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EMPLOYMENT AND HOUSING IN LIMA, PERU

By

W. Paul Strassmann

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Department of Agricultural Economics
Michigan State University
East Lansing, Michigan 48824-1039

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W. Paul Strassmann

Professor of Economics
Co-Director
Small Enterprise Approaches to Development Project
Michigan State University
East Lansing, Michigan

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Foreword

This paper is one of a series of reports produced by Michigan State University's Off-Farm Employment Project. The project, which is funded by the Office of Multi-Sectoral Development, Bureau of Science and Technology, U.S. Agency for International Development, has the basic purpose of enhancing the ability of AID missions and host country institutions to identify and implement programs and policies that generate off-farm employment and income opportunities benefiting the rural poor. One of the major components of the project is the generation of new knowledge relating to off-farm activities. In collaboration with host country institutions and AID missions, detailed field surveys of small-scale enterprises have been conducted in such countries as Egypt, Jamaica, Honduras, and Thailand; the results of these studies will be published in this series. A second component of the project involves the marshalling and dissemination of existing knowledge of off-farm activities. A state-of-knowledge paper has already been produced; in addition, special studies relating to off-farm activities will continue to appear in this series. Previously completed studies in this area currently available through the Off-Farm Employment Project include:

1. Carl Liedholm, "Research on Employment in the Rural Non-Farm Sector in Africa," African Rural Economy Paper No. 5, 1973.
2. Carl Liedholm and Enyinna Chuta, "The Economics of Rural and Urban Small-Scale Industries in Sierra Leone," African Rural Economy Paper No. 14, 1974.

3. Enyinna Chuta, "The Economics of the Gara (Tie-Dye) Cloth Industry in Sierra Leone," African Rural Economy Working Paper No. 25, 1978.

4. Adwale Mabowonku, "An Economic Evaluation of Apprenticeship Training in Western Nigerian Small-Scale Industry," African Rural Economy Paper No. 17, 1979.

5. Steve Haggblade, J. Defay and Bob Pitman, "Small Manufacturing and Repair Enterprises in Haiti: Survey Results," Michigan State University Rural Development Working Paper No. 4, 1979.

6. Enyinna Chuta and Carl Liedholm, "Rural Non-Farm Employment: A Review of the State-of-the-Art," Michigan State University Rural Development Paper No. 4, 1979.

7. Omar Davies, Yacob Fisseha and Claremont Kirton, "Small-Scale Enterprises in Jamaica: Initial Survey Results," Michigan State University Rural Development Working Paper No. 8, 1979.

8. Enyinna Chuta, "Techniques of Production, Efficiency and Profitability in the Sierra Leone Clothing Industry," African Rural Economy Working Paper No. 30, 1980.

9. Middleton Wilson, "Some Problems in Operating a Loan Program for Craft and Emerging Small-Scale Non-Farm Enterprises in Jamaica," Michigan State University Rural Development Working Paper No. 15, 1981.

10. Yacob Fisseha and Omar Davies, "The Small-Scale Manufacturing Enterprises in Jamaica: Socioeconomic Characteristics and Constraints," Michigan State Univeristy Rural Development Working Paper No. 16, 1981.

11. Enyinna Chuta, Carl Liedholm, Ola Roberts and Joseph Tommy, "Employment Growth and Change in Sierra Leone Small Scale Industry: 1974-1980," African Rural Economy Working Paper No. 37, 1981.

12. Peter Kilby, "Small Scale Industry in Kenya," Michigan State University Rural Development Working Paper No. 20, 1982.

13. Mahmoud Badr, Nadia El Sheikh, James Seale, Stephen Davies, Abdel Azim Mostafa, Abdel Rahman Saidi, "Small Scale Enterprises in Egypt: Fayoum and Kalyubiya Governorates Phase I Survey Results," Michigan State University Rural Development Working Paper No. 23, 1982.

14. W. P. Strassmann, "Employment in Construction: Multi-Country Estimates of Costs and Substitution Elasticities for Small Dwellings," Michigan State University International Development Working Paper No. 3, 1982.

15. Donald C. Mead, "Subcontracting in Rural Areas of Thailand," Michigan State University International Development Working Paper No. 4., 1982.

Copies of these papers can be obtained free of charge by writing:

Carl Liedholm
Off-Farm Employment Project
Department of Agricultural Economics
Michigan State University
East Lansing, Michigan 48824-1039
U.S.A.

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EMPLOYMENT AND HOUSING IN LIMA, PERU

LIST OF TABLES

I. INTRODUCTION

Every economy needs to produce a wide variety of goods, and no economy is healthy if many willing workers are unemployed. Most specific economic sectors are not, however, justified on the grounds of creating jobs but on their intrinsic merits and their relative efficiency compared with imports. That observation applies to agriculture, mining, education, health services, and numerous others. The building of dwellings and related infrastructure, however, seems to be an exception. For this sector the jobs that are created are looked on as an extra benefit that is stressed at length especially when a new housing program is launched. Perhaps that stress is due to the fact that housing programs can start up suddenly and mean conspicuous recruiting of thousands of workers. Then, when some phase of a home building program is complete, just as many workers can suddenly be laid off. The same applies to all construction. Other sectors are more likely to operate continuously and without such large employment changes. Whatever the explanation, this report will explore the connections between housing and employment in the Metropolitan Area of Lima.

The second chapter after the introduction will be oriented toward construction costs and supply. General trends in construction employment will be related to the level of wages and to the type of dwelling being built. The chapter notes that a substantial share of employment is in infrastructure and in improvements and additions carried out by the occupants.

Employment and production can never depend on supply alone. They depend on the interaction of supply with demand, with the share of income that a nation or its aggregate of households is willing to devote to housing instead of to other goods and services. The first part of Chapter III suggests that from both the national and the household point of view, the average new dwelling should be a small one. Most new households cannot afford to pay for more, and the country cannot afford to make larger houses and apartments a partial gift.

A survey of 1,167 households was carried out in Lima during June 10 - July 3, 1980, as a cooperative effort between the Office of Technical Manpower Studies (Now the Directorate of Employment and Migration Studies), General Employment Bureau, Ministry of Labor of Peru, and Michigan State University, East Lansing, Michigan, U.S.A. With data from this survey, demand elasticities were estimated and are reported in Chapter III. The chapter concludes with a review of the way Peruvian housing institutions have developed and with a brief account of how they have affected housing demand.

A special problem in analyzing the possibilities for job creation in building is that the annual volume of construction is never more than a small addition to the existing stock of dwellings. But this small addition will be around for decades. Chapter IV shows the way housing production must be related not only to the existing stock of dwellings, but also to the changing set of households according to income level. The 1980 distribution is compared with 1970 and with projections to the early 1990's. The importance of location is described in terms of six different types of neighborhood.

Improvements and additions to existing housing are the subject of the fifth chapter. Such work is already widespread but must be encouraged even more if a great improvement in housing is to be attained. With our survey we can relate types of improvement to the characteristics of households that make them. We can show with hedonic price analysis how much these improvements have already contributed to the value of dwellings. Unfortunately, home improvement changed mainly the owner-occupied housing stock since a variety of laws affecting rental housing discouraged both improvement and maintenance.

According to the sixth chapter, it matters what the specific jobs of occupants of dwellings are if one wants to explain the extent of improvement and choice of housing. Especially important is whether or not that occupation is carried on in the dwelling itself. The home business may be a workshop, a store, a service, or an office. It allows the dwelling to be used as a productive asset and therefore raises incomes and encourages further expansion of the dwelling. Plans are under way to study these possibilities in greater detail.

After a final chapter with a summary of conclusions, comes Appendix A which shows how a preliminary estimate of employment in proposed building projects may be made quickly.

II. EMPLOYMENT AND WAGES IN RESIDENTIAL CONSTRUCTION

General Trends

In the Lima Metropolitan area, construction employment like other types has lagged behind population growth. At a 4.3 percent average annual growth rate, however, it did maintain its 7 percent share of the labor force from 1961 until 1975. Afterwards with deteriorating economic conditions, the number of employed and underemployed construction workers fell from 65,000 to 50,000 in mid-1978, and their share of the labor force fell to 5 percent. After 1978 construction recovered faster than other sectors, as it always does, and employment quickly rose by 10 percent, bringing the share to 5.5 percent of the labor force. The extent of open unemployment among construction workers fell from 11,000 in July-August of 1978 to 6,000 in April 1980.[1] The amount of uncounted selfhelp building on improvements alone was equivalent to some 20,000 additional workyears.

Like other wages in Lima, those of construction workers fell steadily in real terms during 1974-1979 until purchasing power reached a low of 60 percent of the 1973 level in June 1979. Salaries of office workers and professional fell to 51 percent. By May 1980 wages had recovered to a 76 percent level, and salaries to 59 percent. In general, wages kept up with inflation by rising at an annual rate of 66 percent during the first 8 months of 1980, but construction wages lagged by rising only 40 percent in nominal terms.

A survey of payrolls of enterprises employing 10 or more workers showed that in May 1980 construction workers received 1,414 soles daily (US $4.96).[2] A special survey posed the question directly to workers

and found that the amount was only S/1,173 (US $4.12). Fringe benefits and social costs must be added to these amounts for all those enterprises that actually paid them. Included are payments for social security, a pension fund, accident insurance, a payroll tax for FONAVI (the housing fund), and other taxes, holiday benefits, and the like that can amount to 75 percent of daily wage payments in the case of construction.[3] In estimating costs in May 1980, construction firms therefore stated that the daily cost of an unskilled worker was S/2,056 (US $7.21) and that of a skilled worker S/2,200 (US $7.72). The margin of skilled over unskilled pay was thus said to be only 7.0 percent. Experts in construction practice believed that the skill premium was closer to the 36 percent level reported by workers themselves and that firms might well overstate their costs per worker by 90 percent, or more in the case of the unskilled. Where unemployment is intense, workers may find it wise to say that they have worked only three hours when it actually took five to finish the job. Others may remain unduly long in the category of "new and temporary." Census reports have invariably shown that construction employment is larger than the amount shown on payrolls. Wages are lower, but employment is higher.

Employment is determined partly by the level of wages because buildings may be built in more and less labor intensive ways. For example, because wages had lagged behind capital costs since the 1960's, it was unusual in 1983 to see tower cranes in Lima, even in the construction of highrise buildings. But construction employment mainly varies with economic conditions because the proportion of labor costs in the total does not respond that elastically to small changes in relative costs of

labor, machines, materials, etc. So construction employment grows as national product grows: Only it fluctuates around the trend as much as building does. In good years the volume of all formal sector construction valued added rose to 5 percent of national product, and in poor years it fell to 3 percent. Basically, however, it grew at the same rate as the national economy, so its share has averaged around 4 percent since 1950. Housing amounted to about half the total -- or over 60 percent if an estimate for selfhelp building is added. Note that "value added" is only about half the value of what is built.

During relatively prosperous years in Lima, about 33,000 workers have been formally employed in residential building. If the annual volume of selfhelp improvement had also been formally built, an additional 20,000 workers would have been counted. Thus defined, selfhelp building has generated more than a third of the employment for building dwellings. In this sense over 60 percent of construction employment was residential. That comes to 5.6 percent of the employed labor force. Not included are the workers making the infrastructure for residential areas, perhaps an additional six or seven thousand work years annually.

Employment Estimates by Housing Type

How did we make these estimates, given that builders mainly keep track of labor costs, often through subcontracts, and do not know the time actually involved? In order to obtain a base for such employment figures, we asked experienced estimators in three different Peruvian organizations to give us costs per component for a standard Tunisian core housing plan which we had studied in other countries.[4] It has floor space of 24.9 m^2 and a flat roof supported by reinforced concrete posts and a collar beam. There is a small kitchen with a sink, and in the

bathroom a toilet is connected to a septic tank. Another esimate was for 34.4 m^2 Peruvian core house that added a shower and an extra wash-basin.

Noteworthy is that the Tunisian core house could be built at a lower cost in Peru than in any of the other five countries. According to Peruvian builders, it could also be built with fewer onsite workers (101 workdays); but information from workers suggests that 154 would be needed, 17 more than in Medellín, Colombia. This discrepancy is due to the tendency of Peruvian builders to claim that they are paying the high legal wages and fringe benefits, which the workers dispute, as mentioned before. Workers say that the differential paid to skilled workers is higher and that a larger portion of unskilled workers is used in construction. The differences between the two types of sources can be seen in column 6 of Table 1.

In general the information from workers on pay and pay differentials is probably more reliable, but in this report we shall use the lower estimates of employment generation given by the builders. As a result, all estimates in the remainder of this report should be regarded as conservative. For example, for the 34.4 m^2 Peruvian core house, data from workers would suggest that the labor content is 234 workdays, but we shall use the 132 workdays reported by builders.

Table 2 shows how onsite workdays per dwelling rise from 101 for the smallest core unit to 1,105 for a 200 m^2 luxury residence. If the indirect labor content of materials is added, according to the findings of Rufino Cebrecos Revilla, employment goes from 142 to 1,602 workdays. On a per square meter basis, onsite employment falls from 4.0 workdays to 3.6 and then rises back to 5.5. It rises the most at the intermediate

Table 1 -- Cost of Construction and Characteristics Related to Employment Generation for a Standard 24.9m^2 Dwelling, August 1979; Lima, June 1980.

	1. Colombo Sri Lanka	2. Rawalpindi Pakistan	3. Lusaka Zambia	4. Tunis Tunisia	5. Medellín Colombia	6. Lima Peru	7. Mean, Six Countries
1. Cost of Construction, C, US$	3,117	3,482	5,107	4,253	3,794	2,852	3,768
2. Daily pay, w_u, of unskilled workers, according to:							
a. Workers	.94	1.92	3.05	4.17	3.30	4.35	2.97
b. Builders	1.02	2.00	3.80	4.70	4.24	7.21	3.83
3. Ratio of skilled to unskilled wages, p, according to:							
a. Workers	1.713	1.818	1.898	1.808	2.786	1.356	1.897
b. Builders	2.125	2.300	2.000	1.654	2.975	1.070	2.021
4. Unskilled workers employed per skilled worker, q, according to:							
a. Workers	1.50	1.73	1.50	.48	1.46	1.70	1.40
b. Builders	1.31	1.53	1.62	1.37	2.11	.74	1.45
5. Ratio labor costs to total cost, r,	.150	.185	.198	.314	.205	.265	.220
6. Employment generator, $\phi = \frac{r(1+q)}{(p+q)}$							
a. Worker-based	.117	.142	.146	.203	.119	.234	.160
b. Builder-based	.101	.121	.143	.246	.125	.255	.165
7. Workdays for the dwelling, according to:							
a. Workers	388	258	244	207	137	154	231
b. Builders	309	210	192	223	112	101	191

level where quality rises faster than space. This pattern is best observed by looking at incremental employment generation, as follows.

The change from the smallest core to that of 34.4 m^2 and to the minimal 45 m^2 unit is mainly one of additional space. Since the cost of plumbing can be distributed over more square meters, the cost per square meter actually falls. The initial unit requires 4.0 workdays per square meter, but the marginal increments only take 3 workdays per square meter. After that the marginal changes cost 5.0 and 5.7 workdays per extra square meter, followed by a leveling off.

Employment in Expansion or Upgrading

Even harder to observe than formal construction employment on new dwellings is that in expansion or upgrading. Such employment may proceed piecemeal over a long period of time and be partly carried out by the household. More days than permanent building workers would need may have been worked by the household, but the difference should not be counted as the equivalent of real employment. It is time spent on learning or leisure.

If the value of an improvement or expansion is not known, one can assess employment generated by using the additional floor space that has been produced. If the house is at the minimal level, extra floorspace generates 3 onsite workdays per extra square meter. If it is at the "good" level, it generates 5-6 workdays per extra square meter. If one only knows the number of rooms that have been added, one has to assume that they are of average size for that quality range unless there is information to the contrary. Note that at the "good" and "excellent" level, materials are somewhat more labor-intensive than at lower levels. (Table 2, line 6).[5]

Table 2

Employment Generation in Different Housing Types, Lima, Peru, 1980

	24.9m² Core	34.4m² Core	45m² Minimal	75m² Basic	120m² Good	200m² Excellent
1. Difference in floorspace compared with the next smaller type, m^2.	-	9.5	10.6	30.0	55.0	80.0
2. Onsite workdays per m^2 of floorspace.	4.0	3.8	3.6	4.2	5.2	5.5
3. Ratio: Change in onsite workdays to change in m^2 of floorspace. (Marginal workdays).	-	3.0	3.0	5.0	5.7	6.0
4. Onsite workdays per dwelling.	101	132	162	315	624	1105
5. Ratio, indirect materials employment to onsite employment.	.40	.40	.40	.40	.45	.45
6. Ratio change in materials employment to change in m^2 of floorspace.	-	1.2	1.2	2.0	2.8	2.7
7. Indirect employment, in materials, workdays.	41	52	65	125	281	497
8. Sum, onsite and indirect materials employment, workdays.	142	182	227	440	905	1,602

Note: Workdays per square meter were analyzed in detail for the two core housing types. It is assumed that the extra workdays for additional square meters rise in proportion to the marginal square meter cost. The ratios of materials to onsite labor come from Rufino Cebrecos Revilla, Construcción de Vivienda y Empleo (Lima: Publicaciones CISEPA, Pontífica Universidad Católica, Documento de Trabajo 35, April 1978), p. 39. These estimates can vary by plus or minus 25 percent in accordance with the volume and techniques by particular enterprises.

With this approach, we found that the average poor household, earning less than 15,000 soles monthly (US $53), generated 54.6 workdays of upgrading (See Table 3). The average rich household, receiving more than S/162,000 (US $568) monthly, generated 292.2 days of upgrading labor. The weighted average for six income and six housing levels was 152 workdays. Since that is the average, one can multiply it by the number of households, divide it by the number of years, and make an estimate of the share of the labor force active in upgrading. It is a small share of total employment, but a large -- possible one-third -- share of construction labor.

In 1980 some 556,500 households out of 897,000 assumed to be in Lima were owner-occupants, and if each had generated 152 equivalent workdays in improvements, that makes a total of 84.6 million workdays or 338,000 workyears. Spread over 11 years, the improvements therefore created about 31,000 jobs per year, an amount equivalent to 2.2 percent of the labor force. Note that only .7 percent was formal construction labor. In normal times, the Lima area had 70,000 construction workers, 7.2 percent of the labor force. Uncounted selfhelp labor brings the total to 90,000 workers. Thus the formal and informal upgrading work on owner-occupied dwellings easily came to 33 percent of construction labor. An additional 13,000 jobs were created in building materials production for upgrading and in the inputs into building materials, etc.

TABLE 3. Number of Rooms, Rooms Added, Floorspace, Floorspace Added, and Workdays on the Additions. Owner-occupants by Income Range, Lima, 1980.

Households monthly income (Thousands of 1980 soles)	Average No. of Rooms Added	Current No. of Rooms	Floorspace Added, m^2	Current Floorspace, m^2	Workdays per added m^2	Workdays per addition
F0 15 or less	.56	2.56	18.2	83.0	3.0	54.6
F1 15.1- 28	.91	2.62	27.9	80.4	3.0	81.3
F2 28.1- 50	1.33	3.36	38.2	96.5	3.9	150.3
F3 50.1- 90	1.02	4.27	29.2	122.4	4.5	132.6
F4 90.1-162	1.11	5.31	37.2	181.3	5.2	196.9
F5 Over 162	1.00	7.17	45.9	330.4	5.9	292.2
Weighted Mean	1.12	4.02	35.7	127.8	4.3	152.1

Source: Survey of 724 owner-occupants in Lima, Peru, June 10-July 3, and a cost analysis of floor plans by three contracting organizations.

Note: The percentage change in floorspace is assumed to equal the percentage change in number of rooms. The workdays/m^2 reflect the mix of housing types (H0, H1...H5) that households were actually occupying.

Infrastructure Employment

To the employment generated by dwelling construction and improve- must be added that needed to build the infrastructure. Infrastructure cost and employment can vary greatly with the nature of the terrain, climate, density of settlement, as well as the type and quality level of the specifications. In the Lima Metropolitan Area in 1980 specifications tended to be rather lavish even for simple serviced sites intended for core housing. Streets were broad and equipped with sidewalks and curbs; electric lines had to be underground. As a result, costs were high: S/637,000 (US $2,284) per lot in June 1980. Trunk lines to distant reservoirs or generating stations are not included in these estimates. With aerial electrical lines, simpler streets and walks, less gardening, and better layouts, infrastructure cost per lot could fall by half and approach the 1980 equivalent of US $1,000.

Employment per lot would also fall with lower costs, but an increased number of lots would generate more building and improvement employment. In general, the amount of employment in infrastructure tended to be roughly proportional to the expenditure regardless of the specifications. If the equivalent of US $1 million were spent, employment generation would be 39,000 workdays according to workers; and according to contractors 24,000 workdays. The difference again depends on whether a daily wage including fringe benefits of S/2,055 or US $7.21 for unskilled labor is actually paid; or whether daily labor costs are only S/1,240 or US $4.35. The possibilities for mechanization are sufficiently great and yet costly that its use will vary directly with wage levels. Of course, the differential for skilled workers also plays a part in factor substitution.

A quick way to estimate employment in infrastructure is to multiply the amount to be spent by 0.17, an "employment generator," Ø, and to divide that by the unskilled wage rate including fringe benefits. Employment in building core housing can be found by multiplying the expenditure by 0.23 and dividing that by daily labor costs.[6] A given volume of spending will create 35 percent more jobs if devoted to building instead of infrastructure. Whether workers' or employers' figures are used does not affect this proportion; but the relative amount of employment generation can be quite different from that in other countries with different wage levels.

A 34.4 m^2 core house in June 1980 would have cost S/1.24 million (US $4,360) and taken 132 workdays according to builders. Infrastructure cost for such a unit should have been much less than the amount give above, S/637,000 (US $2,284), which was 52 percent as much as the house and would have required 54 workdays.

In building, using workers' figures, an investment of about S/1.7 million (US $6,000) was needed to generate a workyear (275 days) of onsite housing construction employment. For infrastructure, in 1980 S/2.0 million (US $7,000) had to be spent for an onsite workyear. In either case if labor costs including fringe benefits approached the legal amount, one-third of the employment would be lost for any given expenditure.

III. DEMAND, FEASIBLE HOUSING PROGRAMS, AND EMPLOYMENT

Employment in housing construction cannot be predicted only on the basis of the supply factors discussed in Chapter II. Something has to be known about demand. But in housing, demand analysis is very complicated, primarily because the expense and durability of the product brings in long-term finance, the alternative of renting, and the role of the old housing stock. By contrast, hats are also a form of shelter, but one does not normally rent them, buy them with a mortgage, or choose one that is second-hand. Before going into these complications, one does well to remember a simple principle: Annual housing production and employment will not long stay at levels higher than a country can afford, meaning higher than levels that its households can afford.

Investment, Savings, and Potential Housing Demand

How much of a country's labor force and other resources can be assigned to building housing and related infrastructure can be approached at two levels -- that of the nation and that of the households.

At the national level, economic planners can decide what portion of gross national product can go into new housing and then channel sufficient finance into housing banks. This decision is made on the basis of what portion of investment resources should go into new housing instead of agriculture, mining, transportation, and industry. A typical level is one-fifth of investment resources or 4 percent of gross national product. For Peru in 1980, 4 percent of US $16.182 billion would have been US $647 million for new housing.

The preliminary estimate of the Peruvian population in 1980 was 17.4 million. During 1972-1981 the population grew at an annual 2.6 percent. For Lima-Callao the growth rate was higher due to migration, 3.8 percent, and for other urban centers it was higher still, 4.5 percent. Let us assume that only 125,000 households needed new dwellings because they had migrated or were newly formed. In that case they could on the average receive no more than a dwelling worth US $5,176 (or S/1.5 million of 1980).

$$\frac{\text{Gross National Product x 4\%}}{\text{Number of homeless households}} = \text{Average Value of a New Affordable Dwelling}$$

$$\frac{\text{US \$16.182 billion x 4\%}}{125{,}000} = \text{US \$5,176}$$

If this US $5,176 dwelling were put on a site with infrastructure costing US $1,400, then only US $3,776 would be left over for the dwelling structure. That means the average new dwelling would have been much like the 34.4 m^2 core described in the second column of Table 2. There would later have been much informal adding on, which would not have been counted officially as part of national product. The formal employment would have been 132 workdays on the site, 52 indirect workdays in the materials, and 33 workdays on the infrastructure. Total employment: 217 workdays per dwelling or 27.125 million workdays altogether, or 98,600 full-time workyears.

The actual allocation of formal building resources was, of course, quite different. Fewer but much more expensive units were built, and so other households had to double up or informally build smaller units without adequate infrastructure.

Affordable Housing From the Household Perspective

From the perspective of households, an affordable house depends on monthly income and the availability of finance. Let us assume that there are no gifts or subsidies. After all, the affordability of gifts is a problem for the giver, not the recipient, and the flow of most subsidies quickly slows down to a trickle. Finance must therefore be obtained at its unsubsidized price, the market rate of interest. The interest rate is basically the yield that investment could have in manufacturing, commerce, or other uses and therefore prevents the waste of funds. During inflationary times, loans will not be voluntarily granted unless repayments cover price increases in addition to market interest.

There is nothing novel about the equations of housing finance. The loan that a household is willing to accept, V, depends on the annual sum of monthly payments, a, the number of years to repay, n, and the real rate of interest, r.

$$(1) \qquad V = a \left[\frac{(1+r)^n - 1}{r(1+r)^n}\right]$$

In Lima the average monthly income according to the survey made for this report was US $235 per household. If one fifth of that was available for housing (US $47), then US $564 was available annually. With an interest rate of 12 percent and a mortgage maturity of 15 years, a loan of $3,841 could have been granted.

$$V = 564 \left[\frac{(1.12)^{15} - 1}{.12(1.12)^{15}}\right] = 3,841$$

Referring back to Table 2, we can see that this amount could pay for no more than a 24.9 m^2 core house, assuming about US $1,000 for infrastructure. Employment per dwelling and infrastructure would have been 176 workdays. With some downpayment, the dwelling would have been larger and employment greater.

In recent years many financial innovations have been developed besides allowing for inflation and changing interest rates. These have the purpose of making finance available without subsidy to households with less means so that they can afford to buy a larger dwelling. One of these is the rising payment mortgage, cuotas crecientes. Each year payments rise by some percentage, b, and this allows the households to keep devoting the same proportion of monthly income to housing as real income rises due to experience, promotions, etc. Let us assume that payments rise by 5 percent each year, b=.05. Let us also assume that the mortgage maturity can be extended to 20 years and that the real rate of interest is only 10 percent. How much more housing can be afforded? The equation of housing finance becomes:

$$(2) \qquad V = a \left[\frac{(1+r)^n-(1+b)^n}{(r-b)(1+r)^n}\right]$$

If b = 0, this equation is the same as equation (1).

$$V = 564 \left[\frac{(1.10)^{20}-(1.05)^{20}}{.05(1.10)^{20}}\right] = 6,831$$

Under these favorable financial terms, that still involve no subsidy that would decapitalize the giver, the average household could afford a US $6,831 dwelling. If infrastructure is somewhat more elaborate and the site therefore costs around $1,800, the household could now afford a US $5,000 minimal dwelling of 45 m^2. Employment per unit would be 227 workdays plus 42 in infrastructure for a total of 269 workdays. (See Table 2)

Households that do not expect their real incomes to grow could, of course, not afford to undertake that kind of mortgage. The average of the two estimates, US $3,841 and US $6,831, is US $5,336. This amount is not far from the US $5,176 derived from housing as an affordable share of gross national product. The two estimates are consistent.

An appropriate housing policy does not promote the building of only one or two types of small dwelling and forbid all others. High income households should be allowed to spend what they want on a labor-intensive commodity with a low import content. At the same time a housing-employment policy should recognize that most households have less than the average income (since the median level is below the average). Consequently the greatest need for new housing is at the core and minimal levels. Viable financial institutions must be evolved to meet this need, or substandard settlements will proliferate. Peru has a good record of developing such institutions, but this was interrupted during the 1970's, partly through difficult economic conditions and the acceleration of inflation. After a section on demand elasticities, we shall review the development of housing institutions insofar as they are related to employment.

Demand Elasticities

The preceding section had estimates based on the assumption that households would spend twenty percent of their income on payments for housing. If that is true for households at all income levels, percentage changes in spending on housing must equal percentage changes in income. The ratio of these two percentages is called the "income elasticity of demand for housing." If the two percentages are the same, the elasticity is 1.0. A necessary assumption is that the households and the price per unit of housing quality are otherwise alike. An attempt to measure income elasticities must, therefore, follow a procedure that compensates for the lack of uniformity in households and dwelling prices.

Most occupants of housing are owners who, if effect, rent to themselves. They can answer questions about value better than they can about merely implicit monthly payments. In our survey of 724 owner-occupants in June and July of 1980 (described in the appendix) we asked, "Si fuera a vender esta vivienda hoy: ¿ A qué precio cree que la podría vender?" Everywhere households have been found very accurate about that. The reasonable assumption is that variations in estimated value match variations in implicit monthly payments. For 341 tenants this problem did not arise.

The overall result is that the income elasticity for owners was about 1.25. This means that spending on housing doubles whenever incomes rise by 80 percent. If twenty percent is spent on housing at the median level, then only 17.8 percent of income is spent at half that level and 22.2 percent on twice that level. With further doubling, the housing share rises to 24.7 and 27.4 percent. For tenants, rent control probably kept the elasticity to a low .86 below the median income level. Above, it was 1.2 if household characteristics are taken into account.

Statistically the income elasticity of demand is determined by logarithmic regressions, as shown in Table 4. For all owners (including hire-purchase or alquilar-venta) it was 1.24 (line 3). Below the median income level, it was .80 and above, 1.31 (lines 8 and 13). For tenants the comparable elasticities are .90, .86, and 1.07. Size of the household did not raise spending on housing but, on the contrary, had a negative effect, especially above the median income level. Not important was the proportion of adults in the household. For owner occupants, this proportion had a mean of .66 and median of .63. The average household had 5.4 members: 3.6 adults and 1.8 children below the age of 18. In other regressions, age of the head of the household was included as another independent variable that might reflect the stage in the life cycle of the household. At a statitiscally significant level it had a slight positive effect for owners and a slight negative effect for tenants.

An assumption involves relating a durable structure that can be financed over years to the income of a single month. Households are more likely to relate such a purchase to their income expectations over a period of years, to "permanent" not "current" income. If unexpected, transitory, or special funds are received, they are likely to be saved. Investment in housing is probably the leading form of saving for most households. The highly significant association of special income receipts with the value of occupied dwellings is shown in Table 4, column 4, lines 5, 10, and 15.

Any preferences for buying a certain type of house with a given income cannot be realized easily if housing institutions and government policies are discouraging. Some lucky households may get more than they would really pay for, but others will get less and must try to improve it with additions. A brief review of housing institutions follows.

Table 4 -- Logarithmic Regressions: Monthly Rent or Estimated Value on Income, Households Size, Proportion of Adults, and Special Income. Lima, 1980.

Sample		Coefficients of Independent Variables					
Log of Monthly Rent or Value		Log Income (s.e.)	Log nr. of occupants (s.e.)	ratio, adults to occupants (s.e.)	Special Income dummy (s.e.)	Constant (s.e.)	F ($\bar{R}^2$)
Total Sample							
Tenants n=341	1.	.896** (.088)				4.221** (.349)	102.6** (.231)
	2.	.946** (.104)	-.196 (.145)	-.043 (.297)		4.329** (.383)	35.2** (.232)
Owners n=724	3.	1.237** (.062)				8.913** (.252)	396.7 (.354)
	4.	1.224** (.067)	-.260* (.118)	.268 (.178)		9.229** (.309)	140.7 (.367)
	5.	1.271** (.129)			.480** (.133)	8.688 (.591)	58.3 (.249)
Monthly Income: $175 and less							
Tenants n=190	6.	.858** (.186)	--	--	--	4.370** (.642)	21.3** (.097)
	7.	.858** (.197)	-.014 (.198)	.086 (.439)		4.326** (.713)	7.1** (.088)
Owners n=377	8.	.799** (.143)				10.358** (.496)	31.4** (.075)
	9.	.811** (.150)	-.045 (.183)	.355 (.286)		10.189** (.566)	11.6** (.078)
	10.	.761** (.139)			.816** (.180)	10.368 (.484)	26.8 (.121)
Monthly Income: Above $175							
Tenants n=151	11.	1.070** (.222)	--	--	--	3.427** (.994)	23.3** (.129)
	12.	1.176** (.238)	-.477* (.224)	-.155 (.410)	--	3.801** (.999)	9.8** (.150)
Owners n=347	13.	1.308** (.131)				8.663** (.601)	100.2 (.223)
	14.	1.267** (.133)	-.409** (.152)	.146 (.222)		9.442** (.656)	39.0** (.248)
	15.	1.271** (.129)			.480** (.133)	8.688** (.591)	58.3 (.249)

Source: Survey of households, June 10-July 3, 1980.
** Significant at .01 * Significant at .05

A Review of Housing Institutions

The most important aspect of housing policy is the rate at which land and finance are made available to different income groups. If these are accessible, labor and materials will not be major bottlenecks in a country like Peru. Housing finance has to reflect such general economic conditions as the rate of growth of national product, the level of savings and tax collection, the amount of investment in other productive sectors, and even the state of exports and size of capital inflows. Housing policies should not only focus on the characteristics of specific projects but heed the way the entire housing stock is changing. These changes are a response to both the number and the types of households, large and small, new and old, rich and poor, owners or tenants.

In recent decades, the share of Lima rose from a fifth to a fourth of the national population; and within Lima the share of squatters rose from less than 20 percent in the 1950's to 27 percent in 1980. Their annual rise was over 9 percent.

Since squatters mainly settle on public land, the expansion of their pueblos jóvenes depends largely on official tolerance, perhaps even tacit encouragement. Tolerance was fairly high during the military regimes of Manuel Odría (1948-56) and Juan Velasco Alvarado (1968-75). Average annual settlement in new squatter areas came to over 25,000 people under Odría and to over 54,000 under Velasco, meaning a shift of 2.6 and 1.8 percent of the Metropolitan population each year. Migration to and expansion of older squatter areas are not included in these figures. During the intervening period of Presidents Manuel Prado and Fernando Belaunde (1956-68), new settlement formation was less -- about 17,000 people annually or about 1.0 percent of the Metropolitan population.[7]

During this period an attempt was made to have settlers acquire public utilities promptly with full-cost loans instead of subsidies that might further accelerate migration to Lima.

In general, the provision of water and sewerage has been efficiently managed since 1963 in Lima, reaching most of the population and charging enough to cover operating and investment costs. In 1980, 73 percent of households had at least a water faucet and 62.5 percent had a toilet connected to the sewerage syste. In June 1981, the National Water and Sewerage Service (SENAPA) was established to consolidate and to coordinate existing agencies, such as the ESAL of Lima, which became SEDAPAL and as such acquired more autonomy except for the level of investment and monthly charges.

Finance for building has been channeled through a variety of public agencies set up by successive governments. A national mortgage bank, Banco Central Hipotecario, dates back to President Augusto Leguía (1919-30). The Corporación Nacional de Vivienda (CNV) was set up under President Bustamente (1945-48) and built thousands of units. Pedro Beltrán, Prime Minister under President Manuel Prado, fostered a system of mutual savings and loan associations and created an Instituto Nacional de Vivienda (INV) for encouraging private (expandable) housing as the solution to the nation's "number one problem." The CNV and INV were combined in a Junta Nacional de la Vivienda (JNV) by the 1962-63 military government. A Banco de la Vivienda became the supervisor of and financial channel to the mutual associations. By 1967 appropriations to the JNV were cut by 89 percent from the 1963 level. Meanwhile public housing projects were built that only the middle and upper middle class could afford. A Ministerio de Vivienda y Construccíon was set up by Velasco

in 1969 and given responsibilities for planning many aspects of the sector. In 1981 some functions were once again decentralized, but the ministry still formulates general policies, primarily from a physical perspective. It also makes feasibility studies for World Bank Urban Development Loans that stress infrastructure, serviced sites, and slum upgrading.

In 1979 came the Fondo Nacional de Vivienda (FONAVI) which finances housing construction with funds obtained from a 5 percent payroll tax and a 1/2 percent matching contribution by workers. Public housing is built, administered, and sold by the Empresa Nacional de Edificaciones (ENACE) which replaced the Empresa de Administración de Inmuebles del Peru (EMADI). It uses FONAVI funds at only a 3 percent rate of interest together with other funds that finally bring interest rates to 16-27 percent (unadjusted for inflation). In accordance with Ministry of Housing Policies ENACE not only had 14,000 middle class units (46-87 m^2) under construction in early 1983, but also a few sites and services plots for low income households. Since the beneficiaries of ENACE housing had to make repayments that, because of inflation, would add up to less than 30 percent of real value received, financial institutions were threatened with decapitalization. Hence, a reform of financing terms was being considered. In the meantime when 1,172 dwellings at Torres de San Borja were completed and offered under the old highly favorable terms, some 150,000 households applied to become beneficiaries (El Comercio, Feb. 11, 1983). Most could not have afforded to apply for them without the prospect of a decapitalizing subsidy.

Much less likely to be decapitalized through inadequate repayments was the Banco de Materiales, BM, an ingenious institution set up in September 1980. By early 1983 loans were limited to the equivalent of US $2,250 exclusively for materials, hence initially appropriate for no more than 35 m^2 core housing. Subsequent loans were available for expansions up to 70 m^2. Interest rates were a low 15 - 16 percent annually, but their decapitalizing effect was almost entirely (90 percent) eliminated by short (2 1/2 year) amortization periods, 5 - 20 percent downpayments, and an initial 20 percent profit on materials. BM bought at bulk rates but sold at retail prices. Although borrowers had to prove at least a provisional claim to land, mortgages were not required. Instead, security came from assurances of payroll deductions for the recipient or a consigner.

This ingenious program was expanding slowly in order to learn what was feasible. By November 1982 only some US $5 million had been lent to about seven thousand applicants. In the meantime it had been learned that loan recipients preferred their own plans to the standard blueprints of BM. They rejected such innovations as unconventional toilets even though a 40 percent saving might result. Finally, as in other countries with similar programs, most borrowers preferred to hire workers and not attempt selfhelp construction. The Banco de Materiales shows that viable financial institutions can be created even during difficult inflationary times. In addition it supports exactly the kind of housing that was relatively neglected during the 1970's, as we shall see in the next chapter.

IV. GROWTH AND USE OF THE HOUSING STOCK FROM 1970 TO 1990

Housing and employment problems cannot be solved by simply planning to build enough to make up the difference between the number of households and the number of dwellings. That approach can lead to the construction of units that are too expensive and that will exceed both national and household budgets. One must define the problem in terms of specific income levels and different housing types.

The Distribution of Income and the Housing Stock

How income was distributed in Lima-Callao during 1980 is shown in Table 5 with 17 categories. Incomes in our sample ranged from a monthly US $7 to US $4,211. The average was US $235; the mean US $175; and more households said US $105 (30,000 soles) than anything else. Since 17 categories are too many for a simple analysis, we shall combine them into 6 income ranges and call them F0, F1, F2, F3, F4, and F5. The boundaries between the ranges are US $54, 97, 175 (the median), 315, and 567. Each boundary is 80 percent above the preceding one. The percentage of households in each range, beginning with the lowest is 4.1, 12.7, 37.1, 26.9, 14.5, and 4.7 percent, rising and falling in the usual lognormal manner that has been found elsewhere.

The way the 1980 housing stock, divided into six major housing categories (H0, H1...H5), was used by Lima households in the six income categories (F0, F1...F5) is shown in Table 6. Each row shows what sort of housing was occupied by an income group, and each column shows how a housing type was distributed among different income groups.

Table 5 -- Income Distribution in the Metropolitan Area of Lima, Peru, June, 1980.

Income per Month, Thousands of Soles	Percentage of Households		1980 Soles	1980 Dollars
$\chi \leq 10$	2.3	Mean	66,977	235
10.1 - 20	5.7	Standard error	1,990	7
20.1 - 30	17.1	Standard deviation	67,986	239
30.1 - 40	15.2	Median	49,888	175
40.1 - 50	13.7	Mode	30,000	105
50.1 - 60	9.5	Minimum	2,000	7
60.1 - 70	6.2	Maximum	1,200,000	4,211
70.1 - 80	5.8	Kurtosis	85,901	--
80.1 - 90	5.4	Skewness	6,945	--
90.1 - 100	6.1	Gini	.417	--
100.1 - 120	3.4	Mean, Owner-occupants	71,900	252
120.1 - 140	2.5	Mean, tenants	61,200	215
140.1 - 160	2.5			
160.1 - 180	1.5			
180.1 - 200	1.2			
200.1 - 250	.5			
250.1 +	1.5			
	100.0			

Source: Survey of 1,167 households carried out in Lima during June 10 - July 3, 1980, by the Technical Office of Manpower Studies, General Bureau of Employment, Ministry of Labor.

Note: At this time US $1.00 = 285 soles.

The Gini coefficient for income distribution was .430 in 1971-1972 according to Carlos Amat, León Chavez, Hector León, Estructura y Niveles de Ingreso Familiar en el Peru (Lima: Ministerio de Economía y Finanzas, 1977). About four years earlier a Gini of .480 was reported in Adolfo Figueroa, "Estructura del Consumo y Distribución de Ingresos de Lima Metropolitana," Programa ECIEL, Serie de Estudios Económicos, No. 1, Departamento de Economía, Pontífica Universidad, Católica del Peru. A lower Gini implies greater equality.

The division of the housing stock into six categories -- temporary, substandard, minimal, basic, good, and excellent -- is a standard approach that has been used in studying the housing of other countries. Physical characteristics of each housing type are given in the first seven rows of Table 7. They involve materials, space and access to utilities. Within each category are a number of sub-types. For example, classified as "substandard" H1 are both adobe huts with latrines and with water from public standpipes as well as rooms in tenements and callejones for families that must share sanitary facilities with others. Note that temporary housing H0 is larger and on a bigger site than H1 housing. With inferior materials it is easier to build a bigger shack; and on the outskirts of the city families usually squat on a parcel large enough to accommodate a few chickens and goats. As others move in, some of the land is sold and a more solid but smaller house is built.

In Lima owner occupants at the F1 level received about S/19,000 (US $67) monthly and typically seemed willing to acquire H1 dwellings worth 20 times their income. The proportion gradually rose until households earning US $587 were willing to pay for dwellings worth 30 times their income. To make preferred housing double in value, rising 100 percent, income only had to rise 80 percent. The ratio of these two percentages is the income elasticity of demand equal to 1.25 if all other characteristics of households were unchanged in the six ranges, as explained in Chapter III.

Patterns of Location

In general, value of the site was around 30 percent of the total value of the dwelling. From the extreme northern, southern, or upland outskirts of Lima to the central business district, land values rose by a factor of a thousand -- from 200 to over 200,000 soles (US $0.70 - $700) per square meter in early 1980.

Table 6 . Distribution of the 1980 Housing Stock and Net Additions since 1970. (Thousands of units and percentages.)

Households Monthly Income \ Dwellings		H_0 Temporary	H_1 Sub-standard	H_2 Minimal	H_3 Basic	H_4 Good	H_5 Excellent	Σ_F
F_0	1980 Dollars 54 or less	24.2 (2.7)	6.3 (.7)	4.5 (.5)	.9 (.1)			36.8 (4.1)
F_1	54.1 - 97	63.7 (7.1)	21.5 (2.4)	16.1 (1.8)	10.8 (1.2)	1.8 (.2)	.9 (.1)	113.7 (12.7)
F_2	97.1 - 175	113.0 (12.6)	64.6 (7.2)	67.3 (7.5)	45.7 (5.1)	30.5 (3.4)	10.8 (1.2)	332.8 (37.1)
F_3	175.1 - 315	36.5 (4.1)	38.6 (4.3)	33.2 (3.7)	60.1 (6.7)	45.7 (5.1)	26.9 (3.0)	241.4 (26.9)
F_4	315.1 - 567	11.7 (1.3)	5.4 (.6)	15.2 (1.7)	19.7 (2.2)	34.1 (3.8)	44.0 (4.9)	130.1 (14.5)
F_5	Over 567			2.7 (.3)	2.7 (.3)	12.6 (1.4)	25.1 (2.8)	42.2 (4.7)
Σ_H	Total	249.5 (27.7)	136.3 (15.2)	138.1 (15.4)	139.9 (15.6)	125.6 (14.0)	107.6 (12.0)	897.0 (100.0)
1970 Stock		96.3	102.0	119.0	124.6	79.3	45.3	566.5
Net Addition, 1970 - 1980		153.2 (46.4)	34.3 (10.4)	19.1 (5.8)	15.3 (4.6)	46.3 (14.0)	62.3 (18.9)	330.5

Source: Percentage distribution from the survey of 1,167 household carried out during June 10 - July 3, 1980, by the Office of Technical Manpower Studies, Dirección General del Empleo, Ministerio de Trabajo, Lima. If the average household size was 5.53, and the population of the Lima Metropolitan Area was 4.96 million, there were 897 thousand households.

Table 7 -- Characteristics of Major Housing Types

Housing Type	H0 Temporary	H1 Substandard	H2 Minimal	H3 Basic	H4 Good	H5 Excellent	Mean of Sample (median)
1. Wall materials	Many inferior: straw mats, adobe, quincha, refuse.	Some inferior: adobe, wood.	All good materials: fired bricks, reinforced concrete, concrete blocks, dressed stone.				
2. Roof materials	Same.	Wood, metal or asbestos sheets.	All good materials: reinforced concrete, clay tiles, some asbestos cement sheets.				
3. Water source	River, well, water wagon, standpipe, neighbor sells.	Public standpipe, tap shared with others.	All have piped water on the premises.				
4. Sanitary facilities	None or latrine.	Latrine, WC shared with others.	All have flush toilets connected to the sewerage system or modern septic tanks			Two or more bathrooms.	
5. Rooms, number	1-2	2-3	2-3	3-4	4-5	5 and more	3.5 (3.0)
6. Typical floor space, m^2	45	37	45	75	120	200	104
7. Typical value of structure per m^2. 1980 dollars.	Below 22	27	56	73	92	120	---
8. Typical value of structure without the site, 1980 dollars.	Below 1,000	1,000	2,500	5,500	11,000	24,000	---
9. Typical area of site, m^2	185	60	75	120	170	Over 200	148
10. Typical value of the site per m^2, 1980 dollars	Below 3	8	13	17	24	Over 35	---

Table 7 (cont'd) -- Characteristics of Major Housing Types

Housing Type	H0 Temporary	H1 Substandard	H2 Minimal	H3 Basic	H4 Good	H5 Excellent	Mean of Sample (median)
11. Typical site value, 1980 dollars	Below 350	500	1,000	2,000	4,000	Over 7,000	---
12. Rental range, 1980 dollars	Below 3.5	3.5 - 7	7 - 14	14 - 28	28 - 56	Over 56	21 (7.7)
13. Value range, 1980 dollars	Below 1,000	1 - 2,000	2 - 4,000	4 - 8,000	8 - 16,000	Over 16,000	10,000 (3,500)

Source: Survey of 1,167 household carried out during June 10 - July 3, 1980, by the Office of Technical Manpower Studies, Dirección General del Empleo, Minsterio de Trabajo, Lima; Cartilla de Instrucciones para la Declaración Jurada de Autovaluo (Lima: Consejo Provincial de Lima, 1980); and personal interviews with experts.

The way the six major housing types were distributed among six types of Metropolitan Lima neighborhoods can be seen in Table 8. The types of neighborhood are standard classifications: Luxury residential, conventional, standard urbanization, popular urbanization, Pueblos Jóvenes, and substandard-subdivided. The last category combines callejones, corralones, quintas, and rancherías. Since most of these were rented, they made up only 6.5 percent of the owner-occupied housing stock shown in Table 8 (row 2, column 7). In these neighborhoods, 36.2 percent of housing was in the lowest H0 and H1 categories, but 12.8 percent was H4 or H5, good or excellent. This contrast shows the wellknown diversity within neighborhoods of Lima: Slums can be next to mansions.

The most uniformity is found in Pueblos Jóvenes and Luxury Residential neighborhoods. In Pueblos Jovenes 52.6 percent of housing was still so incomplete, poorly serviced, and of such low value that it had to be classified as H0 or temporary. Put differently, 75.4 percent of such housing was in Pueblos Jóvenes (row 1, column 1).

At the other extreme (in the lower right corner of the table), we find that 68 percent of housing in luxury residential neighborhoods was excellent with five or more rooms made of good materials plus two or more bathrooms, etc. But 72 percent of excellent housing was outside of these wealthiest neighborhoods. Due to good maintenance, expansion, and improvements, one finds 29.8 percent of it in conventional neighborhoods, 17.4 percent in both standard and popular urbanizations, and a few are even in Pueblos Jóvenes. The role of improvements will be analyzed in the next chapter.

Table 8. Percentage of Owner-Occupied Housing by Type and Neighborhood.

	1. H0 Temporary	2. H1 Substandard	3. H2 Minimal	4. H3 Basic	5. H4 Good	6. H5 Excellent	7. Total
1. Pueblos Jovenes	52.6 (75.4)	16.8 (54.1)	15.0 (41.4)	10.9 (28.0)	3.3 (7.4)	1.5 (3.3)	100 (37.8)
2. Substandard, subdivided	23.4 (5.8)	12.8 (7.1)	27.7 (13.1)	23.4 (10.3)	8.5 (3.3)	4.3 (1.7)	100 (6.5)
3. Popular urbanization	15.6 (12.0)	12.9 (22.4)	17.7 (26.3)	18.4 (25.2)	21.1 (25.6)	14.3 (17.4)	100 (20.3)
4. Standard urbanization	7.5 (3.1)	2.5 (2.4)	13.7 (11.1)	23.8 (17.8)	26.2 (17.4)	26.2 (17.4)	100 (11.0)
5. Conventional	6.0 (3.7)	9.4 (12.9)	5.1 (6.1)	13.7 (15.0)	35.0 (33.9)	30.8 (29.8)	100 (16.2)
6. Luxury residential	0 (0)	0 (0)	4.0 (2.0)	6.0 (2.8)	22.0 (9.1)	68.0 (28.1)	100 (6.9)
Total	26.4 (100)	11.7 (100)	13.7 (100)	14.8 (100)	16.7 (100)	16.7 (100)	100 (100)

Source: 1980 Housing Survey of 724 owner occupants. Figures in parentheses show the percentage distribution within columns. Others give that of rows.

Type of neighborhood is associated with the way dwellings were built, as can be seen in Table 9. Of course, in the 38 percent of cases when the dwelling was not built by the occupants, that information was not known or not sought. That applies to a high 62 percent of conventional neighborhoods and 66 percent of the substandard, subdivided.

Self-help and mutual aid was mainly used in Pueblos Jóvenes and popular urbanizations where it made up 46 percent and 24 percent of housing. These two areas had 83 percent of such housing. They were also the areas with the largest share (68 percent) of housing built by workers hired directly by the family. As a share of the total, these two ways of creating dwellings accounted for 42.4 percent of the dwelling stock, to which some share of the second-hand dwelling stock must be added, no doubt enough to bring the total close to 60 percent.

Public agencies had supplied only 3 percent of the dwelling stock, and this was divided about evenly among conventional neighborhoods and standard or popular urbanizations. Large-scale private developers had supplied 4.8 percent of housing, and 11.5 percent had been built by a private builder for the current occupant. Nearly 48 percent of such housing was in conventional or luxury residential neighborhoods. In these neighborhoods it made up 12.4 and 30.3 percent of housing.

The percentage distribution of different types of neighborhoods within the seven major sectors of Metropolitan Lima can be seen in Table 10. Thus we see in line 6 that the Southern districts are more than 70 percent Pueblos Jóvenes, while they do not quite reach 50 percent in the North (line 5). Since the North has a population about one-third higher, even without including Rimac, the numbers in Pueblos Jóvenes in

Table 9. Builders and Neighborhoods. Percentage Distribution of Owner-Occupants

	Luxury Residential	Conventional	Standard Urbanization	Popular Urbanization	Substandard, Subdivided	Pueblos Jovenes	Total
1. Self-help, Mutual	0.8 (2.6)	5.9 (3.9)	5.6 (11.5)	19.9 (24.1)	4.8 (9.5)	63.0 (46.4)	100 (19.8)
2. Workers hired by family	5.7 (19.7)	15.5 (12.4)	3.4 (8.0)	26.5 (36.6)	6.4 (14.7)	41.3 (34.6)	100 (22.6)
3. Large-scale Developer/Private	1.8 (1.3)	35.7 (6.1)	28.6 (14.2)	26.8 (7.9)	3.6 (1.7)	3.6 (0.6)	100 (4.8)
4. Builder, private	17.2 (30.3)	30.6 (12.4)	23.1 (27.4)	15.7 (11.0)	3.7 (4.3)	6.0 (2.5)	100 (11.5)
5. Public agency	2.8 (1.3)	27.8 (3.0)	27.8 (8.8)	25.0 (4.7)	13.9 (4.3)	--	100 (3.1)
6. Dwelling was not new	7.6 (44.7)	46.0 (62.1)	7.6 (30.1)	6.7 (15.7)	17.0 (65.5)	11.21 (15.9)	100 (38.2)
7. Total	(100) 6.5	(100) 28.3	(100) 9.7	(100) 16.4	(100) 9.9	(100) 27.0	100 (100)

Source: 1980 Household survey.

the two extremes of the city are actually about the same. Unlike the South, the North also has many "popular urbanizations" -- low-cost housing developments promoted by cooperatives and the like. These can also be found East of the center, especially in San Juan de Lurigancho. Together, North and East have 80 percent of popular urbanizations, while North and South have 68 percent of Pueblos Jóvenes. Fifty-eight percent of substandard, subdivided housing are found in the central districts and in Callao, but even here they make up only a minority (16%) of the stock. For the city as a whole, that category comes to 10 percent. Forty percent of the housing stock is in conventional neighborhoods and in standard urbanizations, types that are especially characteristic of the districts that extend from San Luis to San Miguel. Beyond these, mainly along the coast are the four high-income districts that have more than half (53%) of the Lima area's luxury residential housing although it actually makes up only somewhat more than a third of the housing within the four districts.

A Comparison with 1970

The distribution of housing and incomes in 1980 may be compared with that of 1970. The median level was already at the boundary between the F2 and F3 ranges: S/50,000 or US $175. Of course, there had been only 566,500 households in 1970. As in 1980, a certain number of F3 and F4 households lived above the diagonal of the Table and many F1, F2 and F3 households lived below. Income distribution was somewhat worse than in 1980 with both more F5 households at the high end and more F1 and F2 households at the low end, but housing conditions were somewhat better in 1970.

Table 10 -- Distribution of Housing in Seven Sectors of the Metropolitan Area of Lima Among Six Types of Neighborhoods, 1980.

	1. Luxury Residential	2. Conventional	3. Standard Urbanization	4. Popular Urbanization	5. Substandard, Subdivided	6. Pueblos Jóvenes	7. All[a]
	%	%	%	%	%	%	%
1. Center: Cercado de Lima, Rimac, Breña, la Victoria.	0.7	51.7	10.9	0	21.8	14.3	100.0 (25.2)
2. Callao: Cercado de Callao, Bellavista, La Perla, Carmen de la Legua.	6.1	28.9	9.6	23.5	12.2	21.7	100.0 (9.9)
3. High-income: Miraflores, San Isidro, Barranco, Surco.	37.4	7.5	18.7	5.6	19.6	11.2	100.0 (9.4)
4. Intermediate: Jesus Maria, Lince, Magdalena, Pueblo Libre, San Luis, San Miguel, Surquillo.	15.4	54.8	17.6	3.2	9.0	0	100.0 (17.1)
5. North: San Martin de Porras, Independencia, Comas, Carabayllo	0	0	7.9	43.5	1.4	46.8	100.0 (18.5)

Table 10 (cont'd) -- Distribution of Housing in Seven Sectors of the Metropolitan Area of Lima Among Six Types of Neighborhoods, 1980.

	1. Luxury Residential	2. Conventional	3. Standard Urbanization	4. Popular Urbanization	5. Substandard, Subdivided	6. Pueblos Jóvenes	7. All[a]
6. South: Chorillos, San Juan de Miraflores, Maria del Triunfo.	0	15.7	5.7	0	8.2	70.4	100.0 (13.6)
7. East: El Agustino, Ate, San Juan de Lurigancho.	0	10.4	4.3	50.4	4.3	30.4	100.0 (9.9)
All	6.7	28.9	9.9	16.7	10.2	27.6	100.0 (100.0)

Source: June-July 1980 Housing Survey.

Note: Figures in parentheses in the last column indicate the percentage distribution of housing among the seven major sectors of Lima.

Not counting additional vacant units, the net addition to the housing stock during the 1970's had been 330,500 units worth about 700 billion 1980 soles (US $2.5 billion). Table 11 shows the distribution of the additions. About one-third of the additions were good and excellent H4 and H5 housing and represented 85 percent of housing investment. Nearly half of the new housing was in the lowest H0 category and amounted to no more than 5 percent of the value built. Many of the new units were built to replace old ones that were demolished. The tables show only the net effect.

During the 1970's the share of H2 and H3 housing fell from 43 to 31 percent of the housing stock. While the rest of the stock nearly doubled during the decade, rising by 97.0 percent, H2 and H3 housing rose by only 13.2 percent. In terms of value, only about seven percent of net additions to the dwelling stock were in this range although it was appropriate for nearly two-thirds of the population. It is no wonder that prices and rents in the H2-H3 range had a tendancy to rise 20 percent faster than the average of the housing stock.

Because of failure to encourage enough H2 and H3 building, the share of small temporary and substandard units, often without adequate public utlities, rose from 35.0 percent in 1970 to 42.9 percent in 1980.

At the high end of the scale is housing worth more than S/2.4 million (US $8,400) or renting for over S/8,000 (US $28) monthly. The share of such dwellings rose from 22 to 26 percent during 1970-80. Indeed, the rise was concentrated among excellent H5 units worth over S/4.8 million (US $16,800). Housing was already more unequally distributed than income, and during the 1970's that inequality became worse.

Table 11

Types, Number, and Cost of Dwelling Units that were Net Additions to the Occupied Housing Stock during 1970-1980.

Housing Type	Distribution of Additions (percent)	Net Additions (thousands)	Cost per Unit (1980 Dollars)	Total Cost (1980 Dollars millions)	Distribution of cost (perce
H0	46.4	153.2	880	134	5.4
H1	10.4	34.3	1,750	60	2.4
H2	5.8	19.1	3,500	67	2.7
H3	4.6	15.3	7,000	107	4.4
H4	14.0	46.3	12,300	569	23.0
H5	18.9	62.3	24,600	1,530	62.0
Total	100.0	330.5	(Average: 7,460)	2,467	100.0

Note: Cost includes site preparation and infrastructure but not pure land value.

Source: See text.

Housing Targets for 1990 - 1993

What sorts of housing will have to be built if reasonable targets are to be attained by 1990? If population grows at 4 percent annually, the Lima Metropolitan area will reach 7,342,000 in 1990. If average household size will be 5.53 persons, then 1,328,000 dwellings will be required in addition to vacant units that facilitate movement. If households "undouble" at a rapid pace, still more will be needed. Suppose that the 1980 population was only 4.43 million or 820,000 households, and that the growth rate was only 3.8 percent. In that case the number of households will not reach 1,328,000 until 1993.

If housing is neither subsidized nor unduly taxed or controlled, whatever is built is what people are expected to rent at market prices or to buy with cash or loans that cover inflation plus a competitive rate of interest. If household incomes grow at 2.5 percent annually during 1980-1990, and if the distribution around the median remains unchanged, then families will fall as shown into the categories of column 7 of Table 12. Only 10.6 percent will earn S/28,000 or less (at 1980 prices), US $97, compared with 16.8 percent in June 1980. Over US $315 will be earned by 32.4 percent, compared with the former 19.2 percent. Around sixty percent will remain in between, but that will be sixty percent of a much larger total. Row 7 shows the housing stock that will be needed. Note that it is identical to column 7. If household incomes grow at only 2.0 percent annually, this distribution will not be reached until 1993.

The housing that can be sold or rented is not the same as that which needs to be built since much of the existing stock will remain for another decade or so. Let us assume that <u>all</u> remains. For every dwelling that deteriorates, another is upgraded, so that what remains are net results.

Table 12 . Hypothetical Distribution of Housing and Households in Metropolitan Lima in 1990. (Thousands of Units and Percentages).

		1.	2.	3.	4.	5.	6.	7.
	Dwellings / Households Monthly Income	H_0 Tempo-rary	H_1 Sub-standard	H_2 Minimal	H_3 Basic	H_4 Good	H_5 Excel-lent	Σ_F
	1980 Dollars							
1.)	F_0 54 and less	27.3 (2.1)						27.3 (2.1)
2.)	F_1 54.1 - 97		112.8 (8.5)					112.8 (8.5)
3.)	F_2 97.1 - 175			333.0 (25.1)				333.0 (25.1)
4.)	F_3 175.1 - 315				423.9 (31.9)			423.9 (31.9)
5.)	F_4 315.1 - 567					273.7 (20.6)		273.7 (20.6)
6.)	F_5 Over 567						157.3 (11.8)	157.3 (11.8)
7.)	Σ_H	27.3 (2.1)	112.8 (8.5)	333.0 (25.1)	423.9 (31.9)	273.7 (20.6)	157.3 (11.8)	1,328.0 (100.0)
8.)	Remaining 1980 Housing in 1990	-	136?	138.1	139.9	125.6	107.6	651.3
9.)	Needed to Build, 1980-1990.			194.9 (28.8)	284.0 (42.0)	148.1 (21.9)	49.7 (7.3)	676.7 (100.0)

Note: The target is to have the average household in each income range on the diagonal of the matrix, which has been set up to reflect revealed preference for monthly payments of rent or investment in owner-occupied housing. If population growth is only 3.8 percent (not 4.0) and if household income growth is only 2.0 percent (not 2.5), then this distribution will not be reached until 1993.

What has to be built, then, is the difference between demand and the remaining stock. Row 8 is subtracted from row 7 to yield row 9. A total of 676,700 units has to be built in the H2-H5 categories, meaning 51 percent of the total number needed. Table 13 shows the breakdown and cost of the needed construction.

The total cost of US $5.72 billion or US $572 million per year seems astronomical. It is 150 percent more than was spent on these housing types during 1970-1980. Government cannot hope to generate that much finance directly. Yet for a population of seven million, it comes to only some US $39 monthly per household -- one sixth of average income in 1980. It is an amount that is well in line with shares that households are willing to spend on housing as a convenience and an asset. Of course, maintenance and operating expenses of the existing housing stock have to be added to these totals. Yet it is an amount that is so large that it will probably not be generated if anything impedes the development of new sites, the mobilization and security of savings, the chance to upgrade and expand old houses, and the right to rent or sublet at market prices. The scale of what is needed and what is possible is so large that government will be fully challenged in providing the infrastructure and in removing obstacles and insecurity everywhere else.

Failure to encourage enough building, as seemed to be the case during the 1970's, ironically does not mean that households will have more funds for other uses. A shortage of housing will drive up the price of the existing stock so that a larger share of income is paid for less housing. Particularly affected during the 1970's, as already stated, were H2 and H3 housing for which the supply rose relatively less and

Table 13 -- Types, Number, and Cost of Dwelling Units that Need to be Built during 1980-90 to Provide Housing Appropriate for Household Income Levels.

Housing Type	Distribution of Need (percent)	Number Needed (thousands)	Cost per Unit (1980 Dollars)	Total Cost (1980 Dollars millions)	Distribution of Cost (percent)
H2	28.8	194.9	3,500	682	12.0
H3	42.0	284.0	7,000	1,988	34.9
H4	21.9	148.1	12,300	1,822	31.8
H5	7.3	49.7	24,600	1,223	21.4
Total	100.0	676.7		5,716	100.0

Note: Cost includes site preparation and infrastructure but not pure land value. If population growth is only 3.8 percent (not 4.0) and if household income growth is only 2.0 percent (not 2.5), then these amounts will not have to be built until 1993.

prices relatively more. The higher prices were not allowed to stimulate a sufficient supply response, and a consequence of that was less construction employment, less income and multiplier effects, and finally less ability to pay for new housing.

It is likely that in 1990 (or 1993) around 140,000 or 10 percent of households will continue to earn less than US $97 monthly. In absolute numbers, this is only a 10,000 decline from the 150,000 households in the lowest ranges in 1980. If all 140,000 households are provided with a serviced site, materials, and foundations for a core house, the cost would be very high. At US $1,400 per site and core, the total comes to US $196 million annually. Nevertheless, if there are to be housing subsidies, this is where they should go and in a manner consistent with providing employment opportunities, not just housing.

V. UPGRADING: IMPROVEMENTS AND ADDITIONS

The preceding discussion has implied that a housing-employment program that avoids the distortions of the 1970's must allow a vast number of very small units to be built with long-term finance but without subsidies. If most developments were indeed to consist of no more than serviced sites (lotes y servicios), or only 25 m^2 to 35 m^2 one- or two-room dwellings, could one expect the occupants to expand and to improve them later? The vast amount of expansions and improvements that Lima households have already made leave no doubt about the answer. Much construction employment would continue to be informal, but it would be working with a better initial site and unit than was the case when the formal sector built only upper middle class housing.

Types of Improvement

Making additions and improvements to housing is an important economic activity in Lima. The vast majority of owner-occupants add rooms, plaster and paint, install better windows and doors, and improve plumbing facilities. During their mean time of ownership of 11 years, they have raised the value of their dwellings by over one-third.

The average owner-occupied dwelling of 128 m^2 was built with five onsite workdays per square meter and incorporates about 640 workdays. Of these, 152 workdays are in additions and improvement, as already discussed in connection with Table 3. They represent a 31.1 percent addition to the original 488 workdays.

The best practical way to measure improvement is by the number of types that were made and by the effect of changes on total value, holding

other elements constant. Adding a room and interior plastering and painting were the most popular types of improvement in Lima during 1960-1980. In addition many of the poor rebuilt their houses entirely, while most above the median income level changed their sanitary facilities in a major way. Improvement was a continuing activity, not one that stopped after three or four years.

Some kind of improvement or expansion of the dwelling had been made by 81.6 percent of 1980 owner occupants. Half had made more than three types of improvement, and a quarter more than five types.

Types of Improvement	Percentage	Percentage Made Below US $175 Monthly Income
None	18.4	17.0
1 - 2	30.2	30.0
3 - 5	25.6	29.1
6 or more	25.8	23.9

As can be seen in Table 14, seventeen types of improvement have been identified. Only one percent of households reported improvements that did not fit into these categories. The table shows what percentage of occupants have made each type of change, and a further breakdown divides the sample into those below and above the median income level. The average household (counting only improving households) made four or five types of changes.

The longer a household occupies a dwelling, the more types of improvement it will make. Households that had been in a place only 1-2 years averaged two types of improvement after the initial building, while those who had been there over a decade averaged 4.7 types of improvements. This steady rate of improvement by all income groups contradicts the opinions of those who believe that after reaching a certain level, perhaps H2,

Table 14 -- Percentage of Owner-Occupants Making Different Types of Improvements

Type of Improvement	Total Sample n = 724	Monthly Income US $175 or less n = 377	Monthly Income Over US $175 n = 347
A. Basic	%	%	%
1. Reconstruct the house	30.2	40.1	19.6
2. Room(s) added	41.9	46.7	36.6
3. Wall materials changed	25.3	30.5	19.6
4. Roof materials better	17.0	16.4	17.6
B. Utilities			
1. Water facilities better	25.4	27.1	44.6
2. Toilet better	26.7	22.5	56.0
3. Kitchen improvements	26.0	21.5	30.8
C. Finishes			
1. Interior plastering and painting	39.4	27.6	52.2
2. Floor improvements	30.1	28.4	32.0
3. Windows and doors improved	29.4	23.6	35.7
4. Outside plastering	19.6	18.3	21.0
5. Interior ceiling finished	11.5	8.5	14.7
D. Site Changes			
1. Grading	20.2	29.2	10.4
2. Adding fill	12.2	18.0	6.6
3. Fence or wall	10.4	6.9	14.1
4. Garden	9.9	6.1	14.1
E. Other	1.2	1.1	1.4

dwellings in new settlements will not improve further but will deteriorate into new slums.[8] On the contrary, failure to provide enough H2 and H3 units during the 1970's made these more valuable and raised the incentive to produce them through expansion and selfhelp.

In Pueblos Jóvenes, the average household had 6.2 members, including 3.2 adults, who earned US $153 monthly. In 10.4 years at the site, they had added 1.4 rooms, or rebuilt the house entirely, making four or five types of improvements altogether (See Table 15, column 6). In the rest of the Lima Metropolitan Area, families added 1.1 rooms, and the average number of improvement types was also four or five. The greatest adders and improvers were those in popular urbanizations. Deterioration occurred primarily in that part of the new housing stock that had been converted to rental use.

Rental Deterioration

Mainly owner-occupied dwellings, not rented units, are improved by those who live there. Owned dwellings therefore improve with age for about twenty years while rented units deteriorate. The average owner-occupied dwelling aged 16-20 years was worth 156 percent more than the average such dwelling aged 1-5 years. By contrast a comparably older rental unit would have lost 48 percent of its value. Even if materials, space, sanitary facilities, etc. are held constant, a ten-year-old rental unit will rent for 31 percent less than a five-year-old unit. The effect is partly due to the disincentive of rent control to landlords who might carry out maintenance or improvements. A decree of September 1977 limited annual rent increases to 10 percent for existing housing and to 12 percent for new housing. Tenure was guaranteed from one generation to the next. These terms were later modified in complex ways that continued to inhibit

the rental market. Much of the worst central city rental housing was donated or willed to the Catholic Church, the University of San Marcos, or the Beneficiencia Social, which also sells lottery tickets. High-cost housing was partially exempt.

Rent control means inability to charge what a dwelling is worth in the eyes of some potential occupants. It is difficult to raise the rent more than a nominal amount on current tenants. The longer a dwelling has been rented to a particular household, the lower rent is likely to be, and the less likely is it that this household will move. The following figures show how rents declined and value rose with years of occupancy.

Years of Occupancy by the Current Household	Monthly, rent 1980 dollars, mean,	Mean Value of Non-rented units, 1980 dollars
1-2	21.9	8,880
3-5	18.9	8,490
6-10	16.7	8,460
Over 10	10.1	10,210

The years of deterioration that go with a falling real value of rent may lead the occupants to believe that they are getting less than they are paying for. Among all current tenants, 67.9 percent said that the landlords were bad and never made any repairs or maintenance at their own expense. Another 15.7 percent found them poor, doing very little. Those who had been tenants in the past but were now owners had found them bad only 49.8 percent of the time and poor in 19.6 percent of cases. Past tenants had found landlords satisfactory or better in 30.2 percent of cases; but only 16.0 percent of current tenants now found them that good. The

Table 15 -- Characteristics of Households and Dwellings by Type of Neighborhood, Metropolitan Lima, May-June 1980.

	1. Luxury[c] Residential	2. Conventional	3. Standard Urbanization	4. Popular Urbanization	5. Substandard, Subdivided	6. Pueblos Jovenes	7. All[a]
1. Number (%)	76 (6.5)	330 (28.3)	113 (9.7)	191 (16.4)	116 (9.9)	315 (27.0)	1,167 (100.0)
2. Income, Monthly US $	501	273	254	201	187	153	235
3. Household size, No.	4.8	4.7	5.2	6.0	5.1	6.2	5.4
4. Adults, No.	3.8	3.2	3.3	3.2	3.1	3.2	3.2
5. Age of Head	52.4	47.0	44.1	42.5	45.7	43.6	45.3
6. Employed, No.	2.1	1.8	1.8	1.7	1.7	1.7	1.8
7. Value[b], US $ (n =)	35,800 (55)	13,100 (149)	10,400 (86)	8,400 (166)	5,100 (48)	2,600 (291)	9,200 (805)
8. Rent US $ (n =)	39 (19)	16 (176)	12 (26)	15 (23)	9 (66)	9 (19)	15 (341)
9. Floorspace m^2	246	100	98	109	65	87	104
10. Site Area m^2	301	107	144	173	120	152	148
11. Rooms, No.	5.79	3.49	3.90	3.68	2.72	2.97	3.51
12. Rooms added (owners)	.44	.99	.71	1.82	.54	1.38	1.20

Table 15 (cont'd) -- Characteristics of Households and Dwellings by Type of Neighborhood, Metropolitan Lima, May-June 1980.

	1. Luxury[c] Residential	2. Conventional	3. Standard Urbanization	4. Popular Urbanization	5. Substandard, Subdivided	6. Pueblos Jóvenes	7. All[a]
13. Improvements, No. (owners)	3.3	5.4	3.0	5.5	4.4	4.4	4.5
14. Years at Site	12.2	12.5	7.6	9.5	13.8	10.4	11.0

Source: May - June 1980 Housing Survey.

Notes: a. Includes 26 unclassified households.

b. No value was indicated by 21 households, including some of the 82 free users.

aggravation of rent controls as prices rise has inevitably affected the volume of private rental construction and conversion. Note also the steady decline of rental income as a percentage share of gross domestic product:[9]

1950-51	8.9
1955-56	7.9
1960-61	7.3
1965-66	6.4
1970-71	6.1
1975-76	5.9

The share of rental units in the Peruvian housing stock fell from 84.9 percent in 1940, to 69.1 percent in 1961, and 39.1 percent in 1972. In our 1980 Metropolitan Lima sample it was 29.2 percent. Among owning households of the sample, only 3.3 percent (24) said that they had financed additions by taking in lodgers or tenant families in rooms, apartments, or houses on the lot where they lived. They were two-thirds of sample landlords. Nineteen percent of sample tenants said they lived on the same site as their landlords. Only four households claimed that rent from tenants living on the same site was their primary source of income, more important than all other sources combined. No doubt rent control in time of inflation has discouraged additions and improvements for earning this type of income. If renting is not a secure and profitable activity, the rental stock of housing will continue to deteriorate. Note that in Lima the average value of owned housing of S/2.8 million (US $9,800) was comparatively high: 3.25 times the annual income of occupants. The average rent of S/6,020 (US $21) was low, however: only 9.8 percent of the monthly income of tenants.

Characteristics of Upgrading Households

The average owning household in 1980 consisted of six members: Two or three children under 18 and three or four adults. Two of the adults were workers, and 7.5 percent were unemployed. Their combined monthly income from all sources averaged S/71,900 (US $252). Mean age of the head was 47 years, and the family had lived in the dwelling for 11 years, as mentioned above. During this period they had expanded its size from 92 to 128 square meters for a 1980 improvement of about S/770,000 (US $2,700) and thus brought its value to S/2.6 million (US $9,100). Two persons per room was typical, but a fifth of households (average size, 6.9 persons) considered themselves too crowded, and two or three people were willing to move out if they could find an affordable separate dwelling.

Since almost all owners make improvements, the process is not strongly associated with differences in income. Poor households, it is true, can afford to make fewer improvements; but they can also afford less housing to begin with and therefore want to make more improvements. The net result is that the poor make different types of improvement -- those types that bring a rudimentary shack to a minimal level of size and quality. They level the site, bring in fill, change the walls and roof, and plaster the inside. (See Table 14 or 16).

Especially interesting is that, given income, those poor with access to a sewer system connection will make three times as many types of improvement as those without. That connection not only makes sanitary improvements physically possible, but it may also be the critical factor that gives a household pride and confidence in the value of a particular site. With all other characteristics of a house unchanged, access to the public sewerage system will raise dwelling value by 50 percent. If it is then rebuilt with permanent instead of temporary, makeshift materials, its

value will quadruple. Thus infrastructure provision has a strong employment multiplier. Availability of infrastructure in different types of Lima neighborhoods is shown in Table 17, which also gives type of tenure. The greatest deficiency was in Pueblos Jóvenes (column 6).

A leading characteristic of the poorer households who live in worse housing is that they are younger. Average age of the household head in the lowest two housing categories is 44 years, and in the lowest two income categories, 45 years. In the highest income and housing categories, average age is 50 years.

Income and the life cycle stage of the household are obviously correlated. What matters in this connection is the number of working adults. The highest compared with the lowest income range has twice as many adults per household but three times as many employed workers. In fact, their average number is exactly three. By housing category the pattern is less pronounced with the number of employed workers per household rising from 1.6 to 2.3 from the lowest H0 to the highest H5 range.

Essentially, if a household grows with additional adults, rooms are likely to be added. A fall in the birth rate in Peru will probably not lower the incentive to improve dwellings for about 18 years, that is, until the decline lowers the growth rate of the adult population.

Table 16 -- Percentage of Owner-occupants Making Different Types of Improvements in Different Types of Neighborhoods, Lima, 1980.

	1. Luxury Residential	2. Conventional	3. Standard Urbanization	4. Popular Urbanization	5. Substandard, Subdivided	6. Pueblos Jóvenes	7. All[a]
A. Basic	%	%	%	%	%	%	%
1. Reconstruct the house	6.0	9.4	10.0	37.4	12.8	49.3	30.2
2. Room(s) added	24.0	31.6	25.0	55.1	21.3	51.5	41.9
3. Wall materials changed	6.0	13.7	8.8	38.8	19.1	32.8	25.3
4. Roof materials better	4.0	12.8	8.8	30.6	8.5	17.9	17.0
B. Utilities							
1. Water facilities better	12.0	14.5	12.5	32.0	21.3	33.2	25.4
2. Toilet better	24.0	27.4	18.8	33.3	21.3	25.9	26.7
3. Kitchen improvements	22.0	23.9	26.2	40.8	12.8	21.2	26.0
C. Finishes							
1. Interior plastering and painting	56.0	50.4	43.8	47.6	38.3	25.2	39.4
2. Floor improvements	22.0	28.2	17.5	44.9	17.0	30.3	30.1
3. Windows and doors improved	26.0	29.1	27.5	41.5	23.4	24.8	29.4
4. Outside plastering	6.0	23.1	10.0	25.9	19.1	20.1	19.6
5. Interior ceiling finished	4.0	10.3	11.2	23.1	2.1	28.9	11.5

Table 16 (cont'd) -- Percentage of Owner-occupants Making Different Types of Improvements in Different Types of Neighborhoods, Lima, 1980.

	1. Luxury Residential	2. Conventional	3. Standard Urbanization	4. Popular Urbanization	5. Substandard, Subdivided	6. Pueblos Jóvenes	7. All[a]
D. Site Changes							
1. Grading	2.0	1.7	2.5	20.4	4.3	39.8	20.2
2. Adding fill	2.0	.9	2.5	13.6	4.3	23.7	12.6
3. Fence or wall	12.0	13.7	21.2	10.2	6.4	6.6	10.4
4. Garden	14.0	12.0	13.7	16.3	--	5.8	9.9
E. Other	4.0	0.9	1.2	2.7	--	0.4	1.2

Table 17 -- Utilities and Tenure of Dwellings by Type of Neighborhood, Metropolitan Area Lima, May-June, 1980.

	1. Luxury Residential	2. Conventional	3. Standard Urbanization	4. Popular Urbanization	5. Substandard, Subdivided	6. Pueblos Jóvenes	7. All[a]
Water	%	%	%	%	%	%	%
1. Two or more bathrooms	46.1	16.7	15.9	6.3	1.7	1.9	11.4
2. One bathroom	48.7	51.5	61.9	55.5	49.1	23.5	45.1
3. Own tap, no shower	1.3	7.3	9.7	12.6	16.4	35.2	16.5
(sum, 1-3)	(96.1)	(75.5)	(87.5)	(74.4)	(67.2)	(60.6)	(73.0)
4. Shared tap	3.9	20.9	7.1	8.9	27.6	6.7	13.3
5. Water truck	0	0	.9	12.6	0	22.2	8.1
6. Other	0	3.6	4.5	4.1	5.2	10.5	5.8
	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Sanitation							
7. Sewerage system connection	94.7	73.6	79.6	66.0	58.6	36.2	62.5
8. Septic tank	0	.3	4.4	2.1	2.6	4.1	2.3
9. Shared facilities	5.3	20.6	6.2	7.9	30.2	1.6	11.9
10. Latrine	0	.9	6.2	19.9	5.2	41.0	15.7
11. None	0	3.6	3.5	4.2	3.4	16.2	7.0
	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Tenure							
12. Percent Owner-occupants	65.8	35.5	70.8	77.0	40.5	87.0	62.0
13. Percent of Owner-occupants who are landlords	8.0	12.8	2.5	4.8	12.8	1.1	5.5

Table 17 (cont'd) -- Utilities and Tenure of Dwellings by Type of Neighborhood, Metropolitan Lima, May-June, 1980.

	1. Luxury Residential	2. Conventional	3. Standard Urbanization	4. Popular Urbanization	5. Substandard, Subdivided	6. Pueblos Jóvenes	7. All[a]
14. Owners, clear title,	48.7	26.4	29.2	62.8	31.0	84.8	50.3
15. Owner, mortgaged	15.8	4.8	24.8	6.3	4.3	2.2	7.0
16. Hire-purchase	1.3	4.2	16.8	7.9	5.2	0	4.7
17. Rented	26.3	53.6	23.0	12.0	56.9	6.0	29.4
18. Lent free by family	3.9	3.6	3.5	9.4	.9	4.1	4.5
19. Other	3.9	7.3	2.7	1.5	1.8	2.9	4.1
	100.0	100.0	100.0	100.0	100.0	100.0	100.0
20. Number	76	330	113	191	116	315	1,167

Source: May-June 1980 Housing Survey.

Notes: a. Includes 26 unclassified households.

Paying for Improvements

About 92 percent of improvements and expansions were financed without loans, and 64 percent of changes were made with selfhelp labor. Households below the median income level had carried out three quarters of their improvements by paying cash for the materials and doing the work themselves. Above the median income level, somewhat more than half of the improvements had been made by selfhelp, but some of these had been completed before the household had reached the median income level. Most households well above the median will pay cash for the materials and hire a group of workers for the job. The credit that paid for about 8 percent of improvements came mainly from a variety of formal sources, not from materials suppliers or friends and relatives. Credit was somewhat more important below than above the median income level. In Pueblos Jóvenes 73 percent of improvements were made with selfhelp, and 96 percent of these had no credit or loans for the materials. Selfhelp improvement was even more important in popular urbanizations, about 80 percent. Of these 97 percent had neither credit nor loans for the materials. See Table 18.

Of interest is not only how improvements were actually financed in the past, but how they might be paid for in the future. Respondents were asked if any members of their families would be available for work on community projects, digging trenches, carrying materials, and the like, if payment were only in building materials that could not be resold but had to be installed on their own dwellings. Seventy-two percent said they would.

Table 18 -- Improvement Financing. Percentage Distribution, Metropolitan Lima, May-June, 1980.

	1. Luxury Residential	2. Conventional	3. Standard Urbanization	4. Popular Urbanization	5. Substandard, Subdivided	6. Pueblos Jóvenes	7. All[a]
	%	%	%	%	%	%	%
1. Selfhelp, cash for materials	30.9	47.8	54.9	77.1	72.3	69.8	61.4
2. Selfhelp credit for materials	--	--	--	0.7	--	0.7	0.3
3. Selfhelp loans for materials	--	0.9	4.9	2.0	1.2	2.5	1.9
4. Cash for labor and materials	61.8	48.2	36.6	11.8	25.3	18.3	30.6
5. Loans from friends or relative for all work	--	0.9	--	0.7	1.2	1.9	1.0
6. Loans from credit institutions for all work	7.3	1.8	3.7	7.2	--	5.6	4.2
7. Other	--	0.4	--	0.7	--	1.1	0.6
	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: May-June 1980 Housing Survey.

Note: a. Includes 26 unclassified households.

Respondents were also asked, "Were it possible, would you mortgage your house to obtain money for an addition or an improvement?" Among owners 18.0 percent said, yes. On the less sever terms of the Banco de Materiales, many more seemed willing to borrow to expand.

Improvements raise dwelling value, not just in line with their cost, but primarily in accordance with the willingness of others to pay that much more for an improved unit. After all, to determine value, we had asked, "If you were going to sell your dwelling today, at what price do you believe that you could sell it?" In Lima this value primarily reflects the quality of the dwelling structure, and the neighborhood, not distance. Mainly at the high end of the value scale did distance assume importance. With all other characteristics the same, a dwelling that makes these workers travel twice as long to their jobs will be worth 15 percent less. On the average, high income workers travel 25 minutes to work. They would travel 50 minutes, if they could purchase an identical S/7.2 million (US $25,000) house for only S/6 million (US $21,000).

In general, double the distance would cost a dwelling only 10 percent of its value if the type of neighborhood were the same. Variations in neighborhood with other characteristics unchanged are such that an identical dwelling will be worth 86 percent more if the surroundings are conventional instead of a Pueblo Joven. The underlying econometrics is a hedonic price analysis.

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Pueblo Joven	100
Substandard, subdivided	148
Popular urbanization	152
Standard urbanization	165
Conventional	186
Luxury residential	230

Hedonic Price Analysis

The determination of the relative importance of different housing attributes with hedonic price analysis has become a standard approach among economists. Assumed is that the competitive interaction of demand and supply gives an equilibrium price per unit (such as 1.0 m^2) for each attribute. That price is multiplied by the quantity of the attribute, for example, floorspace, to determine its contribution to value. Where variables are not continuous but either present or absent, there is either a given contribution to value or none. The given contribution may, however, be a specific percentage increase that depends on other components, not a fixed pecuniary amount. Plastering adds more to the value of a large house than to a small one although its percentage contribution may be the same.

The usual way of estimating the hedonic price equation is in log-linear functional form in which all variables are expressed in logarithms. The price of the house (as estimated by owners) is regressed against such attributes as age, floorspace, number of rooms, and distance from workplaces. Dummy variables that are either 1.0 or 0.0 are used for the presence or absence of quality materials, access to water, sanitary facilities, and electricity. All these are known for a set of observations, such as the households in our survey. The coefficients of the independent variables that the regression yields and that are reported in Tables 19 and 20 are the hedonic prices for attributes of owner-occupied and rented dwellings.

As Table 19 shows, twelve characteristics turned out to be significant at the 95 percent confidence level or better. Altogether they explained about 75 percent of variations in value.

The most important characteristics are basic materials, number of rooms, floorspace, and plumbing facilities. Let us show how improvements in each of these affects total value. Suppose we begin with a two-room, 40 m^2 shack made of straw mats, wood, and refuse, worth ₱170,000 (US $600). If the shack is rebuilt with bricks, concrete blocks, and reinforced supports and roof, its value more than triples to ₱554,000 (US $1,900). [(antilog .613)(antilog .551)(170,000)=544,000.] The shack has moved from the H0 Temporary into the H1 Substandard category. If it is now connected to the sewerage system and has a complete bathroom installed, it moves to the minimal category, and its value doubles to ₱1.1 million (US $3,900). [(antilog .413)(antilog .297)(544,000)=1,106,000.] It does not cost ₱562,000 (US $2,000) to make the plumbing installation, but the inconvenience of no water and no sewer-connected bathroom makes a dwelling without them worth half as much. The value that households attach to such facilities, their willingness to pay, is what makes water and sewerage infrastructure such a desirable urban investment.

If the sample dwelling is now plastered and painted on the outside, its value rises by 18.4 percent to ₱1,310 million (US $4,600).

Now let us double the size of the dwelling from two to four rooms and from 40 to 80 square meters. The coefficients found for rooms and floorspace in the double-logarithmic regression are elasticities. Using the coefficients from Table 19, column 1, rows 2 and 3, we see that 100

percent more floorspace raises value by 26.1 percent; and that doubling the number of rooms raises value by 34.6 percent. Together they raise it by 83.5 percent. The effect on the illustrative dwelling is to bring its value to $2.4 million (US $8,400). One additional room would move the dwelling from the H3 Basic to the H4 Good category.

Housing Characteristics and Rental Value

Having just illustrated the way in which a hedonic regression can reflect and explain value, an aside on rent and housing characteristics is appropriate. Table 20 shows what happens when the identical variables of Table 19 are regressed on monthly rent. Striking is that much less of the variance is explained: $\bar{R}^2 = .574$, not .746 as before. Only three, not twelve variables are statistically significant at the 95 percent level or better. Only one of these three was also significant for owner-occupants. That one is the presence of two or more bathrooms, an element unlikely to exist in low-cost dwellings affected by rent control.

One of the other two variables is the negative association with having neighbors with higher incomes than one's own. Why that should depress rent is not clear. The negative association of rent with a building's age is more obvious and contrasts with the positive association of value and age for owner-occupants. As stated before, owner-occupants improve their premises, while neither tenants nor landlords have an incentive to make improvements under rent control. That the remaining twenty physical characteristics of a dwelling do not explain its rental level is probably due to inability to charge what the bundle is worth in the eyes of tenants since it is especially difficult to raise the rent to market levels on current tenants.

Table 19 -- Determinants of Dwelling Value: Hedonic (log - log) Regression Coefficients, Lima, 1980.

Variable	Total Sample n = 805	Total Sample, District Dummies n = 805	Low Range: H0-H3 n = 554	High Range: H3-H5 n = 372
1. Age of dwelling	.076 (.040)	.066 (.040)	.121** (.046)	-.047 (.043)
2. Floorspace	.261** (.068)	.269** (.068)	.180* (.086)	.222** (.064)
3. Number of rooms	.346** (.092)	.306** (.089)	.260* (.111)	.323** (.101)
4. Walls made of bricks, concrete blocks, or reinforced concrete	.621** (.102)	.666** (.099)	.613** (.103)	.292 (.252)
5. Roof made of tiles or reinforced concrete	.746** (.104)	.654** (.103)	.551** (.110)	-.008 (.147)
6. Exterior plastered and painted: finished	.169* (.078)	.082 (.078)	.133 (.087)	.111 (.094)
7. Water access (dummies)				
a. Own tap, no shower	.033 (.104)	.059 (.102)	.077 (.105)	-.136 (.247)
b. One complete bathroom	.374** (.145)	.266 (.143)	.297* (.151)	.155 (.238)
c. Two or more bathrooms	.839** (.176)	.624** (.176)	.020 (.477)	.550* (.248)
8. Sanitation (dummies)				
a. Latrine	.068 (.138)	.032 (.133)	.097 (.137)	.014 (.627)
b. Shared flush toilet	.517* (.242)	.147 (.243)	.435 (.248)	.345 (.792)
c. Septic tank	.176 (.220)	.183 (.213)	.052 (.225)	.253 (.631)
d. Sewerage system connection	.481** (.171)	.410* (.166)	.413* (.172)	.052 (.583)

Table 19 -- (continued)

Variable	Total Sample n = 805	Total Sample, District Dummies n = 805	Low Range: H0-H3 n = 554	High Range: H3-H5 n = 372
9. Electricity (dummies)				
a. Monophase	-.061 (.114)	-.081 (.111)	-.036 (.116)	-.044 (.285)
b. Triphase	.340* (.172)	.124 (.178)	.319 (.322)	.364 (.299)
10. Site area	.274** (.058)	.272** (.057)	.233** (.069)	.112 (.058)
11. Travel time to work, average, all workers	-.136** (.044)	-.108* (.043)	-.079 (.050)	-.164** (.050)
12. Income of neighbors (dummies)				
a. Higher than own	.029 (.110)	-.024 (.108)	-.122 (.131)	.115 (.119)
b. Lower than own	-.271 (.149)	-.200 (.146)	-.151 (.160)	-.251 (.183)
13. Constant	9.531** (.359)	9.395** (.355)	9.836** (.427)	12.910* (.801)
14. Adjusted R^2	.746	.761	.532	.483
15. F Statistic	93.69	77.38	25.23	14.47
16. Mean value of dwelling, US $ of 1980	8,900	8,900	2,440	17,900

Source: Survey of 1,167 households, June 10 - July 3, 1980.

Note: Statistical significance at the .01 level is indicated by two stars and that at the .05 level by one star. Standard errors are given in parentheses. US $1 = 285 soles.

The low range includes all dwellings worth 2.4 million soles or less. The high range includes all dwellings worth more than 1.2 million soles. Value was determined by asking, "If you were going to sell your dwelling today, at what price do you believe that you could sell it?"

Table 19 -- (continued)

The coefficients of the district dummies with Pueblos Jóvenes as a base are:

a.	Luxury	.831** (.172)	d.	Popular/Urbanization	.420** (.091)
b.	Conventional	.621** (.120)	e.	Substandard, subdivided	(.394)* .160
c.	Standard urbanization	.501** (.126)	f.	Unclassified district	.272** (.057)

In separate regressions for the six neighborhood types the coefficients (when significant) were about the same or somewhat higher than those for the low and high ranges. Adjusted R^2's were higher only for the Conventional neighborhoods (.826) and for Popular Urbanizations (.692).

Table 20 -- Determinants of Rent: Hedonic (log - log) Regression Coefficients, Lima, 1980.

Variable	Total Sample n = 341	Low Range: H0-H3 n = 294	High Range: H3-H5 n = 372
1. Age of dwelling	-.313*	-.240	-.275
	(.156)	(.202)	(.177)
2. Floorspace	.041	.141	-.025
	(.352)	(.438)	(.436)
3. Number of rooms	.359	.271	.137
	(.314)	(.373)	(.418)
4. Walls made of bricks, concrete blocks or reinforced concrete	-.388	-.493	.383
	(.393)	(.425)	(.479)
5. Roof made of tiles or reinforced concrete	.589	.606	----
	(.404)	(.438)	
6. Exterior plastered and painted: finished	-.235	-.348	----
	(.438)	(.476)	
7. Water access (dummies)			
a. Own tap, no shower	.896	1.064*	-.403
	(.497)	(.533)	(.661)
b. One complete bathroom	.799	.829	-.404
	(.481)	(.516)	(.234)
c. Two or more bathrooms	1.533**	1.215	----
	(.582)	(.827)	
8. Sanitation (dummies)			
a. Latrine	-1.772	-1.940	----
	(1.172)	(1.259)	
b. Shared flush toilet	.427	.358	----
	(.562)	(.621)	
c. Septic tank	-.974	-.738	----
	(1.056)	(1.123)	
d. Sewerage system connection	.093	.204	----
	(.592)	(.643)	

Table 20 -- (cont'd)

Variable	Total Sample n = 341	Low Range: H0-H3 n = 294	High Range: H3-H5 n = 105
9. Electricity (dummies)			
a. Monophase	.019 (.407)	.484 (.480)	.361 (.600)
b. Triphase	.419 (.527)	.490 (.889)	.569 (.623)
10. Site area	.335 (.307)	.190 (.388)	.396 (.381)
11. Travel time to work, average, all workers	.045 (.143)	.007 (.179)	-.045 (.175)
12. Income of neighbors (dummies)			
a. Higher than own	-.878** (.296)	-.726* (.327)	-.075 (.449)
b. Lower than own	-.067 (.317)	.901 (.343)	.684 (.384)
13. Constant	6.181** (1.209)	6.700** (1.429)	7.466** (1.831)
14. Adjusted R^2	.574	.290	.213
15. F Statistic	7.45	2.52	1.769
16. Mean monthly rent, dollars	21.1	9.3	43.2

Source: Survey of 1,167 households, June 10-July 3, 1980.

Note: Statistical significance at the .01 level is indicated by two stars and that at the .05 level by one star. Standard errors are given in parentheses. US $1 = 285 soles.

The low range includes all dwellings renting for US $28 or less. The high range includes all dwellings renting for more than US $14.

In the high range a number of variables dropped out because virtually all or no dwellings had that characteristic.

VI. OCCUPATIONS AND HOUSING

So far housing has been related to employment in two primary ways -- the employment that goes with the building process and how any type of employment generates income for buying, renting, or improving dwellings. In this last section, we become more specific. We consider the way types of occupations, from unskilled construction worker to manager, go with different types of housing. In addition, we divide occupations into two categories, those that are carried on in a home business and those that are not.

Type of Employment and Housing

Does the type of housing vary with the type of employment of the occupants? This question has many aspects, and some of these can be addressed with data from the 1980 housing survey. As can be seen in the tables, occupations of household heads were grouped in the usual fashion, except that the professional category was subdivided three ways and that construction workers were singled out from other skilled and unskilled manual workers, respectively. Educators and salespeople are those of all levels, from teacher to rector, from hawker to wholesaler. Public and private sector work are combined in the categories, which are standard classifications. The "others" category includes a single miner, people on pensions, etc.

Table 21 shows incomes, dwelling values, and montly rent. Construction workers were the poorest, receiving the equivalent of only US $150 monthly, with the skilled receiving only 5 percent more than the unskilled from all household income sources. Administrators and technical professionals received three or four times as much, around $500 monthly.

But they lived in dwellings worth nine times as much as those of skilled construction workers, who, in turn, lived in dwellings with double the value of unskilled construction workers -- if dwellings were owned. Value ranged from about one-year's income for unskilled construction workers to about four and a half year's worth for the highest income groups. As previously noted, housing was more unequally distributed than income because of insufficient mid-level H2 and H3 housing.

Part of the value of housing is due to land values in a neighborhood, which reflects a variety of amenities. Over half of unskilled and skilled construction workers lived in Pueblos Jóvenes, while more than half of professionals and managers lived in the best conventional and residential districts. They made up more than half of the working population in luxury residential areas.

Salespeople and office workers were the most common category in conventional neighborhoods; service workers were most important in standard urbanizations, and skilled workers not in construction were most important in popular urbanizations. (See Table 22).

Construction workers, skilled workers, salespeople, and educators had added one room since moving in. For others the average addition was only half a room, meaning about half had added one, and the other half, none. The major adders were usually the major improvers in other ways, having made three or more different types of improvement, while others had made less than three. But the difference is not large, as may be seen in Table 23. In terms of the overall effect of all this, skilled manual workers, in construction or out, were the leading improvers. However, more unskilled construction workers than anyone (36 percent)

Table 21. Monthly Income, Housing Value, and Rent by Occupation of the Household Head. Percentage Distribution.

	Monthly Household Income US $	Dwelling Value US $	Value / Income	Monthly Rent US $	Proportion of Renters, Percent	n=
1. Skilled construction workers.	154	2,924	19	6	26	119
2. Other skilled workers and artisans.	177	4,683	26	8	29	221
3. Unskilled construction workers.	147	1,529	10	11	18	11
4. Other unskilled workers.	182	2,923	16	3	13	15
5. Office workers.	279	12,812	46	19	40	129
6. Salespeople.	205	7,777	38	13	28	225
7. Agriculture, fisheries.	186	4,939	27	11	20	20
8. Service workers.	196	6,753	34	12	28	177
9. Professional technicians.	461	26,288	57	27	26	51
10. Educators.	298	9,740	33	14	14	21
11. Other professionals.	351	19,964	57	45	27	44
12. Administrators, managers.	528	27,551	52	33	38	73
13. Others.	133	17,606	132	12	37	61
14. Total Sample.	235	9,817	42.0	15	29	1167

Source: Survey of June 10 - July 3, 1980.

Table 22. Distribution of Households by Occupation of the Head among Neighborhood Types. Percentages.

	Luxury Residential	Conventional	Standard Urbanization	Popular Urbanization	Substandard, Subdivided	Pueblos Jovenes	Tota
1. Skilled construction workers.	2.5 (3.9)	16.8 (6.1)	5.9 (6.2)	12.6 (7.9)	5.0 (5.2)	54.6 (20.6)	10((10.2
2. Other skilled workers and artisans.	0.9 (2.6)	24.9 (16.7)	8.1 (15.9)	18.6 (21.5)	9.0 (17.2)	37.1 (26.0)	10((18.9
3. Unskilled construction workers.	--	18.2 (0.6)	--	18.2 (1.0)	--	54.5 (1.9)	10((0.9
4. Other unskilled workers.	--	13.3 (0.6)	6.7 (0.9)	6.7 (0.5)	13.3 (1.7)	53.3 (2.5)	10((1.3
5. Office workers.	7.0 (11.8)	45.0 (17.6)	10.1 (11.5)	18.6 (12.6)	4.7 (5.2)	10.1 (4.1)	100 (11.1
6. Salespeople.	5.3 (15.8)	27.6 (18.8)	7.1 (14.2)	17.8 (20.9)	13.3 (25.9)	28.0 (20.0)	100 (19.3
7. Agriculture, fisheries.	5.0 (1.3)	10.0 (0.6)	15.0 (2.7)	15.0 (1.6)	35.0 (6.0)	20.0 (1.3)	100 (1.2
8. Service workers.	2.8 (6.6)	22.0 (11.8)	12.4 (19.5)	18.1 (16.8)	14.1 (21.6)	27.7 (15.6)	100 (15.2
9. Professional technicians.	25.5 (17.1)	29.4 (4.5)	17.6 (8.0)	13.7 (3.7)	7.8 (3.4)	3.9 (0.6)	100 (4.4
10. Educators.	14.3 (3.9)	28.6 (1.8)	9.5 (1.8)	23.8 (2.6)	4.8 (0.9)	19.0 (1.3)	100 (1.8
11. Other professionals.	15.9 (9.2)	43.2 (5.8)	13.6 (5.3)	18.2 (4.2)	2.3 (0.9)	4.5 (0.6)	100 (3.8
12. Administrators, managers.	19.2 (18.4)	42.5 (9.4)	13.7 (8.8)	4.1 (1.6)	8.2 (5.2)	8.2 (1.9)	100 (6.3
13. Others.	11.5 (6.5)	31.2 (5.8)	8.2 (4.4)	16.4 (5.2)	13.1 (6.9)	18.0 (3.5)	100 (5.2
14. Total Sample.	6.5 (100)	28.3 (100)	9.7 (100)	16.4 (100)	9.9 (100)	27.0 (100)	100 (100

Table 23. Extent of Dwelling Improvement by Owner Occupants according to the Occupation of the Head of the Household.

	"Dwelling Much Improved"	Number of Improvement Types	Number of Rooms	Number of Rooms Added
1. Skilled construction workers.	23	3.5	2.8	1.0
2. Other skilled workers and artisans.	23	3.2	3.1	1.0
3. Unskilled construction workers.	36	3.1	2.8	0.8
4. Other unskilled workers.	7	1.3	2.9	0.3
5. Office workers.	16	2.3	4.0	0.6
6. Salespeople.	20	3.0	3.2	0.8
7. Agriculture, fisheries.	10	1.9	3.0	0.5
8. Service workers.	18	2.7	3.1	0.7
9. Professional technicians.	14	2.6	5.0	0.5
10. Educators.	10	3.1	4.9	1.1
11. Other professionals.	18	2.8	4.5	0.4
12. Administrators, managers.	21	3.0	5.3	0.5
13. Others.	18	2.2	3.5	0.5
14. Total Sample.	19	2.8	3.5	0.7

Source: Survey of June 10 - July 3, 1980.

considered their dwellings "much improved." Other unskilled workers had done the least, with only 7 percent finding their dwellings "much improved." Their incomes were higher, but their abilities were less.

The amount of improvement should, of course, be related to the state of the dwelling and the stage of the household in its life cycle. While the heads of most households were in their mid-40's (around the sample average of 45.3), unskilled construction workers were substantially younger, around 38.6. Nevertheless, their household size of 5.7 was close to the sample average of 5.4. They had been the fewest years at the site, 8.6 years compared with an average of 11.0; and the age of their dwelling -- 6.2 years, was less than half the average age -- 13.4 years. (See Table 24).

Educators had lived the longest at given sites, 15.8 years, and lived in even older dwellings, averaging 17.1 years. The typical head, aged 50, had moved to his dwelling at age 36.

Among all occupational groups, 30-47 percent lived in dwellings that had been built for others. Selfhelp building was naturally most important for construction workers, especially the skilled, who had acquired buildings that way at a rate of 45 percent, more than double the sample average of 20 percent. Officer workers, managers, and non-technical professionals often hired a private builder, but other occupational groups were more likely to hire workers directly, acting as their own contractors. Nontechnical professionals were more likely than others to buy a dwelling from a large private developer. (Table 25)

Table 24. Household and Dwelling Characteristics according to the Occupation of the Head of the Household.

	Age of Household Head	Household Size	Years at Site	Age of Dwelling	Area of Site (M^2)	Area of Dwelling (M^2)
1. Skilled construction workers.	42.3	6.2	10.8	9.8	176.9	74.3
2. Other skilled workers and artisans.	44.2	5.6	11.3	13.2	121.9	83.0
3. Unskilled construction workers.	38.6	5.7	8.6	6.2	130.1	74.1
4. Other unskilled workers.	44.9	6.4	13.3	13.9	81.4	67.7
5. Office workers.	45.4	4.9	9.4	15.1	123.4	105.1
6. Salespeople.	43.9	5.7	10.7	12.6	127.9	104.4
7. Agriculture, fisheries.	50.1	6.0	9.2	8.5	114.5	84.3
8. Service workers.	44.7	5.8	11.0	12.9	144.9	83.8
9. Professional technicians.	45.7	5.0	10.3	15.5	344.3	178.2
10. Educators.	50.0	5.7	15.8	17.1	150.7	140.5
11. Other professionals.	47.4	4.3	11.0	15.3	154.1	147.6
12. Administrators, managers.	45.7	5.1	10.7	16.9	191.6	200.3
13. Others.	57.7	3.1	15.0	17.5	138.4	101.0
14. Total Sample.	45.3	5.4	11.0	13.4	148.4	104.5

Source: Survey of June 10 - July 3, 1980.

Table 25. Manner of Constructing the Dwelling. Owner-occupants according to the Occupation of the Head of the Household. Percentage Distribution.

	Self-help, Mutual Aid	Workers Hired by Family	Private Large Scale Developer	Private Builder	Public Agency	Dwelling was not new	Total
1. Skilled construction workers.	45	20	2	1	1	31	100
2. Other skilled workers and artisans.	23	26	2	6	3	40	100
3. Unskilled construction workers.	36	27	0	0	0	36	100
4. Other unskilled workers.	20	13	0	7	13	47	100
5. Office workers.	8	16	9	19	3	44	100
6. Salespeople.	19	30	2	9	4	37	100
7. Agriculture, fisheries.	25	30	0	5	10	30	100
8. Service workers.	23	24	4	11	4	34	100
9. Professional technicians.	4	26	12	18	4	37	100
10. Educators.	19	24	10	14	0	33	100
11. Other professionals.	7	5	21	23	2	43	100
12. Administrators, managers.	4	15	6	29	3	44	100
13. Others.	18	16	7	16	0	43	100
14. Total Sample.	20	23	5	12	3	38	100

Source: Survey of June 10 - July 3, 1980.

The richest group, administrators, occupied dwellings three times as large as the poorest -- unskilled workers: 200 m^2 compared with 70 m^2. The smaller difference in site area, (192 m^2 vs 81 m^2) was due to the fact that the poor had their one-story dwellings on sites larger than the house, while the rich had their multi-story houses on sites smaller than the floorspace. The average was a 105 m^2 dwelling on a 148 m^2 lot. With 344 m^2, technical professionals occupied the largest sites with their 178 m^2 dwellings.

At 74 m^2, dwellings of skilled and unskilled construction workers were equal in size, but the skilled had double the value per m^2 although both lived primarily in Pueblos Jóvenes. An important difference between the skilled and unskilled construction workers' dwellings is access to water and the sewer system. Only 9 percent of the unskilled had that, less than any other group. By contrast, 42 percent of skilled construction workers had a sewer system connection, and over one third had a complete bathroom. (Table 26). Thus they were both more able and more motivated to make improvements.

Except for educators, nearly all professionals and managers had a sewer system connection, and over a fourth had two or more bathrooms. Office workers and educators were somewhat below those levels. About half of non-construction skilled manual workers, salespeople, and other service workers had a sewer system connection and at least one complete bathroom.

Table 26. Type of Water and Sanitary Facilities according to the Occupation of the Head of the Household. Percentages.

	Two or More Bathrooms	One Complete Bathroom	Public Standpipe	Sewerage System Connection
1. Skilled construction workers.	0.8	33.6	6.7	42.0
2. Other skilled workers and artisans.	3.2	40.7	3.6	51.6
3. Unskilled construction workers.	--	9.1	9.1	9.1
4. Other unskilled workers.	6.7	26.7	13.3	26.7
5. Office workers.	14.7	64.3	0.8	81.4
6. Salespeople.	9.8	40.9	1.3	56.4
7. Agriculture, fisheries.	5.0	55.0	5.0	50.0
8. Service workers.	7.9	39.5	2.8	59.3
9. Professional technicians.	29.4	56.9	--	94.1
10. Educators.	14.3	66.7	--	81.0
11. Other professionals.	45.5	52.3	--	95.5
12. Administrators, managers.	27.4	60.3	--	89.0
13. Others.	16.4	18.0	3.3	67.2
14. Total Sample.	11.4	45.1	2.7	62.5

Source: Survey of June 10 - July 3, 1980.

Home Businesses

This chapter on occupations and housing concludes with an important interrelation between the two: those occupations that are carried on in the dwelling itself. Within the dwelling, households may have a store, a workshop, or carry out some service. The topic of renting rooms to lodgers or tenants has already been discussed, and that type of business will be excluded here. In all cases the home business allows the household to have a larger dwelling, and the dwelling is part of the capital that makes the business possible. As long as income levels are low, this joint opportunity for improving incomes, employment, and housing must be strongly encouraged.

Out of the 1,167 households interviewed during our 1980 survey, 132 had home businesses: 11.3 percent. In nearly three-quarters of them the head of the household was employed in the business. Altogether there were 284 home workers.

Monthly incomes of households with home businesses were 96 percent as high as incomes of those without a business, hence the two appeared to be about the same. Average value of the dwelling was less by 13 percent in the case of owner-occupants, and rent was 7 percent less in the case of tenants with a home business. Floorspace was somewhat bigger, but site area, number of rooms, number of rooms added, and the likelihood of a sewerage system connection was about the same. (Table 27).

These similarities hide the fact that home businesses in the poorer neighborhoods make people relatively better off, while in higher-income neighborhoods home businesses are operated by those who are worse off. A sample of merely 132 observations does not allow generalization with

much confidence, and therefore a much larger survey exclusively devoted to home businesses is being planned. In the meantime, we cannot go beyond comparing 65 home businesses in popular urbanizations and Pueblos Jóvenes with 51 in high income neighborhoods -- conventional, standard urbanizations, and luxury residential neighborhoods. Sixteen home businesses in other types of area are omitted from this comparison of the popular versus the high-income.

First of all, a larger proportion of dwellings in popular areas had home businesses -- 12.8 percent compared with 9.8 percent. Table 27, line 2. In the popular neighborhoods they gave their operators incomes that were 11 percent higher, while in the high-income neighborhoods they went with incomes that were 6 percent below that of those around them. Nevertheless, household incomes of families with homebusinesses in the high income areas were 52 percent above those of such families in popular neighborhoods, US $286 compared with US $188.

Home business dwellings had a value 33 percent above others in the neighborhood in popular areas, but 27 percent below others in high-income areas. The amount of floorspace in these areas by dwellings with and without home businesses had the same average, 121 m^2; but in popular neighborhoods, dwellings without businesses had only 92 m^2, 23 percent less. (Table 27, line 9.). Area of the site was 16 percent less in high-income areas if there was a home business, but in the popular areas it was 11 percent more for a total of 175.7 m^2. In the high-income areas, home business operators had about the same number of rooms as others, but they were twice as likely to have added one of these. Finally, in the high-income areas, home-business dwellings were less likely to have a sewer system connection than others, while in the popular areas they were more

Table 27. Home Businesses and Others: Characteristics of Dwellings in Which the Household Head or Anyone (Including Head) Works at Home Compared with Others (None Works at Home).

	Total Sample			Conventional, Standard, Residential Areas		Popular Urbanizations and Pueblos Jovenes	
	Head	Anyone	None	Anyone	None	Anyone	None
1. Sample Size	94	132	1035	51	468	65	441
2. Percent	8.1	11.3	88.7	9.8	90.2	12.8	87.2
3. Household Income, Monthly [US Dollars (1980)]	217	226	236	286	304	188	169
4. Years at Site	15.2	13.6	10.7	14.6	11.0	13.1	9.6
5. Owners, Sample Size	65	95	710	30	260	60	397
6. Value, US Dollars (1980)	6,275	8,119	9,360	12,553	17,056	6,019	4,513
7. Tenants, Sample Size	23	29	312	19	202	3	39
8. Rent, US Dollars (1980)	15.2	14.5	15.6	11.6	18.4	12.5	12.2
9. Site Area, m^2	137.4	144.9	148.9	122.2	145.9	175.7	158.0
10. Floorspace, m^2	98.9	114.7	103.2	121.2	121.0	119.9	92.1
11. Number of Rooms	3.32	3.56	3.50	3.82	3.93	3.46	3.20
12. Rooms Added	.71	.81	.73	.63	.35	1.12	1.30
13. Sewerage System Connection, Percent	60.6	60.6	62.7	66.7	79.3	56.9	46.0

Source: Sample of 1,167 households, June 10 - July 3, 1980.

Table 28. Occupation of Home Workers by Type of Residential Area. Percentage Distribution, Metropolitan Area of Lima, 1980.

	All Neighborhoods	Popular Urbanizations and Pueblos Jovenes	Conventional, Standard Urbanizations, Residential	Other Neighborhoods
1. Skilled construction workers.	4.9	6.1	4.0	2.8
2. Other skilled workers and artisans.	30.6	31.1	34.0	19.4
3. Unskilled construction workers.	2.1	1.4	2.0	5.6
4. Other unskilled workers.	1.1	1.4	1.0	0
5. Office workers.	10.6	7.4	14.0	13.9
6. Salespeople.	25.4	27.7	22.0	25.0
7. Agriculture, fisheries.	0.7	1.4	0	0
8. Service workers.	14.4	10.8	15.0	27.8
9. Professional technicians.	2.1	3.4	1.0	0
10. Educators.	1.4	2.0	1.0	0
11. Other professionals.	2.5	4.7	0	0
12. Administrators, managers.	4.2	2.7	6.0	5.6
Total Sample, percent	100.0	100.0	100.0	100.0
n =	284	148	100	36

likely to have such a connection. In both types of areas, operators of home businesses were likely to have been 3 1/2 years longer at the site than other residents. A home business takes a while to establish, and apparently it keeps households from moving as readily.

Among types of occupations, the distribution of home businesses was about the same in high-income and popular areas. Most common were skilled workers (not in construction), 34 and 31 percent. Salespeople were second with 22 percent in high-income areas and 28 percent in popular areas. Next came service workers and people who worked in home offices. (See Table 28).

A general preliminary impression is that home businesses served somewhat more elite neighbors in the high-income neighborhoods, but that they were themselves an elite in popular neighborhoods. They may have reduced income inequality in high-income neighborhoods and increased it in popular neighborhoods, while raising the average in both types of areas. Their efficiency seems to be supported by their survival among those households that have lived longest at a site. They are clearly associated with larger, better, or more improved housing than would otherwise be the case. All of this came about without special policies to foster home businesses, such as training, changes in urban layout, or small loan programs. It seems reasonable to suppose, therefore, that such policies would have a beneficial effect.

VII. CONCLUSION

Housing and employment problems in developing countries have often been regarded as partially or wholly insoluble. Housing investment is erroneously seen as a subtraction from more productive uses of capital. More housing seems to mean less income growth and less capacity to afford housing. At the same time, more employment opportunities in housing construction are believed to accelerate migration in a way that leaves more people unemployed after the program is over. What is not stated is that these undesirable events are likely only if housing is subsidized.

The experience of Peru confirms that such pessimism is out of place. Problems exist because 43 percent of the 1980 Lima housing stock must be classified as substandard or worse and because more than 400,000 additional households must be accommodated during the 1980's. But solutions also exist: Housing programs can mobilize savings that would be less productive or not available at all for other uses. With flexible savings institutions and a realistic approach toward landlords and tenants, employment opportunities in this sector, including work in upgrading, should rise steadily, leaving workers with better incomes than they would have had elsewhere, which is what really matters.

A reasonable standard of housing welfare can only be attained by a building program that allows all types of construction to be carried on with whatever resources the owners and occupants can save over a decade or two. The building of minimal and basic units especially should not be neglected, as it was during the 1970's. But with rising incomes, nearly 200,000 new good and excellent units will also be needed. At all

levels many better dwellings will have to be created through expanding and improving the existing housing stock. This upgrading process has already had conspicuous importance in Lima and is fortunately being supported by some new lending programs. At the same time, that part of the existing housing stock that is rented cannot be allowed to deteriorate until it disappears. Whoever saves and builds for tenants makes a contribution to housing welfare and requires incentives that can withstand inflation. Outright subsidies should be limited to the poorest households and be provided in the form of infrastructure and loans for buying materials. Streets, water, sewerage disposal, and electricity are necessary components that have been provided competently in recent decades. Their expansion must now continue at a lower cost that more households can afford.

In relatively prosperous years, about sixty thousand workers in Lima have been employed formally or informally in dwelling construction. Of these, one tenth or so build the infrastructure and one third add improvements to already completed buildings. This third does not consist of observed workdays but of an estimate of the number workdays that professional construction workers would have needed for the apparent amount of expansion. Including that implied by the improvements, onsite residential construction employment was about six percent of the employed labor force of the Lima Metropolitan Area.

If wages rise relative to other building costs, construction work becomes less labor-intensive; and when they fall, the pattern is reversed. There is a discrepancy between the daily wages and fringe benefits as reported by building firms compared with statements by workers. Given

the system of subcontracting and sub-subcontracting, reports by workers are probably more accurate. Especially credible is the report of workers that the differential for skilled workers was 36 percent, not the mere 7 percent that would have applied if all the legal minima could have been strictly enforced.

Using the building firms' estimates of labor intensity, onsite employment rose from about 100 workdays for a 25 m^2 core house to 1,100 workdays for a 200 m^2 excellent residence. Put differently, there is a rise from 4 workdays per square meter to 5.5 workdays per square meter. To this total must be added the 40-45 percent of employment contained in the components, the materials and equipment that make them, and so forth. The average owner-occupied dwelling of 127.8 m^2 was built with about 640 onsite workdays, of which 152 workdays were in additions and improvements. To this total one must add about 260 workdays in materials and 50 workdays in infrastructure.

Housing is related to employment not only through its process of construction, but also through the type of profession of the occupants. The most expensive housing in the most elegant neighborhoods is occupied by professional technicians, such as physicians and engineers, and by administrators or managers. They have the highest incomes. The smallest worst serviced, and least valuable dwellings in Pueblos Jóvenes are occupied by skilled construction workers and unskilled workers of all types. They were the poorest. Nevertheless, skilled construction workers had made more improvements to their dwellings than anyone else and had added the largest percentage of rooms. Consequently their dwellings were worth nearly twice as much as those of unskilled construction workers. But these unskilled workers were somewhat younger and had lived fewer years in the improved dwelling.

Construction workers were most likely to have obtained their housing through self-help building, while all other households were most likely to have acquired an already existing dwelling. If the building was new, other skilled workers, salesmen, educators, and professional technicians were most likely to have hired workers directly; while administrators and managers would let a building firm do the contracting.

The study concludes by noting that eleven percent of dwellings were partly used as store, workshop, or office. In popular urbanizations and Pueblos Jovenes, the proportion rose to nearly thirteen percent, one in eight. These home businesses helped to make the incomes of households eleven percent higher than they would otherwise have been. With this income they obtained dwellings thirty percent larger and thirty-three percent more valuable than those of their neighbors. At the same time, the larger and better dwellings were probably a prerequisite for operating the home business. The interaction needs to be studied more thoroughly in order to develop suitable policies for urban layout, credit, and training. A generation of experiments, usually but not always successful, has made Peru a leader in dealing with urban expansion. No doubt other countries will continue to learn from imaginative programs tried first in the Metropolitan Area of Lima.

FOOTNOTES

[1]Informes Ocupacionales (Lima: Dirección General del Empleo, Ministerio de Trabajo, November 1980), Table 14.

[2]Sueldos y Salarios: Encuestas de Establecimientos (Lima: Dirección General del Empleo, Ministerio de Trabajo, December 1980), Table 3. According to Table 5, Enterprises with 10 - 24 workers, the smallest ones surveyed, paid average wages of only S/1,108 (US $3.89).

[3]For fringe benefits and the rates allowed on piecework, see Jorge Palma Martinez, Guía Práctica del Trabajador en Construcción Civil del Peru (Lima: Palma, 1980). Also "Tablas de Porcentajes de Leyes Sociales en Edificación," Camara Peruana de Construcción (mimeographed) Lima, 1980.

[4]The six country studies were under the supervision of Norma Botero (Columbia), Davindar Lamba (Kenya), Ehsan Ahmed (Pakistan), Nimal Gunatilleke (Sri Lanka), Ridha Ferchiou (Tunisia), and Manenga Ndulo (Zambia). See W. Paul Strassmann, "Employment in Construction: Multi-Country Estimates of Costs and Substitution Elasticities for Small Dwellings," Economic Development and Cultural Change, forthcoming.

[5]Rufino Cebrecos Revilla, Construcción de Vivienda y Empleo (Lima: Documentos de Trabajo No. 35, Departamento de Economía, Pontífica Universidad Católica del Peru, April 1978).

[6]See Appendix A for an explanation.

[7]David Collier, Squatters and Oligarchs: Authoritarian Rule and Policy Change in Peru (Baltimore: Johns Hopkins University Press, 1976), p. 49. During 1962-63, partly during the Godoy-Lindley military government, an additional 35,200 people formed settlements.

[8]Abelardo Sánchez León, Raul Guerrero de los Ríos, Julio Carderón Cockburn, Luis Olivera Cardenas, Tugurización en Lima Metropolitana (Lima: Desco, Centro de Estudios y Promoción del Desarrollo, 1979. Writing from a Marxist perspective, the authors assert that without a social transformation, "slumification of the new settlements will be a permanent and increasingly acute problem." (p. 159). They concede, however, that they have made a "qualitative" rather than a "quantitative analysis". (p. 14) The book nevertheless contains interesting accounts of specific neighborhoods which sometimes contradict the basic thesis. For example, the authors recognize that former squatter areas of San Martin de Porres have developed into middle class neighborhoods. (pp. 135-36).

[9]Oficina Nacional de Estadística, Cuentas Nacionales del Peru, 1950-1978 (Lima, May 1978).

APPENDIX A

The Production Function and Derivation of the Employment-Estimating Equation

In the simple production function to be used here, substitution among unskilled and skilled workers (N_u,N_s) does not affect substitution between labor as a whole and non-labor factors of production -- capital, materials, and organization (K, M, O). Involved is the assumption of separability, that can be expressed formally as follows:

$$Y = [F(K,M,O)]^a[G(N_u,N_s)]^b \qquad (1)$$

Here Y is output and a and b are output elasticities for non-labor and labor factors respectively. The widespread observation that the share of labor in building costs remains close to one-quarter in spite of great variations in the skilled-unskilled pay ratio and the skilled-unskilled employment ratio is consistent with b = .25. Assumed is an absence of economies of scale and therefore a = .75. The elasticity of substitution between the two types of factors is thereby also implied to be unitary. In a sample of 74 firms in six countries we found it to be 0.95.

Between the two types of labor, we found it to be 0.88. As unskilled wages rose from US$1 to US$5 per day, the skill premium, generally remained around 100 percent, and the share of skilled workers stayed around 40 percent.

The issues of separability and labor-labor substitution elasticities have not yet been studied at the level of laborers versus craftsmen within an industry. The literature was recently reviewed by Daniel S. Hamermesh and James Grant in "Econometric Studies of Labor-Labor Substitution and their

Implications for Policy," Journal of Human Resources, Fall 1979. Thirty-six contributions are covered, beginning with Zvi Griliches, "Capital Skill Complementarity," Review of Economics and Statistics, November 1969, the seminal piece.

Many of the U.S. studies implicitly assume separability and measure substitution among types of labor without testing effects on non-labor inputs (usually capital). The only justification for the exclusion is that the consequent bias will be less than that introduced by poorly measured non-labor data. Ambiguities about the amount of capital and the volume of profits are often greater than those about employment and wage rates.

Employment Estimation with Two Types of Labor

With the assumption of two types of labor with a variable elasticity of substitution between them, we shall derive the employment generator, $\emptyset$, using the three ratios:

$r = W/C$,	the wage bill, W, in total costs, C.
$p = w_s/w_u$,	the ratio of skilled to unskilled wages.
$q = N_u/N_s$,	the number of unskilled workers employed for every skilled worker.

The wage bill, W, is equal to the daily wage rate, including fringes, w, times the number of workdays, N, of each type of worker -- skilled, s, and unskilled, u.

$$W = w_s N_s + w_u N_u \qquad (2)$$

Using the second two ratios above, we can simplify matters by expressing everything in terms of the wages of unskilled workers, w_u, and the number of skilled workers, N_s, since $w_s = w_u p$ and $N_u = N_s q$.

$$W = w_u N_s \, (p + q) \qquad (3)$$

We now have the employment of skilled workers for a given wage bill.

$$N_s = \frac{W}{w_u(p + q)} \qquad (4)$$

Using the ratio, r, or W = rC, skilled employment can be related to the cost of the project,

$$N_s = \frac{rC}{w_u(p + q)} \qquad (5)$$

Since the number of unskilled workers is equal to qN_s, total employment, $N = N_s(1 + q)$, or

$$N = \frac{r(1 + q)}{(p + q)} \cdot \frac{1}{w_u} \cdot C \quad \text{and} \quad \emptyset = \frac{r(1 + q)}{(p + q)} \qquad (6)$$

$$N = \emptyset \cdot \frac{1}{w_u} \cdot C \qquad (7)$$

The first term of (6) related the three ratios to one another and is the generator, $\emptyset$. The second term is the reciprocal of the unskilled wage rate. Togehter these two constitute a multiplier that relates the total cast of a project, C, to the employment, N, that is generated. Because of the possibility of inflation, the term with the ratios; $\emptyset$, is likely to be more stable than the other two. But r and q may vary with the type of project, i, and should actually be expressed as r_i and q_i.

Employment Estimation with Three Types of Labor

If there is a third type of labor, more highly skilled and paid than skilled labor, the employment estimator becomes slightly more complex. Assume the following ratios are constant:

$m = w_h/w_u$	the ratio of earnings of the third type of labor to those of unskilled labor per day.
$k = N_u/N_h$	the number of unskilled workers for each worker of the third type.

The total amount of labor is now:

$$N = N_u + N_s + N_h$$

The wage bill, W, will be:

$$W = w_u N_u + w_s N_s + w_h N_h$$

After a series of algebraic substitutions, the employment estimator for three types of labor turns out to be:

$$\phi_3 = \frac{r(q + k + kq)}{(mq + pk + kq)}$$

To determine employment, this term has to be multiplied by the total cost, C, and divided by the unskilled wage rate, w_u.

$$N = \phi_3 \cdot \frac{C}{w_u}$$

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