World Development, Vol. 12, No. 7, pp. 743–753, 1984.
Printed in Great Britain.

0305-750X/84 $3.00 + 0.00

The Timing of Urban Infrastructure and Housing Improvements by Owner Occupants

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Summary. — Housing in developing countries depends primarily on improvements and expansion by owner occupants. A survey of Lima households suggests that economic ability to improve matters less than willingness which, in turn, is inspired by access to water and sewerage systems. Opportunities for installing a home workshop may also be important. Seventeen types of improvement in squatter settlements and 'popular urbanizations' are examined using a variety of econometric tests. Differences in income mainly determine which *type* of improvement households choose to make. The *rate* of improvement, however, roughly doubles with access to infrastructure, and the effect far outweighs access cost. Consequently, the earlier that infrastructure is installed, the faster will housing conditions in general improve. This conclusion is confirmed by smaller surveys in Lusaka, Medellín, Nairobi, Rawalpindi and Tunis.

1. INTRODUCTION

Until the 1970s housing policy in most developing countries sought to replace slums with modern houses that the poor could not afford. Building standards were unrealistically high and supported by financial institutions that, among other evils, reinforced the use of costly, inappropriate, capital- and import-intensive technology.[1] But even after shelter and access to urban amenities were recognized as basic needs that none should lack, attempts to bring housing costs down through technological and financial innovations failed. The unsuccessful technological innovations involved changes in materials, design and site methods, especially prefabrication.[2] The financial schemes included compulsory savings plans, indexed mortgages and graduated repayment systems, some with negative amortization.[3] Nevertheless, the present value of the stream of monthly payments that the poor could afford was still less than the cost of a redesigned and specially financed, two-room, modern house.

Hence, policy by national housing agencies and international donors had to accept the alternative: construction of less than adequate housing with conventional materials and designs, primarily by the occupants themselves, the sort of thing that was going on anyway. Acceptance meant not just ceasing to eradicate owner-built huts but a greater public supply of the inherently collective goods of streets, drainage, lighting, water and sewer systems, schools, parks and other urban amenities and safeguards.

A remaining problem is timing. Should the infrastructure be laid out first on empty land, or should it come in afterwards and improve existing, usually illegal settlements? If rapid housing improvement is the goal, the answer depends on whether or not the cost of infrastructure (if not heavily subsidized) reduces the economic ability of the occupants to make improvements or whether, by contrast, it raised their willingness to do so. In so far as infrastructure raises the productivity of households, for example, through the possible use of expanded dwellings for stores and home work-

* For helpful comments I am especially indebted to Kraig Baier, Jorge Bernedo, Abel Centurión, Michael Farbman, Alfredo Laraburre, Rodolfo Salinas and Paul Vitale. They bear no responsibility for mistakes in the final draft. Thanks go to Paul Winder for expert computer programming. Financial support came from the US Agency for International Development.

shops, economic ability and willingness may go together. In examining these issues empirically, we came to the conclusion that the earlier infrastructure is installed, especially a water and sewer system, the more rapidly will other improvements follow.

2. THE DATA FROM LIMA

The issue of timing was tested with a large survey in Lima, Peru,[4] and smaller surveys in other countries. Any study of Lima can draw on a profuse literature on urbanization that, more than any other, has altered worldwide professional opinion of squatter settlements from negative to positive. The pioneering studies of José Matos Mar, William Mangin and John F.C. Turner, were followed by those of David Collier, Peter Lloyd, Susan Lobo and others.[5] Neither their findings nor the history of demographic change and urban policy in Lima can be adequately summarized here.

Briefly, however, the population of the Lima Metropolitan Area multiplied seven times from 645,000 in 1945 to nearly five million in 1981. The annual growth rate rose from 5.1% during 1940–61 to 5.4% during 1961–72 and then fell back to 3.8% as birth rates fell and economic conditions worsened. The earthquake of 1940 led to the first major influx of squatters, but later inflows were due to demographic factors and income disparities. The squatters settled first on the hills of San Cosme, El Augstino and San Cristóbal and then spread to the banks of the Rimac River and to the deserts north and south of the city. From the 1950s to 1980 their share of the population rose from less than 20% to 27%. The annual rise was over 9%.

Squatter settlements are usually begun by well-organized 'invasions' of several hundred families. Official recognition, land titles and public utilities are expected but uncertain. Construction begins with shacks made of wooden posts and straw mats and proceeds to bricks and concrete. Since most squatters settle on public land, the expansion of their *Pueblos Jóvenes* (young towns) depends largely on government tolerance, even tacit encouragement. Tolerance was fairly high during the military regimes of Manuel Odría (1948–56) and Juan Velasco Alvarado (1968–75). Annually 2 or 3% of the population shifted from inner city slums to new settlements. Migration to and expansion of older squatter areas must be added to this shift. During the democratic administrations of Presidents Manuel Prado and Fernando Belaunde (1956–68), new settlement formation was less, involving about 1% of the Metropolitan population per year.

The democratic administrations, including that of Fernando Belaunde after his re-election in 1980, gave high priority to government-sponsored housing projects. Some of these were too elaborate, and without subsidies only the upper middle class could have afforded them. Other projects were more realistic. Pedro Beltrán, Prime Minister under President Manuel Prado tried to encourage expandable housing as the solution to 'the nation's number one problem'. As early as 13 January 1955, his newspaper, *La Prensa*, had sponsored raffles of 'Cheap Houses that Grow'. The idea was to have settlers acquire public utilities with full-cost loans instead of with subsidies that might further accelerate migration to Lima. Sets of developed sites with or without rudimentary dwellings were often sold to trade unions and cooperatives as 'popular urbanizations'. Payment was a collective responsibility. Some private sellers of land even organized cooperatives of buyers that would then qualify for government loans. The prospect of collateral also gave access to the organized credit system. Construction usually began with permanent housing made of bricks and concrete, and everything being legal, infrastructure was usually but not always installed. Completely finished housing, though small and promoted by government agencies, would not be classified as 'popular urbanization', however, but as 'standard urbanization'.

3. DWELLING IMPROVEMENTS AND NEIGHBOURHOODS

(a) *The data*

Although our survey covered the entire Metropolitan Area of Lima, as shown in Tables 1 and 2, the aim of this article is a comparison

of improvements by owner-occupants as related to the timing of infrastructure investment in the two types of neighbourhoods primarily occupied by the poor: Popular Urbanizations and *Pueblos Jóvenes*.[6] In 1980 43.4% of Lima households lived in these two types of area.

The characteristics of dwellings and households are given in Tables 1 and 2. Households in Popular Urbanizations and *Pueblos Jóvenes* are more likely than others to have added a room to the original structure, 1.8 and 1.4 rooms, respectively (Table 1, line 4). Adding rooms was the main type of improvement throughout the city and the one that is most

Table 1. *Characteristics of dwellings by type of neighbourhood,* Metropolitan Lima, June–July 1980*

	1 Luxury residential	2 Conventional	3 Standard urbanization	4 Popular urbanization	5 *Pueblos Jóvenes*	6 Substandard, subdivided	7 All†
1. Floorspace (m^2)	246	100	98	109	87	65	104
2. Lot area (m^2)	301	107	144	173	152	120	148
3. Rooms (number)	5.79	3.49	3.90	3.68	2.97	2.72	3.51
4. Rooms added (owner)	0.44	0.99	0.71	1.82	1.38	0.54	1.20
5. Water tap or bathroom (% of dwellings)	96.1	75.5	87.5	74.4	60.6	67.2	73.0
6. Sewerage system connection (%)	94.7	73.6	79.6	66.0	36.2	58.6	62.5
7. Improvement types, owners (number)	3.3	5.4	3.0	5.5	4.4	4.4	4.5
8. Owner-occupation (%)	65.8	35.5	70.8	77.0	87.0	40.5	62.0
9. Value,‡ US $ (owner, *n*)	35,800 (55)	13,100 (149)	10,400 (86)	8,400 (166)	2,600 (291)	5,100 (48)	9,200 (805)
10. Rent, US $ (tenants, *n*)	39.30 (19)	16.40 (176)	11.75 (26)	15.00 (23)	8.8[illegible] (19	9.05 (66)	15.50 (341)

Source: June–July 1980 Housing Survey.

* For definition of the six neighbourhood types, see note 7.

† Includes 26 dwellings in unclassified neighbourhoods.

‡ No value was indicated by 21 households, including some of the 82 free users. US $1 = 285 soles.

Table 2. *Characteristics of households by type of neighbourhood, Metropolitan Lima, June–July 1980*

	1 Luxury residential	2 Conventional	3 Standard urbanization	4 Popular urbanization	5 *Pueblos Jóvenes*	6 Substandard, subdivided	7 All*
1. Sample distribution (number, %)	76 (6.5)	330 (28.3)	113 (9.7)	191 (16.4)	315 (27.0)	116 (9.9)	1,167 (100.0)
2. Household size (number)	4.8	4.7	5.2	6.0	6.2	5.1	5.4
3. Adults (number)	3.8	3.2	3.3	3.2	3.2	3.1	3.2
4. Age of head	52.4	47.0	44.1	42.5	43.6	45.7	45.3
5. Employed (number)	2.1	1.8	1.8	1.7	1.7	1.7	1.8
6. Income (monthly, US $)	500.7	273.0	254.4	200.7	153.0	187.0	235.1
7. Years at site	12.2	12.5	7.6	9.5	10.4	13.8	11.0
8. Owners, no mortgage (%)	48.7	26.4	29.2	62.8	84.8	31.0	50.3
9. Owner, mortgage (%)	15.8	4.8	24.8	6.3	2.2	4.3	7.0
10. Hire-purchase, %	1.3	4.2	16.8	7.9	0	5.2	4.7
11. Renter (%)	26.3	53.6	23.0	12.0	6.0	56.9	29.4
12. Lent free and other tenure	7.8	10.9	6.2	10.9	7.0	2.7	8.6
13. Employed in home business (%)	3.9	8.7	4.3	6.0	12.5	7.4	8.5
14. Improvements made with some self-help labour (%)	30.9	48.9	59.8	79.8	73.0	73.5	63.6

Source: June–July 1980 Housing Survey.
* Includes 26 unclassified households.

easily quantified. The other 16 types of improvement, such as adding a fence or plastering walls, are simply registered as having been carried out or not. Households in *Pueblos Jóvenes*, for example, have made 4.4 types of improvement, about the same number as the average owning household. Those in Popular Urbanizations had made 5.5 types of improvement, substantially more than any other group except those in conventional neighbourhoods who had made 5.4 (Table 1, line 7) but had averaged three additional years of occupancy in their dwellings. Hence, they had more time to improve. What those types of improvement were and the extent to which they were made by owner-occupants in the various neighbourhoods is shown in Table 3.

Our objective is to explain why households in Popular Urbanizations made more improvements than those in *Pueblos Jóvenes*. Were they sufficiently different or were they provided with different opportunities?

Demographically, the two groups were very similar. Household size for Popular Urbanization averaged 6.0 and for *Pueblos Jóvenes*, 6.2. Both had 3.2 members 18 years old or more and 1.7 members employed. Age of the average head was 42.5 and 43.6 years. The average household in Popular Urbanizations had lived there for 9.5 years, while those in *Pueblos Jóvenes* had been there 10.4 years. Compared with the rest of the city, households in both groups were larger, younger, and newer to their neighbourhood (Table 2, lines 2–5).

(b) *Income versus opportunity*

Income levels were 31% higher in the Popular Urbanizations, $201 monthly compared with $153 (Table 2, line 6). Regression analysis showed that income was significantly (0.01 level) associated with the number of improvement types for households below the median income level of 50,000 soles or US $175. But it explained only 2.1% of the variation. Above the median income level, income played no part in explaining home improvement. In general, as income rises, so does the ability to make improvements, but with better housing the need to do so falls. The large difference in improvements between households in Popular Urganizations and those in *Pueblos Jóvenes* is therefore not explained by income. The somewhat greater use of self-help labour (79.8 compared with 73.0%) in making improvements in Popular Urbanizations also suggests that what made the difference was not ability but willingness, perhaps inspired by opportunity.

That opportunity did not, however, seem to include greater possibilities for having a home business. Only 6.0% of workers in Popular Urbanizations worked at home, compared with 12.5% in *Pueblos Jóvenes* and 8.5% in the Metropolitan Area (Table 2, line 13). Without knowing the occupational distribution of these home workers, little can be said about their role in requiring or inspiring dwelling improvements. But the subsamples of homeworkers (19 and 68) are too small for further disaggregation. Further analysis will therefore be undertaken on the basis of a new survey of 1706 Lima home businesses completed in December 1983 by the Directorate of Employment and Migration Studies for Michigan State University.

Most plausible among opportunities is that improvements will seem more worthwhile if one's lot is large, securely owned, and well equipped with water, sewerage lines, and other infrastructure. Lots in Popular Urbanizations were only 14% larger than those in *Pueblos Jóvenes* (Table 1, line 2), probably not enough to make much difference. Tenure matters, but for the average squatter with 10.4 years at a site the chance of eviction around Lima was known to be low.

That leaves the big difference in infrastructure. The proportion of sites with piped water in Popular Urbanizations was 74.4% compared with 60.6% in *Pueblos Jóvenes*; and the share with sewerage system connections was 66.0% compared with a mere 26.2%. If a dummy variable for a sewerage connection is introduced in the regression to explain the number of improvements, it is significant at the 0.01 level and more than doubles the explained variation. It also brings down the coefficient for income and lowers its significance to the 0.05 level.

A different way of assessing the extent of improvement is with Logit analysis. In Lima

Table 3. *Percentage of owner-occupants making different types of improvements in different types of neighbourhoods, Lima, 1970*

	1 Luxury residential	2 Conventional	3 Standard urbanization	4 Popular urbanization	5 *Pueblos Jóvenes*	6 Substandard, subdivided	7 All*
A. Basic							
1. Reconstruct the house	6.0	9.4	10.0	37.4	49.3	12.8	30.2
2. Room(s) added	24.0	31.6	25.0	55.1	51.5	21.3	41.9
3. Wall materials changed	6.0	13.	8.8	28.8	32.8	19.1	25.3
4. Roof materials better	4.0	12.8	8.8	30.6	17.9	8.5	17.0
B. Utilities							
1. Water facilities better	12.0	14.5	12.5	32.0	33.2	21.3	25.4
2. Toilet better	24.0	27.4	18.8	33.3	25.9	21.3	26.7
3. Kitchen improvements	22.0	23.9	26.2	40.8	21.2	12.8	26.0
C. Finishes							
1. Interior plastering and painting	56.0	50.4	43.8	47.6	25.2	38.3	39.4
2. Floor improvements	22.0	26.2	17.5	44.9	30.3	17.0	30.1
3. Windows and doors improved	26.0	29.1	27.5	41.5	24.8	23.4	29.4
4. Outside plastering	6.0	23.1	10.0	25.9	20.1	19.1	19.6
5. Interior ceiling	4.0	10.3	11.2	23.1	28.9	2.1	11.5
D. Site Changes							
1. Grading	2.0	1.7	2.5	20.4	39.8	4.3	20.2
2. Adding fill	2.0	0.9	2.5	13.6	23.7	4.3	12.6
3. Fence or wall	12.0	13.7	21.2	10.2	6.6	6.4	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

Source: June–July 1980 Housing Survey.

* Includes 26 unclassified households.

as a whole 18.4% of households made no improvements and 25.8% made six or more types of improvements. Below the median income level, 17.0% made none and 23.9% made six or more. As Table 4 shows, with a sewer system connection, the probability of having made six or more improvements more than doubles.

Table 4. *Probability of having made six or more improvements (%)*

	Sewerage system connection		No. connection
Household size:	6		
Years in place:	11.1	30.7	15.2
Household size:	4		
Years in place:	5	22.8	10.6

Source: Data from a survey of 1167 households, June–July 1980, The logit equation is: log of the odds equals −2.709 + 0.1054 (household size) + 0.03192 (years in place) + 0.909 (sewer system dummy variable). *T* statistics are 3.05 or higher.

(c) *Differences in value*

Another difference between the two types of neighbourhood is in average dwelling value (Table 1, line 9). Those in Popular Urbanizations were worth $8400, as assessed by the occupants,[7] and those in *Pueblos Jóvenes* were valued at less than a third as much, or $2600. There is a difference of 21 m^2 in lot size and 22 m^2 in floorspace that goes with an additional 0.7 rooms. With hedonic analysis we can assess the separate contributions to value of these space factors as well as age of the dwelling, type of materials, finish or plaster and paint, water access, type of sanitation, availability of electricity and travel time to work. The conclusion is that with all those held constant, a dwelling would still have a value 52% higher if located in a Popular Urbanization instead of a *Pueblo Jóven*. The value of a $2600 house would rise to $4000. Access to the sewerage system and the installation of a complete bathroom would raise the value of this dwelling by a further $3800 to $7800. Of course the difference is far more than the plumbing installation would actually cost. The higher value may well reflect the additional improvements and embellishments that confident owners would make on a structure of *given* size, location and type of materials.[8]

The difference in value is not just due to the number but also to the kind of improvements that owners in the two types of neighbourhood make. Table 3 shows that those in *Pueblos Jóvenes* are more likely to grade the land, add fill, and to reconstruct the house entirely (usually substituting permanent materials for straw mats and scrap wood). By contrast, dwellings in Popular Urbanizations will already have all those qualities, and owners are more likely to improve their kitchens, floors, windows, doors, and to plaster and paint the interior. They are ready to go beyond the barest essentials although their incomes are not much higher but even encumbered by more loans and more taxes.

(d) *Cost*

An analysis of the benefits of piped water and sewerage systems is incomplete without a comparison of costs. In Lima water vendors have charged 16–25 times more per litre than the municipal water agency. Those who have to buy water from the vendors use less but still pay about 2.5% of their income for water, compared with about 0.5% for others.[9] In 1980 the capital cost of equipping a lot with a water connection was $116; $80 for the street lines and $36 for the domestic connection.[10] According to the World Bank, communal standpipes would cost less than half as much as individual connections, depending on density, although 'it is almost impossible to generalize'.[11] In any case, the extra cost of an individual connection must be judged in terms of the effect on attitudes and improving activities by the occupants.

The case for waterborne sewerage systems is weaker. The cost of a connection is likely to be 2–5 times that of piped water, depending partly on the slope and character of the terrain. In the level or gently sloping areas around

Table 5. *Determinants of dwelling value: hedonic (log–log) regression coefficients, Lima, 1980*

Variable	Total sample	Total sample		
	Total sample $n = 805$	District dummies $n = 805$	Low range** $n = 554$	High range** $n = 372$
1. Age of dwelling	0.076	0.066	0.121*	−0.047
	(0.040)	(0.040)	(0.046)	(0.043)
2. Floorspace	0.261*	0.269*	0.180**	0.222*
	(0.068)	(0.068)	(0.086)	(0.064)
3. Number of rooms	0.346*	0.306*	0.260**	0.323*
	(0.092)	(0.089)	(0.111)	(0.101)
4. Walls made of bricks, concrete blocks or reinforced concrete	0.621*	0.666*	0.613*	0.2[illegible]
	(0.102)	(0.099)	(0.103)	(0.2[illegible])
5. Roof made of tiles or reinforced concrete	0.746*	0.654*	0.551*	−0.008
	(0.104)	(0.103)	(0.110)	(0.147)
6. Exterior plastered and painted	0.169**	0.082	0.133	0.111
	(0.078)	(0.078)	(0.087)	(0.094)
7. Water access (dummies)				
a. Own tap, no shower	0.033	0.059	0.077	−0.136
	(0.104)	(0.102)	(0.105)	(0.247)
b. One complete bathroom	0.374*	0.266	0.297**	0.155
	(0.145)	(0.143)	(0.151)	(0.238)
c. Two or more bathrooms	0.839*	0.624*	0.020	0.550**
	(0.176)	(0.176)	(0.477)	(0.248)
8. Sanitation (dummies)				
a. Latrine	0.068	0.032	0.097	0.014
	(0.138)	(0.133)	(0.137)	(0.627)
b. Shared flush toilet	0.517**	0.147	0.435	0.345
	(0.242)	(0.243)	(0.248)	(0.792)
c. Septic tank	0.176	0.183	0.052	0.253
	(0.220)	(0.213)	(0.225)	(0.631)
d. Sewerage system connection	0.481*	0.410**	0.413**	0.052
	(0.171)	(0.166)	(0.172)	(0.583)
9. Electricity (dummies)				
a. Monophase	−0.061	−0.081	−0.036	−0.044
	(0.114)	(0.111)	(0.116)	(0.285)
b. Triphase	0.340**	0.124	0.319	0.364
	(0.172)	(0.178)	(0.322)	(0.299)
10. Site area	0.274*	0.272*	0.233*	0.112
	(0.058)	(0.057)	(0.069)	(0.058)
11. Travel time to work, average, all workers	−0.136*	−0.108**	−0.079	−0.164*
	(0.044)	(0.043)	(0.050)	(0.050)
12. Income of neighbours (dummies)				
a. Higher than own	0.029	−0.024	0.122	0.115
	(0.110)	(0.108)	(0.131)	(0.119)
b. Lower than own	−0.271	−0.200	−0.151	−0.251
	(0.149)	(0.146)	(0.160)	(0.183)
13. District				
a. Luxury		0.831*		
		(0.172)		
b. Conventional		0.621*		
		(0.120)		
c. Standard urbanization		0.501*		
		(0.126)		
d. Popular urbanization		0.420*		
		(0.091)		
e. Substandard, subdivided		0.394**		
		(0.160)		
f. Unclassified district		0.272*		
		(0.057)		
g. Pueblos jóvenes		base		
14. Constant	9.531*	9.395*	9.836*	12.910**
	(0.359)	(0.355)	(0.427)	(0.801)
15. Adjusted R^2	0.746	0.761	0.532	0.483
16. F statistic	93.69	77.38	25.23	14.47
17. Mean value of dwelling, dollars	8900	8900	2440	17.900

Source: Survey of 1167 households, 10 June–3 July, 1980.

* 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?'

* Statistical significance at the 0.01 level; ** statistical significance at the 0.05 level. Standard errors are given in parentheses. US $1 = 285 soles.

Lima, the network of street lines cost $145 per lot in 1980 and the domestic connections $70: total, $215.[12] This amount is about half as much as the annual $400.3 cost per site estimated as typical for poor countries by a 1978 World Bank study. At that cost a household with $180 monthly income would have to spend 26% to finance the connection over 20 years at 8% interest.[13] At the Lima cost of $215 and average income in *Pueblos Jóvenes* of $153, the share of income needed would be 15%, still high but at least worth considering together with modest subsidies. The alternative sanitation methods are communal toilets, bucket cartage, vacuum truck cartage, pit latrines, composting toilets and certain novel low-cost septic tanks that may cost $20–$70 per year.[14] The problem is that these methods are not ecologically suitable for a large metropolis and may cause occupants to wait for or move to sewerage-system-connected lots before making improvements.

4. COMPARISON WITH OTHER COUNTRIES

These results for Lima can be compared with those of similar studies that we have made on a smaller scale in five other cities: Lusaka, Zambia; Medellín, Colombia; Nairobi, Kenya; Rawalpindi, Pakistan; and Tunis, Tunisia.[15] In each we compared the amount of expansion and improvement by 40–80 households on sites that had begun as core housing with improvement in pure squatter settlements. In two cities -- Lusaka and Medellín – we found that the amount of improvement in both types of settlement was about the same. In three cities – Nairobi, Rawalpindi and Tunis – occupants of core houses had added and improved to a far greater extent.

A closer look at the two types of settlements in the five cities suggests why there was that contrast – much difference in upgrading in three cities and little difference in two. In the three cities in which the core house occupants had improved more than squatters, they also had more access to waterborne sewerage systems. In Nairobi, it was 98.7% of core dwellers connected compared with no access for squatters. In Rawalpindi 78.3% in core houses had flush toilets, but only 8.5% of squatters had them. All core houses in Tunis had flush toilets, compared with only 44% of squatters.

In both Lusaka and Medellín, core house dwellers had about the same access to piped water and a sewerage system as squatters: none in Lusaka and the vast majority in Medellín. Thus in Lusaka both core housing and squatter settlements had 95% of dwellings equipped with pit latrines. In Medellín complete bathrooms had been installed by 93% of core house recipients and by 87.5% of squatters, showing that the authorities had extended the water and sewerage systems to their areas.

The conclusion is not that pit latrines and neighbourhood standpipes are never appropriate. The poorest countries simply cannot afford more than that. Innovations that make outhouses and standpipes more functional and attractive should be welcomed. At the same time it should be clear that families throughout the world think much more of their dwelling if it has piped water and a flushing toilet. They regard it as a much better investment and a more tolerable habitat, and they will work evenings and weekends to plaster and paint, to install better windows and doors, to plant a garden, and to add a room, perhaps even a workshop. Thus infrastructure investment kindles employment and brings forth housing.

NOTES

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2. W. Paul Strassmann, *Housing and Building Technology in Developing Countries* (East Lansing, Michigan: MSU International Business and Economic Studies, 1978).

3. Morris L. Sweet and S. George Walters, *Mandatory Housing Finance Programs: A Comparative International Analysis* (New York: Praeger, 1976); N.O. Jorgensen, *Housing Finance for Low Income Groups with Special Reference to Developing Countries* (Nairobi: Housing Research and Development Unit, University of Nairobi, 1977).

4. The Lima survey was conducted by the Directorate of Employment and Migration Studies (formerly the Technical Office for Manpower Studies), General Bureau of Employment, Ministry of Labor, under the supervision of Edgar Flores. Abel Centurion, Jorge Bernedo and Norma Botero. For sampling efficiency a two-stage stratified cluster design was used. Of 5800 classified subdistricts with about 120 dwellings in each, 203 subdistricts were chosen at random, yet in accordance with the stratification. All 24,400 dwellings in these subdistricts were then registered, and an average of 6.3 dwellings was selected at random from each for interviews. One hundred and sixty-two losses occurred due to demolition, conversion, vacancy, refusal to respond, or repeated absence. Fifty-three supplemental dwellings were added in accordance with a systematic procedure to allow for increased density of settlement. The original aim was 1200 interviews. Exact dates of the survey were 10 June–3 July 1980.

5. José Matos Mar, *Las Barriadas de Lima* (Lima: Instituto de Estudios Peruanas, 1966); John F. C. Turner, 'The reeducation of a professional', in Turner and Robert Fichter (eds.), *Freedom to Build* (New York: Macmillan, 1972), pp. 122–147; William Mangin and John F. C. Turner, 'The barriada movement', *Progressive Architecture* (May 1968); William Mangin, 'Latin American squatter settlements: a problem and a solution', *Latin American Research Review*, Vol. 2, No. 3 (1967); David Collier, *Squatters and Oligarchs: Authoritarian Rule and Policy Change in Peru* (Baltimore: Johns Hopkins University Press, 1976); Peter Lloyd, *Slums of Hope? Shanty Towns of the Third World* (London: Penguin, 1979); Susan Lobo, *A House of My Own* (Tucson: University of Arizona Press, 1982). For a contrasting view, see Abelardo Sanchez León, Raul Guerrero de los Ríos, Julio Carderón Cockburn and Luis Olivera Cardenas, *Tugurización en Lima Metropolitana* (Lima: Desco, Centro de Estudios y Promoción del Desarrollo, 1979).

6. The six categories of neighbourhoods are in standard use by researchers in Lima such as the Office of Technical Manpower Studies, the Centro de Estudios y Promocion del Desarrollo (DESCO), and others. 'Substandard and subdivided' is my term of *Quintas, callejones, corralones, and rancherías. Quintas* are old subdivided mansions; *callejones* are small individual rented units around a common patio. The others are makeshift and rustic.

'Luxury Residential' neighbourhoods consist primarily of large (250 m^2, six rooms besides kitchen and baths) detached dwellings with garages. In 'conventional' neighbourhoods dwellings are smaller, not detached, and if not apartments, they were usualy built to order for the original occupant. 'Standard urbanizations' are neighbourhoods in which developers had a number of blocks equipped with public utilities before allowing construction of middle class housing (four rooms, 100 m^2). They differ from the 'conventional' mainly in being newer and laid out on a larger scale.

7. The interview question was, 'If you were going to sell your dwelling today, at what price do you believe that you could sell it?' Housing researchers have found this method accurate throughout the world, meaning a small variation from actual sales price or values assessed by appraisers.

8. Using *Pueblos Jóvenes* as the base, the dummy variable for a Popular Urbanization had a coefficient of 0.420 and was significant at the 0.01 level. For the sewerage system connection the coefficient was 0.410 (standard error 0.166) and for one complete bathroom it was 0.266 (standard error 0.143). See Table 5.

9. Vinod Thomas, 'The measurement of spatial differences in poverty: the case of Peru', *World Bank Staff Working Paper No. 273* (Washington: 1978), p. 78, cited in Johannes Linn, *Cities in the Developing World: Policies for Their Efficient and Equitable Growth* (New York: Oxford University Press, 1983), p. 148.

10. This estimate applies to the cost per lot if 500 lots with an average area of 116.2 m^2 are equipped. Cost data were supplied by the Peruvian Ministry of Housing and Construction and by the Lima office of the Agency for International Development.

11. Robert Saunders and Jeremy Warford, *Village Water Supply* (Baltimore: Johns Hopkins University Press for the World Bank, 1976) p. 125.

12. See note 11.

13. John Kalbermatten, DeAnne Julius, and Charles Gunnerson, *Appropriate Sanitation Alternatives: A Technical and Economic Appraisal* (Baltimore: Johns Hopkins, 1982), Tables 3.1 and 3.11, cited by Linn, *op. cit.* (1983), p. 151.

14. R.F. Carroll, *Affordable Sanitation for Developing Countries*, Building Research Establishment Note, N 147/80 (Garston Watford: November 1980).

15. In the summer of 1979 the survey of Lusaka was conducted by Manenga Ndulo; that of Medellín by Norma Botero; Nairobi by Davinder Lamba and Suresh Amlani; Rawalpindi by Ehsan Ahmed; and Tunis by Ridha Ferchiou. They generally selected specific neighbourhoods, not the entire city at random, as was done in the case of Lima.

See also W. Paul Strassmann, *The Transformation of Urban Housing: The Experience of Upgrading in Cartegena, Colombia* (Baltimore: Johns Hopkins University Press for the World Bank, 1982). In Cartegena access to water had the same stimulating effect on home improvement within squatter settlements, but the city had no projects of core housing, sites and services, or popular urbanizations at the time of the study.