of conventional construction. These goals were exceeded rapidly by the Japanese manufacturers. Houses are now built like cars in a continuous assembly line fashion. Six

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\(^{11}\) Automation in Housing & Manufactured Home Dealer magazine, 1984.

\(^{12}\) Automation in Housing & Manufactured Home Dealer magazine, 1984.
companies produce about 90% of the factory made houses sold in Japan, which indicates the high level of investment in machinery and robotics that the Japanese have committed to. One of Japan’s largest factories could produce in 1986 almost 30,000 units per year\textsuperscript{13}. As a result of the computer aided design capabilities, customization is possible and almost limitless. Japan’s high automation can produce an entire house in less than two days, while modules for a customized house can be completed in less than one hour\textsuperscript{14}. As is common with other Japanese industries, they are always seeking to improve their products. Government and private industry work together and fund the R&D efforts necessary, where full-size houses are tested against all climatic conditions. New materials are created and experimented with including combinations of wood and cement\textsuperscript{15}.

In the case of Scandinavia: Sweden, Norway, and Denmark have also a quite developed factory-built modular home industry. This industry has existed since the 1920s but as of the mid-1970s, Swedish government and industry officials worked together to make significant advances in their home building technologies. A typical house can be installed on site in two days or less\textsuperscript{16} and is produced from logs entering the plant to a full house being delivered on the other. Computer aided design allows unlimited number of plans and the correct calculation of materials required and costs. The Scandinavian industry is well

\textsuperscript{13} Imported Machines for Living. Charles W. Graham. Texas Architect March-April 1986, page 60.
known for their energy efficient construction which features triple-glazed windows installed with refrigerator-type sealing.

**Types of Wood-based Housing:**

**Conventional Frame:**

This is the most widely used form of construction, where all sawing, sanding, assembly and erection is done at the site. The trend however is to increase the amount of factory-built components namely roof trusses but also floor trusses and wall panels due to the reduction of labor and construction time they provide. Various degrees of factory fabrication are practiced and listed below.

**Prefabricated Housing:**

A prefabricated house is one built by precutting and pre-assembly in a factory of some or all parts of the house. Walls, floors, and ceilings/roofs are usually made in sections, or panels, with both exterior and interior finish work completed in the factory. Large structural members are cut to size and made ready to join into a frame. Kitchens, bathrooms, and closet units are built like cars on an assembly line complete with plumbing and electrical work ready for hook-up at the site.

**Pre-cut kits:**

Precutting is the oldest and simple form of manufactured housing. This home is built from a kit of framing lumber and other materials cut to size at the factory. Instructions are
provided for assembly following predetermined steps and use of coded lumber parts. Conventional techniques are used for assembly. Precut packages usually include components such as doors and windows, and all necessary elements such as nails and shingles to complete the shell. Log houses are a very popular type. The Dome Home is another, made of reassembled triangular panels bolted together. Not all precut kits are the same. The bare-bones kits include only the wood for the outside walls of the house, with the door and window openings cut in. The most complete ones may include roofing and flooring systems, staircases, interior partitions, wall paneling, windows, doors and hardware. The construction quality will depend on the sawmilling operation i.e. in the case of log homes, logs can be supplied ungraded, random length to industry graded lumber and although all logs may look alike at the saw mill, the character of a log home is different depending on the log profile used, which is determined by how the log is milled and finished. Logs in some kits are hand hewn to preserve the rustic look. Others are hand peeled, leaving some of the bark and knotholes intact. Still others are machine planed to a smoother finish and uniform dimensions in either a square or round shape. There is no guarantee that just because the pieces are precision cut they will be nailed together with equal accuracy.

Precut houses differ little from standard construction in detail and theory. They may be assembled more quickly than conventional houses since most of the cutting is done at the factory. The principal advantages are in simplified purchasing of materials and step-by-step instructions for erecting a selected home which appeals to the novice owner-builder.
Post-and-Beam Construction:

The next step in industrialization is the frame and infill system comprising a structural frame including carrying elements of the floor, wall and roof i.e. girders, posts, trusses to which are attached infill elements i.e. small wall, floor and roof panels, capable of transmitting imposed loads such as wind and live loads to the structural elements\textsuperscript{17}. Post and Beam construction lends itself to this approach.

Unlike conventional frame construction with load bearing interior walls, post-and-beam construction provides complete freedom of wall placement, since post and beams, not walls support the building\textsuperscript{18}. Post-and-beam housing can be left as an enormous room, can be built with glass walls or divided up into more conventional spaces depending on the needs of the user. All side walls can be pre-cut into panels that are then put up in sections. In fact the entire framing of the house (which includes not only the bays but also all insulation, roof shingles, siding, and interior framing) can be delivered on flatbed trailers for assembly by the builder. Many such designs are created with energy conservation in mind through a combination of light and heating devices, central air conditioning and heating as well as solar panels, to produce a highly efficient unit.

Panelized Housing:

\textsuperscript{17} Dwelling House Construction. Manufactured Housing page 401.
\textsuperscript{18} Engineered with Charm. Home Magazine, February 1985 page 76.
This involves precutting all shell elements and assembling the wall panels and sometimes, floor and roof panels. Windows and doors are usually inserted into the wall panels. The panelized package includes the many precut pieces and elements needed to complete the shell at the site.

Usually only the home’s outside walls are built in the factory, some with wiring and insulation in place behind the finished drywall (closed panels). Many times these are packaged with other factory-built components and shipped to the construction site. There they are lifted into place by a crane and traditional stick-building techniques are used to complete the construction.

**Panel Construction**\(^{19}\)

Most panel construction is adapted from standard platform construction in order to meet different building codes. The typical panel consists of studs 16” or 24” on centers and an exterior grade of plywood, hardboard, or factory-applied siding, with a down lap to cover the exposed floor construction at the edge. Insulation and other finishing material are generally applied in the field, after wiring has been installed in the wall, therefore conforming to standard practices. Other panelized homes are being produced from stressed-skin panels, which are the most efficient structural wood systems for walls, floors, and roofs\(^{20}\). Stressed-skin panels are constructed from ribs to which plywood is bonded by gluing. Under load, the plywood sheathing acts integrally with the ribs, requiring fewer

\(^{19}\) Extracted from Dwelling House Construction.

\(^{20}\) Dwelling House Construction. Manufactured Housing page 403.
and smaller ribs. Stressed-skin panels have been in use for many years and tested by the US Forest Products Laboratory. Many building codes do not recognize this form of construction and the use of stressed-skin panels has been limited in some areas.

Wall panels are classified by their length. “Small” panels range from 2’ to 8’ in length. Any panels larger than 8’ are called “large”. These may range from 9’ to 40’ in length. Panels longer than 40’ require special road permits for their transport and are, therefore, unusual. Panels smaller than 16’ do not require cranes or special mechanical equipment. Small panels may be lifted by a standard building crew of four people.

Panel height and length are controlled by the economies available through the use of standard material sizes. Plywood is available in 8’ and 9’ lengths and panels are seldom taller, except at the gable end. Plywood is available in 4’ and 5’ widths. Panel length is designed, where possible, to fully utilize the materials. In other words, panels tend to be close to 4’, 5’, 8’, 10’, etc. in length.

Panel systems may be either loadbearing or post and beam. Loadbearing panel systems are most common and economical, especially when large panels are used, but small loadbearing panel systems offer more design flexibility. Post and Beam panel systems are gaining in popularity frequently used with stressed-skin or sandwich infill thereby avoiding code problems, since the posts and beams support the structure.
Structural Sandwich Constructions\textsuperscript{21}

Closely related to the stressed-skin panels are the composite constructions or materials known as structural sandwiches. They may be used as the total loadbearing wall, floor, and roof construction, or may be employed as the infill units in frame and-infill construction. In the latter case, the units are fitted into a wood or metal frame. Two methods are feasible. The first, or horizontal-rail method, uses posts at corners and intermediate points, with horizontal rails running from post to post. The sandwich panels are fitted into the frame and screwed or nailed into place with caulking to provide watertight joints. The second, or post and lintel, type of construction uses wall-height panels, places the long dimensions of the panels vertically and eliminates the horizontal rails but uses more posts. Several variants of the post and lintel construction may be employed. The framing may be exposed on the exterior and the sandwich panels applied to the inner faces of the framing members. As usual, gaskets or caulking materials are depended upon to provide watertight joints. An obvious variant to this construction is to place framing members on the inside instead of the outside and to make the frame a feature of the interior of the house. A third variant is to use rabbeted or grooved framing members into which the panels are fitted in a manner similar to the horizontal rail construction described above.

Panel Construction Details\textsuperscript{22}

\textsuperscript{21} Extracted from Dwelling House Construction.
\textsuperscript{22} Extracted from Dwelling House Construction.
Panel construction differs from traditional construction in panel connection details. Panel joints are either edge or right-angle connections. They can be considered part of the traditional family of wood joints, except that panel joints involve two and sometimes three elements: the exterior skin, the frame, and occasionally, the interior skin. Frequently one element in the panel may butt while another element may pass, forming a lap joint.

The erection of a panel system house is simple but must be done with care. The most important step is starting out with a level and square foundation. Half-inch tolerances are usually acceptable and can be accounted for in the sill details. Time spent starting out right by aligning and leveling the sill is repaid many times in the simplicity with which the rest of the building goes up. Conversely, careless alignment of the sills causes recurring problems throughout erection. The erection of the typical panel system includes the floor consisting of precut joists and headers and precut plywood rapidly assembled on the foundation. Wall panels and roof trusses which are usually delivered in one truck load - wall panels are placed and roof trusses suspended into position. Roof plywood is nailed into place and the house is closed in one day. Interior partitions are all non-bearing and are assembled later from precut stock.

**Mobile Housing:**

These homes are built entirely at the factory following construction standards set by the US Department of Housing and Urban Development, which supersede local building codes. Homes are only mobile in name: about 70% of all existing homes have never
moved from their original sites. They are also known as sectional houses (when units are joined together) or HUD-Code homes.

The mobile home industry has been the answer to low-cost housing in the United States. Their manufacturers however have increased the size, quality and amenities of their offerings trying to attract first-time buyers. Many feature wood siding, pitched roofs with overhangs, cathedral ceilings, fireplaces, bay windows and drywall interiors. Quite often they are sold like any other real estate with land and on a permanent foundation. This is in sharp contrast to the long, narrow and flat-topped mobiles with metal siding and no foundation sitting in mobile-home parks and taxed as personal property and not real estate. In other instances, the use of site-built facades and other structures can create a different and customized look similar to that of conventional homes. However still a small fraction of mobile homes sold consist of two or more sections.

Mobile homes are not the same to modular homes which is sometimes a subject of confusion. Mobile homes are built to a national building code administered by HUD, while modular homes are held to the same local codes as conventionally built homes. When mobile home manufacturers fail to go beyond the minimum requirements of the HUD code, the differences are striking. For example, ceilings in mobile homes may be built at the 7-foot level, rather than the 7 1/2 foot height required in most local building codes. Hallways tend also to be narrower i.e. 28 versus 36 inches.

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23 Sizing up a factory-built house, Factory built homes, October 1984, page 63.
24 Sizing up a factory-built house, Factory built homes, October 1984, page 65.
Zoning is still an issue because in many areas local laws require mobile homes to be located in mobile-home parks or three acre parcels of land. New legislation though is slowly being enacted to permit the use of mobile homes in residentially zoned areas mainly as communities no longer treat them as outcasts as long as the homes blend with the local architecture, meaning top of the line models on permanent foundations.

Formaldehyde emissions were common in the past in mobile homes causing eye, nose, and throat irritations, headaches, nausea and asthmalike symptoms. These were caused by the materials used in panel board construction and poor ventilation designs. Advances in new particle board products and HUD-building codes have been made to eliminate this problem. Similarly, more fire-resistant ceiling materials are now used.

Although most of the mobile homes are purchased with short-term loans of 10 to 15 years, requiring 20% down payments, the Federal Housing Administration now insure a mortgage that’s essentially the same as the type it backs on other homes i.e. 30 years long, while requiring 5% down payment. Most industry insiders agree that mobile homes have a price advantage over Modular.

**Modular Housing:**

The vision of manufacturing housing like cars in assembly lines has been a fascinating concept more many years and has not been an easy road to fulfillment. The underlying
problem has been the most obvious: while mass produced cars are easily transported down a highway, a traditional house is much more wide than the roads. Not surprisingly then was the advent of mobile homes first, built on trailers. These tended to be narrow and so, in an effort to create factory built houses with a more traditional floor plan, manufacturers turned to the concept of modular housing.

A module is a box-shaped element, factory built and transported to destination, where it is placed on a permanent foundation and can be attached to other similar elements to make a complete dwelling unit. They can be built employing standard framing, stressed-skin, sandwiches or combinations. Some modules have siding and roofing installed. Others have wood wall paneling or interior finish, such as gypsum wallboard and even carpeting. Yet another module which has received a lot of attention because it reduces the on-site labor for plumbing, electricity and even heating is the mechanical core, often referred to as wet core or utility core. It consists of a bathroom complete with fixtures and finished walls. All of the plumbing pipes are in the wall and floor and only need to be connected to supply and waste lines when in place on the job. Some mechanical cores consist of one and one half baths. Others have the wet part of the kitchen and kitchen cabinets installed on an outside wall of the bathroom core and are arranged to become a wall of the kitchen when in place. Still other mechanical cores have parallel walls back of the plumbing wall arranged to provide a space for water heater, the heating plant, and ductwork. The cores a built away from the jobsite, delivered, lifted by crane and slid into place at the proper floor level.
The modular building method is not limited to individual home building. It has successfully been used to provide schools and apartments\textsuperscript{25}.

According to the Modular Home Council of the Home Manufacturers Councils in Washington, DC the key advantage of modular housing is its bottom line i.e. "profits can be realized much faster than would be possible with traditional on-site construction".

Modular housing is built remote from the site in a factory controlled environment and thus permits the maintenance of high and uniform standards. Modular housing plants include sophisticated equipment and apply standardized procedures where all aspects of construction can be monitored by seasoned professionals. Because it must be transported to site, modules are designed and built in compliance not only with the codes set up by Federal and State agencies but with even higher structural integrity than conventional on-site construction.

As an example using sandwich construction, the module construction at the factory starts with a phenolic-impregnated kraft paper honeycomb core with unsaturated polyester impregnated woven glass fiber roving fabric facings. Over this is applied 1/2" gypsum board, in turn faced with suitable interior and exterior facings, such as sprayed-on chopped glass fiber and polyester with, possibly, a finish painted surface. Full floor, wall, and

\textsuperscript{25} Industrialized Building. Fundamentals of Carpentry - Practical Construction page 491.
ceiling or roof panels are assembled into the complete house shell. Non-bearing partitions, conventional or sandwich, are inserted, finish exterior surfaces and cabinetry are applied, exterior surfaces caulked, flashed, and finished as necessary and the house is moved, set on the foundation and field utility connections made.

Arguments against modular housing factories include the higher installed cost of its machinery. However, this is more than offset by the lower machinery and equipment investment necessary by the builders and constructors who use this technology with their clients i.e. smaller constructors can be in business much more readily than with conventional construction techniques as it is economically feasible to put up a few units at a time whereas stick builders need greater volume to turn a profit.26

Because modular structures are delivered on-site 90%-95% complete, the cost advantages include:

- reduced on-site labor;
- less need for supervision;
- less risk of pilferage and vandalism;
- significantly lower interim interest costs;
- eliminates the danger of cost-overtuns;
- less inventory is required thereby minimizing working capital;

26 Sizing up a factory-built house, Factory built homes, October 1984, page 68.
• higher sales volume is possible because of the speed of delivery;
• lower material costs possible due to the volume purchase of modular factories;
• avoidance of material shortages;

These advantages are not only important to the builder but also to the owner. Just ask any Argentine home owner who has spent months supervising and checking the construction of his/her home and it is immediately clear that the potential to have a house completed in a few days without cost overruns or theft is an instant success. On-site work only include providing a foundation, utility lines, rough plumbing and electrical work, attaching the modules to the foundation, some minor finishing work, plumbing and electrical hookups, entrance steps and decks, and landscaping. For even the most difficult of installations like a two bedroom townhouse where modules are stacked onto each other, it only took eight workers six hours to assemble them.

Modular housing technology has long been considered undesirable and of low quality due to the confusion brought up by mobile homes. Much has changed in the field of mobile homes making them sophisticated enough to provide suitable housing. Modular housing on the other hand has had very high quality standards and the advent of computerized

27 Sizing up a factory-built house, Factory-built Homes, October 1984, page 63.
designs makes it now flexible enough to provide for many designs, thus making it impossible to differentiate from a custom made house. Modular housing today ranges from elaborate single family homes, to customized light commercial buildings and even mid-rise condominiums. The limitations, however, reside in the maximum module dimensions capable of being transported through the road system. One example of non-look alike designs is found in NEST\textsuperscript{28}. There are four basic modules constructed in a factory using conventional framing techniques. Every NEST home would contain a 38-foot long host, or mother module with 11’6” ceilings. This unit contains the living room, dining area, optional floating fireplace, and a den. The other modules have sloping roofs and fit next to, or “nest” against the host module at the 11’6” elevation. The 42’2” kitchen module also contains a master bedroom and a bath with walk-in closet that together with the host module might form a cozy retirement or vacation home. The third module, also 42’2” long, contains two bedrooms and a bath or a bedroom, bath, and a “tropics” room that opens off the living room. The fourth module is 28 feet long and was designed to be used as a guest bedroom, mother-in-law apartment, or home office with bath. This module could be attached to the rest of the house or be a freestanding structure. All of these units are 12 feet wide for ease of transport. All designs allows walls to be opened between the modules in a variety of places, and the elimination of many interior walls combined with the high and sloping ceilings and celestories contribute to a surprisingly open, airy feeling. Of course, inside surfaces use laminates for easy-to-clean surfaces and furniture can be built in and included in the mortgage. Exterior sidings can be shingles, stucco, adobe effect

\textsuperscript{28} Modular Housing: The next generation. Home magazine, October 1985 page 78.
or others. No one expects that NEST or similar designs will do more than supplement stick-built housing. However, as technology continues to evolve and materials become cheaper, uniformity in building codes are implemented and shipping restrictions eliminated, then the price of modular homes will be further reduced.

Final Comments about Factory-Built Homes:

Most houses built in the United States have some components which are factory-built. The automation of the construction business should not mean lower quality. On the contrary, it is very difficult to tell the difference between them and a home where the sawing, sanding and pounding is done within feet of where the structure rises from its foundation. In fact, there are sound reasons to seek out industrialized housing because the best examples of prefabricated homes offer better quality for no more money. The structural integrity of a factory-built home, with superior strength is a result of the conditions peculiar to the manufacturing process and the necessity to transport the components to site. Only the highest-quality, kiln-dried lumber can be used because warped, badly knotted or splintered pieces would jam the finely calibrated assembly-line jigs. Emerging as perfectly square-cut joists and wall panels, the pieces are not only nailed together but reinforced with glue.\(^{29}\) Besides getting a home that may last longer, a buyer of a modular or panelized home is less likely to experience nail pops, doors and cabinets that stick, creaky floors, noises from settling, and cracks on the drywall. The tight construction also tends to improve the energy efficiency of the home.

\(^{29}\) Sizing up a factory-built house, Factory-built Homes, October 1984, page 64.
Despite the cost advantages arising from the faster delivery, savings in material costs, lower assembly line wages (roughly half of site-workers\textsuperscript{30}) and reduction of vandalism at the construction site, shipping costs so far tend to offset much of what otherwise would have been saved, at times making factory-built homes comparable in price to stick-built versions. Needless to say, any variations from factory standards will increase their price, although today’s computer age and flexible manufacturing processes are resolving this problem. Buyer’s approach is thus to add extra bedrooms, decks, garages etc. using regular stick building at a later time.

Because of the ease of construction, Modular and similarly prefabricated units may interest investors who want a more direct involvement in building, either in a partnership with builders who will handle the mechanical work or as limited partners in syndicates. For example there are companies in the United States which organize private investor groups through financial planers, accountants, lawyers and broker-dealers; manufactures and assembles the modules for the syndicates into apartment buildings, motels, commercial buildings and retirement housing; arranges for mortgage financing; and manages the projects once they are completed. These companies also sells homes directly to individuals\textsuperscript{31}.

\textsuperscript{30} Sizing up a factory-built house, Factory-built Homes, October 1984, page 64.
\textsuperscript{31} Sizing up a factory-built house, Factory built homes, October 1984, page 66.
As mentioned, modular homes need not be dull or ordinary. Even with the most basic of factory-built modules it is possible to join them in an almost infinite variety of combinations.\footnote{Modular Housing: The Next Generation. Home magazine, October 1985, page 77.}
Appendix 4

How would Wood-Based construction affect the Argentine Housing industry?

The data presented earlier for the Argentine housing starts, as expected by the government and based on traditional construction techniques, implies that the investment of around 2.7% of GDP in housing projects (1994) generated 203,000 direct and 61,000 indirect jobs. Considering Argentina’s GDP of 1994 (approximately US$ 12.13 billion) we thus have US 327.5 million invested in housing in 1994.

For comparison purposes, we have derived some estimates from the US Bureau of Labor Statistics, data from 1976 adjusted to 1980 prices\(^{33}\), to look at the effect on employment of the wood based housing construction. We have selected data from the 70’s, as we consider that the construction techniques which would be implemented in Argentina would be about as efficient as those prevailing in the US at that time. This is due to logical technology transfer inefficiencies which are common in the initial phases of implementation of any new construction techniques. Thus, using productivity levels of the wood based industry in the 70’s rather than the 90’s (which has much higher modularization of its industry) will be a more valid comparison.

Based on the Bureau of Labor Statistics data, the combined single and multifamily housing construction had the following impact on job creation by an expenditure on contract construction of US $1 billion:

<table>
<thead>
<tr>
<th>Construction Industry</th>
<th>Private Housing Jobs</th>
<th>% of Total</th>
</tr>
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<tbody>
<tr>
<td>On-site</td>
<td>18,200</td>
<td>38%</td>
</tr>
<tr>
<td>Off-site</td>
<td>2,400</td>
<td>5%</td>
</tr>
<tr>
<td><strong>Other Industries</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>13,700</td>
<td>29%</td>
</tr>
<tr>
<td>Transportation &amp; Services</td>
<td>10,300</td>
<td>22%</td>
</tr>
<tr>
<td>Other</td>
<td>2,800</td>
<td>6%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>47,400</td>
<td>100%</td>
</tr>
</tbody>
</table>

We can therefore estimate that the impact for Argentina’s US$ 327.5 million investment in 1994 would represent:

<table>
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<tr>
<th>Construction Industry</th>
<th>Private Housing Jobs</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-site</td>
<td>5,960</td>
<td>38%</td>
</tr>
<tr>
<td>Off-site</td>
<td>786</td>
<td>5%</td>
</tr>
<tr>
<td><strong>Other Industries</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>4,487</td>
<td>29%</td>
</tr>
<tr>
<td>Transportation &amp; Services</td>
<td>3,373</td>
<td>22%</td>
</tr>
<tr>
<td>Other</td>
<td>917</td>
<td>6%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>15,523</td>
<td>100%</td>
</tr>
</tbody>
</table>

This estimate of 15,523 jobs is significantly lower to the 264,000 shown by the Argentine statistics. The difference can be explained by the fact that the US based estimates do not include jobs derived from planning, designing and other development related activities nor do they include the rippling, multiplier, or crowding out effects on the economy. Similarly, they do not include any effects on job creation due to any stimulus programs on housing.

The Argentine numbers seem to be high, but if we take the traditional estimates from the
US, that a total of 1.6 to 2.3 jobs are created as a whole per housing unit, the 108,000 units constructed in 1994 would equate to 172,800 to 248,400 jobs. In other words, Argentina’s government estimates for job impact are as follows:

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<tbody>
<tr>
<td>UnitsConstructed</td>
<td>108,000</td>
<td>130,000</td>
<td>162,000</td>
<td>210,000</td>
<td>274,000</td>
</tr>
<tr>
<td>Jobs per Unit</td>
<td>2.44</td>
<td>2.33</td>
<td>2.24</td>
<td>2.17</td>
<td>2.07</td>
</tr>
</tbody>
</table>

This shows that with the passing of time, the productivity in construction is correctly expected to increase (lower jobs per unit), and that it is presently close to the 2.3 jobs/unit of the US less efficient range. The slight differences can be attributed to the obvious differences in construction methods, workers training, bureaucracies, material importation, mix of single and multifamily units built and others.

Despite the arbitrary selection of our assumptions, we believe that in general, we can expect that the wood housing construction would require less number of people involved in on-site direct work but have more of a multiplier effect in the economy than is today the case in Argentina.

For the Construction Industry only, we can estimate a job creation impact for both wood-based and conventional brick and mortar methods. We will base this estimate on the rule of thumb used in the US that for each (‘wood-based’) unit built, 1 job is created in construction alone, and we are assuming that for the traditional Argentine construction a larger percentage of jobs are created in on-site construction than off-site.
According to the projections of the Argentine government for future new housing starts, we have:

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<tbody>
<tr>
<td><strong>Construction Jobs</strong></td>
<td>108,000</td>
<td>130,000</td>
<td>162,000</td>
<td>210,000</td>
<td>274,000</td>
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<tr>
<td><strong>Wood-Based (*)</strong></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td><strong>Non-Construction Jobs</strong></td>
<td>108,000</td>
<td>130,000</td>
<td>162,000</td>
<td>210,000</td>
<td>274,000</td>
</tr>
<tr>
<td><strong>Wood Based (*)</strong></td>
<td></td>
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<td></td>
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<tr>
<td><strong>Total Wood-Based</strong></td>
<td>216,000</td>
<td>260,000</td>
<td>324,000</td>
<td>420,000</td>
<td>548,000</td>
</tr>
<tr>
<td><strong>Construction Jobs</strong></td>
<td>177,120</td>
<td>198,422</td>
<td>233,680</td>
<td>286,067</td>
<td>347,582</td>
</tr>
<tr>
<td><strong>Conventional (</strong>)**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Non-Construction Jobs</strong></td>
<td>86,880</td>
<td>104,578</td>
<td>130,320</td>
<td>168,933</td>
<td>220,418</td>
</tr>
<tr>
<td><strong>Conventional (</strong>)**</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Conventional</strong></td>
<td>264,000</td>
<td>303,000</td>
<td>364,000</td>
<td>455,000</td>
<td>568,000</td>
</tr>
<tr>
<td><strong>Construction</strong></td>
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</table>

(*) Assumes 1 job for the construction industry and 1 for the rest of the economy, per unit built.

(**) For example for 1994 we have assumed that the 2.44 jobs per unit in Argentina compared to the worse case scenario of 2.3 jobs per unit in the US - a difference of 0.14 jobs per unit all accrue to the construction jobs required by the Argentine present methods. Further we add the impact of the non-construction job generation which in the case of the US we estimate to be at 1.3 jobs per unit built (2.3 - 1.0) while for Argentina it should be lower. This means therefore a maximum of 2.28 jobs in construction (1 + 0.14 + 2.44 -1.3) and a minimum of 1.00 (as efficient as the US wood-based construction). We can build different scenarios in between, but have included in the table above, only the mid-point as assumption or 1.64 jobs-per unit [ 1 + (2.28 -1)/2 ] for 1994. For the future years we assume no changes and thus calculated as proportional increases to the number of units built.

The above comparison implies that although the wood-based construction technology would produce more indirect employment, the larger impact of its lower direct construction job requirements gives it a lower overall job generation. On the other hand,
the faster construction and flexibility it provides, should mean larger number of units built on any given year. Not taking into account the beneficial effect of financing wood based housing (in reality it would allow for more units built by constructors due to lower working capital requirements), we can estimate its impact by simply moving forward the forecast of units built for the wood based construction case by 1 year (i.e. conventional construction could take an average of 16 months and that of wood only 4 months). The comparison of forecasts would now be in favor of wood-based technology.

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</tr>
</thead>
<tbody>
<tr>
<td>Total Jobs Wood-Based Construction</td>
<td>324,000</td>
<td>420,000</td>
<td>548,000</td>
</tr>
<tr>
<td>Total Jobs Conventional Construction</td>
<td>303,000</td>
<td>364,090</td>
<td>455,000</td>
</tr>
<tr>
<td>Jobs # Difference Percent increase in Jobs Wood vs. Conventional</td>
<td>21,000</td>
<td>56,000</td>
<td>93,000</td>
</tr>
</tbody>
</table>
Appendix 5

Availability of Raw Materials

Concern for the long-term stability of the natural forest base, especially in tropical areas, led to question whether the supply of such natural wood resources would become severely limited because of rapid deforestation rates in most countries. While wood is becoming a more valuable resource, the region's future supply of low cost accessible timber may be limited and thus should be subject to careful management in the years ahead.  

Urbanization in Latin America has brought about a broadening of literacy in the population together with a rapid growth in per capita income which has raised the demand for paper products, construction and packaging materials, among others. This demand is expected to grow, even though income growth-rates have suffered substantially during the world-wide recession of the early 1980's.

Agricultural production in Latin America has gradually changed during the 1970's. The region has expanded its agricultural frontier, often at the expense of national forestry conservation. Hopefully this process should gradually slow-down because annual crops are often the lowest-value of all land uses. "Permanent" crops, including combinations of annual plantations, livestock and forestry production, may represent the highest long-term value utilization for the aggregates of tropical soil, water, and forest.

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34 Forest-Based Development in Latin America, Inter-American Development Bank
The growing awareness of the potential value of their forest resources on the part of some Latin Americans created a favorable climate for undertaking an in-depth review of the forest-based sector's potential for long-term growth.

**Forestry sector in Argentina**

Argentina has made an important effort in the forestry area during the last 40 years. As a result it has about 800,000 hectares and from 1956 till now its cumulative annual plantation rate has been around 7%. In the last decade however, this rate decreased to 3.5% (a trend towards disinvestment).

The country has more than 20 millions hectares technically suited for forest activities. This surface is equal to the whole of Uruguay. Most of its forestable areas are found in three big regions:

- 6.0 million hectares in the Buenos Aires province;
- 5.0 million hectares in the Mesopotamia area; and
- 4.0 million hectares in Patagonia Andina.

From 1985 to 1993, the forest surface was increased every year by 25,000 hectares of plantations, 80% of this area was in Buenos Aires and the Mesopotamia. This amount allowed the country to satisfy the internal demand of wood-products and at the same time develop a small industry oriented to exports (about 6.0 million m³ per year).
The trade balance of this sector is negative and growing since 1991. By 1993, the forest-sector exports were $380 million, of which $175 million comes from natural forest and $164 million from plantations (about 2,500,000 m³ or 15,000 hectares). In 1994 the trade deficit increased to $619 million with $325 million in exports and $944 million in imports.\textsuperscript{35}

Argentina’s wood species have very high-growth rates. This, combined with very accessible land and a variety of weather makes this sector a very attractive one with great comparative advantages on a world-wide scale. The productivity of the Argentine forest is equal or better than many traditional forest-countries and can be further increased by adding state-of-the-art technology.

The following table shows the Argentine strength in forest activities for both long and short fibers as compared with other countries:

\begin{tabular}{|l|l|l|}
\hline
\textit{Fiber Class} & \textit{Country} & \textit{Annual growing in m³ per hectare.} \\
\hline
Long Fiber & USA & 8 - 10 \\
 & Chile & 20 - 22 \\
 & Brazil & 22 - 24 \\
 & Argentina & 22 - 24 \\
\hline
\end{tabular}

\textsuperscript{35} Direction de Production Forestal, INDEC
| Short Fiber | Portugal | 16 - 20 |
| Brazil     | 30 - 45  |
| Argentina  | 30 - 40  |

The investment in this sector for the 1994-1996 period was close to $900 million and employed in building new pulp mills, revamping of old factories and planting new areas. The majority of this investment came from foreign investors who foresee Argentina’s potential in this sector.

Based on the Latin American experience so far, one can identify three main prerequisites that must be met in order to increase the contribution of forestry and forest industry to the national development.

- there must be a strong and continued commitment on the part of public and private policy-makers to formulate policies and to identify and execute productive forestry investments;

- there must be a major expansion of the institutional capacity (technical, managerial, and administrative) to carry-out the specific investment projects; and

- the financial resources must be available in the right form and under the right conditions to undertake the investment chosen.\(^{36}\)

---

\(^{36}\) Forest-Based development in Latin America, Inter-American Development Bank
It seems evident that the first prerequisite: commitment, is on its way to being satisfied in several countries. The degree of commitment is, of course, a matter of individual national policy. Thus, the discussion that follows focuses on the second and third prerequisites: institutional capacity and financing.

The Argentine Government has launched a national Plan called “Plan de Desarrollo Forestal Argentino” (Argentine Forestry Development Plan), to develop the forest sector into a wealth-generator for the country, with high-quality products, and incorporating high technology to allow the country to compete in foreign markets.

The basic goals of this national plan for the 1996 to 2005 period are:

- Promote the concentration of high-quality forest with the industry facilities looking for economies in the commercialization.
- Fast production technology up-grading
- Add different practices -that allow to increase wood quality- to the forest maintenance activity
- Increase productivity per hectare
- Reduce cut cycles between 10 to 20%
- Increase economies of scale in forest activity

At the same time, the government has taken many deregulation actions to give more dynamism to the forest activity and make it more competitive. A major bottleneck in the
past was the lack of institutional capacity to identify, develop and implement major innovative forestry investment programs. Many custom duties for machines, chemical products, seeds, and other essentials for the forest activity were eliminated. The government has taken the responsibility to make the complex administrative procedures required in import and export activities, easier. At the same time, it facilitates different credit lines through the state-owned bank, to forest investments for small and medium size companies. The Agricultural Secretary is working on a national fire avoiding systems to prevent, detect and control fire in forest areas. A national standard system will be created to certify and measure the quality of the Argentine products and to make those standards comparable with international ones. Here, the Argentinean government is working together with the World Bank.

With this plan, the government expects to increase the forestry surface from 25,000 hectares in 1993 to more than 350,000 hectares in year 2005 as shown below:
At the same time, the plan is expected to increase the forest industry personnel from 15,500 in 1996 to 124,000 people by the year 2005. Similarly, the government expects that the export sector will grow to more than $5.0 billion by that time.\(^{37}\)

**Forestry sector in Chile:**

Like we said before, the Argentine forest industry will not be able initially to absorb a very strong increment in demand. Chile, on the other hand, has developed a well-defined forest industry and is in condition to satisfy this demand in the short term.

The forestry activity was stimulated by the government in Chile in 1974 under the Decree Law number 701 to encourage planting of certain trees. To obtain this subsidy, a land owner must qualify at the appropriate government agency by having his/her land meet certain conditions of suitability. An official opinion is given within 60 days. This certificate of forestry suitability can be rejected by the government agency if so, the land owner must give back the subsidy collected to that moment.

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\(^{37}\) Desarrollo Forestal, Ministerio de Economia y Obras y Servicios Publicos, November 1995
Within a year of granting the ‘certificate of forestry capability’, the land owner must present a very detailed plan of how he/she will meet the forest plan. This includes the execution of every job of forestation, any dune stabilization, improvements in existing forests and prunings, for a period no longer than five years form the date of certification. The agency can reject these plans or modify them if there is anything not meeting their criteria. In a 20-year program, the government will subsidize 75% of the forestry costs for every approved plan. Similarly, it will subsidize the costs resulting from handling the forest products themselves.

The results have been extraordinary. Increments in wood production and forest exports are shown in the following tables and graphics. 38

CHILEAN TOTAL WOOD PRODUCTION AND CONSUMPTION (000 m³ round wood)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>5000</td>
<td>7000</td>
<td>9000</td>
<td>11000</td>
<td>13000</td>
<td>15000</td>
<td>17000</td>
<td>19000</td>
<td>21000</td>
<td>23000</td>
<td>25000</td>
<td>27000</td>
<td>29000</td>
<td>31000</td>
<td>33000</td>
<td>35000</td>
<td>37000</td>
<td>39000</td>
<td></td>
</tr>
</tbody>
</table>

Period analyzed:
18 years
Growth 317.0%
Average Growth: 8.3%
In the same period, Chilean forestry exports increased from $166.3 million in 1976 (8% of total Chilean exports) to $1,520 million (13.1% of total country exports) in 1994. 39

38 Instituto Forestal de Chile (Chilean Forest Institute)
39 Banco Central de Chile (Chilean Central Bank)
Chilean Exports by Sector (figures in $ million FOB)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Exports</th>
<th>Forest Product Exports</th>
<th>% of Forest exports of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1976</td>
<td>2,083</td>
<td>166.3</td>
<td>8.0%</td>
</tr>
<tr>
<td>1977</td>
<td>2,190</td>
<td>206.0</td>
<td>9.4%</td>
</tr>
<tr>
<td>1978</td>
<td>2,408</td>
<td>255.9</td>
<td>10.6%</td>
</tr>
<tr>
<td>1979</td>
<td>3,894</td>
<td>403.6</td>
<td>10.4%</td>
</tr>
<tr>
<td>1980</td>
<td>4,671</td>
<td>580</td>
<td>12.4%</td>
</tr>
<tr>
<td>1981</td>
<td>3,906</td>
<td>415.1</td>
<td>10.6%</td>
</tr>
<tr>
<td>1982</td>
<td>3,710</td>
<td>337.0</td>
<td>9.1%</td>
</tr>
<tr>
<td>1983</td>
<td>3,836</td>
<td>323.0</td>
<td>8.4%</td>
</tr>
<tr>
<td>1984</td>
<td>3,657</td>
<td>372.3</td>
<td>10.2%</td>
</tr>
<tr>
<td>1985</td>
<td>3,823</td>
<td>317.6</td>
<td>8.3%</td>
</tr>
<tr>
<td>1986</td>
<td>4,222</td>
<td>393.4</td>
<td>9.3%</td>
</tr>
<tr>
<td>1987</td>
<td>5,102</td>
<td>558.5</td>
<td>10.9%</td>
</tr>
<tr>
<td>1988</td>
<td>7,048</td>
<td>710.8</td>
<td>10.1%</td>
</tr>
<tr>
<td>1989</td>
<td>8,193</td>
<td>771.2</td>
<td>9.4%</td>
</tr>
<tr>
<td>1990</td>
<td>8,580</td>
<td>840.4</td>
<td>9.8%</td>
</tr>
<tr>
<td>1991</td>
<td>9,048</td>
<td>939.6</td>
<td>10.4%</td>
</tr>
<tr>
<td>1992</td>
<td>10,125</td>
<td>1,169.9</td>
<td>11.6%</td>
</tr>
<tr>
<td>1993</td>
<td>9,416</td>
<td>1,239.0</td>
<td>13.2%</td>
</tr>
<tr>
<td>1994</td>
<td>11,645</td>
<td>1,520.9</td>
<td>13.1%</td>
</tr>
</tbody>
</table>

Period Analyzed: 18 years
Growth: 459.2% 814.0% 63.5%
Average Growth: 10.0% 13.1% 2.8%

Chilean planted area increased from 19,200 hectares in the period 1960-1969 to 116,700 in the period 1990-1993. This represents a growth of 607.8% and average growth of 7.5%. By 1994 the total plantation forest area in Chile reached 1,400,000 hectares of Pinus Radiata.
Appendix 6

Primary Converting Industry

Softwood lumber and softwood plywood products are most closely related to the residential construction industry. These are respectively sawn (lumber) or shaped from the log or fabricated into rigid panels by reducing wood to veneer, particles, flakes, strands, or fibers, which are in turn, reconstituted into thin sheets by pressing between heated platens usually in combination with an adhesive. Sheets thus formed are broadly classified as plywood - fabricated from veneer - and building board that consists of an array of sheet products under generic classifications including particleboard, flakeboard, hardboard and insulation board.

In this section we will describe the Argentine situation regarding those plants which convert round logs into value-added products i.e. sawmills, plywood and board mills, etc.

The Southern Cone of Latin America (the ABC countries), Argentina, Brazil and Chile, to which one can include Uruguay and Paraguay, have significant forest resources and potential to support a large Forest Products industry. There are differences however due to past policies and economic and political environments among these countries.

Most sawmill companies in Chile are more integrated and have larger ownership of forests while in Brazil and particularly in Argentina they don’t. Most of the Argentine saw mills, in particular those in Misiones province (the largest Forest Products producer in Argentina
and supplier of 50% of the national demand of sawn wood and plywood) re-equipped themselves with Brazilian made machinery while Chile has done so primarily with Scandinavian and North American technology.

Sawmill cuts are thus similar between Brazil and Argentina but differ in respect to the use given to the logs. In Brazil logs are processed in lengths of 2 to 2.4 meters and diameters of 18 cm. This makes for a higher yield in feet cut per ton purchased (usually around 180 feet/ton) compared to Argentina who utilizes about the same diameter wood but with lengths of 3 meters and above. The difference is because Brazil only uses 28% of its wood for construction purposes and the balance 72% goes into furniture, toys, packaging etc.\textsuperscript{40}. Argentina on the other hand uses longer wood for mainly construction and plywood which explains the loss of yield due to the trunk’s conical shape. In a 1993 study\textsuperscript{41} the productivity in Brazil measured as m3 processed per man-hour was slightly higher than Argentina’s, but it is considered to be the same now after the Argentine re-equipment with Brazilian machinery.

Chile uses logs of 4 meters in length and with larger diameters, primarily from Pinus Radiata, than in Argentina and Brazil and has a more integral operation where also shorter pieces are processed and laterals are used intensively due to their integration to the furniture industry. Most large operations are part of horizontally integrated companies

\textsuperscript{40} Data from Tawber Consulting Company, Brazil
\textsuperscript{41} Desarrollo Industrial de la industria maderera de Misiones y su posible tendencia. Ing. Agr. Gabriel A. Marangoni, AMAYADAP Misiones sent to the authors January 1996.
including Forestation and Pulp & Paper plants. This has allowed Chile with over 1.3 million hectares of plantations to export over $2 billion dollars in Forest Products per year and this amount is expected to continue growing.

Brazil is also a powerful force in the area, with plantations in its Southern regions of 2 million hectares of which 1.4 million are of pine producing about 2 million m3 of sawn woods per year. Its exports have also grown, for example, just in the furniture sector Brazil exported $300 million dollars and in sawn wood about $50 million\(^{42}\).

Argentina's Forest Products industry could be much more productive and competitive. As can be seen by the table below, the cost of logs is lower than Brazil's and Chile's yet the prices of its sawn products is significantly much higher.

| Country       | Prices for Forest Products in South America's Southern Cone (US/m3)\(^{43}\) |  |
|---------------|---------------------------------------------------------------------------------|--|---|
|               | Logs | Sawn Wood (not dried) | Sell Price |
| CHILE         | 30-40 | 90  | 100-115 |
| BRAZIL        | 20-22 | 90-110 | 115-130 |
| ARGENTINA     | 19-23 | 100-115 | 140-155 |

The future supply of wood in Misiones is expected to be good up until the year 2000. From then on the supply of good diameter wood is expected to be reduced due to the lack of reforestation programs during the eighties. This is already being felt as shown by the

\(^{42}\) Desarrollo Industrial de la industria maderera de Misiones y su posible tendencia. Ing. Agr. Gabriel A. Marangoni, AMAYADAP Misiones sent to the authors January 1996.

\(^{43}\) Desarrollo Industrial de la industria maderera de Misiones y su posible tendencia. Ing. Agr. Gabriel A. Marangoni, AMAYADAP Misiones sent to the authors January 1996.
price increases in the area of El Dorado, Misiones where in 1991 pine logs were sold for $17 dollars/ton; by 1993 at $19 and presently reaching $21 dollars/ton (about a $1 dollar increase a year\textsuperscript{44}) and can be partially explained due to the fact that the larger diameter woods are becoming more distant from the mills and is not uncommon to see 300 km. separating forest and mills\textsuperscript{45}. This also helps explain the low yield in operations when smaller diameter wood is processed.

Between 1966 and 1985 Argentina had a sustained growth in its production and consumption of native and plantation wood as seen below but has lived in a very unstable economy which affected it significantly. This meant very little investment in equipment and the impossibility to perform marketing strategies for its products.

<table>
<thead>
<tr>
<th>Year</th>
<th>Argentina</th>
<th>Misiones</th>
<th>Misiones %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1966</td>
<td>1,534,320</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>1970</td>
<td>1,868,760</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>1975</td>
<td>2,331,830</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>1980</td>
<td>3,416,220</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>1981</td>
<td>3,387,800</td>
<td>762,850</td>
<td>22.5</td>
</tr>
<tr>
<td>1982</td>
<td>4,255,200</td>
<td>1,230,710</td>
<td>28.9</td>
</tr>
<tr>
<td>1983</td>
<td>5,297,160</td>
<td>1,917,910</td>
<td>36.2</td>
</tr>
<tr>
<td>1984</td>
<td>4,853,340</td>
<td>1,785,530</td>
<td>36.8</td>
</tr>
<tr>
<td>1985</td>
<td>4,824,120</td>
<td>1,975,630</td>
<td>41.0</td>
</tr>
<tr>
<td>1994</td>
<td>N/A</td>
<td>3,290,000</td>
<td>N/A</td>
</tr>
</tbody>
</table>

\textsuperscript{44} Desarrollo Industrial de la industria maderera de Misiones y su posible tendencia. Ing. Agr. Gabriel A. Marangoni, AMAYADAP Misiones sent to the authors January 1996.

\textsuperscript{45} Las Industrias de Transformación mecánica de la madera en Misiones. Ing. Forestal Carlos Ferreyra. Argentina Forestal No. 3 November-December 1994 page 14.

\textsuperscript{46} Data from Anuario IFONA, Argentina
Other studies break the demand between sawmills and pulp mills as follows: 3.1 million tons per year total of which 1.65 million tons/year are for sawmills; 1.75 million tons/year go to Pulp & Paper mills and about 280,000 tons/year are consumed in chip production\(^{47}\).

Due to the government forestation plans, which were best between 1974 and 1980, production tripled and Misiones participation in the country’s total increased from 22% in 1981 to 41% in 1994.

The production of sawn wood for the whole country between the years 1981 and 1985 has been as follows\(^{48}\).

<table>
<thead>
<tr>
<th>Year</th>
<th>M3 Sawn Wood</th>
<th>M3 Logs processed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981</td>
<td>979,288</td>
<td>1,959,655</td>
</tr>
<tr>
<td>1982</td>
<td>1,095,872</td>
<td>2,471,511</td>
</tr>
<tr>
<td>1983</td>
<td>1,120,708</td>
<td>2,475,652</td>
</tr>
<tr>
<td>1984</td>
<td>936,036</td>
<td>2,069,816</td>
</tr>
<tr>
<td>1985</td>
<td>901,823</td>
<td>1,953,638</td>
</tr>
</tbody>
</table>

This shows that Argentina's consumption of sawn wood-products was about 1 million m3.

Today, it consumes between 1.3 and 1.4 million m3 of which Misiones province supplies more than half\(^{49}\).
Given the importance of the Forest Products industry in Misiones, we chose to analyze this province’s industry as a way to determine the status of the Argentine Wood Processing industry.

According to the census by the Ecological Ministry of the Province of Misiones in 1993, there were about 640 sawmill operations of different size and use of woods in the province. Their number has not changed much since then but the re-equipment in particular of the larger mills has increased. Of the 640 sawmill plants, 229 work with native woods; 203 operate with only plantation wood; and 208 with both. Further, 90 other plants were involved in secondary processing i.e. 9 compensated wood plants, 17 laminating, 7 “faqueadoras” and 57 carpentry and furniture shops\(^5\).

According to the Dirección de Bosques, M.E.R.N.R, the log production in Misiones has been as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Plantation Wood (m³)</th>
<th>Native Wood (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974</td>
<td>N/A</td>
<td>750,000</td>
</tr>
<tr>
<td>1977</td>
<td>N/A</td>
<td>500,000</td>
</tr>
<tr>
<td>1980</td>
<td>765,000</td>
<td>N/A</td>
</tr>
<tr>
<td>1984</td>
<td>1,900,000</td>
<td>400,000</td>
</tr>
<tr>
<td>1988</td>
<td>2,500,000</td>
<td>N/A</td>
</tr>
<tr>
<td>1994</td>
<td>2,900,000</td>
<td>394,000</td>
</tr>
</tbody>
</table>

The trend in sawmill plants has shifted towards mixed production and the native forest has remained in equilibrium between supply and demand.

---

The size-distribution of the mills, according to the study by Ing. Agr. Gabriel Marangoni shows that the majority of mills are quite small.

<table>
<thead>
<tr>
<th>Range</th>
<th>Production</th>
<th>Number of mills</th>
<th>Production (estimated)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.- Large</td>
<td>+ than 30,000</td>
<td>4</td>
<td></td>
<td>21</td>
</tr>
<tr>
<td>2.- Medium</td>
<td>15,000 to 29,999</td>
<td>12</td>
<td></td>
<td>31</td>
</tr>
<tr>
<td>3.- Small</td>
<td>7,000 to 14,999</td>
<td>30 (estimated)</td>
<td></td>
<td>36</td>
</tr>
<tr>
<td>4.- Very Small</td>
<td>- than 7,000</td>
<td>N/A</td>
<td></td>
<td>12</td>
</tr>
</tbody>
</table>

The Argentine Forest Products industry can be classified in four groups: Native (hardwood) sawmills; Sawmills and plywood mills of plantation wood; Wood panel manufacturing; and finished and semi-finished products from plantation woods\(^{51}\). Each of these groups has a particular situation.

The native wood sawmills use technologies more than 40 years old, which are not efficient. They have high fixed costs and have wood supply problems as the suitable wood is each time farther away. Most have low productivity and present poor future prospects. Few have their own forest resources but those that do usually manage them properly and are relatively vertically integrated with production of panels, furniture and housing parts.

---

The sawmills and plywood mills using plantation wood have increased production in the last 5 years and are expected to do well in the foreseeable future\textsuperscript{52}. The medium and large size producers have incorporated new machinery and are among the most modern plants in the country. Most of their production though (about 70\%) goes to primary products such as structural lumber of generally low value added (0.3-0.4$/foot), while 20\% goes to secondary industrialization products such as plywood which has seen significant increase.

Laminated Wood Plants are the highest added value facilities for Misiones province and some include high technology equipment. They face supply problems due to the lack of laminable raw materials (native woods) and in particular because of the lack of planning for plantation woods in the last three decades. The result has been that plantation wood from the Province of Corrientes is being used at a premium cost, while fierce competition from imported products from Brazil and even Paraguay ensued.

Finished and semi-finished Pine Products. New plants have been started. By the end of 1994 about 10 such companies were producing wood beams, furniture, clear wood (knot-free), finger-joint, moldings, housing parts etc. primarily oriented to the export market. The government of the province of Misiones for example considers this area as the one in

\textsuperscript{52} Las Industrias de Transformación Mecánica de la Madera en Misiones. Ing. Forestal Carlos Ferreyra. Argentina Forestal Magazine No. 3 November-December 1994 page 15.
which the private industry should orient itself, given the international demand and prices ($650 to 800 $/m³ CIF Europe or USA\textsuperscript{53}) for parts and kits of furniture and housing.

According to another report\textsuperscript{54}, in 1993 the province of Misiones supplied to the Argentine domestic market 734,994 solid m³ of wood in different products of which 203,348 solid m³ were of native wood and 528,645 solid m³ were plantation wood. The totals by origin and product are included in the next table\textsuperscript{55} (production in solid m³).

<table>
<thead>
<tr>
<th>Origin</th>
<th>Logs</th>
<th>Sawn-wood</th>
<th>Sandwich</th>
<th>Laminated</th>
<th>Plywood</th>
<th>Compensated</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native</td>
<td>4,293</td>
<td>130,942</td>
<td>13,077</td>
<td>1,967</td>
<td>1,807</td>
<td>40,006</td>
<td>14,253</td>
<td>203,348</td>
</tr>
<tr>
<td>Plantation</td>
<td>15,019</td>
<td>381,599</td>
<td>494</td>
<td>895</td>
<td>117,755</td>
<td>2,599</td>
<td>10,284</td>
<td>528,645</td>
</tr>
<tr>
<td>Total</td>
<td>19,312</td>
<td>512,541</td>
<td>13,571</td>
<td>2,862</td>
<td>119,562</td>
<td>42,605</td>
<td>24,537</td>
<td>734,994</td>
</tr>
</tbody>
</table>

Employment in the sector was about 7,000 people in 1993\textsuperscript{56} and is not considered much different to the present employment levels. Productivity levels have increased in the larger mills due to the new equipment installed and ranges between 20 to 70 m³/man-month, depending on the size of the mills. This is key as if we consider an operator's salary including social benefits of US$ 600 per month, the higher productivity levels represent a labor cost of $8.6 while for the less efficient plants it represents $30 per m³. This would


\textsuperscript{54} Las Industrias de Transformación Mecánica de la Madera en Misiones. Ing. Forestal Carlos Ferreyra. Argentina Forestal Magazine No. 3 November-December 1994 page 17

\textsuperscript{55} Ing. Forestal Carlos Ferreyra. Subsecretario de Bosques y Forestación de la Provincia de Misiones.

\textsuperscript{56} Census of Dirección de Bosques M.E.R.N.R.
imply that average productivity should not be less than 35-40 m3/man-month to be acceptable for Argentina's markets\textsuperscript{57}.

Labor costs are expected to increase as the use of new technology brings more labor specialization. Therefore, the investment in new technologies must be carefully made to only select the highest productivity machinery possible.

In this regard, better log utilization and production yield are key. Present average yield data for Misiones' industry is as follows:

<table>
<thead>
<tr>
<th>Log Diameters</th>
<th>M3 Toras</th>
<th>M3 Boards</th>
<th>Yield %</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 18.9 cm</td>
<td>1.60</td>
<td>0.51</td>
<td>31.79</td>
</tr>
<tr>
<td>19-22.9 cm</td>
<td>2.83</td>
<td>1.17</td>
<td>41.47</td>
</tr>
<tr>
<td>23-26.9 cm</td>
<td>4.37</td>
<td>1.99</td>
<td>44.95</td>
</tr>
<tr>
<td>&gt; 27.0 cm</td>
<td>6.48</td>
<td>3.20</td>
<td>49.42</td>
</tr>
</tbody>
</table>

The above helps explain the cost structure of Argentine wood products, which as we said, could see improvements to reach at least comparable levels to those of Brazil and Chile.

Today's forecasts of future production in Misiones assumes a 4-5% annual increase, due to exports and increase in domestic demand, reaching by the year 2000 around 800,000 m3/year of sawn plantation woods. Other studies\textsuperscript{58} estimate that Misiones has a surplus of wood, due to low demand in the last several years of about 700,000 tons/year and expects

\textsuperscript{57} Desarrollo Industrial de la industria maderera de Misiones y su posible tendencia. Ing. Agr. Gabriel A. Marangoni, AMAYADAP Misiones sent to the authors January 1996.

\textsuperscript{58} Data from report by Ing. Federico Kolln, Alto Paraná S.A. sent to authors on January 1966.
a 10% a year increase in demand in the near term. This would put demand by the start of
the next century at 2.5 million tons/year for sawmills and 4.95 million tons/year for Pulp
mills (this assumes three new start-up mills in Misiones which in the opinion of the authors
is doubtful all will occur).

Continued investment in technology oriented towards higher added value production,
increase in quality, yield and volume are still required if Argentina wants to expand and
successfully compete in the export market. Already Misiones has seen an increase in better
cutting machinery and material handling within the mills, but this has been done mainly in
the larger mills. Smaller mills should disappear or combine in order to achieve better
production and marketing productivity.

To put the Argentine industry in perspective, the following is a quantification of the
industry in the United States. The number of lumber mills in the United States in 1981
was\textsuperscript{59}.

<table>
<thead>
<tr>
<th>Region</th>
<th>No. of Mills</th>
<th>Production (billion board feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>West</td>
<td>400</td>
<td>13.5</td>
</tr>
<tr>
<td>South</td>
<td>515</td>
<td>9.6</td>
</tr>
<tr>
<td>North and East</td>
<td>355</td>
<td>2.1</td>
</tr>
<tr>
<td>Total</td>
<td>1,270</td>
<td>25.2</td>
</tr>
</tbody>
</table>

\textsuperscript{59} Aiding the Homebuilding and Forest Products Industries, chapter 5 Conditions of the Forest Products Industry: Reduced Demand and Other Problems page 86. Report to the Chairman Committee On Appropriations House of Representatives of the United States, U.S. General Accounting Office, August 31, 1982.
The West was the leading producer of lumber even though the South had more mills. Three large firms produced over 1 billion board feet per year but the industry had 1,200 smaller firms with each firm producing 50 million board feet or less per year.

The US Plywood industry as per the American Plywood Association in 1980 consisted of 180 mills of which 111 were in the West, 65 in the South, and 4 in the North. The majority of production (54.2%) of the 16.5 billion square feet came from the West, while the South and North contributed 44.9% and 0.9% respectively.

Employment estimates for the US Forest Products Industry based on the “Employment and Earnings” report of the Bureau of Labor Statistics for 1975-1980 was as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Total US employees</th>
<th>Employees in West and South</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>613,000</td>
<td>455,000</td>
</tr>
<tr>
<td>1976</td>
<td>674,000</td>
<td>501,000</td>
</tr>
<tr>
<td>1977</td>
<td>717,000</td>
<td>533,000</td>
</tr>
<tr>
<td>1978</td>
<td>751,000</td>
<td>557,000</td>
</tr>
<tr>
<td>1979</td>
<td>760,000</td>
<td>563,000</td>
</tr>
<tr>
<td>1980</td>
<td>684,000</td>
<td>508,000</td>
</tr>
<tr>
<td>1981</td>
<td>660,000</td>
<td>490,000</td>
</tr>
</tbody>
</table>

The report covering the Lumber and Plywood Residential Construction and Other Consumption for the 1970's reflect the following:

<table>
<thead>
<tr>
<th>Lumber Consumption (billion board feet)</th>
<th>1972</th>
<th>1975</th>
<th>1978</th>
<th>1982 (cst.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Construction</td>
<td>19.0</td>
<td>10.9</td>
<td>18.5</td>
<td>8.8</td>
</tr>
<tr>
<td>Other</td>
<td>20.6</td>
<td>19.4</td>
<td>22.8</td>
<td>21.1</td>
</tr>
<tr>
<td>Total</td>
<td>39.6</td>
<td>30.0</td>
<td>41.3</td>
<td>30.0</td>
</tr>
</tbody>
</table>
Plywood Consumption (billion sq.ft.)

<table>
<thead>
<tr>
<th></th>
<th>1972</th>
<th>1975</th>
<th>1978</th>
<th>1982 (est.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Construction</td>
<td>10.1</td>
<td>6.1</td>
<td>10.2</td>
<td>5.1</td>
</tr>
<tr>
<td>Other</td>
<td>8.4</td>
<td>9.8</td>
<td>10.1</td>
<td>10.7</td>
</tr>
<tr>
<td>Total</td>
<td>18.5</td>
<td>15.9</td>
<td>20.3</td>
<td>15.8</td>
</tr>
</tbody>
</table>

Housing starts in the US during this period were:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Family</td>
<td>1.44</td>
<td>0.97</td>
<td>1.45</td>
<td>0.78</td>
</tr>
<tr>
<td>Multi-Family</td>
<td>0.86</td>
<td>0.13</td>
<td>0.55</td>
<td>0.32</td>
</tr>
<tr>
<td>Total</td>
<td>2.3</td>
<td>1.1</td>
<td>2.0</td>
<td>1.1</td>
</tr>
</tbody>
</table>

From a technical point of view, comparing a typical mill in Argentina with that of the US, when talking about sawmills for pine for small and medium diameters, both typically use twin blade saws but the higher yield in the United States comes from the better material handling and recirculation of all wood pieces for optimum utilization. Most machinery in the US is equipped with modern sensor positioning devices which is not the case in Argentina. For larger diameter softwoods the use of carriage cutting in the US is intended to obtain the highest yield and quality of the boards, while in Argentina they are used to cut wood for further feeding into other machines.\(^60\) This should be changed if wood pricing as expected will increase. Many products, common in the US are not known in Argentina, like a 1 1/2 to 2 inch thick board “chop” to obtain knot-free wood. All US solid-wood production starts from dry wood (8 to 10%), which not every mill in Argentina is capable of doing. Most of the US mills use all residual material which is not common yet in Argentina. Furthermore, when a log is to be processed, cut, and other

products manufactured as boards, the mill knows beforehand which products it needs to produce and what can be obtained from each log and its yield. Computerized systems are very helpful in this area and which Argentina is still lacking. From a marketing point of view, most Argentine mills do not know what the market needs especially internationally due to their lack of marketing capabilities.
Building Materials Comparison

Wood Products

Different studies conducted in the United States and in Canada, point out to the advantages of wood as a construction material. To start with, wood is the major structural and construction material which is renewable and with few exceptions, the building products derived from it are quite homogeneous in their energy and man-power requirements. In contrast, commodities based on non-renewable raw materials require appreciably more energy per ton of product.

A study by the Committee on Renewable Resources for Industrial Materials (CORRIM) in the United States\(^\text{61}\), compared representative housing designs employing wood products and alternative steel and concrete materials. It analyzed each major component of a house and concluded that substantial differences existed in energy requirements among the different materials employed. They report: "in roofs, a design incorporating steel rafters required approximately twice the energy of constructions in which wood trusses or rafters were used. Exterior walls sided with bricks or constructed with concrete blocks required seven to eight times the energy of all-wood constructions; while exterior and interior walls framed with metal required approximately twice the energy of counterpart wood-framed constructions. Floors constructed from wood materials required only about ten

---

percent as much energy as concrete slab construction or one with steel supporting members. With few exceptions, manpower and capital costs were not appreciably different for wood and non-wood based systems....For example: steel floor joists required 50 times as much energy as wood counterparts. Aluminum framing for exterior walls was nearly 20 times as energy intensive as wood framing, and steel framing required approximately 13 times as much energy as wood. Steel rafters exceeded wood trusses nearly sevenfold in energy requirements and aluminum siding required approximately five times the energy of plywood and fiberboard. The energy requirement for brick veneer siding was approximately 25 times that of wood-based siding materials. No clear patterns emerged from the analysis in terms of labor or capital depreciation."

The above study made use the “Reference Materials System” concept by Bethel and Schreuder (1976) which provides an opportunity to study the flow of forest-based materials into primary structural and architectural commodities and to examine their energy, manpower and capital requirements for their manufacture and final conversion into building systems, as compared with alternatives manufactured from non-renewable raw materials. Representative designs of floor, wall and roof constructions (available in the 1970’s) were chosen for the study. Both wood-based and non-wood products were compared from the point of extraction of the raw material to erection of the building site.

Twelve primary materials fabricated from forest resources were selected, the first eight:
<table>
<thead>
<tr>
<th>Softwood Lumber</th>
<th>Underlayment Particleboard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardwood Lumber</td>
<td>Medium Density Fiberboard</td>
</tr>
<tr>
<td>Softwood Plywood</td>
<td>Wet-Formed Insulation Board</td>
</tr>
<tr>
<td>Hardwood Plywood</td>
<td>Wet-Formed Hardboard</td>
</tr>
</tbody>
</table>

encompass a high percentage of all primary structural and architectural materials manufactured from wood. The remainder four: (i) structural flakeboard, (ii) reconstituted structural board, (iii) structural particleboard and (iv) lumber-laminated-from-veneer are more advanced materials with potential applications after the 1970’s.

All material flow trajectories were maximized around the primary product output and were based on averages attained in efficient manufacturing plants in the US. Requirements for man-power, energy and depreciated capital were developed from harvesting and transport of wood from forest to mill, for each raw material supplied to the manufacturing plants on the basis of one oven-dry ton of mill input raw material. Transportation modes and distances for wood-based commodities from the manufacturer to the retail lumber yard, were developed on the basis of statistics assembled by manufacturing and transportation associations. Information on transportation from the lumber yard to the building site was based on data supplied by a geographically dispersed sample of retail distributors of building products in the US. Erection data was provided by the National Association of Home Builders. Data comparable to those used for wood-based structural and architectural products were developed for alternative building materials manufactured
from non-renewable sources. This information was computed from census data or extracted from the Brookhaven National Laboratory Data Bank. Distribution of nonwood building materials from the retailer to the building site was assumed to be similar to that of wood materials.

Summarizing the results of the study regarding costs of extraction, manufacturing and transportation to the building site for the construction materials analyzed are shown on the next tables. All values are based on one ton of commodity.

### Man-Hours Per Oven Dry Ton

<table>
<thead>
<tr>
<th>Wood Based Commodity</th>
<th>Logging Extraction</th>
<th>or Manufacture</th>
<th>Transport (Mill to Building site)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium Density Fiberboard</td>
<td>3.43</td>
<td>2.86</td>
<td>2.08</td>
<td>8.37</td>
</tr>
<tr>
<td>Underlayment Particleboard</td>
<td>5.04</td>
<td>2.64</td>
<td>1.99</td>
<td>9.67</td>
</tr>
<tr>
<td>Softwood Lumber</td>
<td>3.92</td>
<td>3.06</td>
<td>3.06</td>
<td>10.04</td>
</tr>
<tr>
<td>Structural Flakeboard</td>
<td>3.97</td>
<td>3.99</td>
<td>2.14</td>
<td>10.10</td>
</tr>
<tr>
<td>Lumber Laminated from Veneer</td>
<td>3.08</td>
<td>4.53</td>
<td>3.06</td>
<td>10.67</td>
</tr>
<tr>
<td>Insulation Board</td>
<td>2.28</td>
<td>6.54</td>
<td>2.13</td>
<td>10.95</td>
</tr>
<tr>
<td>Softwood Sheathing Plywood</td>
<td>3.1</td>
<td>4.55</td>
<td>3.31</td>
<td>10.96</td>
</tr>
<tr>
<td>Hardwood Plywood</td>
<td>4.33</td>
<td>8.03</td>
<td>2.67</td>
<td>15.03</td>
</tr>
<tr>
<td>Oak Flooring</td>
<td>4.46</td>
<td>8.07</td>
<td>2.67</td>
<td>15.20</td>
</tr>
<tr>
<td>Wet-Formed Hardboard</td>
<td>2.72</td>
<td>14.7</td>
<td>2.08</td>
<td>19.52</td>
</tr>
<tr>
<td>Total</td>
<td>36.33</td>
<td>58.99</td>
<td>25.19</td>
<td>120.51</td>
</tr>
<tr>
<td>Percent of Total</td>
<td>30</td>
<td>49</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>3.6</td>
<td>5.9</td>
<td>2.5</td>
<td>12.05</td>
</tr>
</tbody>
</table>
### Man-Hours Per Ton

<table>
<thead>
<tr>
<th>Nonwood Based Commodities</th>
<th>Extraction</th>
<th>Manufacture</th>
<th>Transport (Mill to Building site)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravel</td>
<td>0.08</td>
<td>0.00</td>
<td>1.03</td>
<td>1.11</td>
</tr>
<tr>
<td>Concrete Slab</td>
<td>0.09</td>
<td>0.79</td>
<td>1.03</td>
<td>1.91</td>
</tr>
<tr>
<td>Concrete Block</td>
<td>0.09</td>
<td>1.75</td>
<td>1.24</td>
<td>3.08</td>
</tr>
<tr>
<td>Gypsum Board</td>
<td>0.34</td>
<td>1.74</td>
<td>1.24</td>
<td>3.32</td>
</tr>
<tr>
<td>Clay Brick</td>
<td>0.08</td>
<td>2.93</td>
<td>1.36</td>
<td>4.37</td>
</tr>
<tr>
<td>Liquid Asphalt</td>
<td>0.10</td>
<td>4.30</td>
<td>1.33</td>
<td>5.73</td>
</tr>
<tr>
<td>Asphalt Shingles</td>
<td>0.18</td>
<td>4.40</td>
<td>1.33</td>
<td>5.91</td>
</tr>
<tr>
<td>Tar Paper</td>
<td>0.64</td>
<td>4.00</td>
<td>1.33</td>
<td>5.97</td>
</tr>
<tr>
<td>Vermiculite</td>
<td>0.08</td>
<td>10.70</td>
<td>1.71</td>
<td>12.49</td>
</tr>
<tr>
<td>Steel Nails</td>
<td>0.89</td>
<td>10.10</td>
<td>2.18</td>
<td>13.17</td>
</tr>
<tr>
<td>Steel Studs</td>
<td>0.89</td>
<td>10.10</td>
<td>2.25</td>
<td>13.24</td>
</tr>
<tr>
<td>Steel Joists</td>
<td>0.89</td>
<td>10.10</td>
<td>2.25</td>
<td>13.24</td>
</tr>
<tr>
<td>Glass Fiber</td>
<td>1.12</td>
<td>17.50</td>
<td>1.71</td>
<td>20.33</td>
</tr>
<tr>
<td>Aluminum Siding</td>
<td>0.62</td>
<td>50.10</td>
<td>2.25</td>
<td>52.97</td>
</tr>
<tr>
<td>Carpet and Pad</td>
<td>1.61</td>
<td>93.70</td>
<td>2.98</td>
<td>98.29</td>
</tr>
<tr>
<td>Plastic Vapor Barrier</td>
<td>0.82</td>
<td>96.70</td>
<td>1.48</td>
<td>99.00</td>
</tr>
<tr>
<td>total</td>
<td>8.52</td>
<td>318.91</td>
<td>26.70</td>
<td>354.13</td>
</tr>
<tr>
<td>Percent of Total</td>
<td>2</td>
<td>90</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.5</td>
<td>19.9</td>
<td>1.7</td>
<td>22.1</td>
</tr>
</tbody>
</table>
## Capital Depreciation in Dollars Per Oven Dry Ton

<table>
<thead>
<tr>
<th>Wood Based Commodities</th>
<th>Extraction</th>
<th>Manufacture</th>
<th>Transport</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Softwood Lumber</td>
<td>3.09</td>
<td>3.91</td>
<td>3.25</td>
<td>10.25</td>
</tr>
<tr>
<td>Structural Flakeboard</td>
<td>3.13</td>
<td>11.37</td>
<td>2.36</td>
<td>16.86</td>
</tr>
<tr>
<td>Lumber Laminated from Veneer</td>
<td>2.42</td>
<td>11.98</td>
<td>3.25</td>
<td>17.65</td>
</tr>
<tr>
<td>Softwood Sheathing Plywood</td>
<td>2.44</td>
<td>12.09</td>
<td>3.43</td>
<td>17.96</td>
</tr>
<tr>
<td>Underlayment Particleboard</td>
<td>6.72</td>
<td>13.74</td>
<td>2.20</td>
<td>22.66</td>
</tr>
<tr>
<td>Hardwood Plywood</td>
<td>3.41</td>
<td>18.37</td>
<td>3.14</td>
<td>24.92</td>
</tr>
<tr>
<td>Insulation Board</td>
<td>3.84</td>
<td>24.06</td>
<td>2.29</td>
<td>30.19</td>
</tr>
<tr>
<td>Oak Flooring</td>
<td>3.51</td>
<td>26.07</td>
<td>3.14</td>
<td>32.72</td>
</tr>
<tr>
<td>Medium Density Fiberboard</td>
<td>3.21</td>
<td>27.89</td>
<td>2.18</td>
<td>33.28</td>
</tr>
<tr>
<td>Wet-Formed Hardboard</td>
<td>4.59</td>
<td>48.08</td>
<td>2.18</td>
<td>54.85</td>
</tr>
<tr>
<td>Total</td>
<td>36.36</td>
<td>197.56</td>
<td>27.42</td>
<td>261.34</td>
</tr>
</tbody>
</table>

Percent of Total: 14% Extraction, 76% Manufacture, 10% Transport

Mean: 3.64 Extraction, 19.76 Manufacture, 2.74 Transport
<table>
<thead>
<tr>
<th>Nonwood Based Commodities</th>
<th>Extraction</th>
<th>Manufacture</th>
<th>Transport</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravel</td>
<td>0.19</td>
<td>00.00</td>
<td>1.17</td>
<td>1.36</td>
</tr>
<tr>
<td>Concrete Slab</td>
<td>0.19</td>
<td>0.80</td>
<td>1.17</td>
<td>2.16</td>
</tr>
<tr>
<td>Concrete Block</td>
<td>0.19</td>
<td>0.80</td>
<td>1.47</td>
<td>2.46</td>
</tr>
<tr>
<td>Clay Brick</td>
<td>0.19</td>
<td>0.80</td>
<td>1.61</td>
<td>2.60</td>
</tr>
<tr>
<td>Liquid Asphalt</td>
<td>0.77</td>
<td>4.90</td>
<td>1.57</td>
<td>7.24</td>
</tr>
<tr>
<td>Gypsum Board</td>
<td>0.37</td>
<td>6.23</td>
<td>1.47</td>
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</tr>
<tr>
<td>Tar Papers</td>
<td>1.16</td>
<td>5.80</td>
<td>1.57</td>
<td>8.53</td>
</tr>
<tr>
<td>Asphalt Shingles</td>
<td>0.82</td>
<td>7.40</td>
<td>1.57</td>
<td>9.79</td>
</tr>
<tr>
<td>Steel Nails</td>
<td>4.78</td>
<td>16.60</td>
<td>2.68</td>
<td>24.06</td>
</tr>
<tr>
<td>Steel Studs</td>
<td>4.78</td>
<td>16.60</td>
<td>2.73</td>
<td>24.11</td>
</tr>
<tr>
<td>Steel Joists</td>
<td>4.78</td>
<td>16.60</td>
<td>2.73</td>
<td>24.11</td>
</tr>
<tr>
<td>Glass Fiber</td>
<td>0.96</td>
<td>33.00</td>
<td>1.86</td>
<td>35.82</td>
</tr>
<tr>
<td>Vermiculite</td>
<td>0.08</td>
<td>34.50</td>
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<td>36.44</td>
</tr>
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<td>Aluminum Siding</td>
<td>2.14</td>
<td>48.60</td>
<td>2.73</td>
<td>53.47</td>
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<td>Carpet and Pad</td>
<td>8.11</td>
<td>103.80</td>
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<tr>
<td>Plastic Vapor Barrier</td>
<td>6.29</td>
<td>117.40</td>
<td>1.64</td>
<td>125.33</td>
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<td>total</td>
<td>35.80</td>
<td>413.83</td>
<td>30.80</td>
<td>480.43</td>
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<tr>
<td>Percent of Total</td>
<td>8</td>
<td>86</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>2.24</td>
<td>25.86</td>
<td>1.93</td>
<td>30.03</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Softwood Lumber</td>
<td>0.943</td>
<td>0.786</td>
<td>4.060</td>
<td>1.966</td>
<td>7.755</td>
<td>8.313</td>
<td>2.909</td>
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<tr>
<td>Oak Flooring</td>
<td>1.073</td>
<td>0.844</td>
<td>4.847</td>
<td>1.977</td>
<td>8.741</td>
<td>11.388</td>
<td>3.050</td>
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<tr>
<td>Lumber Laminated from Veneer</td>
<td>0.740</td>
<td>0.144</td>
<td>6.443</td>
<td>1.966</td>
<td>9.293</td>
<td>3.540</td>
<td>5.753</td>
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</tr>
<tr>
<td>Softwood Sheathing</td>
<td>0.747</td>
<td>0.145</td>
<td>6.726</td>
<td>2.081</td>
<td>9.699</td>
<td>3.697</td>
<td>6.002</td>
<td></td>
</tr>
<tr>
<td>Plywood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structural Flakeboard</td>
<td>0.956</td>
<td>0.578</td>
<td>6.933</td>
<td>1.314</td>
<td>9.781</td>
<td>8.616</td>
<td>2.270</td>
<td></td>
</tr>
<tr>
<td>Medium Density Fiberboard</td>
<td>0.783</td>
<td>3.748</td>
<td>5.555</td>
<td>1.146</td>
<td>11.232</td>
<td>2.741</td>
<td>8.491</td>
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</tr>
<tr>
<td>Insulation Board</td>
<td>0.622</td>
<td>4.920</td>
<td>5.619</td>
<td>1.234</td>
<td>12.404</td>
<td>0.667</td>
<td>11.737</td>
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<tr>
<td>Hardwood Plywood</td>
<td>1.041</td>
<td>0.244</td>
<td>9.998</td>
<td>1.977</td>
<td>13.260</td>
<td>10.629</td>
<td>3.018</td>
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<tr>
<td>Underlayment Particleboard</td>
<td>4.617</td>
<td>2.503</td>
<td>5.598</td>
<td>1.198</td>
<td>13.916</td>
<td>1.529</td>
<td>12.387</td>
<td></td>
</tr>
<tr>
<td>Wet-Formed Hardboard</td>
<td>0.743</td>
<td>9.919</td>
<td>9.743</td>
<td>1.146</td>
<td>21.551</td>
<td>0.797</td>
<td>20.754</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>12.265</td>
<td>23.831</td>
<td>65.52</td>
<td>16.014</td>
<td>117.63</td>
<td>51.917</td>
<td>76.371</td>
<td></td>
</tr>
<tr>
<td>Percent of Total</td>
<td>10.4</td>
<td>20.3</td>
<td>55.7</td>
<td>13.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>1.23</td>
<td>2.38</td>
<td>6.55</td>
<td>1.60</td>
<td>11.76</td>
<td>5.192</td>
<td>7.64</td>
<td></td>
</tr>
</tbody>
</table>
Energy Requirements in Million BTU (Oil Equivalent) Per Ton

<table>
<thead>
<tr>
<th>Nonwood Based Commodity</th>
<th>Extraction</th>
<th>Processing</th>
<th>Transport</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravel</td>
<td>0.05</td>
<td>0.00</td>
<td>0.40</td>
<td>0.45</td>
</tr>
<tr>
<td>Gypsum Board</td>
<td>0.14</td>
<td>2.73</td>
<td>0.65</td>
<td>3.52</td>
</tr>
<tr>
<td>Liquid Asphalt</td>
<td>0.00</td>
<td>3.20</td>
<td>0.73</td>
<td>3.93</td>
</tr>
<tr>
<td>Tar Paper</td>
<td>0.20</td>
<td>5.00</td>
<td>0.73</td>
<td>5.93</td>
</tr>
<tr>
<td>Asphalt Shingles</td>
<td>0.03</td>
<td>5.70</td>
<td>0.73</td>
<td>6.46</td>
</tr>
<tr>
<td>Concrete Slab</td>
<td>0.52</td>
<td>7.60</td>
<td>0.40</td>
<td>8.52</td>
</tr>
<tr>
<td>Concrete Block</td>
<td>0.52</td>
<td>7.60</td>
<td>0.65</td>
<td>8.77</td>
</tr>
<tr>
<td>Clay Brick</td>
<td>0.57</td>
<td>7.73</td>
<td>0.76</td>
<td>9.06</td>
</tr>
<tr>
<td>Vermiculite</td>
<td>0.04</td>
<td>14.20</td>
<td>0.92</td>
<td>15.16</td>
</tr>
<tr>
<td>Glass Fiber</td>
<td>0.62</td>
<td>26.70</td>
<td>0.92</td>
<td>28.24</td>
</tr>
<tr>
<td>Plastic Vapor Barrier</td>
<td>4.49</td>
<td>25.10</td>
<td>0.75</td>
<td>30.34</td>
</tr>
<tr>
<td>Carpet and Pad</td>
<td>6.60</td>
<td>28.69</td>
<td>1.90</td>
<td>37.19</td>
</tr>
<tr>
<td>Steel Nails</td>
<td>2.45</td>
<td>46.20</td>
<td>1.48</td>
<td>50.13</td>
</tr>
<tr>
<td>Steel Studs</td>
<td>2.45</td>
<td>46.20</td>
<td>1.67</td>
<td>50.32</td>
</tr>
<tr>
<td>Steel Joists</td>
<td>2.45</td>
<td>46.20</td>
<td>1.67</td>
<td>50.32</td>
</tr>
<tr>
<td>Aluminum Siding</td>
<td>26.80</td>
<td>172.00</td>
<td>1.67</td>
<td>200.47</td>
</tr>
<tr>
<td>total</td>
<td>47.93</td>
<td>444.85</td>
<td>16.03</td>
<td>508.81</td>
</tr>
<tr>
<td>Percent of Total</td>
<td>9.4</td>
<td>87.40</td>
<td>3.2</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>2.99</td>
<td>27.80</td>
<td>1.00</td>
<td>31.80</td>
</tr>
</tbody>
</table>

The data shown is considered to be adequate for the purpose of drawing conclusions but it must be recognized that they are averages of a highly variable base. Wood-Processing industries have excessive variability in operating efficiency, and in some plants, the
residual material is not utilized. Management support and equipment years in service vary from plant to plant and thus averages of well operated plants were taken.

In looking at the material flow and residual products usage, it is worthwhile mentioning that panel products reconstituted from fibers or dry residues allow the highest percentages of principal product recovery. Residues from these products do not provide raw materials for other manufactured products. On the other hand, commodities requiring the largest tonnage of input material per ton of product i.e. lumber and hardwood plywood generate in the manufacturing process significant quantities of residues suited for by-product manufacturing.

The results shown above, pinpoint to the fact that Wood Products are mostly homogeneous in man-hour and capital requirements than non-wood materials. Harvesting forests and transporting wood to the mills is more demanding in labor than extraction of non-wood raw materials but due to the larger variability of non-wood products, their average is higher than that of wood. The most notable differences between wood and non-wood commodities is in their energy demand. Non-wood commodities are non-renewable and consume more energy to produce.

The summary of the results for the different components of a residential building, including logging or extraction, manufacture, transport to house site, and erection can be seen in the following table. These numbers are standardized per 100 square feet section.
<table>
<thead>
<tr>
<th>Roofs</th>
<th>Manpower</th>
<th>Net Energy</th>
<th>Capital Depreciation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Man-Hours</td>
<td>Million BTU</td>
<td>Dollars</td>
</tr>
<tr>
<td>1. W-type Wood Truss with Wood Shingles</td>
<td>8.96</td>
<td>2.44</td>
<td>6.14</td>
</tr>
<tr>
<td>2. Same but with Asphalt Shingles.</td>
<td>9.04</td>
<td>3.22</td>
<td>6.72</td>
</tr>
<tr>
<td>3. Steel Rafters (Flat Roof)</td>
<td>9.17</td>
<td>5.11</td>
<td>6.38</td>
</tr>
<tr>
<td>4. Flat Roof with LVL Rafters and Flakeboard</td>
<td>9.36</td>
<td>2.45</td>
<td>6.59</td>
</tr>
</tbody>
</table>

**Exterior Walls**

<table>
<thead>
<tr>
<th></th>
<th>Man-Hours</th>
<th>Net Energy</th>
<th>Capital Depreciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Plywood Siding (no sheathing), 2x4 Frame</td>
<td>7.99</td>
<td>1.99</td>
<td>4.15</td>
</tr>
<tr>
<td>2. Medium-Density Fiberboard Siding.</td>
<td>9.86</td>
<td>2.54</td>
<td>6.41</td>
</tr>
<tr>
<td>Plywood Sheathing, 2x4 Frame.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Medium Density Fiberboard Siding, 1/2 inch Insulation Board, and Plywood Corner Bracing.</td>
<td>9.26</td>
<td>2.69</td>
<td>6.71</td>
</tr>
<tr>
<td>4. Concrete Building Block, no Insulation</td>
<td>18.45</td>
<td>16.53</td>
<td>5.56</td>
</tr>
<tr>
<td>5. Aluminum Siding over Sheathing</td>
<td>9.83</td>
<td>4.95</td>
<td>4.61</td>
</tr>
<tr>
<td>6. MDF Siding, Sheathing, Steel Studs</td>
<td>9.89</td>
<td>4.79</td>
<td>7.20</td>
</tr>
<tr>
<td>7. MDF Siding, Sheathing, Aluminum Framing</td>
<td>11.26</td>
<td>5.53</td>
<td>6.91</td>
</tr>
<tr>
<td>8. Brick Veneer</td>
<td>22.00</td>
<td>17.89</td>
<td>8.37</td>
</tr>
</tbody>
</table>

**Interior Walls**

<table>
<thead>
<tr>
<th></th>
<th>Man-Hours</th>
<th>Net Energy</th>
<th>Capital Depreciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Wood Framing</td>
<td>3.87</td>
<td>0.95</td>
<td>2.17</td>
</tr>
<tr>
<td>2. Aluminum Framing</td>
<td>3.99</td>
<td>2.25</td>
<td>2.13</td>
</tr>
<tr>
<td>3. Steel Framing</td>
<td>3.53</td>
<td>1.88</td>
<td>2.25</td>
</tr>
</tbody>
</table>

**Floors**

(all with carpet and Pad except #2)

<table>
<thead>
<tr>
<th></th>
<th>Man-Hours</th>
<th>Net Energy</th>
<th>Capital Depreciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Wood Joist, Plywood Subfloor, and Particleboard Underlayment</td>
<td>9.15</td>
<td>2.85</td>
<td>7.58</td>
</tr>
<tr>
<td>2. Wood Joist, Plywood Subfloor, Oak Finish Floor</td>
<td>8.51</td>
<td>1.19</td>
<td>6.40</td>
</tr>
<tr>
<td>4. Concrete Slab</td>
<td>11.62</td>
<td>22.06</td>
<td>11.81</td>
</tr>
<tr>
<td>5. Steel Joist, 2-4-1 Plywood</td>
<td>11.97</td>
<td>23.26</td>
<td>16.34</td>
</tr>
<tr>
<td>6. LVL Joist and Flakeboard</td>
<td>7.76</td>
<td>2.05</td>
<td>7.23</td>
</tr>
</tbody>
</table>
The most striking difference involving the erection of a residential house using wood vs. non-wood materials lies in the energy requirements. In roofs, the design using steel rafters needs approximately twice the energy of constructions using wood trusses or wood rafters. Exterior walls sided with brick or constructed with concrete blocks require seven to eight times the energy of all-wood constructions and exterior and interior walls incorporating metal require approximately twice the energy of wood-frame construction. Floors from wood materials need only ten percent as much energy as the concrete slab or that with steel supporting members.

With the exception of wall constructions incorporating brick veneer and concrete blocks, which require two to three times the labor man-hours of wood constructions, manpower requirements do not differ much between designs. No clear definition is derived regarding the use of capital equipment. Wood based floor systems appear to be approximately 1/2 as capital intensive as their non-wood counterparts. The energy requirements showed the largest differences: Steel for joists, for example, require 50 times as much energy as wood components. Aluminum framing for exterior walls is about 20 times as energy intensive as wood framing. Steel framing is approximately 2/3 of Aluminum’s. Similarly, aluminum and steel studs for interior walls require twelve and eight times the energy of wood studs to perform similarly. Steel Rafters exceed Wood Trusses sevenfold in energy requirements and aluminum siding requires approximately five times that of aluminum and 25 times that of wood-based siding materials. No clear overall patterns emerge regarding labor and
capital depreciation requirements. It may be seen that steel floor joists as well as is brick siding are substantially higher than wood products in labor and capital depreciation.

The analysis of the latest wood construction trends and materials, shows that it is possible to decrease the amount of wood required in a building without sacrificing its structural integrity. This is possible due to design advances in wood-construction. As this materializes, wood will increase its market share in the construction materials field if the cost of technical energy continues to increase.

Another study worth mentioning is that of the Canadian Wood Council on Cost Comparison of Residential Construction. This particular study concentrated in comparing wood-frame to steel frame housing, as since the early 1970’s there had been a resurgence in interest in steel framing for residential construction in Canada. This had become notorious in 1993 and 1994 due to the increased cost of wood, a result of the temporary withdrawal from harvesting of federal lands in the north-western United States, resulting in a reduction of six billion board feet. Meanwhile demand was fueled by reconstruction needs due to hurricane, earthquake and floodings in the US and by the emergence from recession in Canada and the US\textsuperscript{62}. While lumber prices are driven primarily by building construction demands, steel demand is affected primarily by industrial construction and by the automotive and durable goods industries. While steel prices remained relatively stable during the recent North American recessionary period, this is a reflection of the broader

market forces at work and not an inherent property of the material. This is demonstrated by the 8% price increase for bulk steel in the first half of 1994\textsuperscript{63}.

The Canadian Wood Council engaged Heylar and Associates to examine the cost and technical differences between wood and steel frame residential construction. Three model houses were designed by Gabor & Popper Architects and constructed in the Toronto area\textsuperscript{64}. A town-house (two-story building), a bungalow (one-level building) and Two Story House were designed and built according to the latest National Building Code of Canada. Material prices were those available to constructors in the Toronto area in March 1994. Wood prices were obtained from four suppliers and averaged for the purposes of the study. Steel prices were obtained from a fabricator of steel framing components in Toronto. These prices, in Canadian Dollars, are indicated in the next table.

<table>
<thead>
<tr>
<th>Lumber Framing Material</th>
<th>$ per lineal foot</th>
<th>$ per thousand feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot;x4&quot;</td>
<td>0.44</td>
<td>660</td>
</tr>
<tr>
<td>2&quot;x6&quot;</td>
<td>0.62</td>
<td>630</td>
</tr>
<tr>
<td>2&quot;x8&quot;</td>
<td>0.93</td>
<td>800</td>
</tr>
<tr>
<td>2&quot;x10&quot;</td>
<td>1.39</td>
<td>870</td>
</tr>
<tr>
<td><strong>Steel Framing Materials</strong></td>
<td><strong>$ per lineal foot</strong></td>
<td><strong>$ per thousand feet</strong></td>
</tr>
<tr>
<td>3-5/8&quot; stud (non load-bearing)</td>
<td>0.18</td>
<td>180</td>
</tr>
<tr>
<td>3-5/8&quot; 20 gauge stud (load-bearing)</td>
<td>0.55</td>
<td>550</td>
</tr>
<tr>
<td>6&quot; 18 gauge</td>
<td>0.59</td>
<td>590</td>
</tr>
<tr>
<td>8&quot; 18 gauge steel joist</td>
<td>1.13</td>
<td>1130</td>
</tr>
<tr>
<td>8&quot; 16 gauge steel joist</td>
<td>1.43</td>
<td>1430</td>
</tr>
<tr>
<td>8&quot; 14 gauge steel joist</td>
<td>1.72</td>
<td>1720</td>
</tr>
<tr>
<td><strong>Sheathing Materials</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roof Sheathing</td>
<td>1/2&quot; plywood</td>
<td>$19.25/sheet</td>
</tr>
<tr>
<td>Floor Sheathing</td>
<td>5/8&quot; plywood</td>
<td>$24.75/sheet</td>
</tr>
<tr>
<td>Floor Overlay</td>
<td>1/4&quot; plywood</td>
<td>$24.75/sheet</td>
</tr>
<tr>
<td>Wall Sheathing</td>
<td>7/16&quot; OSB</td>
<td>$13.50/sheet</td>
</tr>
</tbody>
</table>

\textsuperscript{63} Globe and Mail, "US steel prices soar as industrial demand surges". August 10, 1994

\textsuperscript{64} Cost Comparison Residential Framing. Wood The Renewable Resource No. 1. Canadian Wood Council.
Contractors were interviewed to determine material and labor cost advantages and disadvantages for steel framing. The cost comparison includes the extra costs associated with steel framing for items needed to secure door frames and trim, isolate electrical and mechanical systems from the steel frame, and for grommets to protect wiring passing through steel studs. Same labor productivity was assumed for all type of construction i.e. no learning cost was charged to the steel framing.

The material substitution considered in the study is represented in the next table.

<table>
<thead>
<tr>
<th>Element</th>
<th>Wood Framing</th>
<th>Steel Framing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Floors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floor joists</td>
<td>2”x10”</td>
<td>8” - 18 gauge steel</td>
</tr>
<tr>
<td>Floor bridging</td>
<td>2”x2”</td>
<td>1.5” x 0.048 steel strap</td>
</tr>
<tr>
<td><strong>Non load-bearing walls</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Studs</td>
<td>2”x4”</td>
<td>3-5/8” steel studs</td>
</tr>
<tr>
<td><strong>Load-bearing walls</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Studs</td>
<td>2”x6”</td>
<td>3-5/8” 20 gauge steel stud</td>
</tr>
<tr>
<td>Lintels</td>
<td>2”x10”</td>
<td>8” 18 gauge steel stud</td>
</tr>
<tr>
<td>Sheathing</td>
<td>7/16” OSB</td>
<td>na</td>
</tr>
<tr>
<td>Insulation</td>
<td>R27 batt</td>
<td>R14 batt plus 1-1/2” rigid exterior insulation</td>
</tr>
</tbody>
</table>

The study findings indicate that wood framing is less costly than steel framing. In particular for the Town-House and Two-Story house which had 2.8% and 6% cost advantages over steel respectively. For the bungalow (which had fewer load-bearing applications) there was a slight advantage in cost for steel framing (0.3%). Since the completion of the study, the prices of wood products then prevailing (March 1994) have come down from their peak, further increasing the cost advantage for wood framing for residential construction. All costs are shown below.
<table>
<thead>
<tr>
<th>Townhouse Division (1,500 Ft²)</th>
<th>Wood Framing Cost</th>
<th>Steel Framing Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Siteworks</td>
<td>$2,632</td>
<td>$2,632</td>
</tr>
<tr>
<td>Concrete and formwork</td>
<td>$10,062</td>
<td>$10,062</td>
</tr>
<tr>
<td>Masonry</td>
<td>$3,959</td>
<td>$3,959</td>
</tr>
<tr>
<td>Metals</td>
<td>$1,531</td>
<td>$11,844</td>
</tr>
<tr>
<td>Carpentry</td>
<td>$16,650</td>
<td>$7,710</td>
</tr>
<tr>
<td>Thermal and Moisture Protection</td>
<td>$3,129</td>
<td>$3,129</td>
</tr>
<tr>
<td>Windows and Doors</td>
<td>$5,439</td>
<td>$5,439</td>
</tr>
<tr>
<td>Finishes</td>
<td>$10,679</td>
<td>$10,532</td>
</tr>
<tr>
<td>Specialties</td>
<td>$420</td>
<td>$420</td>
</tr>
<tr>
<td>Mechanical</td>
<td>$8,200</td>
<td>$8,700</td>
</tr>
<tr>
<td>Electrical</td>
<td>$1,795</td>
<td>$1,895</td>
</tr>
<tr>
<td>Overhead @ 6%</td>
<td>$3,870</td>
<td>$3,979</td>
</tr>
<tr>
<td>Total</td>
<td>$68,366</td>
<td>$70,301</td>
</tr>
</tbody>
</table>

2.8% cost advantage

<table>
<thead>
<tr>
<th>Bungalow Division (2,000 Ft²)</th>
<th>Wood Framing Cost</th>
<th>Steel Framing Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Siteworks</td>
<td>$5,763</td>
<td>$5,773</td>
</tr>
<tr>
<td>Concrete and formwork</td>
<td>$19,449</td>
<td>$19,184</td>
</tr>
<tr>
<td>Masonry</td>
<td>$11,175</td>
<td>$11,175</td>
</tr>
<tr>
<td>Metals</td>
<td>$3,008</td>
<td>$21,863</td>
</tr>
<tr>
<td>Carpentry</td>
<td>$32,580</td>
<td>$13,541</td>
</tr>
<tr>
<td>Thermal and Moisture Protection</td>
<td>$6,795</td>
<td>$6,795</td>
</tr>
<tr>
<td>Windows and Doors</td>
<td>$7,826</td>
<td>$7,826</td>
</tr>
<tr>
<td>Finishes</td>
<td>$20,339</td>
<td>$19,759</td>
</tr>
<tr>
<td>Specialties</td>
<td>$335</td>
<td>$335</td>
</tr>
<tr>
<td>Mechanical</td>
<td>$9,300</td>
<td>9,800</td>
</tr>
<tr>
<td>Electrical</td>
<td>$2,328</td>
<td>$2,478</td>
</tr>
<tr>
<td>Overhead @ 6%</td>
<td>$7,143</td>
<td>$7,113</td>
</tr>
<tr>
<td>Total</td>
<td>$126,061</td>
<td>$125,662</td>
</tr>
</tbody>
</table>

0.3% cost advantage

<table>
<thead>
<tr>
<th>Two Story Division (2,100 Ft²)</th>
<th>Wood Framing Cost</th>
<th>Steel Framing Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Siteworks</td>
<td>$3,778</td>
<td>$3,778</td>
</tr>
<tr>
<td>Concrete and formwork</td>
<td>$11,339</td>
<td>$11,339</td>
</tr>
<tr>
<td>Masonry</td>
<td>$19,307</td>
<td>$19,307</td>
</tr>
<tr>
<td>Metals</td>
<td>$1,313</td>
<td>$20,145</td>
</tr>
<tr>
<td>Carpentry</td>
<td>$24,747</td>
<td>$11,620</td>
</tr>
<tr>
<td>Thermal and Moisture Protection</td>
<td>$5,282</td>
<td>$5,282</td>
</tr>
<tr>
<td>Windows and Doors</td>
<td>$7,208</td>
<td>$7,208</td>
</tr>
<tr>
<td>Finishes</td>
<td>$14,832</td>
<td>$14,424</td>
</tr>
<tr>
<td>Specialties</td>
<td>$880</td>
<td>$880</td>
</tr>
<tr>
<td>Mechanical</td>
<td>$9,000</td>
<td>$9,500</td>
</tr>
<tr>
<td>Electrical</td>
<td>$2,642</td>
<td>$2,842</td>
</tr>
<tr>
<td>Overhead @ 6%</td>
<td>$6,020</td>
<td>$6,379</td>
</tr>
<tr>
<td>Total</td>
<td>$106,348</td>
<td>$112,704</td>
</tr>
</tbody>
</table>

6% cost advantage
Most interestingly, this study included sensitivity analysis which evaluates the costs of the above projects given the relative price differences between wood and steel. This is important given that their prices vary according to different demands and macroeconomics scenarios. The impact of lumber price changes from those prevailing in March 1994 (0% in horizontal axis) are shown in the following graphs.

![Townhouse diagram](image)

![Two Story diagram](image)
For the Town House and Two-Story models, the price of wood materials would have to increase by 19% and 55% respectively before steel framing would match wood framing cost. For the Bungalow (which was 0.3% cheaper framed in steel), the cost of steel framing materials would have to increase 5% for wood and steel to have the same cost\textsuperscript{65}. Further, no special cost of engineering was assigned to the steel framing which would require it. Since the study, lumber prices have decreased by 5%, rendering wood framing less expensive even for the Bungalow model with less number of load-bearing applications.

\begin{center}
\begin{tikzpicture}
\begin{axis}[
    width=0.9\textwidth,
    title={Bungalow},
    xlabel={Lumber Price Increase \%},
    ylabel={Framing Cost per Ft$^2$ Thousands},
    xmin=-20, xmax=20,
    ymin=24, ymax=36,
    xtick={-20,-10,0,10,20},
    ytick={24,26,28,30,32,34,36},
    legend pos=outer north east,
    legend style={draw=none},
]
    \addlegendentry{Wood}
    \addlegendentry{Steel}
    \addplot[black,only marks,mark=*,mark options={solid},mark size=1.5pt] coordinates {
        (-20,24.5)
        (-10,26.0)
        (0,27.5)
        (10,30.0)
        (20,32.5)
    };
    \addplot[black,only marks,mark=square,mark options={solid},mark size=1.5pt] coordinates {
        (-20,25.0)
        (-10,26.5)
        (0,28.0)
        (10,30.5)
        (20,33.0)
    };
\end{axis}
\end{tikzpicture}
\end{center}

Despite the claims that steel frame construction can make use of up to 66% material recycling, this figure includes steel scraps that never leave the steel mill. Further, unlike the heavy structural steel sections produced in mini-mills which carry as much as 91% recycled content, the sheet steel used for steel framing contains an average of 24% recycled content.

recycled material. The recycling capacity of all materials has to be judged according to the energy and other resources used to collect and re-melt the scrap.

Other important advantages worth mentioning in the use of wood based materials is the lower environmental impact of their manufacturing processes. According to research conducted by the Canadian Research Alliance, the energy requirements, emissions and effluent generation are much less for wood than for steel and concrete.
Appendix 8

Financial Considerations

Mortgage financing is extremely limited in developing countries. In many cities the total volume of formal mortgage loans issued in a given year, accounts for no more than 10 to 20 percent of the annual value of housing investment. Other loans for housing usually comes from relatives, employers, and money-lenders, but savings and current income finance the bulk of construction. When current income is used, construction often occurs incrementally as funds become available over time. Multitudes of urban dwellers living for years in what amounts to just a building site, demonstrates the lack of an efficient housing finance system. In many cases, construction is also highly inefficient; in the absence of complementary inputs, materials languish and often deteriorate.

Housing finance can also contribute to the development of financial depth. In countries where financially-sound mortgage finance systems are in place, demand for mortgage loans often is so high, that mortgage lending becomes the most rapidly growing segment in the financial portfolios of lending institutions. In Malaysia and Thailand, for example, substantial mortgage lending by commercial banks began in the 1970s and 1980s respectively. From the earliest years of commercial bank lending for housing in those countries, the volume of mortgage loans has grown at compound rates of 30 percent per year, or more.
Problems associated with Mortgage lending: the great majority of urban households in developing countries do not have access to mortgage finance. In most developing countries, less than 10 to 20 percent of the annual housing investment is covered by mortgage finance. The development of housing finance institutions is strongly tied to the overall financial sector development, but policy decisions often tend to limit their ability to engage in mortgage lending. Such policies include forcing institutions to give subsidized loans, often at negative interest rates, and to forgive loans. Such actions are, in effect, off-budget subsidies that entice politicians because they escape budgetary allocations, instead creating unmeasured and unseen contingent liabilities. However, the cost of such programs often far exceed those of direct housing subsidies. Hidden subsidies, delivered through the financial system (such as interest rate subsidies) impede financial development, are often regressive, and can impose significant hidden costs and risks.

In the early stages of financial development, the sector tends to accumulate extremely short-term assets and liabilities, and thus tends to avoid financing long-term investments in industry and infrastructure, as well as in housing. In the absence of a well-designed indexation, long-term lending in inflation-prone countries is perceived to be of high risk. Similarly, in countries with weak mechanisms for foreclosure on defaulters, the risk of default on repayments tends to be high.

Partly as a way of overcoming shortages in housing finance, governments in a number of countries have instituted directed credit schemes. These have taken the form either of
government-sponsored housing finance institutions, often supported by direct budgetary transfers, or specified lending targets for housing by commercial lending institutions. In either case, directed-credit lessens incentives for resource mobilization by lending volumes for housing that are actually smaller than they would have been under a more neutral financial regime which allows lending for housing to seek its own level based on market conditions. In industrial countries, the failure of prudential regulation of housing finance institutions has sometimes been catastrophic, as evidenced by the fact that failures of savings and loan (housing finance) institutions in the United States require some US 300 billion in taxpayer subsidies to compensate depositors in the failed institutions, for those deposits which were insured by a federal government agency. Such failures underline the importance of sound and prudential regulation and enforcement.

Housing finance is important to the financial system. Properly structured housing finance policies are important to the stability of the financial sector and thus to the stability of the economy. The Colombian Case: In 1972, the government of Colombia established new housing finance institutions, The “Cajas Ahorra de Vivienda”, which paid positive, real interest rates on deposits, indexed to the rate of inflation. Depositor response to these indexed instruments was immediate and positive, and led to rapid growth of deposits in the housing finance system. In commercial banks, by contrast, real interest rates paid on certificates of deposit had averaged negative 6.5 percent over the preceding 14 years. In
order to compete for deposits, commercial banks were forced to pay more competitive
deposit rates, with the result that from 1972 to 1984, their certificates of deposit paid an
average positive real return of 2.5 percent, allowing them to maintain and subsequently
increase their deposit bases. The direct benefits of this process for Colombia was increased
financial depth. Credit outstanding as a share of GDP increased from an average of 15
percent in the five-year period leading up to 1970, to 36 percent after 1980. During this
same period, most other Latin American countries experienced significant reductions in
monetary assets as a share of GDP. Colombia’s ability to maintain and increase its
financial depth during this period has been cited as a major cause for its favorable
economic growth relative to that of other Latin American countries. This illustrates the
productive contribution that well-structured housing finance system can make toward both
the financial sector and overall economic development. 66

Conversely, failures in housing finance policies can lead to broader financial failures. An
example of this is the collapse of the “Banco Nacional de Habitação” (BNH) in Brazil.
The BNH was created in 1964 to serve as the primary regulator of and a channel for funds
to the Brazilian housing finance system. The major sources of funds for the system were a
compulsory workers savings system and deposits in savings and loan associations. By law,
all deposits were indexed to inflation on a quarterly basis. To protect loan balances and
maintain the system’s solvency, mortgage loan contracts were also indexed. Originally,
both payments and loan balances were indexed on the same basis as deposits. However,

66 Buckley and Dokeniya (1989)
over time, new indexation systems were mandated for payments which caused them to lag behind the general price level. The government then agreed to cover any outstanding balances remaining at the end of the loan term. By 1985, inflation was running at an annual rate of 240 percent, while loan payments were increased by only 112 percent. This growing imbalance jeopardized the solvency of BNH and in 1987 it was closed. Despite this the basic structure of the mortgage finance system was not reformed. The only study on implicit subsidies in the financial system, estimated that the annual subsidy to borrowers on mortgage loan contracts taken-out through 1987 could eventually exceed 2 percent of GDP. As these contracts mature, the Brazilian government must fulfill its obligation to cover the shortfall, with almost certain inflationary consequences.67

As economic development proceeds, it is generally accompanied by increased monetization of the economy, by an increase in the depth and breadth of financial institutions, and by increasingly integrated capital markets. At the lowest-levels of economic development, long-term loans through the formal financial system are rare, as is any form of mortgage finance. With development and economic growth, financial institutions seek to diversify their portfolios to mitigate risk and to achieve a match in the term structure of assets and liabilities. A consequence of this is that formal lending for housing purchases starts to occur, often in the form of overdraft loans or loans that are rolled-over annually. Household savings are encouraged and are sometimes linked to the possibility of receiving housing loans. Further development of the financial system leads to

67 Pinto-Lima (1990); Silveira (1989)
increasing maturities of loans for housing and sometimes to the development of specialized housing finance institutions, some of which may constitute secondary markets in mortgage loans.

Quantitative evidence on the growing importance of mortgage lending is imprecise, but it appears that the relative importance of residential mortgage loans in the portfolios of the financial system, grows from next to nothing to more than 25 percent at moderate levels of economic development. Mortgage loans may constitute 40 percent of the portfolio of the financial system of industrial countries.

How rapidly mortgage lending develops, depends on both the overall pace of finance development and the policies within the housing sector. High and variable inflation rates impede development of the financial sector and long-term lending, and housing is negatively affected. Financial systems characterized by positive real interest rates are more favorable for the development of mortgage finance. In addition, systems of property registration and titling, including workable systems of foreclosure and eviction are necessary to ensure the collateral security of mortgage loans. Finally, the design of mortgage lending instruments and particularly the design of mortgage-index provisions, can make a critical difference. Recent innovations in mortgage instrument’s design, such as the “dual-indexed mortgage” now employed in Mexico and proposed for Turkey, have permitted mortgage lending to expand even during inflationary periods.
Another way to use the financial housing system to stimulate the economy is the Chilean approach. In 1975, Chile was in the midst of a deep recession with a collapsing savings and loan industry. From a peak growth of more than 5 percent in 1971, per capita GDP fell nearly 15 percent in 1975, with a net domestic savings rate of a negative 5 percent of GDP. The financial sector was also shrinking. The ratio of M2 to GNP dropped from more than 40 percent in 1972 to about 15 percent in 1976. There were widely perceived housing shortages with most units produced by the public sector. When Chile reformed its housing subsidy system, beginning as part of a broader liberalization of the economy, the increased flexibility in the procurement of publicly supported housing, led to a very flexible supply response. Production of subsidized housing increased fourfold with a much smaller number of public workers. By 1980, the growth rate of GDP per capita was again more than 5 percent, domestic savings was nearly 5 percent of GDP and the ratio of M2 to GNP was more than 20 percent.  

68 World Bank (1989)

**Financing of Low-Income Housing in the United States**

As a comparison, the data in 1991 for very-low-income housing in the US assumed a typical multifamily unit to cost US 40,000 and about US 562 per month to operate. *In this example a nonamortizing loan with an interest rate of 10.5% was used because this is the least costly way to finance a property and was the rate offered on such loans in 1991. The debt service on a $40,000 unit would therefore be $350 per month. Operating expenses were assumed to be $2,543 per year or $212 per month (that's the average*
operating expense for an individually-metered garden apartment as reported by the National Apartment Association's annual survey of income and expenses in rental projects\(^69\).}

Note that the 10.5%, $350 cost above is in nominal terms. It could start lower if set to rise with inflation. The above costs of housing and financing for a low-income household point to the affordability which the wood-housing approach provides.

Appendix 9

Low Income Housing

This is a very important subject, given that in any economy the poorest sector has the highest difficulties in gaining access to affordable and decent housing. Not only this problem concerns the human suffering aspect but it is also the one which receives the most publicity and thus affects the political fortune of governments.

It is impossible for us to properly cover this subject, which has had so many organizations and professionals involved for decades. Therefore, we will limit ourselves to define what is low-income housing and describe its difficulties; trying to relate this to the low-income housing situation in Argentina, by covering a little bit about its history; describe some recent successful programs in Latin America, which could be adapted and implemented in Argentina; and highlight the impact of wood-based construction in this area.

What is Low-Income Housing?

Since the beginning of modern societies there has been a deficit in housing needs affecting mostly the poorest people, who are the most likely to live in substandard units, live in crowded conditions or likely to go homeless. People most affected are women, single parents and the elderly. Many different low-income housing programs have therefore been created by developed and underdeveloped economies alike, with the goal to provide a decent home and suitable living environments for every family. Most of these programs involve government subsidies, private individuals as volunteers, charities, non-profit
organizations, churches, and home builder's associations, who contribute time, labor, materials, money, expertise and help to the homeless in their communities. These efforts however have never been enough. Even in the United States the situation has deteriorated in the last 20 years, where the home ownership rate among the very-low-income households has significantly declined as a result of higher mortgage rates, changes in the characteristics of low-income households, weak real income growth, and the growing share of income that they must devote to rent.\textsuperscript{70}

Most government programs, as said, are well intentioned but because the problem is never easy to solve, given the infinitely different set of circumstances affecting the population, no matter what criteria is used to allocate access to housing, it will become cumbersome and wasteful. Their impact on beneficiaries also vary and measuring this effect is never easy. A study by the United States' HUD in 1974 for example, calculated the difference between the market rent of a subsidized unit and the amount that program: recipients paid for rent. By that criterion, individual households living in subsidized new or substantially rehabilitated units reap greater benefits than those that receive vouchers or certificates. That is because new or rehabilitated units are built to higher standards than most existing units, but the tenants who live in them pay no more of their income toward housing than those in existing housing who use vouchers and certificates. Vouchers have the least housing impact on beneficiaries because those who receive them are not obliged to

dedicate the entire voucher amount to their housing costs, and so may end up living in units that are not much different from those they would live in if the program did not exist.

Program viability can be measured in terms of whether a program's level of subsidy is sufficient to insure its solvency and health over the term of its assisted projects. According to this, vouchers and certificates, as long as they remain in effect and funded, are viable, although the cost of vouchers and certificates increase as rents rise.

Cases of Low-Income Household - Alternative Programs in Argentina

The response of many low-income communities, forced to move away from their illegal dwellings was to search for and build new housing elsewhere with the assistance of non-profit organizations.

In most cases, the local church, recognized as a trustworthy organization was the key to permit the organization of the low-income community members. They were, in general, a mixture of Argentines and citizens of neighboring countries with generally low level of education (for example in one such project 33% did not finish primary school and 45% did not finish secondary school) and given their difficult lives, were very mistrustful of one another. They usually had no experience, no money, and no land of their own. With the help of Catholic Church fathers, who were able to demonstrate ways to establish cooperatives as a legal framework for the organization of their communities, some alternative solutions were implemented. In general, people living in these communities are
employed in construction (41% of men in one case) or manufacturing (22%), while women are mostly employed as house helpers (52%) and other services, yet usually only one person per household has work and many times unemployment is a common occurrence. The cooperatives eventually organized themselves to work on the housing building project, the technical direction of the construction; obtain the necessary permits, produce budgets, purchase materials and evaluate costs; collect local funds; promote the project to present it to several foreign foundations for further funding; and even arrange for adult education classes (for example those given through the Dirección Nacional de Educación para Adultos -DINEA-, as well as trade skill development by the Consejo Nacional de Educación Técnica -CONET-)\textsuperscript{71}. Usually, the first funds received or collected end-up used to acquire the necessary land. This however is complicated due to the lack of suitable parcels, price gauging by unscrupulous land owners, or plain refusal from other communities and municipalities to have low-income households settle close to them. Further, many projects fail because many people prefer to remain in their precarious homes closer to the city (where they usually are able to illegally connect themselves to utilities) rather than have access to better housing (paying utilities) and having to travel many hours a day to reach their workplaces or to reach services and retail centers. Many times crime becomes a deciding factor in relocation and it is paradoxical to see that low-income households find it safer to live in the old “villas” than in the new neighborhoods, as there is usually no police or other community services.

\textsuperscript{71} De la Villa Miseria al Barrio Autoconstruido. Beatriz Cuenya et. al. page 198
Some projects went ahead with financial support by organizations such as Argentine Caritas, Dutch Cebemo and US Mariknool\textsuperscript{72} while other volunteers such as students of Arquitectura (not on thesis assignments), professors and the CEVE -Centro Experimental de la Vivienda Económica- (Experimental, Low-cost Housing Center) provided technical support. The cooperatives usually do not attempt to contact the Argentine national government as they are convinced that little assistance will be offered. As a matter of fact, even municipal help, offered at one point, never materialized in some of the projects studied. However, it is necessary to mention that government funds, given by the Ministry of Social Affairs (Ministerio de Bienestar Social) through the Provincial Housing Institute (Instituto Provincial de la Vivienda) were sometimes employed to purchase building materials and payment of labor as well as cases where Municipalities would use their vehicles to help transport materials to the sites.

Land costs became in most instances a very large component of the overall project cost. Given the existing regulations for low density housing, like mandates for minimum parking-areas required (which most people find unnecessary given their lack of access to automobile ownership), many projects find it hard to find suitable land or settle for building less number of units. Sometimes land ownership became possible thanks to the generosity of the Church, who donated or subsidized it.

\textsuperscript{72} De la Villa Miseria al Barrio Autoconstruido. Beatriz Cuenya et. al.
Many efforts in the past ended in disillusion when participant’s monthly payments (intended to support the start of future projects -rotative funds), were depleted by the high inflation prevailing then in Argentina.

Other factors which complicate matters in these efforts are:

- Any funding program and attempt to collect payments from the community is never seen with good eyes, as the idea of payment indexation is not recognized as a normal fact of economic life under inflationary periods, but rather as immoral.

- The fact that on paper, many of the households are employed in the construction industry did not prove so valid as the know-how of most people is really low.

- The lengthy construction period with little to show for (which is typical of the foundation and initial phases of conventional housing), caused people to give-up.

- Costs of materials and others were usually indexed while low-income salaries always lagged readjustment, causing sooner or later the abandonment of the project or the redesign to smaller houses.

- Lack of stable employment, made worse during recessionary periods affects pooling payments to the cooperative’s funds, causing friction between members.

- Lack of stable government, which caused frequent changes in officials, aggravating the bureaucratic system further, causing more delays in obtaining construction permits or aid.

Some lessons from these experiences point to the advisability to:
• organize people in small working groups;
• train them in organizational as well as building techniques;
• reduce the areas of mutual help to those most difficult or heavy, where individual work is not feasible;
• have a properly defined and enforced code of work and definition of duties and responsibilities;
• promote individual work whenever possible;
• attempt to reach a level of completion in the construction sufficient to allow the habitation of the units as soon as possible, to reduce the burden of separation between family members (as they are forced to work during week-ends and holidays usually far away from their present home location);
• complement the project with social work, education support and assistance;
• develop leaders and skills among the participants in the project
• Promote and work with organizations involved in research of new low-income housing designs, materials, building methods, etc. as there will be advantages in the use of technologies and techniques which promote less specialized constructive skills, accelerate the construction period and reduce the number of people needed at any one time for construction.

Costs of alternative low-income housing in Argentina
According to the projects studied by Beatriz Cuénya, the labor requirement for these houses was 56.7 man-hours per m²⁷³ and the cost allocation was:

<table>
<thead>
<tr>
<th>Description</th>
<th>Percent Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land</td>
<td>17.3%</td>
</tr>
<tr>
<td>Tool Shed</td>
<td>1.2%</td>
</tr>
<tr>
<td>Foundation</td>
<td>3.9%</td>
</tr>
<tr>
<td>Walls and floors</td>
<td>21.3%</td>
</tr>
<tr>
<td>Door and Window frames</td>
<td>8.5%</td>
</tr>
<tr>
<td>Glass</td>
<td>0.3%</td>
</tr>
<tr>
<td>Roofing</td>
<td>13.7%</td>
</tr>
<tr>
<td>Plumbing, bathroom and electrical installation</td>
<td>15.9%</td>
</tr>
<tr>
<td>Other utilities and sewer</td>
<td>11.0%</td>
</tr>
<tr>
<td>Paint and clean-up</td>
<td>0.6%</td>
</tr>
<tr>
<td>Municipal Permits</td>
<td>6.3%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

It was precisely the labor component which made a difference. Despite the lengthy construction periods (42 months at times) which increase financing costs, they estimated that through cooperative work, savings of 38% of the total cost were possible compared to a non-profit builder and 46% compared to a for-profit organization. However, no credits were given to the advantages of moving to a better house faster such as:

better sanitary conditions, less week-ends working in construction and more time to be with the family.

As mentioned earlier, the self-aided projects described cannot be sustained without subsidies, as the cost of materials will always increase faster than the low-income household’s salaries and the collection of monthly payments is never enough due to job instability and the fact that it can well exceed the paying capacity of the people. Most

⁷³ De la Villa Miseria al Barrio Autoconstruido. Beatriz Cuenya et. al. page 245
importantly, these projects do not come even close to solving the chronic housing deficit of the country.
Appendix 10

This appendix is a compilation prepared from a report produced by the Interamerican Development Bank which we have analyzed and included in our presentation on the subject. We are grateful to the Bank for providing us with this information.

Low-Income Housing Programs in the Region

Traditional support for low-income housing projects in Latin America in the past came through international assistance, yet many projects experienced problems. For example in Costa Rica, they ended thirty-six months behind schedule and with 40% to 80% cost overruns, with households reluctant to move to the new units (despite housing shortages) because the units were considered to be low-standard. The projects also failed financially with very low recovery of costs (effective subsidy levels reached 84% of the project’s costs). In the execution of two projects in Colombia, they experienced significant modifications to the original design, time delays and cost overruns. Also, the targeted population preferring to stay closer to the sea, causing the occupation of the new developments by groups other than the original intended.

A different and positive picture has emerged recently in Latin America. Both Uruguay and Chile have done well in their housing programs, but not without difficulties, especially when trying to incorporate the private sector in the production and financing of low-income housing. Both of these programs leave most of the active role to the private sector while the government remains as a facilitator. Each has been able to accomplish the most difficult task of reaching their low-income household targets as intended, through the establishment of a transparent, need-oriented and objective system of determining beneficiaries.
As said, despite their success in that area, involving the private sector has been a problem, beneficiaries loose the drive to take part in the solution to their housing problem, developers get used to the low risk role of government contractors, and commercial banks find justifications for not entering these lower-income housing markets.

Nonetheless, both the Uruguayan and Chilean experiences have reverted many of the failures of past Latin American programs and we shall describe them in some detail for reference.

**Lessons from the Program's experience in Uruguay**

In the early 1990s, the government of Uruguay started a reform program of the housing sector. The program consolidated the institutional structure, reshaped low-income housing financing and delivery mechanisms and made progress in transferring responsibilities to the private sector.

Because of a state control on the rental housing market, the rental units have been decreasing since the 50's where almost 50% of the houses were rented to 43% in 1963, 33% in 1975, 24% in 1985 to about 20% currently. Suitable homes remain empty due to the inelasticity of supply, owners not interested in selling at the going market prices or
keeping dwellings out of the rental market\textsuperscript{74}. The little supply of rental homes available are expensive and restricted to families not protected by legislation (foreigners).

Uruguay is a very special case due to the small size of its population and housing market. According to census data, at a maximum, 30,000 new dwellings or improvements to substandard dwellings would eliminate the backlog of inadequate homes plus another 40,000 families in overcrowding conditions. Some of the households in the above categories overmatch, thus an estimate of 50,000 units is the size of Uruguay’s problem.

Previous government efforts in the housing sector were allocating substantial amounts of public money in subsidies, which not always benefited the needy sectors of the population. Subsidized interest rates by the Uruguay Mortgage Bank (‘Banco Hipotecario del Uruguay’) turned the bank’s operations into a subsidy machine favoring those who borrowed the most, mostly middle income families able to afford the relatively high-cost housing produced by the Bank (US 45,000 on average). The indexation of loans through a unit of account expressed in local currency the UR (‘unidad Reajustable’), indexed through periodic adjustments to the average wage was not able to solve the financial burden of these housing programs on the Bank.

In 1992 the Government reinstated a fund for low income housing, the National Fund for Housing and Urban Development (FNVU) financed by the proceeds of a 1\% tax on

\textsuperscript{74} Interamerican Development Bank. Strategic Planning and Operational Policy Department. Operational Policy Division, March 1995.
government salaries and pensions, and central government allocations, receiving a US 50.0 million per year or 0.4% of GNP and use of 2% of Central Government receipts. In the first year of operation the fund committed US 78.3 million of highly subsidized houses for rural families (Movement of the Eradication of Unhealthy Rural Housing).

**Limited Private sector involvement**

Private sector activities in housing are carried out by Banks and developers that cater for the demand of upper middle and high income groups (households with more than US 1,500 per month). Interest rates range between 16 and 18% for loans denominated in US dollars with amortization of five to seven years. Developers often offer direct financing of up to 36 months after completion of the project. Vacation homes have concentrated a great deal of activity of the private sector in the late 80’s and early 90’s (not only Uruguayan citizens but Argentines and Brazilians in resort areas such as Punta del Este and surroundings).

Housing production costs are very high due to construction material monopolies, taxes and social legislation raising the cost of labor, as well as compliance with land regulation, building codes and public utilities connection requirements. As a comparison with neighboring countries, the building of a government contracted basic low-income house of approximately 30m2 in full serviced lots of 100m2 were the following:

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75 Notes on the Housing sector reform in Uruguay. Interamerican Development Bank.
<table>
<thead>
<tr>
<th>Country</th>
<th>Cost of low-income 30m2 house in US</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uruguay</td>
<td>$15,000</td>
</tr>
<tr>
<td>Argentina</td>
<td>$12,000</td>
</tr>
<tr>
<td>Paraguay</td>
<td>$9,000</td>
</tr>
<tr>
<td>Chile</td>
<td>$7,000</td>
</tr>
</tbody>
</table>

It is interesting to notice that with the exception of Paraguay, the lower costs of construction has been in countries with the lowest regulation of the construction industry (although as seen later the Chilean transitional experience at low unit cost was claimed to be due to the government's direct intervention). We believe nonetheless that the opening of the economies and deregulation are key in lowering material, utility and labor costs. This is very promising as we know that Argentina has embarked in the deregulation of the construction sector.

With the creation of the Ministry of Housing, Planning and the Environment 'Ministerio de Vivienda, Ordenamiento Territorial y Medio Ambiente' (MVOTMA) in 1991 and the adoption of the 1992 Housing Plan, the Government of Uruguay initiated a significant reform of the housing sector. The main objective was to improve the efficiency and equity in the use of the government funds devoted to housing and to promote the involvement of the private sector in financing and constructing houses for all income groups.

Under the reformed system, the MVOTMA would be responsible for low income housing assuming a largely technical role and not being responsible for financial sector activities such as granting loans or setting up a mortgage portfolio. It would concentrate on families with incomes below U$S900 or less (1995 figures) that represent 60% of the families in
Uruguay. Families with incomes below U$S450 would have preference. The MVOTMA would provide subsidies to eligible families to help them buy homes produced by the private sector. The rest of the demand would be covered by private intermediary financial institutions (IFI) which would include a reformed BHU.

The Integrated Housing Access System of Uruguay (SIAV)

The ‘Sistema Integrado de Acceso a la Vivienda’ (SIAV) establishes a progressive subsidy scheme to provide low-income families access to formal housing provided by the private sector. The SIAV is complementary to private financing mechanisms that would cater to families with incomes above U$S900 per month. The SIAV covers families with incomes below U$S900 per month divided in two categories:

A. Families with incomes below U$S450 per month. Studies conducted in 1992\textsuperscript{77} showed that these families were unable to repay a mortgage-based loan. Under SIAV, eligible families had access to a basic core housing unit (‘Núcleo Básico Evolutivo) with a maximum cost of U$S15,000 in 1995. This unit consists of a core house of 30m2 with bathroom and kitchen. It can be expanded by the family through self-helped mechanisms i.e. the level of subsidy is designed to free the families from payments that may compromise their capacity to expand the NBE into a full house (adding at least additional 15m2 of construction).

\textsuperscript{77} Notes on the Housing sector reform in Uruguay. Interamerican Development Bank.
B. Families with incomes between US$450 and US$900. According to the 1992 studies, these families had difficulties to finance suitable houses, devoting up to 25% of their income to repay a mortgage-backed loan. The SIAV provides subsidies to cover the difference between the cost of the houses and the amount financed by the family with savings and a loan with repayments below 25% of their monthly income. Subsidies are handed as cash vouchers that the beneficiaries use to pay for the eligible house of their choice. Subsidy levels decrease as cost of the house and family income increases with an upper limit of eligibility. Complementary loans are provided by IFIs directly to the purchasing families. Houses are to be provided by private developers and families pay directly to the developers with resources from their savings, the subsidy voucher and the proceeds of the mortgage-backed loan.

Apart from the NBE, there are three other levels of housing SIAV subsidies. These subsidies supplement family savings allowing access to houses provided by the private sector yet engaging up to only 25% of the family income for loan repayment. The rationale for having three levels of subsidies relates to the segmentation of the demand. The existence of Type I subsidy eliminates the pressure that families in the US$451 and up income bracket would otherwise exert over the NBE program by under declaring income. Similarly, Type II subsidies help reduce the pressure that families in the US$901 and up income bracket would exert on the higher subsidy programs (Types II and I). Households with incomes above US$901 per month should have access to mortgage based loans.
provided by IFIs. Their income levels allow them to obtain loans of sufficient amount to pay for a house with monthly repayments representing less than 25% of the income.

<table>
<thead>
<tr>
<th>Income U$S/month</th>
<th>Maximum House Price U$S</th>
<th>Subsidy Type</th>
<th>%</th>
<th>Cost to Buyers U$S</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Savings Loan Other</td>
</tr>
<tr>
<td>-450</td>
<td>15,000</td>
<td>NBE</td>
<td>88</td>
<td>13,125 75 0 1800*</td>
</tr>
<tr>
<td>451-660</td>
<td>19,500</td>
<td>I</td>
<td>55</td>
<td>10,700 1,000 7,800 N/A</td>
</tr>
<tr>
<td>661-810</td>
<td>22,500</td>
<td>II</td>
<td>37</td>
<td>8,300 2,500 11,700 N/A</td>
</tr>
<tr>
<td>811-900</td>
<td>25,500</td>
<td>III</td>
<td>22</td>
<td>5,600 5,600 14,300 N/A</td>
</tr>
<tr>
<td>+900</td>
<td>N/A</td>
<td></td>
<td>0</td>
<td>8,000+ 21,200+ N/A</td>
</tr>
</tbody>
</table>

* Beneficiaries of NBE pay a monthly fee for community development up to a total of U$1,800. The funds are collected by Non-Government Organizations that return 50% to the FNVU.

Beneficiaries of the different subsidy programs are selected from a unified list of applicants according to a ranking formula which considers income, housing needs, amount and time of savings. Targeting the low-income/high-need family is ensured by the weight given to the variables. The system is transparent with lists of beneficiaries published after each assignment process is completed. The published information includes the basic data used to calculate the precedence.

**The Financial Sector in the New Housing System**

The private intermediate financial institutions (IFIs) are to provide the bulk of loans required by families to purchase their homes from private developers. These loans make up for the majority of financing for families with incomes above U$900 per month income. The IFIs also administer the savings which families put into their housing. In order to provide liquidity to a financial system that does not have long-term savings
instruments, the resources are provided by Bank Loans available to the Central Bank to partially re-discount mortgage-backed loans made by the IFIs. Resources are also available for IFIs to partially re-discount midterm loans made to developers to finance the production of houses to supply the system. The creation of a secondary market for mortgage-backed securities is contemplated among the reforms but its implementation is still pending.

Developers and Construction Companies

These are supposed to provide housing demanded by the beneficiaries of SIAV's subsidies Type I, II and III. The effective demand created by the subsidies, expand the market for developers who should find it profitable to supply it, as they could now supply the demand of not only households with incomes above U$S15,000 but also households with incomes above U$S451 a month. According to figures from 1991, this would expand the market from 20% of the households to almost 60%. To capture this market, developers would have to expand the range of houses they supply to include houses with prices within the eligible limits to qualify for subsidies, which is with market prices of up to U$S19,550; U$S22,500 and U$S25,500.

Results
At the time the housing reform went into practice, it was agreed that the commitments that the MVOTMA acquired in the use of the FNVU (government fund reinstated in 1992 as explained earlier) would be honored and thus resources were laid aside. The initial estimates suggested a requirement of U$S78.3 million to finance about 5,500 housing units in three years. By early 1995 the program had committed resources to finance 8,000 houses with an estimated cost of U$S136.9 million, almost twice as much as originally agreed with the Bank.

Originally, the design of the SIAV was that the NBEs, financed with the Bank loan, would have been contracted on a “turn key” basis by the MVOTMA as a preliminary phase for then turning the NBE program into a full cash voucher operation involving private developers producing the NBEs and selling them through the housing market. Private contractors considered too risky to engage in turn key contracts given the bureaucratic barriers to obtain planning permits and utility connections. It was also argued that the cost of financing while constructing the NBEs would increase costs unnecessarily. As a transitional measure it was agreed with the Bank that the MVOTMA will contract NBEs with private contractors and assign them directly to qualified applicants.

As the IFIs are gearing up to enter the system, the BHU assumed the responsibility of financing the loans required by SIAV beneficiaries to complete the market cost of the houses. This commitment induced households to open their savings accounts required by
SIAV in the BHU although they could use any bank. Thus full involvement of IFIs is still forthcoming and the housing system still relies entirely on the BHU to operate.

Uruguay was able to introduce many reforms in a very short period, setting up the low income component of the Integrated Housing Access System while the private supply of housing and private financial support of its beneficiaries is still lagging.

In sixteen months the Government has conducted three calls to register applicants and has completed three rounds of subsidy allocations. It is worth noting that the ratio of beneficiaries to applicants is very low for most programs which indicates that subsidies are reaching a significant proportion of the qualified families, a factor which contributes to create confidence in the system. The system for the selection of applicants with greatest housing needs as measured by socioeconomic scores has worked. The Master Socioeconomic Record ('Ficha Socioeconómica Unica) or FSU measures in a scale of 0 to 100 the level of unsatisfied basic needs of the families. The larger the need, the lower the FSU score. The FSU incorporates family composition (35% of the weight), subsistence capacity -education attainment, employment status- (25% of the weight) and existing housing conditions (40% of the weight). The largest percentage of selected beneficiaries in all programs concentrates in the lower scores of the FSU. Only a small fraction of the beneficiaries have high FSU scores, another indication that the formula used to select beneficiaries seems to filter families in need quite efficiently. On the other hand, the results of the use of cash vouchers issued so far suggest that the system may be
over-subsidizing certain beneficiaries. An analysis of over 700 loans issued by the BHU to complement the vouchers, show that the debt services are well below the target 25% of family income. This is the result of higher than expected levels of savings in families eager to obtain subsidies. Debt service/ income rations of approved loans represent 11% to 15% of household’s incomes while savings reach between 110% and 150% of the minimum required.\textsuperscript{78}

The Lagging Private Financing Sector

As mentioned, the Uruguay low-income housing system program is being financed solely through the BHU. Private financing Institutions have not participated or used the Central Bank’s rediscount facilities. There are several reasons for this. One is the lack of information. Many IFIs are not aware of the new possibilities available to them. However, foreign banks which do not have problems with funding as they could use their headquarters for that purposes (as long as mortgages were denominated in U$$S dollars) indicate that the rediscount facility would not make much difference to them. The critical factor remains the credit risk of households benefiting from the SIAV. For Savings and Loan Cooperatives, the rediscount facilities will make a big difference in their entrance into the mortgage market as they finance their operations with short-term deposits and will now benefit from long-term financing. IFIs continue to serve their traditional high income households. Although SIAV subsidies are considered a facilitator as they reduce the

\textsuperscript{78} The BHU charges a 7% interest rate in loans denominated in U$$s. This rate is below the interest rate charged by commercial banks that range between 16% and 18% in U$$S dollars. Interamerican Development Bank report.
debt/equity ratio of households, which in turn seems to be enhanced by the higher than
expected savings capacity shown by households, it is not clear whether the IFIs will
embrace SIAV. Their response will depend in part on the private sector confidence in the
long-term sustainability of the SIAV.

To date significant resources have been pumped into the housing system. The SIAV has
awarded subsidies for NBEs and issued vouchers for U$S100 million. Further these are
complemented by the savings of beneficiaries and loans provided by IFIs (in a lesser
proportion). Considering all sources approximately U$S130 million have been injected on
top of the U$S140 million of the transitional program.

Competitive and dynamic housing markets solve the complex problem of allocating the
diverse array of housing units in stock to an heterogeneous collection of households quite
effectively. In this way, prices, rents, vacancies are determined and the construction and
rehabilitation of units are stimulated. The reaction of the market in Uruguay to the
changes introduced have been less efficient on several accounts. The usual lag in supply
responding to demand has been more severe in Uruguay in all the housing sub-markets
affected by SIAV. There were delays experienced by the MVOTMA in contracting the
NBEs financed by the Bank loan whose deliveries were programmed for mid 1994. By
early 1995 a total of only 5,700 NBEs were under construction. Further the majority of
the NBEs contracted were in cities of the interior (80%) while most of the demand is in
the Capital of Montevideo. Contractors were generally satisfied that they could construct
a NBE at a profit within the budgets allocated (1,000 UR or U$S15,000) in all cities of the interior. This is because land costs and public services habilitation delays prevent them from providing NBEs at those prices in Montevideo.

Most recently the MVOTMA has started to use part of the funds from the Bank originally earmarked for the construction of NBEs to issue vouchers in order to ameliorate the problems of delays in contracting the NBEs and the inability to provide them in Montevideo. The 1,750 vouchers issued represent 18% of the resources available, allowing beneficiaries to get eligible housing from the stock or build New ones in their own land. Eligible houses need to be certified by the MVOTMA and their market value should not exceed U$S15,000. Initial reports from the interior show that beneficiaries there have been successful in buying houses from the stock with cash vouchers. The same reports indicate the willingness of homeowners to make the necessary repairs in order to qualify the houses for the SIAV. If this is the case, the issuing of vouchers by the NBE programs not only is speeding up the allocation of subsidies and untangling the disbursement of funds, but also having a positive effect on a more efficient allocation of the housing stock and on its conservation. There is also evidence that prices in the low-income sub-market have increased, prompted by the availability of NEB vouchers. Many eligible houses, which were previously empty or under-utilized, entered the market because of the demand created by the vouchers, at prices equal or very close to the value of the vouchers.
In the higher brackets (SIAV subsidy vouchers Types I, II, and III), most beneficiaries use vouchers to buy qualifying houses from stock. Price increases up to 30% have occurred in the housing sub-markets containing eligible units, the result of short-term inelasticity in the supply of houses. Mid-term increases in the supply will depend on the developer’s confidence on the long-term strength of a demand that is highly dependent on government subsidies to access the housing market.

**The Future of the System in Uruguay**

There are many significant tasks still to be accomplished. The most significant is the privatization of housing production and financing for the SIAV beneficiaries. The reformed housing system requires time and stability in the messages sent to the marketplace in order to encourage private developers to participate in the different sub-housing programs. Removal of the bureaucratic red tape for project approval and final registration (that delay final home sales) is required, as for most developers the financial costs associated with such delays, prevent their entry into these sub-markets. The process of issuing subdivision and building permits needs to be streamlined to reduce uncertainties and delays for developers which increase prices to consumers. Further, rigid land use and urbanization standards reduce the capacity of producers to adapt to changing demands and financing capacities in the markets. Public utilities are also factors that discourage investors to enter the middle and low income housing sub-markets. High connection costs and approval delays increase costs and uncertainties as well. Utility companies must streamline their procedures to expedite final connections. It is not uncommon at present
that approved projects take over 18 months to obtain the final reception from the local Municipalities ("Intendencias") and utility companies.

A more detailed analysis of the different sub-markets is required to fine-tune housing policy and the potential role of the rental market must be taken into consideration to devise efficient policies for this sector. Maintenance of the large stock of houses in Uruguay is an important consideration, thus an assessment of the existing policies (taxes, rent controls etc.) on the conservation of the stock is required to improve housing sector policies.

As mentioned, the Uruguay case is unique, given its characteristics of having a large pool of housing stock in relation to its housing deficit. Given this, there are some drawbacks in the allocation efficiency of the funds made available by the Government through the FNVU (National Fund for Housing and Urban Development). The relatively small demand for new low-cost housing reduces the scope for using the resources to subsidize new homes for the needy. This creates the risk of maintaining the subsidy schemes beyond their economic efficiency, just to use the resources allocated to the Fund. The existence of a large stock of houses relative to the size of the population indicates that a fairly large proportion of the subsidies may be spent in purchasing existing houses. At present, new homes are not entering the market fast enough in the low-income segment which is causing their prices to rise. Providing larger subsidies than required (in the likely case of an overfunded program) will increase the selling prices of houses even further without
added benefits to households. As the size of the housing problem reduces, the resources of the Fund should be used for other purposes like promoting the upgrading of substandard settlements and the setting up of mechanisms for financing home improvements and maintenance.

The reform of the regulatory environment for housing production is necessary not only to reduce uncertainty and costs but will signal the Government's commitment to pursue a role as facilitator and of supporting private enterprises. The deregulation of the rental market will also provide options for households incapable of affording self-ownership or not willing to buy, or for households undergoing family cycle-transitions or relocating as a result of job transfers. Efficient rental markets also provide investment venues for deploying long-term savings, particularly of institutional investors. Consistent government signals are also required to generate the necessary confidence in the private developers sector in order for them to enter the SIAV market. Private banks may have the perception that these markets are too risky. In this respect, IFIs in Uruguay are facing the classical problem of reluctance to be the first in an uncertain market⁷⁹. Here again the government has to play a role to reduce this uncertainty.

Lessons from the Chilean Experience

A different picture to the traditional Latin American experience has been emerging in Chile, as a result of consistent housing policies with forty years of government commitment to public investing in the housing sector. In a context of sustained macroeconomics stability, reasonable economic growth and strengthening financial markets, the Chilean Housing sector as of 1992, produces more new houses than the estimated increase in new families and the replacement needs from stock obsolescence.\(^{80}\)

As of 1992, 3.78 million households existed in Chile and occupied 3.10 million houses. Of this total 200,000 dwellings required replacement and low-income families made most of the 800,000 households facing inadequate housing.\(^{81}\)

The low income of the poorest sectors of the economy prevented them to access the supply of housing by the private developers, construction firms, and commercial banking system. Positive interest rates and the indexing of mortgage payments to a unit of account, the “Unidad de Fomento” (UF) have aided in the development of a private mortgage financing system in Chile. However this does not benefit low-income families who cannot meet payments or are reluctant to take indexed payment commitments on the strength of their wages which not always move according with the UF. As in most Latin American markets, Chilean real estate developers and private banks offer houses and financing mainly to upper income families. Between 1973 and 1990 the private formal mechanisms

\(^{80}\) Notes on the Housing sector of Chile. Interamerican Development Bank.
for home construction and financing in Chile accounted for just over 10% of the houses built in the country.

Since its inception in 1983, annual program targets have been set according to the available resources coming from the central government’s budget. The government had expressed its commitment to cover all substandard settlements in the country by 1999 which is feasible since there is no significant growth of substandard settlements in Chile as a result of the program’s efforts and strict implementation of land development controls. The program has proven to be sustainable thanks to the commitment of the government in supplying the necessary resources, as the cost recovery plans have not been met by the Municipalities. Over 130,000 low-income family households living in settlements lacking one or more basic sanitation services have benefited, as the program also targets the development of supply of potable water, sewerage, drainage, electricity and access roads. Good targeting in low-income households has provided significant social benefits, dramatic reductions in infant mortality and incidence of water borne decease.

The participation in the last 5 years of the private sector increased according to the growth in the economy and increases in family income. Recent estimates suggest that the private sector may be responsible for over 30% of the additions to the housing stock.\(^{82}\)

As in most cases in Latin America, the housing rental market was discouraged in the past by rent controls and was not significant. Government intervention, while intending to protect tenants undermined the real value of rentals and reduced the flexibility in the market. The regulations were abolished in 1982 but because the Chileans prefer home ownership, a trend promoted by the government as it only provides support for owner-occupied houses, private investors became less interested in providing rental housing. About 63% of houses in Chile are owner-occupied, 17% are rented and the remaining 20% is under other forms of tenure, mainly beneficial use.

**Government Intervention**

The constraints facing the low-income housing sector prompted the Chilean government to intervene. Over the years, governments of different political orientation tried different policies including:

A. direct construction of houses for specific groups (1950-1960)

B. establishment of savings and loan institutions to cater to middle income households complemented with government produced houses for low-income groups (1960-1970) and;

C. launching of massive public housing programs aimed at providing every family a house (1970-1973).
These attempts have proven to be unsustainable in the long-run and have shown very little successes. However, it pinpoints to the long-term support of the Chilean government to the housing problem.

In the five year period of 1989-1993 expenditures by the government in housing represented 8.7% of the total expenditures in social sectors and 1.3% of GNP. In 1993 the it spent a total of U$S480 million in housing programs\textsuperscript{83}. This commitment has provided Chile with a strong institutional structure lead by the Ministry of Housing and Urban Planning “Ministerio de Vivienda y Urbanismo” (MINVU) and having many cooperatives and non-government organizations devoted to help low-income families in solving their housing problem, as a reaction to the past failures of both the market and the government.

In 1977 the government undertook a thorough reform of the housing sector based on neo-liberal ideas used to reform other sectors of the economy. Housing production and financing were left to the private sector with the government helping the process. However the historic difficulties encountered by the low-income segments of the population i.e. their insufficient purchasing power capacity were still present. The State was to help them supplement their purchasing power with up-front subsidies. Government resources were allocated only to low-income households to supplement their savings and borrowing capacity. Complementary financing was to be provided by private banks with

their own resources. The transition period from the old system to the new conditions required initial deviation from the original plans and because of the lack of interest of private developers to enter this sub-market, the government was forced to take an active role contracting for the production of low-cost housing and assign them to the beneficiaries. Supplementary loans from the government were necessary also as the private banks lacked interest in lending them.

Over the years and through trial and error, a three-tier housing system developed. It includes:

A. private mortgage financing that allows upper middle and high income families to buy houses produced by private developers. Currently commercial banks finance housing loans through mortgage backed securities issued by the banks. These are often sold in the secondary market backed by the financial strength of the issuing bank. Only recently new forms of securitization of mortgages are being explored as is the possibility of introducing leasing for housing.

B. a mixed system, which uses cash vouchers issued by the government: United Subsidies Program (USP), where the beneficiaries can only purchase a house from existing stock after one year of voucher issue; the Special Workers Program (SWP), providing direct subsidies to organized groups with large savings capacity or with assistance from other sources (firms, non-government organizations, etc.); the Rural Housing Subsidy, helping rural households improve their housing conditions; and the Urban Renewal
Program, promoting the renewal of deteriorated dwellings in pre-determined inner-city areas. Vouchers are supplemented by loans supplied by local banks, that assist middle and low middle income families to finance houses also produced by developers. The use of cash vouchers to purchase new homes is associated with the objective to boost the construction industry, and;

C. government contracted houses distributed with heavy subsidies to low income families, including the Basic House Program (BH) which provides finished houses of 42m2 on average with an average cost of U$S6,500; Progressive Housing Program (PH) which provides beneficiaries with a full serviced housing lot and a core house of approximately 14m2 and average cost of U$S4,000 -the core house allowing the families to settle while they expand it into a full house. The government contracts both BH and PH housing with private construction firms and distributes them to the beneficiaries.

For many years the government based its support for low-income families on the Basic Housing Program (BH). It had difficulties in reaching the very low income levels. These households were unable to comply with the savings criteria of eligibility and to service the loans involved in financing the Basic Housing. This led the government to introduce the Progressive Housing Program, assisted by a Bank loan, that provided lower standard dwellings but required less up-front savings and no loan repayment obligations. The program frees beneficiaries of financial obligations after settling on the housing solution provided so they could devote their savings to expand and consolidate the houses. The
Progressive Housing System effectively extended the range of housing services provided by the government to reach the very poor sectors which were doubling-up with other households.

The Chilean Housing System\(^{84}\) can be seen in the following table:

<table>
<thead>
<tr>
<th>Income U$S/month</th>
<th>Type</th>
<th>U$S</th>
<th>%</th>
<th>Savings</th>
<th>Loan</th>
<th>U$S</th>
<th>House Price U$S</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 85</td>
<td>Progressive Housing</td>
<td>3,700</td>
<td>93</td>
<td>250</td>
<td>N/A</td>
<td>3,950</td>
<td></td>
</tr>
<tr>
<td>86-220</td>
<td>Basic Housing</td>
<td>3,950</td>
<td>61</td>
<td>310</td>
<td>2,190</td>
<td>6,450</td>
<td></td>
</tr>
<tr>
<td>221-419</td>
<td>Workers Program</td>
<td>2,520</td>
<td>27.2</td>
<td>1,120</td>
<td>5,610</td>
<td>9,250</td>
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<tr>
<td>221-419</td>
<td>Subsidy Certificate I</td>
<td>3,640</td>
<td>26.0</td>
<td>1,400</td>
<td>8,960</td>
<td>14,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3,360</td>
<td>24.0</td>
<td></td>
<td>9,240</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3,080</td>
<td>22.0</td>
<td></td>
<td>9,520</td>
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<tr>
<td>420-900</td>
<td>Subsidy Certificate II</td>
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<td>11.0</td>
<td>2,800</td>
<td>22,120</td>
<td>28,000</td>
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<tr>
<td></td>
<td></td>
<td>2,800</td>
<td>10.0</td>
<td></td>
<td>22,400</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2,520</td>
<td>9.0</td>
<td></td>
<td>22,680</td>
<td></td>
<td></td>
</tr>
<tr>
<td>361-1,680</td>
<td>Subsidy Certificate III</td>
<td>2,520</td>
<td>6.0</td>
<td>4,200</td>
<td>35,280</td>
<td>42,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2,240</td>
<td>5.4</td>
<td></td>
<td>35,560</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,960</td>
<td>4.7</td>
<td></td>
<td>35,840</td>
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<tr>
<td>N/A</td>
<td>Rural Subsidy</td>
<td>4,200</td>
<td>37.5</td>
<td>Land</td>
<td>7,000</td>
<td>11,200</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3,640</td>
<td>32.5</td>
<td></td>
<td>7,560</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3,080</td>
<td>27.5</td>
<td></td>
<td>8,120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>420-1,680</td>
<td>Urban Renewal</td>
<td>5,600</td>
<td>13.3</td>
<td>1,400</td>
<td>35,000</td>
<td>42,000</td>
<td></td>
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<td></td>
<td>5,320</td>
<td>12.7</td>
<td>2,800</td>
<td>33,880</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5,040</td>
<td>12.0</td>
<td>4,200</td>
<td>32,760</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As seen above, the voucher system is progressive and thus achieves vertical equity by providing larger subsidies the lower the cost of houses. The number of subsidies granted each year varies. The smaller the subsidy requested at registration, the higher probability of obtaining it. This feature is intended to force household savings into housing by encouraging application for the smallest possible subsidy in each range, thus maximizing household contribution per unit of housing financed and increasing their commitment to

\(^{84}\) Notes on the Housing sector of Chile. Interamerican Development Bank.
the repayment for those in the higher income levels, who can access mortgage backed
loans. The Subsidy Certificate Program assigns beneficiaries cash vouchers that they can
apply to purchase privately produced houses that comply with minimum standards and
maximum prices requirements set by MINVU.

Chilean Access System to Subsidized Programs

To enter the subsidized programs, households must demonstrate housing needs and
income through a Social-Stratification-Survey (‘Ficha CAS’) and complete a savings plan
for the amount required by each program (see table above). Very important to the success
of any such program, a transparent procedure guides the assignment of the subsidies, with
a national list of applicants and a formula-based scoring mechanism.

The government supplies houses directly to families with incomes below U$S220 through
the so called ‘Public Stream’ of the Basic Housing (BH) and Progressive Housing (PH)
Programs. In this way, MINVU assigns the houses directly to the beneficiaries selected
from the national list of applicants. The PH Program also allows applicants to apply as
organized groups. The groups often supply the land and contract the houses with the
resources of the ‘Private Stream’ subsidy. This program has lower savings requirement
than the Basic Housing and does not require beneficiaries to make payments after the lot is
assigned so that beneficiaries can use their future savings in the consolidation of a full
house. The Special Workers Program is also a group oriented system where they can
apply for subsidies. Under this modality, subsidies are not assigned from the national
application lists but directly through the Regional Offices of MINVU using pre-defined budgetary allocations.

The demand for the Basic Housing and Progressive Programs has been significant as observed in the table below:

<table>
<thead>
<tr>
<th>Program</th>
<th>Registered</th>
<th>Applicants</th>
<th>Beneficiaries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Progressive Housing “public”</td>
<td>24,000</td>
<td>13,400</td>
<td>5,700</td>
</tr>
<tr>
<td>Progressive Housing “private”</td>
<td>4,700</td>
<td>2,700</td>
<td>700</td>
</tr>
<tr>
<td>Basic Housing</td>
<td>365,000</td>
<td>136,000</td>
<td>22,300</td>
</tr>
</tbody>
</table>

The chances of accessing a housing solution through the Progressive Program were better in 1993. There were 2.4 applicants for each beneficiary in the public mode and 3.9 in the private mode compared with 6.0 applicants for each beneficiary in the Basic Housing Program. This may have been the result of lack of applicants due to the novelty of the program introduced only two years earlier that is still not well known by the public. The Progressive Housing Program should attract part of the 365,000 households presently registered in the Basic Housing Program that cannot comply with the savings and loan requirement conditions of the latter.

Current Government Participation

Due to the lack of interest by private banks to enter the low-income lending, the government opted to provide complementary loans to beneficiaries of the Basic Housing Program through the Ministry of Housing. The U$S2,200 loan is amortized in 12 years with a preferential rate of 7% per year (real commercial rates for 12 year mortgages were
around 18%)\(^\text{85}\). This has caused many problems. Despite many re-negotiations the over 3 months in arrears loans are 60% of the total portfolio and these high arrears have remained even after the government contracted-out the collection of payments. It is suggested that the problem is not related to the capacity of households to repay but due to lack of discipline of the system. There is a general feeling among beneficiaries that one does not need to pay back a government loan. This impression is further enhanced by the reluctance of the government to evict beneficiaries in arrears, fearing the political backlash and the many re-negotiations of the loans in arrears made in the past. This turns the loans into "defacto" subsidies for those that default, a subsidy that is added to the already high subsidy for this program in detriment of the tax-payer and those beneficiaries trying to comply with its repayment.

The Chilean Housing System is benefiting from the stable macroeconomics environment and the rapidly developing financing sector. This has allowed for the consolidation of mortgage based mechanisms administered by private banks and increasingly financed by institutional capital. This economic growth has allowed the government to sustain the heavy burden which its subsidy programs represent. Public housing expenditures comprise 1.3% of GNP or 8.7% of total public expenditures in social matters\(^\text{86}\). A very positive result has been the expanding purchasing power of households, given the economic expansion, which allows them to get market-provided housing services and products.

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\(^{85}\) Notes on the Housing sector of Chile. Interamerican Development Bank.

The system is currently providing over 110,000 new houses per year and during the last five, the number of dwellings produced is more than the estimated numbers of new families created every year (80,000) and the replacement of homes (20,000). By sustaining this level of production, the Chilean Housing System is currently able to provide formal housing to a part of the estimated 800,000 families currently living in substandard dwellings (660,000) or being forced to double up with other families (220,000).  

One of the biggest successes of the system has been the increase in savings. They currently amount to more than U$S350 million in over 800,000 individual savings accounts managed by private banks. This is partly due to economic growth as well as good targeting, given the eligibility criteria discussed earlier. Registered Households (those that demonstrate their housing needs through the unified evaluation record -"Ficha CAS") must comply with a minimum savings plan for at least two years and reach the amounts corresponding to each program, in order to become "Applicants". Applicants remain in a unified list until selected for one of the programs, at which time they become "Beneficiaries" of it. Selection is based on a precedence list defined on the basis of the points obtained by applicants with a formula that weights housing needs, savings, and time in the system. As economic growth continues, savings will also increase whereas the government subsidy needs should diminish. The Savings system has transformed the traditional Latin American picture of lower-income population pressuring the political system for public housing, into a disciplined system of savings in order to have access to

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87 Notes on the Housing sector of Chile. Interamerican Development Bank.
housing. This was made possible due to the transparency and effectiveness achieved by the Chilean Programs. Currently, communities rely on MINVU for the solution to their housing problems and have abandoned land invasions and other informal means of access to land that were common in the 60’s and 70’s. On a less positive note, the system has increased the reliance of low-income families in solutions provided or assisted by the State, limiting their willingness to engage in self-help or community based housing solutions.\textsuperscript{88}

In contrast with its neo-liberal origins, the Chilean housing system is far from being driven by the private sector with the State acting as a facilitator. As it stands today, the system represents a pragmatic application of the original principles. The State’s presence throughout the system is pervasive. Several mechanisms implanted to ensure efficiency in the attainment of quantitative goals affect the efficient allocation of resources and generate inflexibility that reduces the system’s ability to satisfy the needs of the population.

In the original design, the system was to be demand-driven, with the government acting as regulator and to assist the low-income families to gain access to the houses produced by the private sector by supplementing their indebtedness with direct subsidies. In this way the State supports the demand for houses supplied by developers who are then responsible for the different stages of construction and marketing of the houses. Beneficiaries of the subsidies search freely for houses in the private market and apply their vouchers to the

\textsuperscript{88} Notes on the Housing sector of Chile. Interamerican Development Bank.
payment of the house. Houses must comply with minimum amenities and maximum prices requisites in order to qualify, benchmarks set by MINVU. In spite of the demand oriented rhetoric of the system’s design and the visible role assigned to private developers, the system to date is mostly supply-driven and highly intervened by the State. Introduced during the recession years of the late 70’s, official subsidy schemes are oriented to support the demand of houses produced by the formal construction industry by imposing restrictions to the use of vouchers to buy houses from the stock. Given the requirements and characteristics of houses imposed by government, private developers only produce the eligible types of houses and consumers are left with little choice but to fit their aspirations to what is being offered. This problem is particularly acute in the BH and PH programs. Low-income housing demand created by the government failed to attract private developers and to attract banks to provide complementary loans. Due to the resulting low profits by developers in the BH and PH programs, developers concentrate on the higher unit value markets created by the Special Workers Program, the Subsidy Certificate and Urban Renewal Programs. In response, the government had to resort to directly contract Basic and Progressive Houses to supply the demand created by its programs and assigns them in the traditional government-run system of housing supply for low-income households. Further, MINVU provides beneficiaries with the loans they require to complete the financing of the Basic Housing dwellings. Private banks justify their reluctance to support low-cost housing programs on the grounds that low-income

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89 Notes on the Housing sector of Chile. Interamerican Development Bank.
households represent a high credit risk. Not only may they default on the loans in mass but also evictions represent political costs that the banks cannot afford to face.

Considering the houses directly produced by the government (43%) and those purchased with subsidies (25%), the government is directly or indirectly responsible for over two thirds of the system’s output.

Political pressure to attain quantitative targets contribute to the system’s rigidity focusing on the supply side of the equation. This has prompted MINVU to focus on the efficiency in the use of resources, as it claims that through direct contracting and paying builders during project execution, it allows it to produce Basic Housing for an average of U$S6,500 (U$S155 per m2) one of the lowest in Latin America. Standardized housing types are reproduced endlessly and assigned to all types of families regardless of their needs or preferences. This drawback lead to two types of resource miss-allocation. On the one hand, households often receive either less or more housing than they need. On the other, the rigid financing structure based on one price for the one type of house, prevents the system from adjusting household repayments proportionally to their income. As a result, the system is incapable from tapping into all the resources that potentially would have been devoted to housing by the beneficiaries, i.e. beneficiaries systematically report house expenditures of up to 50% less in the Basic Housing program than what they paid
before while renting\textsuperscript{90}. Everything is made even worse by the incapacity of the system to enforce repayment of government loans.

The option to devote the subsidies with preference for buying new houses introduces a further rigidity to the system. Lack of financing hurts the market for existing low-cost homes and prevents the fluid transfer of houses that contribute to the rational allocation of the stock. Further, the long tradition of government support for home ownership, coupled with the many years of rent control (removed in 1979), has discouraged the growth of the rental market crippling another mechanism to efficiently allocate the housing stock and allow the mobility of labor in the economy. MINVU regulations prevent beneficiaries of the Basic and Progressive Programs to rent or sell subsidized houses during the first five years. However, there are references of unauthorized rentals and transfers occurring, which demonstrates a market need for these transactions.

The Ministry of Housing and Urban Development (MINVU) sought two conflictive goals with the reformed housing delivery system: to expand housing production and to reduce the Ministry’s bureaucracy. The original design of the reformed system was consistent with these goals. Production and marketing of houses were to be left to the private sector and consumers were to be expected to care for the quality of the product and competence among producers to improve quality over time. The actual implementation of the reform prevented the attainment of both goals simultaneously. Quality has suffered because when

\textsuperscript{90} Notes on the Housing sector of Chile. Interamerican Development Bank.
the private sector did not respond, the government direct contracting burdened the Ministry. Regional offices of MINVU regularly report difficulties in supervising contracts due to lack of personnel. As a result the government cannot guarantee the quality of the houses with the result that many beneficiaries find poor quality materials and craftsmanship and often make significant repairs and replace faulty components. The Subsidy Certificate market is also subject to quality problems. Price eligibility limitations push developers to reduce costs, a goal often achieved at the expense of quality which due to the complexity of a product such as housing is not immediately obvious to purchasers. Supervision by Municipalities and utilities are only limited to specific connections or to compliance with land use regulations and building codes affecting the soundness of the structure. This problem is exacerbated by the common practice among developers to form specific limited liability companies for the specific purpose of the development which are dismantled upon completion of the project. This obviously limits any purchaser's compensation to claims.91.

The strict bracketing of price and minimum standards developed by MINVU to contract for BHs and PHs led construction companies to develop model homes that maximize profits and that are used for all contracts. This has inhibited innovation with endless repetition of the same models. This has started to change through the possibility offered to organized groups applying for subsidies. It allows them to purchase land and apply the subsidies to comply with savings requirements. It provides also with the opportunity for

91 Notes on the Housing sector of Chile. Interamerican Development Bank.
beneficiaries to influence the solution they receive from contractors. Further, the more active role played by the beneficiaries in the construction process also eases the establishment of community organizations in the new neighborhoods. Over the years community based PH has become very popular and it represents an increasing proportion of the total houses built every year. Pressure for community involvement is mounting, inducing MINVY to consider allowing organized communities to apply as a group to the BH subsidies as in the PH program and to allow participants to choose between a house in a MINVU-contracted subdivision or a cash voucher to buy a house elsewhere either new or from the existing stock.

Urban Impact

The quantitative success of the Chilean housing system has exacerbated one of its major shortcomings, its lack of concern for urban impacts. There is an overriding focus in the government to give priority to the number of houses built with the resources available over the quality of the urban solutions. This has led to significant loss of agricultural areas and to the creation of large low-income neighborhoods without basic urban amenities.

The success of the housing program was based, among other things, on the availability of land, product of the relaxation of land use regulations in the late 1970’s. Companies bought large tracts of agricultural land surrounding major cities. These were then subdivided to cater to the demand created by the government programs. Construction companies holding serviceable land won government contracts for the production of Basic
Housing and used the lands with the best amenities for the market opened by the cash voucher subsidies (non-BH). Profit maximization in front of fixed maximum prices led to cost minimization in production. Low density housing schemes were preferred by developers due to lower construction costs of one or two story houses. World Bank/Habitat Housing Indicators show that in Santiago, the median land price of a developed lot at the urban fringe and the median price of undeveloped raw land are at an average ratio of 2.6 comparable with the most efficient cases. At the same time, the ratio of land prices of unserviced land with and without planning permission is 0.8. Planning permits do not delay development, taking only 3 months.

The Chilean housing policy is facing a growing constraint in the shortage of land. The rapid exhaustion of serviced land in the periphery of the large cities was exacerbated by the lack of investment in trunk infrastructure during the years of economic crisis 1979-1989. Infrastructure investments are recuperating but not fast enough. The concentration of good agricultural land makes the problem very acute. Estimates indicate that in the four decades of rapid urban expansion 1950-1990, the expansion of Santiago consumed approximately 10% of all agricultural land class I existing in the country\textsuperscript{92}. Currently developers in the Santiago area report that the cost of raw land represents the equivalent of 20% to 25% of the final cost of the basic housings, in circumstances where for them to sustain a profit of 11%, the cost of land should not exceed over 8% of total project cost.

The Chilean Housing Policy does not promote enough the renewal of the inner-cities. The current system seems insufficient to promote significant urban renewal. Land legislation does not contain provisions for the government to help in the renewal process. As a result, the bulk of the urban development is taking place in the periphery of the cities, leaving large portions of the central part of the cities underutilized.

Particularly in large cities, BH and PH projects are clustered creating large neighborhoods with households that have similar low-income levels. This low level of income prevents the development of privately provided urban services (education, health and recreation). The public sector has only partially responded to this demand. Housing projects include minimal community facilities, a meeting place and a small playground. Municipalities expand the primary education and health infrastructure with grants from the central government but not always are able to provide for the operation and maintenance of the facilities. One of the main reasons is that the projects implanted in their Municipal land, are exempted from land taxes, the most important source of revenue they have. Further the central government who contracts the BH and PH housing does not contribute in the costs of operation and maintenance. The privately run transportation system usually reacts fast to the demand created by new neighborhoods. The low fares charged allow low-income families access to the system but forces operators to extend their routes to generate sufficient revenue which in turn extends the travel time for the population living in the periphery. Average journey to work in Santiago is over 50 minutes consuming workers almost 2 hours daily.
In the future the government will face further challenges, taking greater care in investment, operation and maintenance of education, health and recreation infrastructure.

**Reaching Low-Income Households**

From its inception the reformed housing programs concerned themselves with the targeting of low-income segments, a departure from previous systems where upper-middle income segments were receiving most of the government subsidies (as interest rates subsidies and loan defaults)\(^{93}\). As we have seen earlier, this has worked rather well. Concern for targeting the subsidies overshadow the need to carefully calculate the amount of subsidies. The evidence points that subsidy levels may be high for beneficiaries in the higher income brackets and that they can be reduced without affecting demand in the corresponding housing sub-markets. Over the years the programs were refined to reduce the range of families able to apply for subsidies. The purpose is to focus expenditures on the lowest decals of the income distribution structure. Also, subsidies for the higher income families have been reduced to devote more resources to low-income groups. The PH program intends to reach families in the lower income deciles that were systematically left out of the Basic House Program, given their lack of savings capacity to contract the loan required by this program. Appropriate targeting and the number of houses produced are the towering accomplishments of the Chilean Housing System. A recent study of the income of a sample of beneficiaries provides evidence of the targeting of the low-cost

housing programs. Over 90% of beneficiaries of the BH and PH programs were found in the bottom quintile of the income distribution. The study also underscores the difficulties encountered by the formal housing programs to reach households at the very bottom of the scale. Only 31% of the beneficiaries of the BH program and 39% of the Progressive Housing Program were in the bottom decile of the income distribution\textsuperscript{94}. The consensus opinion about the problems affecting the lowest segments of the population point to the fact that housing alone is not the only deficiency they face. They require comprehensive programs including nutrition, employment and education.

Despite some shortcomings, the Chilean system has been remarkable in reaching the target population with all its programs. The table below shows the Targeting of the Progressive and Basic Housing Programs in \%\textsuperscript{95}.

\begin{table}[h]
\centering
\begin{tabular}{lccccc}
\hline
Criteria & Factor &  & \textbf{Progressive Housing} &  & \textbf{Basic Housing} \\
 &  &  & Applicants & Beneficiaries & Applicants & Beneficiaries \\
Income & (a) Indigent &  & 55.8\% & 47.5\% & 56.1\% & 52.8\% \\
 & (b) Poor &  & 31.0\% & 35.0\% & 28.3\% & 26.2\% \\
 & Low-income (a) + (b) &  & 86.8\% & 82.5\% & 84.4\% & 79.0\% \\
 & No low-income &  & 13.2\% & 17.6\% & 15.6\% & 21.0\% \\
Housing Situation & Without Potable Water &  & 55.9\% & 66.7\% & 44.3\% & 60.1\% \\
 & Without Sewerage &  & 57.6\% & 72.7\% & 44.8\% & 62.8\% \\
 & Without Electricity &  & 18.1\% & 15.0\% & 9.5\% & 13.4\% \\
 & Poor Roofing &  & 59.5\% & 54.2\% & 43.8\% & 54.2\% \\
 & Poor Flooring &  & 45.7\% & 39.1\% & 38.7\% & 39.5\% \\
 & Poor Walls &  & 71.0\% & 65.5\% & 58.9\% & 69.1\% \\
\hline
\end{tabular}
\end{table}


\textsuperscript{95} Ministry of Housing and Urban Planning. Program Targeting Study. Santiago, Chile 1995.
One of the effects on such reliance to meet targeting results in the failure of the mixed financing system in the most massive program, the Basic Housing. The loan portfolio emerging from the lending made directly by MINVU has such high arrears (60%) and such resiliency to improve that it can only be described as a financial failure. Even if government resources are available for the arrears not to become a financial problem, it still represents an equity problem. Non-compliant households in the Basic Housing Program end up receiving a subsidy which is 95% of the cost of the housing solution.

**Challenges ahead for the Chilean Housing System**

The wide range of coverage and good targeting produced by the Chilean system prevents crowding out of government assisted solutions by higher income groups. Government activities in low-income housing, although quantitatively impressive and having benefited many with improved living standards, may be preventing the private sector from further involvement in their production and financing. Turning part of the government contracted programs, particularly the part of the Basic Housing Program that benefits families with incomes above the average applicant, into a voucher based approach may open new avenues for private sector involvement, improve housing quality and mobilize household’s savings, currently blocked by the rigid delivery and finance mechanisms. To continue supporting the option of access only to fully serviced land and minimum standard shelter, the Chilean Housing System will have to fully address the urban impacts promoting efficient and socially beneficial land development process, including taking advantage of the opportunities offered by the deteriorated inner cities.
The levels and mechanisms of the subsidy system might require a review due to the improvement of the real income of the population in recent years. This may lead to a consolidation of programs and improved targeting and expand the system’s capacity to reach households in need. The purchase of houses from stock should be allowed at all times since it greatly helps adjust supply and demand in the low income housing markets and provides for better labor mobility. The consolidation of subsidy programs with greater participation of households savings and debt will free resources to expand the programs oriented to the very low-income households without capacity to save or repay a loan. Greater flexibility may be obtained by allowing the use of cash vouchers to buy houses from the stock in all subsidy programs. Further, MINVU may gradually scale down its production activities in favor of more community based production modes for low-income programs and more market based production for the higher income programs.

Government investment in trunk infrastructure is required to expand the supply of land in all urban areas. This must be complemented with cost recovery mechanisms to involve developers in the financing of trunk infrastructure (betterment taxes, land readjustment schemes), promoting more efficient uses of developed lands.

Housing should not have to depend on government spending alone or in a large proportion. Given the right conditions, the evolution of saving institutions capable of accumulating the personal savings capacity of the population as the main source of long-
term capital for housing production is the only sustainable solution. Governments however must continue in their coordinating and regulating roles and take responsibility for these functions only, in order to ensure a working mechanism, while foreign aid agencies and similar organizations must pay attention to support investment and not consumption with their loans.