Housing Demand in Developing Countries

Stephen Malpezzi
Stephen K. Mayo

with

David J. Gross

WORLD BANK STAFF WORKING PAPERS
Number 733

WORLD BANK STAFF WORKING PAPERS
Number 733

Housing Demand in Developing Countries

Stephen Malpezzi
Stephen K. Mayo
with
David J. Gross

The World Bank
Washington, D.C., U.S.A.

Manufactured in the United States of America
First printing May 1985
Third printing July 1987

Stephen Malpezzi and Stephen K. Mayo are economists in the Water Supply and Urban Development Department of the World Bank. David J. Gross, a consultant to that department, is assistant professor of public administration at Louisiana State University.

Library of Congress Cataloging in Publication Data

Malpezzi, Stephen.
Housing demand in developing countries.

(World Bank staff working papers ; no. 733)
Bibliography: p.
1. Housing--Developing countries. 2. Housing policy--Developing countries. I. Mayo, Stephen K., 1942- . II. Gross, David J., 1958- . III. Title. IV. Series.
HD7391.M35 1985 338.4'769083'091724 85-9448
ISBN 0-8213-0539-5

Abstract

This paper reports on research conducted at the World Bank to increase understanding of developing country housing markets; in particular, of housing demand behavior. The objectives of the paper are (1) to review previous evidence on housing demand parameters in developing countries, (2) to present new evidence on housing demand parameters (e.g., price and income elasticities, and demographic effects) based on application of standardized models and comparable variable definitions in the cities in eight developing countries (Colombia, Egypt, El Salvador, Ghana, India, Jamaica, Korea, and the Philippines), and (3) to examine similarities and differences among cities in housing demand and, in a preliminary way, explanations for place-to-place differences. The analysis emphasizes differences in housing demand by tenure (particularly for renters and owners, but also for squatters and non-squatters) and, paralleling the literature in developed countries, stresses the importance of accounting for the impact of income and relative prices on housing demand.

The paper is based on research conducted as part of RPO 672-46, Housing Demand and Finance in Developing Countries, the first phase of which encompassed (1) the demand for housing as a "composite good," focusing on expenditure patterns for housing, (2) determinants of land and housing rents and values, focusing on estimating the implicit market prices of housing, infrastructure, and neighborhood amenities using hedonic price indices, and (3) demand for individual housing characteristics such as interior space, quality of construction, utilities, and accessibility, focusing particularly on estimating schedules of the public's "willingness to pay" for different types of housing in different markets. The second phase focuses on (1) applying first phase results to project design, and (2) extending the research to policy issues, namely public and subsidized housing, rent control, tenure, and housing finance.

The authors would like to thank Waleed El-Ansary, James Follain, Manny Jimenez, Sungyong Kang, David Lebow, and Haeduck Lee for providing some of the results reported herein. Valuable comments were provided by many colleagues, especially Bertrand Renaud, James Shilling, Paul Strassman, and Anthony Yezer, but opinions expressed are solely the authors'.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Cities in developing countries are growing at extraordinary rates, often compressing into decades the urbanization process that has taken centuries in developed countries. In coping with this growth, public authorities have devised a wide range of policy instruments to influence the rate and character of city expansion, to meet the needs of people for shelter and urban services, and to allocate resources in ways that redistribute both the costs and benefits of urban growth. Ideally, such policy formulation should be informed by a careful understanding of the behavior of urban markets; in fact, little information on market behavior is available to the policymakers of developing countries. Such basic information is needed for improved project design and, even more importantly, for improved sector-wide policies.

This paper reports on research conducted at the World Bank to increase understanding of developing country housing markets; in particular, of housing demand behavior. While the overall project examines both the demand for housing characteristics and the demand for housing as a composite good, this paper addresses only the latter. The objectives of this paper are (1) to briefly review previous evidence on housing demand parameters in developing countries, (2) to present new evidence on housing demand parameters based on application of standardized models and comparable variable definitions in 16 cities in eight developing countries (Colombia, Egypt, El Salvador, Ghana, India, Jamaica, Korea, and the Philippines), and (3) to examine similarities and differences among cities in housing demand and, in a preliminary way, offer explanations for place-to-place differences. Limited comparisons are also made to two U.S. cities in order to begin comparison of

developing and developed country market behavior. The analysis emphasizes differences in housing demand by city and by tenure group. Simple models which explain both of these observed differences are presented and tested. In parallel with the literature in developed countries, this paper stresses the importance of incomes and prices on housing demand.

This paper presents an abbreviated discussion of a larger comparative study of housing demand in developing countries. Using a number of high quality household-level data sets, a number of empirical regularities are found within and among developing country cities. Among these are, at the household level:

1. Income elasticities of demand among renters are generally small (on the order of 0.3 to 0.6); income elasticities of demand among owners are somewhat larger (on the order of 0.4 to 0.8); these results are generally consistent with findings for developed countries.

2. Owners generally consume a good deal more housing than renters at given income levels; this is not primarily a result of differences in income elasticities of demand but rather a result of differences in expenditure equation constant terms. This suggests that variables such as tastes and assets play important roles in causing consumption differences between renters and owners.

3. Permanent income elasticities of demand for housing are somewhat greater than current income elasticities, although in reasonably "complete" models of demand including price terms and demographic variables, permanent income elasticities are only moderately higher than current income elasticities in simpler models.

4. Price elasticities of demand for cities analyzed here are on the order of -0.8 to -1.0, considerably higher than estimates produced elsewhere in the literature. However, these estimates may have an upward bias because of a specification problem.

Important results at the city level include:

1. Rent-to-income ratios rise across cities as income increases, a result of upward-shifting Engel curves. This phenomenon appears to be associated with increases in the relative price of housing, with differences between current and permanent income elasticities of demand, and with differences in the time period

associated with the two levels of analysis. The city level analyses presumably model very long-run behavior.

2. Very long-run (cross-city) income elasticities of demand are estimated to be one or greater. Very long-run price elasticities are less than one in absolute value. Income elasticities are measured with better precision than price elasticities.

3. Owners generally pay a significant premium for ownership per se. This premium, equal to the difference between the opportunity cost of housing capital and the imputed rental value of housing, is highly variable from place to place depending on market conditions. In particular, ownership premia are high in cities with high rates of housing inflation and significant rates of asset formation through savings or workers' remittances. Security of tenure also influences the magnitude of the premium paid for ownership.

Comparing household level and city level results leads to the following:

1. Income elasticities are much greater in the very long run than within a market. The cross-section results are directly relevant to behavior within a market, while the very long-run results can be applied to make predictions as a country develops. Both are necessary for correct analysis of projects, as will be outlined below. This is not surprising, as it a sound general principle that behavior is more responsive to changes over longer periods of time.

2. Long-run price elasticities from the city level estimation are lower in absolute value than the cross-section price elasticities. This is at variance with the principle just enunciated. The price elasticity estimates suffer from more severe errors in variables problems than the income elasticities; because of the specifications used, the cross-city specifications are probably biased towards zero, and the household level estimates are likely biased towards one.

Policy implications of these and other results from the housing demand research project will be spelled out in detail in forthcoming reports. Here several obvious policy implications will be briefly mentioned.

Affordability calculations for target populations are a critical element of project design. Until now, such projects relied on rules of thumb often, for example, an assumption that households can spend between 20 and 25

percent of income on housing. The results described above demonstrate the inadequacy of any single ratio to predict consumption for different income and tenure groups in different places. In many respects the best solution is to do a careful household survey which includes the target population, and to proceed with simple econometric models like the ones described here to get project-specific estimates. If constrained, a second best solution can be to estimate a variable rule of thumb from the results in this paper. Using the elasticities for the relevant tenure group, the cross-city model can be used to predict the city's average consumption given only an estimate of city average income and a few readily available country level variables such as GDP per capita. Income elasticities within samples do not vary by much from city to city, so a typical cross-section elasticity can be chosen (say the average), or the elasticity from a city deemed similar to the project location. This elasticity can be used to move along the city specific Engel curve to locate an estimate of the affordability ratio of the target population in the target city.

Most current public sector housing projects contain subsidies, implicit or explicit. How inefficient these subsidies are depends critically on the demand and price elasticities of the participants. In general, larger price elasticities imply larger benefits to participants to housing programs, ceteris paribus, although it is well known that private benefits from a subsidy are always less than the benefit from equivalent income transfers. Larger income elasticities imply that unconstrained transfers will have larger housing consumption effects, ceteris paribus. The current research has not nailed down a single set of numbers which can be used to reliably estimate precise measures of program efficiency, but future work can use a range of estimates to examine costs and benefits of alternative programs qualitatively.

The findings on tenure specific differences have several important implications which will be spelled out in more detail in forthcoming work. Note, for example, that affordability calculations that do not account for tenure differences will be seriously biased in many cities. It is currently common practice to use renter samples to make direct inferences about affordability in owner occupied projects without adjustment for these cross tenure differences; it is argued in this paper and in Mayo and Gross (1985) that this is a good approximation if project target groups are limited to current renters. Another implication is that the existence of highly variable homeownership premia suggests that, in some markets, schemes that focus on increasing the rental stock are appropriate and desirable, while in others high premia suggest that the focus should be on increasing the homeowner stock.

The outline of the paper is as follows. The introductory chapter reviews the developing country literature on housing demand. Chapter 2 presents new estimates for many cities from a simple housing expenditure model disaggregated by tenure (rent/own), and then evaluates the simple model using data from three cities. Chapter 3 examines and explains shifts in demand parameters across cities. Chapter 4 examines at greater length differences in housing demand by renters and owners, suggesting that owners' "asset demand" for housing (as distinct from their demand for housing services) is highly variable from place to place depending on market conditions. Chapter 5 summarizes our conclusions and suggests some policy implications of our findings and future research directions.

I. INTRODUCTION

1. Motivation

Cities in developing countries are growing at extraordinary rates, often compressing into decades the urbanization process that has taken centuries in developed countries. In coping with this growth, public authorities have devised a wide range of policy instruments to influence the rate and character of city expansion, to meet the needs of people for shelter and urban services, and to allocate resources in ways that redistribute both the costs and benefits of urban growth. Ideally, such policy formulation should be informed by a careful understanding of the behavior of urban markets; in fact, little information on market behavior is available to the policymakers of developing countries. Such basic information is needed for improved project design and, even more importantly, for improved sector-wide policies.

This paper reports on research conducted at the World Bank to increase understanding of developing country housing markets; in particular, of housing demand behavior. While the overall project examines both the demand for housing characteristics [1/] and the demand for housing as a composite good, this paper addresses only the latter. The objectives of this paper are (1) to briefly review previous evidence on housing demand parameters in developing countries, (2) to present new evidence on housing demand parameters based on application of standardized models and comparable variable definitions in 16 cities in eight developing countries (Colombia, Egypt, El Salvador, Ghana, India, Jamaica, Korea, and the Philippines), and (3) to

---

1/ See, for example, Follain and Jimenez, forthcoming (a, b), Gross (1984).

examine similarities and differences among cities in housing demand and, in a preliminary way, offer explanations for place-to-place differences. Limited comparisons are also made to two U.S. cities in order to begin comparison of developing and developed country market behavior. The analysis emphasizes differences in housing demand by city and by tenure group. Simple models which explain both of these observed differences are presented and tested. In parallel with the literature in developed countries, this paper stresses the importance of incomes and prices on housing demand.

The outline of the paper is as follows. The next section of this chapter reviews the developing country literature on housing demand. Chapter 2 presents new estimates for many cities from a simple housing expenditure model disaggregated by tenure (rent/own), and then evaluates the simple model using data from three cities. Chapter 3 examines and explains shifts in demand parameters across cities. Chapter 4 examines at greater length differences in housing demand by renters and owners, suggesting that owners' "asset demand" for housing (as distinct from their demand for housing services) is highly variable from place to place depending on market conditions. Chapter 5 summarizes our conclusions and suggests some policy implications of our findings and future research directions.

2. Previous Household Studies

Housing markets have been intensively studied in developed countries, especially in the U.S. and Great Britain.[2/] For example, there are many dozens of published studies of the income and/or price elasticities of

---

2/ See Quigley (1979) and Weicher (1979) for concise summaries of recent housing market analysis. See DeLeeuw (1971) and Mayo (1981) for reviews of the demand literature.

the demand for housing. There are three reasons for the size of this literature. First, the many practical difficulties in the specification of econometric housing models (such as the correct measurement of prices, quantities, incomes, and the choice of functional form) have led to a number of alternative approaches by different investigators. Second, housing markets are local and diverse. What is true in one city, even within a country, is not necessarily true in another, so it has been natural to extend demand analyses to a wide variety of places. While divergent empirical estimates can be expected because of heterogeneity among markets, some stylized facts are now broadly supported by empirical work in developed countries--for example, that cross-section income and price elasticities of demand are less than one in absolute value--but even consensus on this general conclusion has been slow in coming. Third, the literature has grown because governments actively intervene in housing markets, and efficient intervention requires detailed knowledge of housing market parameters. In the U.S., in fact, the government has sponsored major studies of housing demand and supply behavior such as those of the Experimental Housing Allowance Program (Bradbury and Downs, Weinberg and Friedman) which were explicitly designed to facilitate choices among alternative housing policy instruments.

Despite the need for careful modeling of housing demand in developing countries, only a small number of studies have been done, and these are only rarely linked to policy applications. Research has tended to focus on a small number of countries where data are available--often better off developing countries. Even when data are available, analysis has often been hampered by limitations in sample design, definitional problems, and poor quality data. Even so, the modest amount of research that has been done has suggested important similarities in patterns of housing demand both among

developing countries and between developing and developed countries.[3] Were these patterns to hold elsewhere, there would be some promise of developing general patterns of prescription in dealing with developing country housing problems. But whether or not these patterns hold for other countries is not known, nor is much known concerning the relationship between idiosyncratic features of local housing markets and housing demand parameters. Some results will no doubt be found to be robust to market conditions, others not. Two important functions of this research are (1) to categorize some results as directly portable (the results which hold under most conditions), and (2) to make seemingly non-robust results portable by explaining how market conditions affect the result (hence making the result predictable).

Further, little is known concerning the impact on housing demand of institutional features of housing markets such as the availability of housing finance, rent control, or laws and practices concerning tenure and occupancy rights; little is known concerning the role of inflation on housing demand; and little is known concerning the impact of the sudden infusions of income and wealth to local economies from foreign worker remittances that have characterized a number of developing countries. Such work has also begun.[4]

The first step in developing a systematic understanding of housing demand in developing countries is to review previous studies. Table 1 summarizes information on housing demand studies in developing countries. The table is arranged by country; most studies of housing demand have been done

---

3/ See, for example, Ingram (1984) and Jimenez and Keare (1984).

4/ Hoy and Jimenez (1984), Friedman, Jimenez, and Mayo (1985), Malpezzi (1984 b, c), Mayo, Struyk and Turner (1985), Renaud (1984), Struyk and Turner (1984).

Table 1

Review of Previous Housing Demand Study Characteristics and Outputs

Author	City/ Country	Last Year of Data	Type of of Data	Model	Income Measure	Price Measure	Strati-cation	Type of Elasticity
Howe and Musgrove	Guyaquil, Ecuador	1968	pooled time series/cross section	ELES	total expenditure	none; price elasticity derived from ELES	6 strata, head's age income	evaluated at means
Howe and Musgrove	Lima, Peru	1969	cross-section	ELES	total expenditure	none, price elasticity derived from ELES	6 strata, head's age income	evaluated at means
Howe and Musgrove	Caracas, Venesuela	1966	cross-section	ELES	total expenditure	none, price elasticity derived from ELES	6 strata, head's age income	evaluated at means
Lluch et al.	Mexico	1968	cross-section	ELES	total expenditure	none, price elasticity derived from ELES	24 strata, socioeconomic status, location	evaluated at means
Betancourt	Central Chile	1964	cross-section	ELES	total expenditure	none, price elasticity derived from ELES	6 strata: head head's age, income	evaluated at means
Lluch et al.	Korea	1972	time series of aggregated cross-section	ELES	total expenditure	housing component of GNP price deflator		evaluated at means
Lluch et al.	Urban households, Korea	1971	cross-section, 9 large cities	ELES	total expenditure	price varies by city	6 strata: head's age, income source, household size	evaluated at means
Lluch et al.	Seoul, Korea	1971	cross-section	ELES	total expenditure	none; price elasticity derived from ELES	6 strata: head's age, income source, household size	evaluated at means
Follain et al.	Korea	1976	cross-section	log-log	consumption and current income	varies by household		constant
Follain et al.	Korea	1976	cross-section	log-log	consumption	varies by Dong		constant
Mayo et al.	Cairo, Egypt	1980	cross-section	log-log	current income and estimated permanent income	none		constant
Mayo et al.	Beni Suef, Egypt	1980	cross-section	log-log	current income and estimated permanent income	none		Constant
Mayo et al.	Cairo, Egypt	1980	cross-section	log-log	predicted current income	none		constant
Mayo et al.	Beni Suef, Egypt	1980	cross-section	log-log	predicted current income	none		constant
Falke	Malaysia	mid 70's?	varies	varies	varies	none	estimates from 3 other studies	varies

Table 1

Review of Previous Housing Demand Study Characteristics and Outputs

DEMAND ELASTICITIES

Author	City/ Country	Pooled Owners & Renters		Renters		Owners		Result of Stratification	Comments
		Income	Own Price	Income	Own Price	Income	Own Price		
Rowe and Mangrove	Guyaquil, Ecuador	M=1.10 R=1.02 to 1.15 IQR=.11	M=-.85 R=-.96 to -.64 IQR=.25						
Rowe and Mangrove	Lima, Peru	M=1.31 R=.89 to 2.35 IQR=.96	M=-.22 R=-.50 to .35 IQR=.69						
Rowe and Mangrove	Caracas, Venezula	M=1.09 R=.28 to 1.9 IQR=.56	M=.33 R=-.67 to -.08 IQR=.40						
Lluch et al.	Mexico	M=.93 R=.51 to 1.38 IQR=.15	M=-.31 R=.88 to .23 IQR=.26					Only urban results reported here.	
Betancourt	Central Chile	M=.79 R=.66 to 1.05 IQR=.26	M=-.34 R=-.55 to -.28 IQR=-.22						
Lluch et al.	Korea	2.48	-.53						
Lluch et al.	Urban Korea	M=.86 R=-.02 to 2.35 IQR=1.24	M=-.28 R=-.50 to -.01 IQR=.31					Only urban results reported here	
Lluch et al.	Seoul, Korea	M=.54 R=.39 to 2.00 IQR=1.78	M=-.22 R=1.28 to .12 IRQ=.64						
Follain et al.	Korea	Consumption: .58	-.13	.42	-.06	.62	-.05	Other estimates show some variation by city when stratified. See original paper. These results from Tables 4 and 6.	
		Current Income: .17	-.05	.12	.03	.21	.07		
Follain et al.	Korea	Rooms = .31 House Space = .45 Lot Size = .41	-.87 -.94 -.35					Dependent variables are measures of space	
Mayo et al.	Cairo, Egypt				Current: .25 Permanent: .38				
Mayo et al.	Beni Suef, Egypt				Current: .50 Permanent:.77				
Mayo et al.	Cairo, Egypt	.30		.30		.31		Dependent variable is log of number of rooms	
Mayo et al.	Beni Suef, Egypt	.19		.25		.17		Dependent variable is log of number of rooms	
Falke	Malaysia	.88 to 1.22						Review article. Primary sources not easily available	

Note: If estimates are stratified we present median of all elasticities (M=), Range (R=), and interegional range (IQR=).

Table 1

Review of Previous Housing Demand Study Characteristics and Outputs

Author	City/ Country	Last Year of Data	Type of of Data	Model	Income Measure	Price Measure	Stratification	Type of Elasticity
Howe and Musgrove	Bogota, Colombia	1968	pooled time series/cross section	ELES[1] static estimates (data treated as single cross section)	total expenditures	none; but implied price elasticities can be construed from ELES.[2]	6 strata based on head's age, income	evaluated at mean
Hamer	Bogota, Colombia	1978	cross-section	linear demand for space; linear and quadratic income terms	linear and quadratic current income	none		evaluated at mean
Ingram	Bogota, Colombia	1978	cross-section	linear demand	current income	hedonic price stratified by employment zone		evaluated at mean
Ingram	Bogota, Colombia	1978	cross-section	log-log demand	current income	"		constant
Ingram	Cali, Colombia	1978	cross-section	linear demand	current income	"		evaluated at mean
Ingram	Cali, Colombia	1978	cross-section	log-log	current income	"		constant
Hamer	Bogota, Colombia	1978	cross-section	log-log demand	current income	none		constant
Strassman	Cartagena, Colombia	1978	cross-section	log-log demand	current income	none	4 owner income classes - see comment	constant
Jimenez and Keare	Santa Ana, El Salvador	1980	pooled time series/cross section, low & medium income	linear; integrated treatment of demand and mobility	weighted average of current and past income	none		evaluated at mean
Jimenez and Keare	Santa Ana, El Salvador	1980	pooled time series/cross section, low & medium income	log-log; combines demand mobility	weighted average of current and past income	none		constant
Jimenez and Keare	Sonsonate, El Salvador	1980	pooled time series/cross section, low & medium income	linear; combines demand and mobility	weighted average of current and past income	none		evaluated at mean
Jimenez and Keare	Sonsonate, El Salvador	1980	pooled time series/cross section, low & medium income	log-log; combines demand and mobility	weighted average of current and	none		constant
Jimenez	Santa Ana, and Sonsonate, El Salvador	1980	cross-section	log-log; elasticities derived from model of self-help housing production	wage income	none	3 strata: (1) hired labor (2) self-help (3) mixed	constant
Keare and Jimenez	Santa Ana, El Salvador	1980	time series/ cross-section	3 year average	none			evaluated at means

Table 1

Review of Previous Housing Demand Study Characteristics and Outputs

		DEMAND ELASTICITIES							
		Pooled Owners & Renters		Renters		Owners		Result of	
Author	City/ Country	Income	Own Price	Income	Own Price	Income	Own Price	Stratification	Comments
Howe and Musgrove	Bogota, Colombia	M=.98 R=.85 to 1.07 IQR=.17	M=-.20 R=-.59 to 1.81 IQR=1.29					Income elasticity slightly lower for older households	
Muth	Bogota, Colombia	.53		.54		.47			Dependent variable is dwelling space
Ingram	Bogota, Colombia			.80 (1978)	-.08 (1978)	.60	-.19		
Ingram	Bogota, Colombia			.72 (1978) .77 (1972)	-.28 (1978) N.A. (1972)	.78	-.44		
Ingram	Cali Colombia			.16	-.30	.64			
Ingram	Cali, Colombia			.47	-.48	.76			
Ingram	Bogota, Colombia			.47		.52			Dependent variable is dwelling space
Strassmann	Cartagena Colombia			.78		1.19 (all owners)		Income elasticity goes up with income for 1st 3 groups	Owner model rerun, stratified by income. Income elasticities are .29, .85, 1.62, .64 from lowest highest income group
Jimenez and Keare	Santa Ana, El Salvador			.42		.68			Uses Heckman procedure to correct for sample
Jimenez and Keare	Santa Ana, El Salvador			.27		1.05			-
Jimenez and Keare	Sonsonate, El Salvador			.53					-
Jimenez and Keare	Sonsonate, El Salvador			.42					-
Jimenez	Santa Ana and Sonsonate, El Salvador					.78 to 1			
Keare and Jimenez	Santa Ana, El Salvador			.43		.45			Estimates by source of income show that MPC is higher from head's wage than other wages; highest MPC is from other income, mainly transfers

Note: If estimates are stratified we present median of all elasticities (M=), range (R=) and interquartile range (IQR=).

for Latin America, but others reported here have been done for Korea, Malaysia, and Egypt. The lowest income countries, and sub-Saharan African countries, are underrepresented. To conserve space, we will not discuss the results of these previous studies in detail.[5/] Here, however, the following points should be noted:

1. Most income elasticities are between 0.5 and 1, indicating generally inelastic demand.
2. Income elasticities for renters are generally below those of owners; the median renter elasticity is about 0.45, with two-thirds of the estimates falling between 0.4 and 0.8. The median owner income elasticity is about 0.65. While several of the owner estimates are above 1.0, none of the renter estimates is above 0.8.
3. Price elasticities are small, with medians for owners and renters equal to -.2 and -.3, respectively; price elasticities are below income elasticities in absolute value.

Despite the regularities noted above, there is still quite a bit of variation in parameter estimates from place to place and, depending on model specification, variation for particular places. It is not known how much of this is due to variation in data, variable definitions, model specification, or underlying behavior.

In order to isolate underlying behavioral differences, we have applied comparable model specification and, insofar as possible, comparable variable definitions to data in 16 cities in eight countries. First, we present results of simple models of housing expenditure which can be estimated

---

5/ See Mayo et al. (1983) for an extended discussion.

with each data set. Then we estimate more complete models which require specialized data available for fewer places. Comparison of these latter results with those of the simple models suggests how robust the results of the simple models are.

II. HOUSING EXPENDITURE FUNCTIONS IN EIGHT DEVELOPING COUNTRIES

A Simple Model of Housing Demand

Consider a utility maximizing household with income Y, which consumes housing (Q) at relative price P, and a unit-priced numeraire good. Straightforward maximization under the usual assumptions yields the demand relation:

$$Q = Q(Y, P)$$

conditional on "demand shifters," usually separately denoted as tastes and demographic variables. An Engel, or expenditure relation, can be derived by shifting P to the left-hand side; also, assuming constant tastes, and that household size dominates other demographic variables:

$$R = R(Y, H)$$

where R is rent ($R = PQ$), and H is household size. For estimation, a particular functional form must be chosen. A straightforward logarithmic specification is:

$$\ln R = a + E_y(\ln Y) + bH + cH^2 + u$$

where E_y is the income elasticity of demand, a, b, and c are regression coefficients, and u is an estimated disturbance.

While it may be desirable to include other demographic variables in the specification, this is not possible in all cities because of data limitations.[1/] The major limitations of such a specification are well known and include: omission of a price term; omission of other demographic

---

1/ Data are documented in the Appendix.

variables; the effects of household participation in government subsidized housing programs (or rent control); failure to account for permanent income effects; and restriction of the functional form to a constant income elasticity of demand. Many of these limitations are addressed in the next section, which draws on the richer data sets available for some cities in the analysis to evaluate this simple model. To anticipate those results, the simple model appears remarkably free of major biases. Functional forms other than loglinear have not been evaluated here.2/

Tables 2 and 3 present estimates of the parameters of Eq. (1) for 16 cities in eight developing countries.3/ Results for two U.S. cities are also included for comparison. For renters, the dependent variable is net rent (exclusive of utility payments). For owners, the dependent variable is either (1) net imputed rent based on the owners' imputations, (2) predicted rent from a hedonic price regression, or (3) constructed by applying a fixed amortization rate to owners' estimates of housing value.4/ Because a common definition of the dependent variable is used for renters, the estimated parameters are more comparable for renters than for owners. For owners, because amortization ratios (ratios of rent to value) sometimes decrease with

---

2/ See Hausman (1981) for detailed discussion of the implicit behavioral foundation behind a logarithmic demand model.

3/ Kumasi, Ghana and Kingston, Jamaica owners are not included because the sample size is too small.

4/ Table 3 shows which method was used for each city. For cities which used amortized housing values, amortization rates were based on percentages of value generally assumed to be between 1 and 1.5 percent of value per month, with this amortization rate fixed for all units in the sample.

TABLE 2

ESTIMATED PARAMETERS OF HOUSING EXPENDITURE FUNCTIONS FOR RENTERS

COUNTRY	CITY		CONSTANT	LOG INCOME	HH SIZE	HH SIZE SQUARED	R-SQUARED	N	INCOME CONF. INTERVALS		ESTIMATED EFFECT CHANGE IN HHSIZE	
COLOMBIA	BOGOTA	(COEF)	1.11	0.66	0.09	-0.006	.40	1016	(LOWER)	0.60	(1 TO 2)	0.07
	(NET RENT)	(T-STAT)		23.53	2.49	1.97			(UPPER)	0.72	(5 TO 6)	0.02
	(1978)	(PROB>T)		0.001	0.006	0.025					(9 TO 10)	-0.03
	CALI	(COEF)	2.81	0.44	0.13	-0.006	.27	257	(LOWER)	0.33	(1 TO 2)	0.11
	(NET RENT)	(T-STAT)		8.03	1.81	0.95			(UPPER)	0.55	(5 TO 6)	0.06
	(1978)	(PROB>T)		0.001	0.036	0.172					(9 TO 10)	0.01
EGYPT	CAIRO	(COEF)	0.25	0.46	-0.17	0.010	.16	303	(LOWER)	0.34	(1 TO 2)	-0.14
	(NET RENT)	(T-STAT)		7.37	1.79	1.22			(UPPER)	0.59	(5 TO 6)	-0.06
	(1981)	(PROB>T)		0.001	0.037	0.112					(9 TO 10)	0.02
	BENI SUEF	(COEF)	-1.2	0.51	0.38	-0.047	.25	63	(LOWER)	0.22	(1 TO 2)	0.24
	(NET RENT)	(T-STAT)		3.56	1.39	1.59			(UPPER)	0.80	(5 TO 6)	-0.13
	(1981)	(PROB>T)		0.001	0.085	0.059					(9 TO 10)	-0.51
EL SALVADOR	SANTA ANA	(COEF)	0.37	0.48	0.13	-0.014	.16	131	(LOWER)	0.27	(1 TO 2)	0.08
	(NET RENT)	(T-STAT)		4.49	1.59	2.00			(UPPER)	0.69	(5 TO 6)	-0.03
	(1980)	(PROB>T)		0.001	0.057	0.024					(9 TO 10)	-0.14
	SONSONATE	(COEF)	0.79	0.50	-0.10	0.007	.16	83	(LOWER)	0.25	(1 TO 2)	-0.08
	(NET RENT)	(T-STAT)		4.04	1.19	1.00			(UPPER)	0.75	(5 TO 6)	-0.03
	(1980)	(PROB>T)		0.001	0.119	0.160					(9 TO 10)	0.03
GHANA	KUMASI	(COEF)	0.82	0.33	0.02	0.000	.11	814	(LOWER)	0.25	(1 TO 2)	0.02
	(NET RENT)	(T-STAT)		8.67	0.58	0.16			(UPPER)	0.41	(5 TO 6)	0.02
	(1980)	(PROB>T)		0.001	0.281	0.436					(9 TO 10)	0.02
INDIA	BANGALORE	(COEF)	0.66	0.58	-0.08	0.003	.18	1041	(LOWER)	0.50	(1 TO 2)	-0.08
	(NET RENT)	(T-STAT)		14.89	2.38	1.21			(UPPER)	0.66	(5 TO 6)	-0.05
	(1975)	(PROB>T)		0.001	0.009	0.113					(9 TO 10)	-0.03
JAMAICA	KINGSTON	(COEF)	-.12	0.70	0.16	-0.012	.30	223	(LOWER)	0.54	(1 TO 2)	0.13
	(NET RENT)	(T-STAT)		8.84	2.21	1.88			(UPPER)	0.86	(5 TO 6)	0.03
	(1975)	(PROB>T)		0.001	0.014	0.031					(9 TO 10)	-0.07
KOREA	SEOUL	(COEF)	5.04	0.45	0.07	-0.004	.15	952	(LOWER)	0.38	(1 TO 2)	0.05
	(CHONSEI)	(T-STAT)		13.48	1.65	0.93			(UPPER)	0.52	(5 TO 6)	0.02
	(1979)	(PROB>T)		0.001	0.050	0.176					(9 TO 10)	-0.02
	BUSAN	(COEF)	6.26	0.31	0.05	-0.001	.08	508	(LOWER)	0.17	(1 TO 2)	0.05
	(CHONSEI)	(T-STAT)		4.47	0.89	0.25			(UPPER)	0.45	(5 TO 6)	0.04
	(1979)	(PROB>T)		0.001	0.187	0.401					(9 TO 10)	0.02
	TAEGU	(COEF)	4.95	0.44	0.03	-0.003	.23	292	(LOWER)	0.30	(1 TO 2)	0.02
	(CHONSEI)	(T-STAT)		6.52	0.41	0.41			(UPPER)	0.57	(5 TO 6)	-0.01
	(1979)	(PROB>T)		0.001	0.341	0.341					(9 TO 10)	-0.03

TABLE 2

ESTIMATED PARAMETERS OF HOUSING EXPENDITURE FUNCTIONS FOR RENTERS

COUNTRY	CITY		CONSTANT	LOG INCOME	HH SIZE	HH SIZE SQUARED	R-SQUARED	N	INCOME CONF. INTERVALS		ESTIMATED EFFECT CHANGE IN HHSIZE	
KOREA	KWANGJU	(COEF)	2.70	0.62	0.09	-0.002	.32	134	(LOWER)	0.43	(1 TO 2)	0.08
	(CHONSEI)	(T-STAT)		6.75	0.68	0.18			(UPPER)	0.80	(5 TO 6)	0.06
	(1979)	(PROB>T)		0.001	0.249	0.429					(9 TO 10)	0.04
	OTH. K. C.	(COEF)	3.33	0.54	0.04	0.002	.17	1000	(LOWER)	0.45	(1 TO 2)	0.05
	(CHONSEI)	(T-STAT)		11.56	0.77	0.36			(UPPER)	0.64	(5 TO 6)	0.07
	(1979)	(PROB>T)		0.001	0.221	0.359					(9 TO 10)	0.09
PHILIPPINES	DAVAO	(COEF)	-1.6	0.88	0.00	-0.002	.42	1376	(LOWER)	0.82	(1 TO 2)	-0.01
	(NET RENT)	(T-STAT)		30.59	0.02	1.02			(UPPER)	0.93	(5 TO 6)	-0.03
	(1979)	(PROB>T)		0.001	0.492	0.154					(9 TO 10)	-0.05
	MANILA	(COEF)	1.27	0.56	0.01	-0.002	.22	605	(LOWER)	0.48	(1 TO 2)	-0.00
	(NET RENT)	(T-STAT)		13.08	0.14	0.85			(UPPER)	0.65	(5 TO 6)	-0.02
	(1983)	(PROB>T)		0.001	0.446	0.197					(9 TO 10)	-0.04
U.S.	PITTSBURGH	(COEF)	3.07	0.26	-0.02	-0.002	.15	946	(LOWER)	0.22	(1 TO 2)	-0.03
	(NET RENT)	(T-STAT)		12.65	0.70	0.44			(UPPER)	0.30	(5 TO 6)	-0.05
	(1975)	(PROB>T)		0.001	0.242	0.330					(9 TO 10)	-0.06
	PHOENIX	(COEF)	3.68	0.18	0.12	-0.015	.13	918	(LOWER)	0.14	(1 TO 2)	0.07
	(NET RENT)	(T-STAT)		10.70	3.67	3.22			(UPPER)	0.21	(5 TO 6)	-0.05
	(1975)	(PROB>T)		0.001	0.001	0.001					(9 TO 10)	-0.17

NOTES:

(1) FOR RENTERS, RENTS ARE NET OF UTILITIES BUT INCLUDE AMORTIZED KEY MONEY IN EGYPT

(2) (PROB>T) IS THE PROBABILITY OF OBSERVING THE SAMPLE UNDER THE NULL HYPOTHESIS

TABLE 3

ESTIMATED PARAMETERS OF HOUSING EXPENDITURE FUNCTIONS FOR OWNERS

COUNTRY	CITY		CONSTANT	LOG INCOME	HH SIZE	HH SIZE SQUARED	R-SQUARED	N	INCOME CONF. INTERVALS		ESTIMATED EFFECT CHANGE IN HHSIZE	
COLOMBIA	BOGOTA	(COEF)	0.77	0.75	-0.00	-0.003	.49	821	(LOWER)	0.70	(1 TO 2)	-0.01
	(IMPUTED)	(T-STAT)		27.79	0.14	1.03			(UPPER)	0.80	(5 TO 6)	-0.03
	(1978)	(PROB>T)		0.001	0.444	0.152					(9 TO 10)	-0.06
	CALI	(COEF)	1.25	0.69	-0.05	-0.000	.38	256	(LOWER)	0.57	(1 TO 2)	-0.05
	(IMPUTED)	(T-STAT)		12.32	0.63	0.08			(UPPER)	0.80	(5 TO 6)	-0.05
	(1978)	(PROB>T)		0.001	0.265	0.468					(9 TO 10)	-0.05
EGYPT	CAIRO	(COEF)	0.89	0.17	0.12	-0.009	.06	76	(LOWER)	-0.06	(1 TO 2)	0.10
	(IMPUTED)	(T-STAT)		1.47	0.58	0.48			(UPPER)	0.41	(5 TO 6)	0.02
	(1981)	(PROB>T)		0.073	0.282	0.316					(9 TO 10)	-0.05
	BENI SUEF	(COEF)	-.09	0.42	0.14	-0.003	.23	63	(LOWER)	0.16	(1 TO 2)	0.13
	(VALUE)	(T-STAT)		3.19	1.00	0.29			(UPPER)	0.69	(5 TO 6)	0.11
	(1981)	(PROB>T)		0.001	0.161	0.386					(9 TO 10)	0.08
EL SALVADOR	SANTA ANA	(COEF)	-2.5	1.11	-0.06	-0.004	.37	169	(LOWER)	0.89	(1 TO 2)	-0.07
	(IMPUTED)	(T-STAT)		10.05	0.50	0.44			(UPPER)	1.33	(5 TO 6)	-0.10
	(1980)	(PROB>T)		0.001	0.309	0.330					(9 TO 10)	-0.13
	SONSONATE	(COEF)	0.39	0.79	-0.13	0.001	.57	27	(LOWER)	0.49	(1 TO 2)	-0.13
	(IMPUTED)	(T-STAT)		5.23	0.78	0.08			(UPPER)	1.10	(5 TO 6)	-0.12
	(1980)	(PROB>T)		0.001	0.222	0.467					(9 TO 10)	-0.11
GHANA	KUMASI	(COEF)	.	.	.	.	.	.	(LOWER)	.	(1 TO 2)	.
	(IMPUTED)	(T-STAT)		.	.	.			(UPPER)	.	(5 TO 6)	.
	(1980)	(PROB>T)		.	.	.					(9 TO 10)	.
INDIA	BANGALORE	(COEF)	2.84	0.43	-0.17	0.007	.15	205	(LOWER)	0.27	(1 TO 2)	-0.15
	(HEDONIC)	(T-STAT)		5.34	2.85	2.13			(UPPER)	0.59	(5 TO 6)	-0.09
	(1975)	(PROB>T)		0.001	0.002	0.017					(9 TO 10)	-0.03
JAMAICA	KINGSTON	(COEF)	.	.	.	.	.	.	(LOWER)	.	(1 TO 2)	.
		(T-STAT)		.	.	.			(UPPER)	.	(5 TO 6)	.
	(1975)	(PROB>T)		.	.	.					(9 TO 10)	.
KOREA	SEOUL	(COEF)	6.06	0.44	-0.04	0.002	.12	952	(LOWER)	0.36	(1 TO 2)	-0.03
	(VALUE)	(T-STAT)		11.03	1.00	0.79			(UPPER)	0.52	(5 TO 6)	-0.01
	(1979)	(PROB>T)		0.001	0.159	0.215					(9 TO 10)	0.00
	BUSAN	(COEF)	5.93	0.45	-0.05	0.002	.10	296	(LOWER)	0.29	(1 TO 2)	-0.04
	(VALUE)	(T-STAT)		5.55	0.49	0.19			(UPPER)	0.62	(5 TO 6)	-0.03
	(1979)	(PROB>T)		0.001	0.312	0.425					(9 TO 10)	-0.01
	TAEGU	(COEF)	6.32	0.47	-0.19	0.011	.18	152	(LOWER)	0.30	(1 TO 2)	-0.15
	(VALUE)	(T-STAT)		5.53	2.39	1.78			(UPPER)	0.64	(5 TO 6)	-0.07
	(1979)	(PROB>T)		0.001	0.009	0.039					(9 TO 10)	0.02

TABLE 3

ESTIMATED PARAMETERS OF HOUSING EXPENDITURE FUNCTIONS FOR OWNERS

COUNTRY	CITY		CONSTANT	LOG INCOME	HH SIZE	HH SIZE SQUARED	R-SQUARED	N	INCOME CONF. INTERVALS		ESTIMATED EFFECT CHANGE IN HHSIZE	
KOREA	KWANGJU	(COEF)	7.53	0.41	-0.27	0.018	.14	84	(LOWER)	0.19	(1 TO 2)	-0.22
	(VALUE)	(T-STAT)		3.69	1.51	1.13			(UPPER)	0.64	(5 TO 6)	-0.07
	(1979)	(PROB>T)		0.001	0.067	0.131					(9 TO 10)	0.07
	OTH. K. C.	(COEF)	2.16	0.79	-0.12	0.003	.26	779	(LOWER)	0.69	(1 TO 2)	-0.11
	(VALUE)	(T-STAT)		16.20	2.14	0.58			(UPPER)	0.88	(5 TO 6)	-0.08
	(1979)	(PROB>T)		0.001	0.016	0.279					(9 TO 10)	-0.06
PHILIPPINES	DAVAO	(COEF)	-3.2	0.99	0.04	-0.004	.28	1968	(LOWER)	0.91	(1 TO 2)	0.02
	(IMPUTED)	(T-STAT)		26.98	0.91	1.37			(UPPER)	1.06	(5 TO 6)	-0.01
	(1979)	(PROB>T)		0.001	0.181	0.085					(9 TO 10)	-0.04
	MANILA	(COEF)	2.46	0.57	-0.02	-0.000	.31	390	(LOWER)	0.48	(1 TO 2)	-0.03
	(IMPUTED)	(T-STAT)		13.34	0.53	0.06			(UPPER)	0.65	(5 TO 6)	-0.03
	(1983)	(PROB>T)		0.001	0.298	0.477					(9 TO 10)	-0.03
U.S.	PITTSBURGH	(COEF)	3.50	0.18	0.08	-0.005	.21	2378	(LOWER)	0.16	(1 TO 2)	0.07
	(HEDONIC)	(T-STAT)		16.89	5.06	2.83			(UPPER)	0.20	(5 TO 6)	0.03
	(1975)	(PROB>T)		0.001	0.001	0.002					(9 TO 10)	-0.01
	PHOENIX	(COEF)	3.62	0.18	0.13	-0.011	.24	2284	(LOWER)	0.16	(1 TO 2)	0.10
	(HEDONIC)	(T-STAT)		18.92	9.52	6.89			(UPPER)	0.20	(5 TO 6)	0.02
	(1975)	(PROB>T)		0.001	0.001	0.001					(9 TO 10)	-0.07

NOTES:

(1) FOR RENTERS, RENTS ARE NET OF UTILITIES BUT INCLUDE AMORTIZED KEY MONEY IN EGYPT

(2) (PROB>T) IS THE PROBABILITY OF OBSERVING THE SAMPLE UNDER THE NULL HYPOTHESIS

income, it may be that income elasticities derived from amortized housing value will exceed those derived from imputed rent.5/

Most of the columns in Tables 2 and 3 are self-explanatory except for columns 7 and 8. Column 7 gives confidence intervals for the income elasticity, whose point estimate is, of course, the coefficient of log income. The upper and lower bounds are plus and minus two standard errors, respectively. Column 8 contains estimates of the combined effects of the two household size variables. For example, the point estimates for household size and its square imply the following pattern for Bogota renters: adding an individual to a one-person household increases housing consumption by an estimated 7 percent; the corresponding increase for a 5-person household is only 2 percent; and housing consumption declines 3 percent when household sizes increase from 9 to 10.

In general, the results presented in Tables 2 and 3 are remarkably consistent with results from developed countries (see Mayo, 1981). The regression fits are typical for this type of equation: typical R-squared statistics are in the .1 to .3 range (minimum is .06, maximum, 57). Fits are similar for owners and renters.

The median of all renter income elasticities is .49; developing country elasticities range from .31 (Busan) to .88 (Davao). Most are clustered between .4 and .6. Interestingly, the U.S. elasticities are the lowest. The income coefficients have been estimated with good precision; typical standard errors are .05, and the largest is .14. The last column of

---

5/ Direct tests of this using data from Cairo indicate that income elasticities of housing value and owners' imputed market rent are in fact significantly different, with the former larger. Forthcoming research on household specific rent-to-value ratios will examine these issues in more detail.

the tables shows an income elasticity confidence interval of plus or minus two standard errors. Among renter equations, all interval boundaries are within the zero-one interval, and most are within the range .2 - .8. This is strong evidence of inelastic demand for housing among renters.

The median of all point estimates of owner income elasticities is .46 with extremes of .17 in Cairo and 1.11 in Santa Ana. The majority of point estimates lie between .4 and .6. Again, the estimates are quite precise. Typical standard errors for the log income coefficient are around .07, and all are less than .14. Two-standard-deviation confidence intervals reveal three cities where the interval contains unit elasticity: Davao, Sonsonate, and Santa Ana. Figures 1 and 2 present these intervals graphically for ease of comparison. Most of the estimated intervals are contained within the interval [.2, 1]. In 9 of 14 cases where comparison is possible, estimated developing country owner income elasticities are greater than those of renters; this finding parallels findings in the literature for developed countries (Mayo, 1981). The data from the U.S. cities is less conclusive: all elasticities, renters and owners, are lower than expected. Comparing expenditure equations across countries reveals practically no systematic variation of income elasticities with country or city income level or size, but considerable variation in intercepts, which are positively related to average city income. Rent-to-income ratios therefore decline systematically with income <u>within</u> cities, but increase with income <u>across</u> cities. This relationship will be explored in detail in Section 3.

Household size is the sole demographic variable included in the simple models (along with its square). While it is expected that consumption of housing increases with household size, some analysts have hypothesized that, for very large households, housing consumption is crowded out by food

FIGURE 1
INTERVAL ESTIMATES OF RENTER INCOME ELASTICITIES

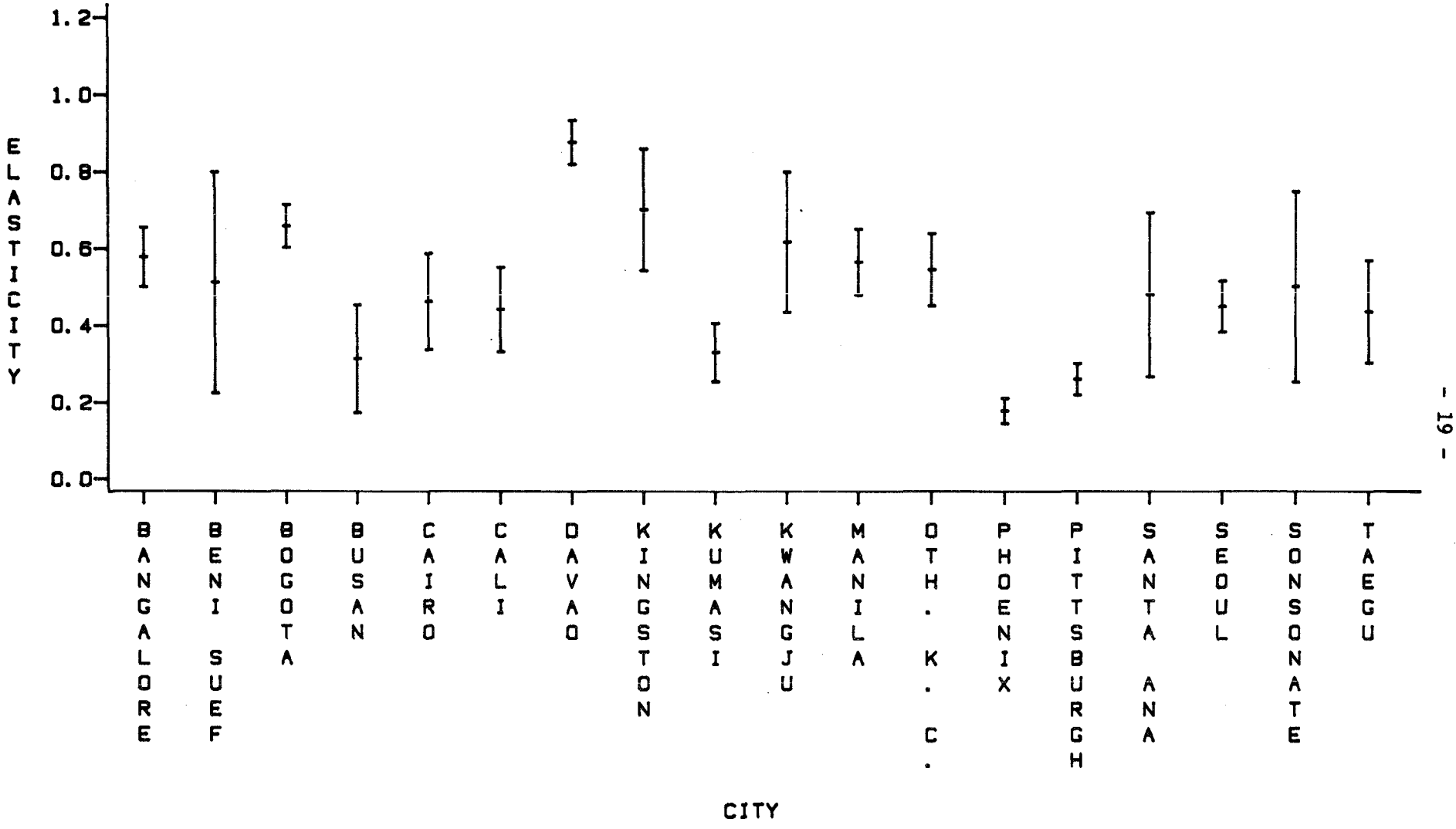
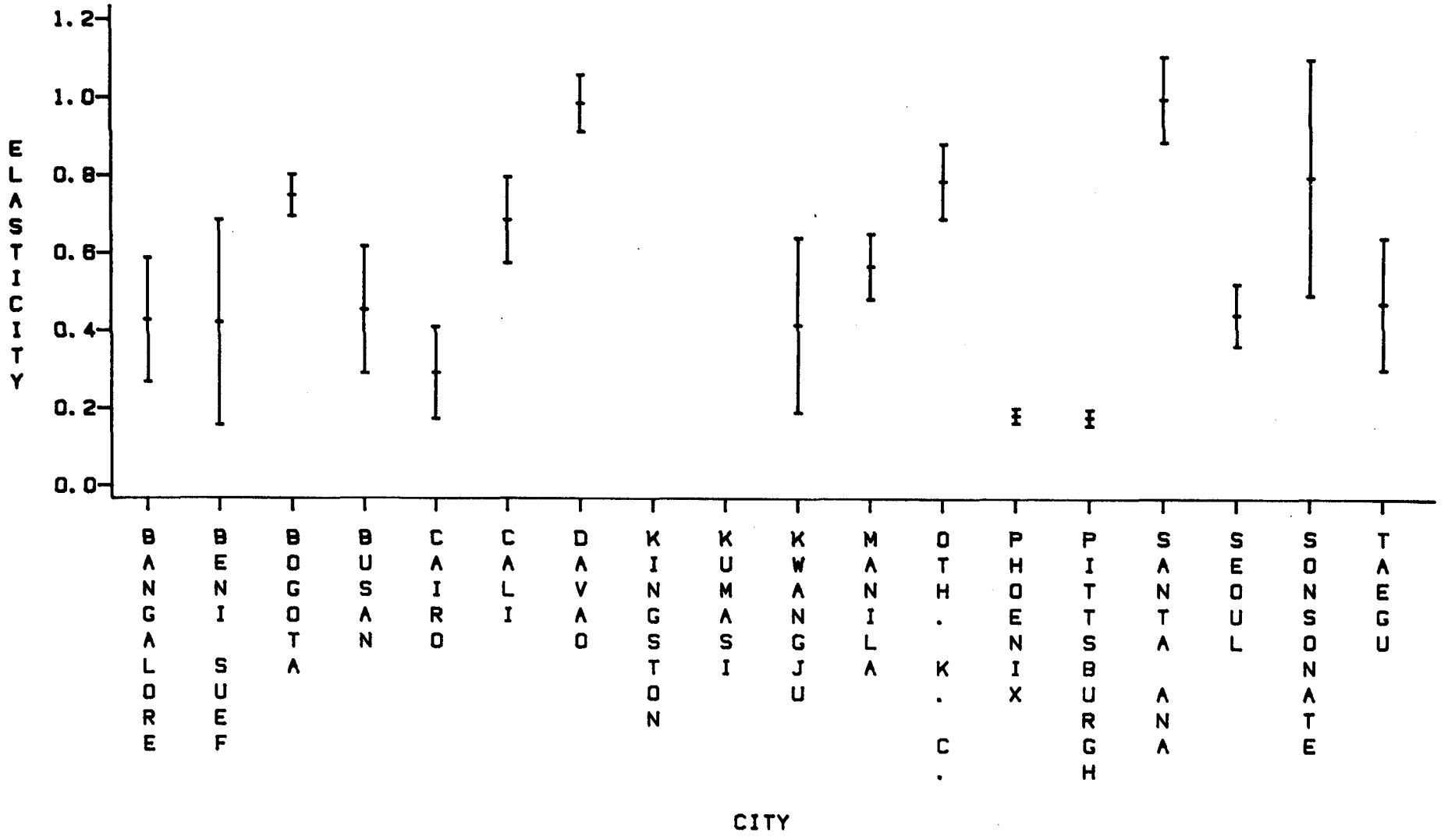


FIGURE 2
INTERVAL ESTIMATES OF OWNER INCOME ELASTICITIES



consumption. If this hypothesis is correct we expect a positive coefficient for household size but a negative coefficient for household size squared. In fact, 11 of 16 LDC renter equations follow this pattern, but only in Bogota and Santa Ana are both variables significantly different from zero and of the expected sign. The "turning point," or size at which other expenditures begin to crowd out additional housing, is a 6-person household in Santa Ana and a 7-person household in Bogota, but in general the estimated relationships are quite flat. Among LDC owners household size appears to be negatively related to housing expenditures, with 11 of 14 coefficients of household size negative, although these relationships are extremely weak. The "crowding out" pattern found for renters is evident in only 3 of 13 owner estimates (although none of these are significant). These results for owners are not surprising since higher adjustment costs presumably lead owners to make longer term housing decisions less strongly related to current demographic characteristics.

2. Evaluating the Simple Model With Data from Egypt and the Philippines

The simple model estimated in 16 cities and presented in Section 2.1 is easily criticized, but as noted, this model was chosen because it could be replicated with many existing data sets. In this section we will present estimates from a more complex model which can be estimated with data from Egypt and the Philippines. These estimates are of interest in their own right, but can also be used to evaluate the simple model. In particular, we will compare income elasticities from the two models using these data sets to test the robustness of the estimated income elasticity.

Possible criticisms of the simple estimates include the following:

1. Current income is inappropriate when estimating the demand for a durable good. Some long-term measure, "permanent" income, or income adjusted for place in the life cycle, is more closely related to the demand for housing.

2. The simple model assumes no variation in the price of housing within the sample. In fact, housing prices vary over space within a city, for example due to variation in land prices. If, as in the Muth-Mills framework, housing prices and income are correlated, then not only do we have no estimate of the price elasticity, but our measure of the income elasticity is biased.

3. In addition to household size, other demographic characteristics such as age of head and sex of head are related to housing consumption. To the extent that these characteristics are correlated with household size, household size results may also be biased.

4. Government programs which provide or subsidize housing consumption may distort estimates which are implicitly assumed to be market outcomes.

5. Much of the sample may be "out of equilibrium," and estimates based on restricted samples such as recent movers or people satisfied with their housing choices would be more appropriate.

6. The definition of a market used here is inappropriate. We should estimate demand relations (a) for submarkets stratified by income, or ethnic group, or location within the city, or (b) use national or regional estimates which are more appropriate because the market is actually wider.

7. Housing consumption is a joint decision (with tenure choice, or with moving, or with upgrading) and so simultaneous models of these choices are appropriate.

8. Housing demand is better treated in a demand-for-characteristics framework rather than as a composite good. Demands for space, location, quality, and other attributes, however defined, are likely to differ from one another.

9. Our choice of functional form is inappropriate. The log expenditure function does not satisfy the postulates of demand theory except as a local approximation. Linear models or systems of demand equations would be more appropriate.

This is not an exhaustive list, but one which reflects much of the recent literature on housing demand.[6/]

6/ Representative references on each respective point include: (1) Mayo (1981), deLeeuw (1971), and Muth (1960); (2) Polinsky (1977); (3) Pollak and Wales (1981); (4) Olsen and Barton (1983); (5) Ihlanfeldt (1981), Hanushek and Quigley (1978); (6) Straszheim (1975), Linneman (1981); (7) Lee and Trost (1978), Weinberg et al. (1981); (8) Rosen (1974), Quigley (1982); (9) Phlips (1974). Obviously this list is not exhaustive.

This section compares results for the simple model used above to results from a more complete model which includes prices and other additional variables. This so-called "complete" model is also the basis for detailed estimates of price and income elasticities in Section 2.3.

How does this new model fare with respect to each of the nine criticisms listed above? The responses corresponding to each criticism are as follows:

1. Substitute total consumption for total income in the "complete" demand equation. Since the permanent income hypothesis states that consumption is strongly related to the unobservable permanent income, accept the hypothesis and use consumption directly as a proxy for the unobservable variable. Results for other permanent income measures are summarized in Section 3 and will be the subject of a separate paper.

2. Assume a simple two-factor model of housing production, where one-factor price (land) varies over space, and other input prices do not. Use the log of land price in the expenditure equation and use to derive price elasticities, as explained in Section 3.

3. Add age of the household head, its square, and sex of the household head to the equation.

4. Include dummy variables for government programs where appropriate.

5. Include length of tenure, and its square, directly in the expenditure relation. There are two possible problems with keeping recent movers and long-time residents in the same sample. It may be that recent movers are closer to equilibrium, on average, but that these departures from equilibrium are symmetric about the average demand relation. Then estimates from the pooled sample are unbiased but inefficient. On the other hand, large negative departures may require adjustment of consumption immediately, while those "overconsuming" feel less pressure to adjust. Then departures from the equilibrium relation are <u>not</u> symmetric in the full sample, and results are biased. Including length of tenure and its square corrects for this bias. It does not necessarily improve efficiency.

6. Some choice must be made regarding market definition, and we choose the common assumption that the market is coincident with the metropolitan area. See Follain and Malpezzi (1980) for tests of this assumption using U.S. data.

7. Studies such as Lee and Trost, and Rosen, find modest impacts on income elasticities of demand when simultaneous methods are used. Estimated income and price elasticities from this type of study are in line with single equation estimates; this is an area we will explore in future work. For now, a few very simple models (pooled samples, with and without dummy variables for

tenure) were estimated, and income elasticities were reasonbly robust (results are available upon request).

8. We view the characteristics demand approach and the composite demand approach as complementary techniques. The definition of a good is always problematic in real-world demand analysis. See Follain and Jimenez (forthcoming, b) for estimates using Colombian, Philipppine and Korean data.

9. Mayo's (1981) survey highlights the fact that qualitatively similar results are obtained using linear and log-linear models. Log models have their own desirable properties such as reduced heteroskedastity, and reducing the influence of extreme rents and incomes on parameter estimates.

Tables 4 to 9 present estimates for the "complete" models described above for Cairo, Beni Suef and Manila. The results from simple models are also presented for comparison. These results are for gross rents (including utilities) and, hence, differ slightly from Tables 2 and 3. The tables also present the differences in the estimates between the two models, and the standardized differences, i.e. the difference in the coefficients divided by the standard error of the complete model. Formal tests are not presented, because the simple and complete models were estimated on different samples.

The larger models clearly fit the data better than the simple models. R-squared statistics typically increase from the range .2--.3 to the range .4--.6, and the increase is impressive even after adjustment for degrees of freedom.

Estimated renter income elasticities of demand are larger in the complete model, but owner elasticities are remarkably insensitive to specification. No obvious pattern of change in the precision of the income estimates emerges. Despite the increase in estimated renter income elasticities in several samples, the results are still consistent with inelastic demand, except in Manila where the point estimate now approaches unity. Price elasticities implied by the land price coefficients are close to -1. Section 2.3, below, presents alternative income and price elasticity results in more detail.

TABLE 4
COMPARISON OF SMALL AND LARGE DEMAND MODELS: BENI SUEF RENTERS

		COMPLETE MODEL	SIMPLE MODEL	DIFFERENCE	STANDARDIZED DIFFERENCE
INTERCEPT	(COEFF)	0.378	-.527	0.905	0.552
	(STD ERROR)	1.640			
	(PROB>T)	0.409			
LOG INCOME	(COEFF)	0.659	0.541	0.118	0.843
	(STD ERROR)	0.14	0.15		
	(PROB>T)	0.000	0.409		
LOG PRICE	(COEFF)	0.105			
	(STD ERROR)	0.090			
	(PROB>T)	0.125			
AGE	(COEFF)	0.002			
	(STD ERROR)	0.050			
	(PROB>T)	0.484			
AGE, SQUARED	(COEFF)	-.000			
	(STD ERROR)	0.001			
	(PROB>T)	0.504			
HHSIZE	(COEFF)	0.092	0.125	-.033	-.165
	(STD ERROR)	0.200	0.320		
	(PROB>T)	0.324	0.000		
HHSIZE SQUARED	(COEFF)	-.011	-.017	0.006	0.300
	(STD ERROR)	0.020	0.030		
	(PROB>T)	0.708	0.124		
FEMALE HEAD	(COEFF)	-.112			
	(STD ERROR)	0.250			
	(PROB>T)	0.672			
LENGTH OF TENURE	(COEFF)	-.046			
	(STD ERROR)	0.020			
	(PROB>T)	0.987			
LENGTH OF TENURE, SQUARED	(COEFF)	0.001			
	(STD ERROR)	0.000			
	(PROB>T)	0.084			
GOVT. HOUSING	(COEFF)	-.201			
	(STD ERROR)	0.310			
	(PROB>T)	0.740			
PUBLIC HOUSING	(COEFF)	.			
	(STD ERROR)	.			
	(PROB>T)	.			
R-SQUARED		.56	.16		
ADJ. R-SQUARED		.47			
SAMPLE SIZE		60	55		

1/ CURRENT EXPENDITURES USED IN COMPLETE MODEL, CURRENT INCOMES. IN SIMPLE MODEL
2/ PRICE=LOT PRICE=(EST. LAND VALUE*BLDG AREA)/NO. OF UNITS

TABLE 5
COMPARISON OF SMALL AND LARGE DEMAND MODELS: BENI SUEF OWNERS

		COMPLETE MODEL	SIMPLE MODEL	DIFFERENCE	STANDARDIZED DIFFERENCE
INTERCEPT	(COEFF)	6.058	0.047	6.011	2.783
	(STD ERROR)	2.160			
	(PROB>T)	0.012			
LOG INCOME	(COEFF)	0.292	0.422	-.130	-.684
	(STD ERROR)	0.19	0.13		
	(PROB>T)	0.081	0.003		
LOG PRICE	(COEFF)	-.007			
	(STD ERROR)	0.140			
	(PROB>T)	0.519			
AGE	(COEFF)	-.079			
	(STD ERROR)	0.050			
	(PROB>T)	0.924			
AGE, SQUARED	(COEFF)	0.001			
	(STD ERROR)	0.000			
	(PROB>T)	0.055			
HHSIZE	(COEFF)	0.235	0.142	0.093	0.581
	(STD ERROR)	0.160	0.142		
	(PROB>T)	0.090	0.065		
HHSIZE SQUARED	(COEFF)	-.018	-.003	-.015	-1.5
	(STD ERROR)	0.010	0.010		
	(PROB>T)	0.945	0.520		
FEMALE HEAD	(COEFF)	0.307			
	(STD ERROR)	0.300			
	(PROB>T)	0.168			
LENGTH OF TENURE	(COEFF)	-.066			
	(STD ERROR)	0.020			
	(PROB>T)	0.995			
LENGTH OF TENURE, SQUARED	(COEFF)	0.001			
	(STD ERROR)	0.000			
	(PROB>T)	0.014			
GOVT. HOUSING	(COEFF)	.			
	(STD ERROR)	.			
	(PROB>T)	.			
PUBLIC HOUSING	(COEFF)	.			
	(STD ERROR)	.			
	(PROB>T)	.			
R-SQUARED		.65	.23		
ADJ. R-SQUARED		.34			
SAMPLE SIZE		20	63		

1/ CURRENT EXPENDITURES USED IN COMPLETE MODEL, CURRENT INCOMES. IN SIMPLE MODEL
2/ PRICE=LOT PRICE=(EST. LAND VALUE*BLDG AREA)/NO. OF UNITS

TABLE 6
COMPARISON OF SMALL AND LARGE DEMAND MODELS: CAIRO RENTERS

		COMPLETE MODEL	SIMPLE MODEL	DIFFERENCE	STANDARDIZED DIFFERENCE
INTERCEPT	(COEFF)	2.399	0.565	1.834	3.335
	(STD ERROR)	0.550			
	(PROB>T)	0.000			
LOG INCOME	(COEFF)	0.508	0.420	0.088	1.760
	(STD ERROR)	0.05	0.05		
	(PROB>T)	0.000	0.000		
LOG PRICE	(COEFF)	0.076			
	(STD ERROR)	0.030			
	(PROB>T)	0.006			
AGE	(COEFF)	-.018			
	(STD ERROR)	0.010			
	(PROB>T)	0.963			
AGE, SQUARED	(COEFF)	0.000			
	(STD ERROR)	0.000			
	(PROB>T)	0.024			
HHSIZE	(COEFF)	-.033	-.059	0.026	0.433
	(STD ERROR)	0.060	0.080		
	(PROB>T)	0.708	0.000		
HHSIZE SQUARED	(COEFF)	0.005	0.003	0.002	0.420
	(STD ERROR)	0.005	0.010		
	(PROB>T)	0.160	0.006		
FEMALE HEAD	(COEFF)	0.174			
	(STD ERROR)	0.080			
	(PROB>T)	0.016			
LENGTH OF TENURE	(COEFF)	-.059			
	(STD ERROR)	0.010			
	(PROB>T)	1.000			
LENGTH OF TENURE, SQUARED	(COEFF)	0.001			
	(STD ERROR)	0.000			
	(PROB>T)	0.000			
GOVT. HOUSING	(COEFF)	1.586			
	(STD ERROR)	1.670			
	(PROB>T)	0.172			
PUBLIC HOUSING	(COEFF)	-.083			
	(STD ERROR)	1.090			
	(PROB>T)	0.530			
R-SQUARED		.61	.17		
ADJ. R-SQUARED		.58			
SAMPLE SIZE		151	296		

1/ CURRENT EXPENDITURES USED IN COMPLETE MODEL, CURRENT INCOMES. IN SIMPLE MODEL
2/ PRICE=LOT PRICE=(EST. LAND VALUE*BLDG AREA)/NO. OF UNITS

TABLE 7
COMPARISON OF SMALL AND LARGE DEMAND MODELS: CAIRO OWNERS

		COMPLETE MODEL	SIMPLE MODEL	DIFFERENCE	STANDARDIZED DIFFERENCE
INTERCEPT	(COEFF)	2.409	1.543	0.866	0.671
	(STD ERROR)	1.290			
	(PROB>T)	0.032			
LOG INCOME	(COEFF)	0.350	0.372	-.022	-.169
	(STD ERROR)	0.13	0.08		
	(PROB>T)	0.004	0.032		
LOG PRICE	(COEFF)	0.112			
	(STD ERROR)	0.060			
	(PROB>T)	0.032			
AGE	(COEFF)	0.006			
	(STD ERROR)	0.030			
	(PROB>T)	0.421			
AGE, SQUARED	(COEFF)	-.000			
	(STD ERROR)	0.000			
	(PROB>T)	0.630			
HHSIZE	(COEFF)	0.120	-.258	0.378	2.520
	(STD ERROR)	0.150	0.140		
	(PROB>T)	0.213	0.004		
HHSIZE SQUARED	(COEFF)	-.008	0.024	-.032	-3.2
	(STD ERROR)	0.010	0.010		
	(PROB>T)	0.787	0.033		
FEMALE HEAD	(COEFF)	-.578			
	(STD ERROR)	0.250			
	(PROB>T)	0.989			
LENGTH OF TENURE	(COEFF)	-.003			
	(STD ERROR)	0.020			
	(PROB>T)	0.560			
LENGTH OF TENURE, SQUARED	(COEFF)	-.000			
	(STD ERROR)	0.000			
	(PROB>T)	0.579			
GOVT. HOUSING	(COEFF)	.			
	(STD ERROR)	.			
	(PROB>T)	.			
PUBLIC HOUSING	(COEFF)	.			
	(STD ERROR)	.			
	(PROB>T)	.			
R-SQUARED		.61	.18		
ADJ. R-SQUARED		.58			
SAMPLE SIZE		151	97		

1/ CURRENT EXPENDITURES USED IN COMPLETE MODEL, CURRENT INCOMES. IN SIMPLE MODEL
2/ PRICE=LOT PRICE=(EST. LAND VALUE*BLDG AREA)/NO. OF UNITS

TABLE 8
COMPARISON OF SMALL AND LARGE DEMAND MODELS: MANILA RENTERS

		COMPLETE MODEL	SIMPLE MODEL	DIFFERENCE	STANDARDIZED DIFFERENCE
INTERCEPT	(COEFF)	-.163	0.916	-1.08	-2.04
	(STD ERROR)	0.530			
	(PROB>T)	0.621			
LOG INCOME	(COEFF)	0.921	0.615	0.306	5.100
	(STD ERROR)	0.06	0.042		
	(PROB>T)	0.000	0.621		
LOG PRICE	(COEFF)	-.031			
	(STD ERROR)	0.030			
	(PROB>T)	0.849			
AGE	(COEFF)	-.005			
	(STD ERROR)	0.020			
	(PROB>T)	0.599			
AGE, SQUARED	(COEFF)	0.000			
	(STD ERROR)	0.000			
	(PROB>T)	0.159			
HHSIZE	(COEFF)	-.036	0.028	-.064	-1.28
	(STD ERROR)	0.050	0.040		
	(PROB>T)	0.764	0.000		
HHSIZE SQUARED	(COEFF)	0.002	-.001	0.003	0.750
	(STD ERROR)	0.004	0.003		
	(PROB>T)	0.309	0.849		
FEMALE HEAD	(COEFF)	-.070			
	(STD ERROR)	0.100			
	(PROB>T)	0.758			
LENGTH OF TENURE	(COEFF)	-.064			
	(STD ERROR)	0.010			
	(PROB>T)	1.000			
LENGTH OF TENURE, SQUARED	(COEFF)	0.001			
	(STD ERROR)	0.000			
	(PROB>T)	0.000			
GOVT. HOUSING	(COEFF)	-.448			
	(STD ERROR)	0.110			
	(PROB>T)	1.000			
PUBLIC HOUSING	(COEFF)	.			
	(STD ERROR)	.			
	(PROB>T)	.			
R-SQUARED		.41	.24		
ADJ. R-SQUARED		.40			
SAMPLE SIZE		659	740		

1/ CURRENT EXPENDITURES USED IN COMPLETE MODEL, CURRENT INCOMES. IN SIMPLE MODEL
2/ PRICE=LOT PRICE=(EST. LAND VALUE*BLDG AREA)/NO. OF UNITS

TABLE 9
COMPARISON OF SMALL AND LARGE DEMAND MODELS: MANILA OWNERS

		COMPLETE MODEL	SIMPLE MODEL	DIFFERENCE	STANDARDIZED DIFFERENCE
INTERCEPT	(COEFF)	-3.91	0.145	-4.05	-6.54
	(STD ERROR)	0.620			
	(PROB>T)	1.000			
LOG INCOME	(COEFF)	0.765	0.740	0.025	0.417
	(STD ERROR)	0.06	0.03		
	(PROB>T)	0.000	1.000		
LOG PRICE	(COEFF)	0.350			
	(STD ERROR)	0.040			
	(PROB>T)	0.000			
AGE	(COEFF)	0.009			
	(STD ERROR)	0.022			
	(PROB>T)	0.341			
AGE, SQUARED	(COEFF)	0.000			
	(STD ERROR)	0.000			
	(PROB>T)	0.159			
HHSIZE	(COEFF)	-.068	-.027	-.041	-1.02
	(STD ERROR)	0.040	0.030		
	(PROB>T)	0.955	0.000		
HHSIZE SQUARED	(COEFF)	0.002	0.000	0.001	0.550
	(STD ERROR)	0.002	0.002		
	(PROB>T)	0.212	0.000		
FEMALE HEAD	(COEFF)	-.061			
	(STD ERROR)	0.110			
	(PROB>T)	0.710			
LENGTH OF TENURE	(COEFF)	-.009			
	(STD ERROR)	0.008			
	(PROB>T)	0.870			
LENGTH OF TENURE, SQUARED	(COEFF)	-.000			
	(STD ERROR)	0.000			
	(PROB>T)	0.758			
GOVT. HOUSING	(COEFF)	0.509			
	(STD ERROR)	0.090			
	(PROB>T)	0.000			
PUBLIC HOUSING	(COEFF)	.			
	(STD ERROR)	.			
	(PROB>T)	.			
R-SQUARED		.44	.26		
ADJ. R-SQUARED		.44			
SAMPLE SIZE		858	1674		

1/ CURRENT EXPENDITURES USED IN COMPLETE MODEL, CURRENT INCOMES. IN SIMPLE MODEL
2/ PRICE=LOT PRICE=(EST. LAND VALUE+BLDG AREA)/NO. OF UNITS

In 5 of 6 sets of estimates, there is little change in the estimated effect of household size on consumption. Cairo owners have large but offsetting changes in the household size variable and its square. No consistent story emerges about the effect of sex on housing consumption. Only in Cairo does sex of the household head appear important, but it has the opposite sign in the renter and owner results. Differences in sign as well as lack of precision make interpretation of this coefficient difficult.

Length of tenure and housing expenditures are negatively related in all estimates. Rents decrease with length of tenure, but at a decreasing rate, in the Cairo and Manila renter results and in the Beni Suef owner equation. In the other three estimates rents decrease with length of tenure at a roughly constant rate. These results are consistent with any or all of four explanations. First, as explained above, if positive and negative departures from equilibrium (being "off the demand curve" in different directions) do not imply symmetric changes in utility, or if adjustment costs are different for increasing versus decreasing housing consumption, then long-term residents--both owner and renters--may systematically consume more or (as here) less than identical recent movers. Second, in many markets landlords customarily grant discounts to long-term renters. There may be lower expected supply costs for landlords renting to tenants who are a known quantity; and it is easier for landlords to raise new rents as new tenants move in, particularly when a key money system is in effect.7/ Third, renters have an obvious incentive to remain longer than usual in dwellings which rent for less than market value. Fourth, it is plausible that owners who have not moved recently fail to keep up completely with changing (and usually increasing)

7/ Key money is a lump-sum payment to the landlord, collected when the tenant moves in.

market values or imputed rents and thus tend to underestimate them in household surveys. It follows that such errors would be greater for long-term owners than recent movers.

Each of these four explanations is consistent with the negative coefficients observed. Note that only the first explanation reflects an actual diference in quantity consumed. The other three reflect differences in actual or imputed prices. Future work using hedonic price techniques can disentangle these influences; next, the income and price elasticities from these larger models will be discussed in more detail.

3. Alternative Price and Income Elasticities from Egypt and the Philippines

The estimates presented above in Section 2.1 are from simple expenditure functions (without price terms) and use current income. These simple models were estimated because they could be replicated with a wide variety of existing data sets, but esimating the same model in different markets does not really facilitate comparisons if it is a poor model. Fortunately, three of the datasets--Cairo and Beni Suef (Egypt) and Manila are from questionnaires which have been designed especially for housing market analysis, and a more complete model was estimated in Section 2.2. This section will focus on additional estimates from those three cities, with particular emphasis on (1) estimates using alternative income measures, and (2) price elasticities of demand for housing.

Section 2.2 presented the full regression results comparing the simple model from Section 2.1 to a model with a land price term and several additional demographic variables. Since the new demographic variables were discussed in some detail we will not discuss them here, in order to focus on alternative income and price elasticities.

Alternative income elasticities. It is now a standard tenet of the theory of the demand for durable goods that the demand for such goods is determined by permanent income rather than current income.[8/] Table 10 presents point estimates of the income elasticity using various income definitions. The first column presents the income elasticity estimate based on the specification of Eq. (1) but with gross rent as the dependent variable. The other three columns present elasticity estimates from models similar to those presented in Section 2.2, i.e., models which include price terms and additional demographic variables. Only the income elasticities are reproduced; the full results of each equation are available upon request.

The second column uses the same income definition as the simple model, current income. This permits direct assessment of the bias in the income elasticity which was discussed by Polinsky: if intrametropolitan price differences are not accounted for, then the income coefficient will be biased downward to the extent that prices and incomes are correlated. In fact, the reverse is true; the estimated income elasticities are lower in the model with the price term. This contrasts with the usual finding in U.S. markets that incomes and prices are negatively correlated and that the simple model is downward biased. The apparent paradox can be explained as follows. First, income is correlated with the new demographic variables, but positively, so bias from omitted demographic variables works in the other direction. Second, there is no observed negative correlation between income and prices in these samples.[9/] If we added another column to Table 10 which contained the simple model plus price alone, observed differences in the income coefficient would not be significant.

8/ See Mayo (1981) for a review.

9/ Manila owners have a positive correlation between price and income (.37); in all other samples the correlation is statistically indistinguishable from zero.

TABLE 10
COMPARISON OF MICRO INCOME ELASTICITIES FROM DIFFERENT MODELS .

		SIMPLE MODEL CURRENT INCOME	LARGE MODEL CURRENT INCOME	LARGE MODEL CURRENT CONSUMPTION	LARGE MODEL PREDICTED CONSUMPTION
OWNERS					
BENI SUEF	(COEF)	0.42	0.23	0.33	0.10
	(STD ERR)	0.132	0.156	0.204	0.249
	(PROB>T)	0.001	0.070	0.053	0.344
CAIRO	(COEF)	0.37	0.18	0.33	0.49
	(STD ERR)	0.084	0.107	0.139	0.222
	(PROB>T)	0.001	0.046	0.009	0.014
MANILA	(COEF)	0.61	0.52	0.77	1.04
	(STD ERR)	0.042	0.050	0.063	0.095
	(PROB>T)	0.001	0.001	0.001	0.001
RENTERS					
BENI SUEF	(COEF)	0.54	0.37	0.68	0.49
	(STD ERR)	0.153	0.100	0.149	0.197
	(PROB>T)	0.001	0.001	0.001	0.006
CAIRO	(COEF)	0.42	0.38	0.55	0.77
	(STD ERR)	0.052	0.060	0.051	0.121
	(PROB>T)	0.001	0.001	0.001	0.001
MANILA	(COEF)	0.81	0.62	0.92	0.77
	(STD ERR)	0.043	0.043	0.056	0.075
	(PROB>T)	0.001	0.001	0.001	0.001

NOTES:
(1) DEPENDENT VARIABLES ARE LOG GROSS RENTS, INCLUDING UTILITIES.
(2) SIMPLE MODEL IS SIMILAR TO MODEL USED IN TABLES 2 AND 3, I.E. LOG OF INCOME, HOUSEHOLD SIZE, AND HHSIZE SQUARED.
(3) LARGE MODEL IS SIMPLE MODEL PLUS PRICE AND DEMOGRAPHIC VARIABLES.

The third and fourth columns of Table 10 present estimates from the larger model, with income defined as current consumption expenditures and an instrumental variable for consumption expenditures, respectively.[10/] These are generally higher than the current income elasticities (except for Beni Suef owners), but there is no clear pattern of higher or lower income elasticities between consumption and its instrument.

The evidence from Table 10 can be summarized as follows. There is no severe downward bias evident in the simple current income models. Permanent income proxies do yield higher elasticity estimates, but the differences are comparatively modest. Further evidence on this point can be found in Section 2.2. The largest differences in income elasticity estimates are found between models using consumption and those using current income, rather than between "large" and "small" models or between models using actual consumption and its instrument.

Price elasticity estimates. Untangling prices and quantities in housing market studies is always problematical. Here we use a simple but appealing formulation due to Muth (1971), to estimate price elasticities. Assuming a two-input homogeneous production function for housing, where the price of one input (land) varies over the sample and the price of the other input (structure) is fixed, Muth shows that the expenditure function can be written:

10/ The instrument is formed by using predicted values from a regression equation relating reported current household expenditure to variables describing the household head's labor force, occupational and educational characteristics, and on measures of household assets. It may be noted in passing that while "permanent income" elasticity estimates are generally above current income elasticity estimates, they do not approach the levels indicated in Section 3 which apply to cross-city results.

$$\ln R = a + k_L (1+E_p) \ln p_L + E_y \ln y + XB$$

where k_L is the share of land in housing, E_p is the price elasticity, XB are the other demand shifters and their coefficients, and other variables are as defined before.

Based on owners' estimates of land values in each of our samples, we estimate land prices for each observation based on a regression of land prices on several location-specific variables such as distance to central business district, the percentage of units in that district with various services, and the presence or absence of loctional amenities.[11/] From these estimated land prices and house values we estimate typical land shares (k_L) in each market for owners and for renters.

The next step is to convert the coefficient of the log of estimated land price from the expenditure functions into price elasticities:

$$E_p = \hat{b}/k_L - 1$$

where $\hat{b}$ is the estimated coefficient. Table 11 presents these elasticity estimates.[12/]

Estimates of the price elasticity are close to 1 in absolute value, ranging from -0.76 to -1.08, with the exception of Manila owners whose price elasticity is estimated to be -0.4.

It should be noted that these price elasticity estimates suggest that demand is considerably more elastic than previous estimates in the

---

11/ Details of variable construction, and descriptions of the land price regressions are available from the authors.

12/ Note that if land prices are measured with error, the price elasticity is biased towards 1.

Table 11

Micro Housing Price Elasticity Estimates

	Coefficient of log land price	Standard error	Land's share	Point[1/] Ep	Interval[2/] Ep
Cairo					
Renters	.076	.03	.60	-.87	(-.77,-.97)
Owners	.112	.06	.80	-.86	(-.71,-1.01)
Beni Suef					
Renters	.105	.09	.43	-.76	(-.34,-1.17)
Owners	-.007	.14	.36	-1.02	(-.25,-1.80)
Manila					
Renters	-.031	.03	.40	-1.08	(-.93,-1.23)
Owners	.350	.04	.55	-.36	(-.22,-.51)

Notes: 1. $Ep = \left(\frac{\text{coefficient}}{\text{land's share}}\right) - 1$

2. Interval estimates are constructed using the coefficient of log price ± 2 standard errors. The estimate of land's share remains fixed across all dwelling units.

literature suggest. However, a shortcoming of this model is that a unitary income elasticity is the null hypothesis, because a land price coefficient of zero implies a price elasticity of one. Therefore, the tests of significance of land price coefficients should not be interpreted as tests of zero price elasticity. Neither are they tests of unitary elasticity, because the land's share estimate, assumed fixed for the sample, actually has a distribution as well. Testing the micro model price elasticities under alternative specifications remains high on any agenda for future research.

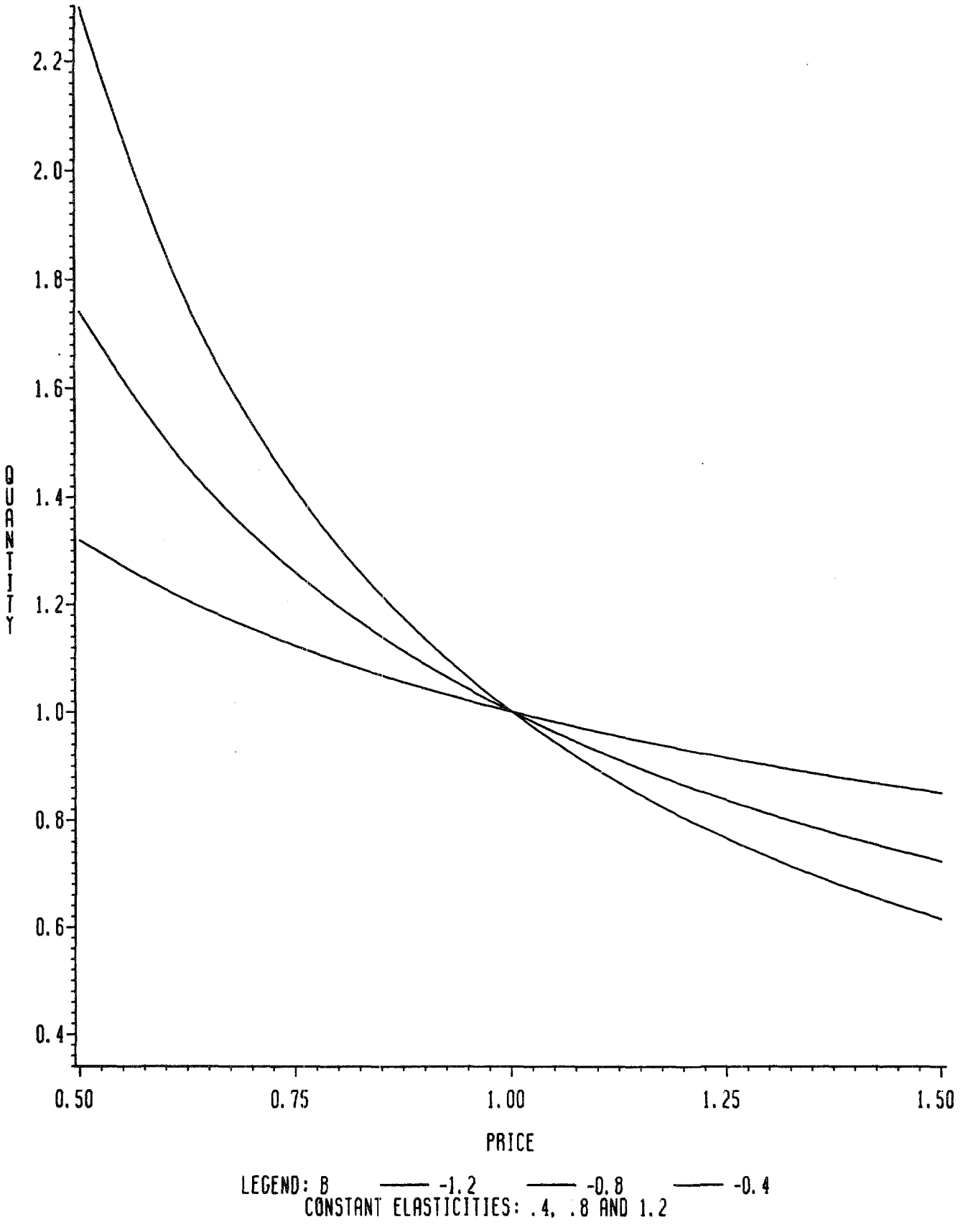
Figure 3 presents the demand curves implied by several price elasticities which are plausible according to these estimates. The benefits or losses to consumers from price changes vary quite a bit depending on which price elasticity is correct (indeed, assuming that a single price elasticity suffices). Graphically, consider a household consuming one unit of housing services at the unit price (i.e. at the point in Figure 3 where all three demand curves intersect). The consumer's surplus, or area between the demand curve and a horizontal line through the quantity consumed (here one) is a measure of how much households would be willing to spend for that amount in addition to what they do spend.13/ Programs change prices and quantities, and comparing the two areas--before and after the program--is one way to measure the benefits of any housing program (or any other event that changes prices and quantities).

A numerical example will illustrate; to facilitate comparisons, switch from geometry to algebra. Consider a project which reduces the

---

13/ See any microeconomics text for elaboration. Simply put, steep demand curves imply that households would pay a high price for the first "bit" of housing, a little less for the next bit, or down to the price actually paid for the last bit. But they only pay the last, lowest price for all "bits."

FIGURE 3
DEMAND CURVES FROM MICRO PRICE ELASTICITIES



effective price of housing by 50 percent. Assume further that participants are free to consume any amount of housing services. The benefit of such a program can be measured by the area under the demand curve, the familiar consumer's surplus measure.[14/] If consumer demand is indeed well represented by the log-linear demand function used above, then it can be shown that the benefit of a program which changes price (and hence also changes desired consumption) can be estimated as:[15/]

$$(1) \qquad \text{Benefit} = \left(\frac{1}{\hat{Q}}\right)^{1/b}\left(\frac{b}{b+1}\right)\left[Q^{\frac{b+1}{b}} - \hat{Q}^{\frac{b+1}{b}}\right] + \hat{R} - R_s$$

where

Benefit = cash equivalent value, a measure of change in consumer's surplus

$\hat{Q}$ = predicted housing consumption in the absence of the program

Q = housing consumption for program participants

$\hat{R}$ = estimated rent in the absence of the program

R_s = actual rent (subsidized) for program participants, and

b = price elasticity of demand.

14/ There are actually alternative empirical measures of consumer's surplus. We use cash equivalent value, or the amount of additional purchasing power which would leave the consumer as well off at the old prices as he is facing the new price set. See Freeman (1979), Chapter 3, for a good introduction.

15/ See Mayo et al. (1980), pp. 96 ff. for details.

The benefit may be thought of as composed of two parts. The first, comprising the terms in parentheses and brackets, depends on the amount of extra housing provided by a program; that is, on the terms Q and $\hat{Q}$, housing comsumption in the program and housing consumption in the absence of the program. The second is simply the additional disposable income brought about by paying a rent R_s in a program rather than a rent (usually higher), $\hat{R}$, in the absence of a program. This is therefore not unrelated to a simple but incorrect measure often used to estimate benefits, $\hat{R} - R_s$, or the change in disposable income following program participation. But whereas in the simple benefit measure an extra dollar of housing is counted as being worth exactly a dollar by program participants, in this benefit calculation (cash equivalent value), extra housing is discounted based on a household's relative preference for housing vis-a-vis other goods.

Table 12 presents results of this calculation under alternative price elasticities. For convenience, starting values for price and quantity were both normalized at one. A fifty percent unconstrained subsidy induces households to consume more housing[16/]; they attach a value to the program given in the benefit column. This benefit is, under quite general conditions, less than the cost of providing the subsidy. The difference between benefit and cost is deadweight loss. The ratio of benefit to cost is another useful measure of program efficiency.

This oversimplified example is only meant to illustrate a few basic concepts, and the consequences of variance in the key parameter, price

---

16/ The word unconstrained is key; most actual projects and programs reduce the price but also constrain participants to consume "off their demand curve," reducing the benefit.

Table 12

Benefits from a Stylized Housing Subsidy, Under Alternative Price Elasticities

Price Elasticity	Quantity Consumed	Program Benefit	Subsidy Cost	Deadweight Loss	Efficiency
-.4	1.2	.56	.60	.04	.93
-.8	1.4	.62	.70	.08	.89
-1.2	1.6	.69	.80	.11	.86

Program provides an unconstrained 50 percent subsidy. Before program, housing consumption and price were both normalized at 1.0.

elasticity of demand.[17/] While at first glance the rows of Table 12 may not seem to vary much, note that if the implementing agency implicitly assumed that the price elasticity was -.4 and it was in fact -1.2 (quite plausible, given the general lack of precise estimates), then the program cost to the implementing agency would be 33 percent more than planned (a subsidy cost of .8 versus .6); and the deadweight loss to society would be almost three times the original calculation.

17/ For a more thorough treatment, see Mayo (1977); for an application to Bank projects, see Mayo and Gross (1985).

III. CROSS-COUNTRY DIFFERENCES EXPLAINED

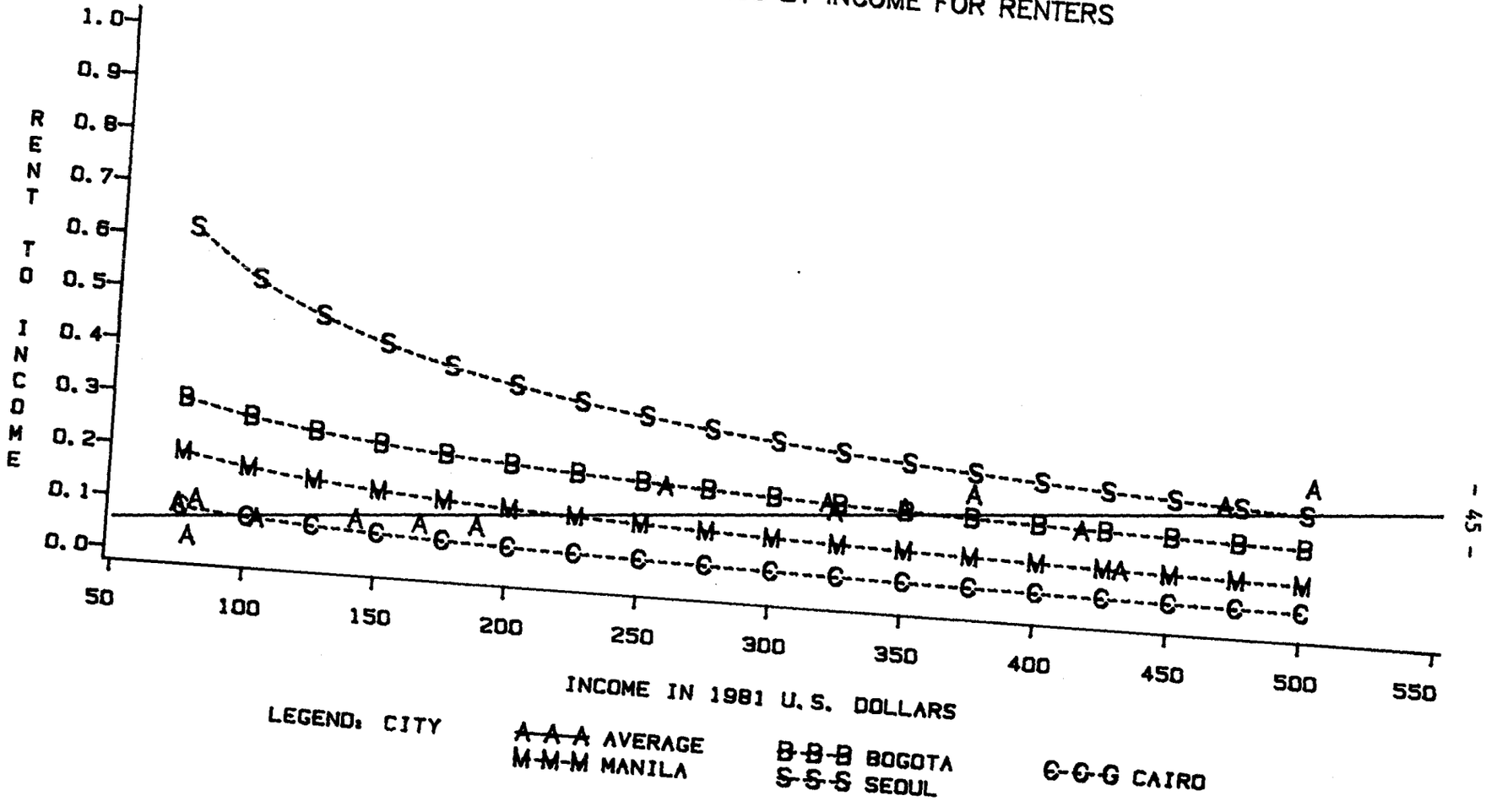
In contrast to the broad similarity in income elasticities and household size parameters across cities and countries, it is clear that there are, in fact, systematic differences in housing demand that are related to both income and city size. These differences are reflected not in the parameters of income and household size, but rather in the constant terms of estimated expenditure functions. Figures 3 and 4 illustrate the relationships between rent-to-income ratios and incomes (based on estimated expenditure functions) for renters and owners in representative cities, together with a regression line fitted through the rent-to-income ratio at each city's mean income. Upward sloping lines represent income elastic demand; downward sloping, inelastic.

Note that: (1) as city mean incomes increase, mean rent-to-income ratios also increase (i.e., Engel curves shift upwards as cities develop), and (2) rent-to-income ratios of owners are consistently above those of renters at given income levels. While the second point is discussed at greater length in Chapter 4, this chapter considers possible explanations for the rather striking result that rent-to-income ratios decline with income within cities but increase with income across cities. After a review of previous cross-country empirical research, and of several related behavioral models, a new set of cross-country estimates is presented.

1. Previous Cross-Country Research

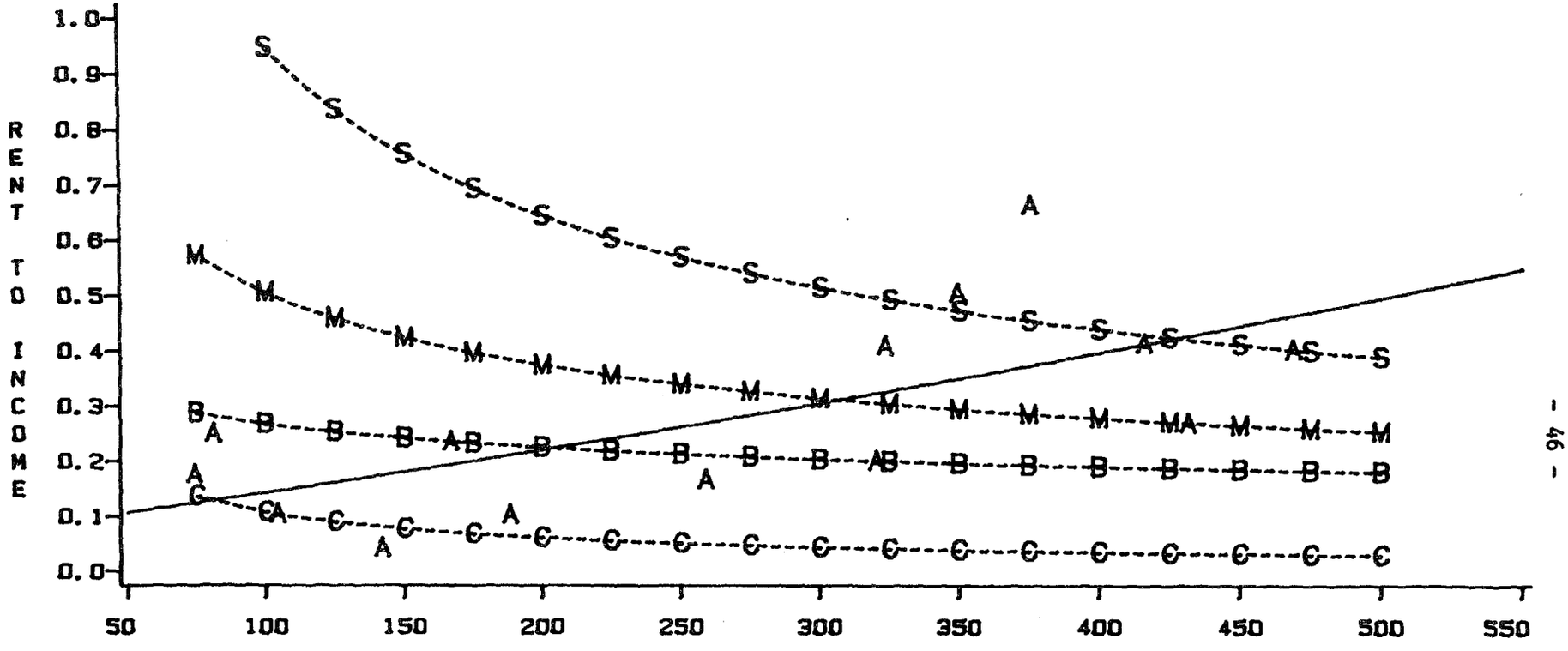
Several previous studies have documented cross-country differences in housing consumption, notably Howenstine (1957), Kuznets (1961), Burns and

FIGURE 4
RENT–TO–INCOME RATIOS BY INCOME FOR RENTERS



AVERAGE IS FOR EACH LDC CITY AT ITS AVERAGE INCOME

FIGURE 5
RENT–TO–INCOME RATIOS BY INCOME FOR OWNERS



LEGEND: CITY A-A-A AVERAGE B-B-B BOGOTA C-C-C CAIRO
M-M-M MANILA S-S-S SEOUL

AVERAGE IS FOR EACH LDC CITY AT ITS AVERAGE INCOME

Grebler (1976), Strassman (1970), Renaud (1980), Kravis et al. (1982), Annez and Wheaton (1984), and Buckley and Madhusudhan (1984). This section briefly reviews the five papers which test some models or exploratory hypotheses about cross-country differences, namely Burns and Grebler, the extensions of their model by Renaud and Buckley and Madhusudhan, the shelter results of the UN's International Comparison Project (ICP) reported in Kravis et al., and the model of Annez and Wheaton.[1/]

Burns and Grebler's study examines the share of housing investment (measured by new residential construction) to gross domestic product, using data from 39 countries, and two time periods. Burns and Grebler regress the share of housing investment against GDP per capita and its square, change in population and its square, and a measure of urbanization, squared. They find evidence that the share of housing investment increases at an early stage of development but on average declines past about $1,600 per capita GDP (1970 U.S. dollars). Further, although there was a wide variance in their dependent variable at different income levels, their simple model explains that variation quite well, and the turning point is quite sharp and precisely measured (see Table 13).

Of course this turning point in the share does not imply that the level of housing investment decreases with development, at least throughout the observed range of the data. And implicit throughout this chapter is the assumption that there is a direct and robust cross-country relationship between housing investment and consumption. Since housing investment is a derived demand, and cross-country comparisons are studies of very long-run

---

1/ Burns and Grebler review earlier literature.

Table 13

Cross-Country Housing Investment Equations,
From Burns and Grebler

	Coefficient	t-statistic	Prob >|t|
Constant	2.80		
GDP Per Capita	38.14	3.95	.001
GDP Per Capita, Squared	-.01215	3.53	.001
Change in Population	-.315	1.57	.126
Change in Population, Squared	.047	.60	.553
Urbanization, Squared	.005	1.14	.262
R^2, unadjusted	.51		
Degrees of Freedom	33		

Dependent Variable: Share of new housing investment to gross domestic product.

Source: Equation 2, Burns and Grebler, p. 108.

behavior, this is not a bad approximation; but formal models of the relationship between housing demand and investment could be undertaken in the future, to make the link more precise.

Recent studies by Renaud and by Buckley and Madhusudhan have shown the Burns and Grebler result to be qualitatively robust. Renaud analyzes time series data from Korea and confirms the nonlinearity of the relationship between the share of housing investment and per capita GDP, but finds the exact turning point to be sensitive to specification. Renaud also considers several additional explanatory variables reflecting financial constraints (Table 14). In general, the financial variables perform well in some specifications but are not robust, which is not surprising given the measurement difficulties involved and the modest number of degrees of freedom.

Buckley and Madhusudhan test the effect of additional financial variables, namely the anticipated rate of inflation, changes in the rate of inflation, and the extent of capital deepening (Table 15). Their analysis confirms the importance of financial conditions in explaining housing investment. In particular, they find that countries with deeper financial markets invest relatively more in housing ceteris paribus. There is also weak support for the hypotheses that the share of investment (1) is higher in less egalitarian countries, (2) increases with anticipated inflation, and (3) decreases with changes in inflation (presumed unanticipated in their model).

These three studies, which focus on the share of new housing investment in GDP, provide a useful set of generalizations about housing investment and development. In particular, the share of investment rises at an early stage but declines as countries pass about $1,600 income per capita, 1970 U.S. dollars (or about $3,400 1981 U.S., the benchmark units used in this study). To put this in perspective, upper middle income countries such as

Table 14

Selected Results: Housing Investment Equations, from Renaud

		Equation (2)	Equation (4)	Equation (6)
Constant	$\hat{\beta}$	5.91	2.59	7.38
	t	21.11	1.84	4.42
	P>|t|	.001	.093	.001
Inverse GNP	$\hat{\beta}$	-22.27		-31.41
	t	10.97		3.55
	P>|t|	.001		.004
Domestic Savings/GNP	$\hat{\beta}$		12.86	-6.06
	t		3.95	1.05
	P>|t|		.002	.317
Inverse (Savings/GNP)	$\hat{\beta}$	1.01		
	t	1.84		
	P>|t|	.084		
Unregulated Money Market	$\hat{\beta}$		-.35	.17
	t		1.30	.74
	P>|t|		.221	.475
R^2, unadjusted		.91	.78	.90
Degrees of Freedom		16	11	11

Dependent Variable: Share of new housing investment to gross domestic product

Source: Renaud (1980), Table 4, p. 398.

Table 15

Effects of Financial Factors on Share of Housing Investment, from Buckley and Madhusudhan

	Coefficient	t-statistic	Prob >|t|
Constant	-1.5		
GDP Per Capita	32.66	5.22	.001
GDP Per Capita, Squared	-.067	4.99	.001
Change in Population	.38	.48	.126
Change in Population, Squared	.02	.11	.553
Urbanization, Squared	.11	2.94	.262
Gini Coefficient of Income	1.75	.74	.001
Financial Deepening	.0127	1.80	.001
Expected Inflation	.04	1.26	.635
Change in Inflation	-.09	1.46	.913
R^2, adjusted	.68		
Degrees of Freedom	25		

Dependent Variable: Share of new housing investment to gross domestic product.

Source: Equation 3, Table 3, Buckley and Madhusudhan, p. 26.

Argentina, Uruguay, South Africa and Yugoslavia were approaching this estimated turning point in 1981 (the benchmark year for the present study), and Venezuela, Greece, Israel and Hong Kong had recently passed it. Other stylized facts from these previous studies include the following: over much of the range of observed data, the relationship between income and investment is stronger than between investment and demographic variables; time series results from individual countries are at least qualitatively consistent with the cross-section results; and in addition to income and population, the structure of the financial sector affects housing investment.

The principal shortcomings of these studies have been discussed at length by the authors themselves. Developed countries are overly represented. Official statistics underestimate total housing investment, because of large informal sectors and because new construction statistics fail to count upgrading, maintenance, and depreciation of existing units. These undercounting errors are doubtless largest for the poorest countries.

Also, these studies cannot be strictly compared with the present paper because housing investment and housing consumption can diverge, although qualitative results should be robust. Because of data problems, Burns and Grebler, and those who followed them, ignored the effects of relative prices, climate, and other variables (although they were careful to point out these omissions). Finally, these models can be thought of as exploratory reduced forms; there is no explicit behavioral model which is used to justify the estimating equations.

Annez and Wheaton address several of these problems. They develop a structural model with five endogenous variables (four stochastic equations and an identity). Their model explains total growth in the housing stock, the officially recorded growth, the average quality of new units, and the cost of

construction. The share of new construction to national product, conceptually similar to the Burns and Grebler dependent variable, then emerges from the identity: share of investment equals the product of change in stock, average size, and cost, divided by GNP.

Annez and Wheaton assembled data from 24 non-socialist countries (largely developed), and estimated two variants of this model. The more complete model includes several policy related variables (the share of public housing in total production, credit cost, and typical loan-to-value ratios), but could only be estimated for a smaller sample of 20 countries. These results are reproduced as Table 16. Key results include the following. When total stock is measured in the number of housing units, its growth is determined by demographic, not economic variables. The reverse is true for the quality of an existing unit. Demographics determine the number of units; incomes and prices determine their quality.[2/] The fraction of production officially recorded is positively related to the level of economic development, as expected. Costs also rise with development. There is no evidence of any supply inelasticity; cost is unrelated to share of housing investment.

Annez and Wheaton note that their estimates imply that as economies develop, increasing incomes fuel housing demand; but, this is in large part offset by increasing prices. The Burns-Grebler result--an inelastic relationship between investment and income--may mask offsetting price and income effects. These will be discussed in more detail in Section 3.3, below.

2/ Weicher and Hartzell (1980) report similar findings for the U.S.

Table 16

Annez-Wheaton Cross-Country Housing Investment Model: OLS Estimates from Their Larger Model

Independent Variables		Dependent Variables			
		Change in Housing Stock	Recorded-to-Total Stock	Average Quality	Average Cost
GNP Per Household	$\hat{\beta}$	-.0003	.000014	.34	.63
	t	1.30	2.85	1.96	2.6
	P>|t|	.215	.011	.070	.020
Average Cost	$\hat{\beta}$			.45	
	t			2.3	
	P>|t|			.037	
Population Growth	$\hat{\beta}$	.72			
	t	3.5			
	P>|t|	.004			
Household Size	$\hat{\beta}$	-1.05*		-.21**	
	t	3.3		.55	
	P>|t|	.005		.590	
Public Housing Share	$\hat{\beta}$	-.60		-.02	.074
	t	.67		.44	1.06
	P>|t|	.514		.667	.305
Loan/Value	$\hat{\beta}$	.22		.168	
	t	.87		2.25	
	P>|t|	.399		.041	
Share of Housing Investment	$\hat{\beta}$				.04
	t				.18
	P>|t|				.860
Inverse, Change in Stock	$\hat{\beta}$		.028		
	t		1.56		
	P>|t|		.137		
Average Winter Temperature	$\hat{\beta}$			-.23	.006
	t			3.3	1.66
	P>|t|			.005	.118
R^2, unajusted		.65	.40	.69	.75
Degrees of Freedom		14	17	14	15

Note: intercepts not reported; all variables in logs.
*change in household size
**average household size

Source: Annez and Wheaton (1984), Table 4, p. 762.

Further evidence on the cross-country price and income elasticities of demand for housing is provided by the U.N. International Comparisons Project (ICP, see Kravis et al.). The ICP is a major research effort which makes international comparisons of consumption and prices. As part of that effort, Kravis and his associates use hedonic index methods to decompose rents for similar units into rental price and quantity indexes, as described in detail in their Chapter 2. These indexes, and indexes of total consumption, are used to estimate simple cross-country demand models, where housing consumption is a function of total consumption and the price per unit of housing services (see their Chapter 9). For example, using the familiar log functional form, they obtain the following OLS estimates using their sample of 34 countries:

$$\ln Q = \underset{(0.54)}{-5.62} - \underset{(.15)}{0.61}\,(\ln P) + \underset{(0.07)}{1.40}\,(\ln Y) \qquad \bar{R}^2 = .93$$

where Q is the per capita quantity index, P is the rental price index, and Y is the per capita total consumption index. Standard errors are in parentheses.

Kravis et al. found this result--inelastic price, slightly elastic income demand--to be robust to specification and econometric technique. However, they do not report results from any functional form which can be used to test for any turning point in demand similar to that found for investment share by Burns and Grebler.[3/]

3/ Kravis et al. report results for log-linear and linear expenditure functions, estimated as single equations and as a system of demand equations.

2. A Kuznets-Type Result

Figures 3 and 4, above, are very similar to the consumption patterns extensively documented by Simon Kuznets (Kuznets, 1961, and his other works cited therein). Qualitatively, housing consumption is remarkably similar to total consumption; that is, there are markedly smaller within-country differences at various income levels than the between-country differences at different income levels.

The empirical work by Kuznets sparked several behavioral models which could explain his results. Similar explanations may be advanced to explain an apparent paradox: there is a strong positive relationship between rent-to-income ratios and incomes across cities; but the relationship within a given city is weak. These alternative explanations each stem from the Keynesian hypothesis that the marginal propensity to consume (here on housing) is less than the average propensity to consume. Several well known models derive this hypothesis from models of optimizing consumer behavior, namely the relative income hypothesis (Duesenberry, 1949), the permanent income hypothesis (Friedman, 1957), and the life cycle model of consumption (Ando and Modigliani, 1963). These models have been cogently summarized elsewhere (e.g. Branson, 1979, ch. 10; Yotopoulos and Nugent, 1976, ch. 10), so here we only point out the implications of the theories for cross-city comparisons. The relative income hypothesis states that utility depends on consumption relative to the surrounding population, or in other words, the savings/consumption decision is driven by the consumer's perceived position in the local income distribution. Within a city, utility maximizing consumers consume higher fractions of their incomes as income falls, because they are trying to attain average consumption with below average income. Conversely, high income people can easily maintain average, or slightly better than average, consumption while spending declining fractions of their incomes.

Across cities, however, as the entire local economy develops, the average consumption-to-income relationship remains stable,[4/] implying a constant consumption share, or a unitary income elasticity.

The permanent income model separates income into permanent (expected long-run) and transitory components. Friedman shows that if current and transitory components are independent within a cross section, then consumption will vary less than income under plausible assumptions, yielding the inelastic within-city curves depicted in Figures 3 and 4. When entire cross sections are averaged out (the cross-city comparisons), the transitory components cancel and the measured income elasticity rises. Cross-city elasticities presumably correspond to permanent income elasticities.

The life cycle hypothesis postulates that typical individuals have income streams which are largest in middle age. In the early years of a person's life, they borrow against later income. In middle age, consumers repay earlier borrowings, and save for old age, when consumption again exceeds income. When household surveys are used to estimate housing demand functions, the highest income sample members are disproportionately middle-age-headed households, at peak earning power but low consumption-to-income. Low-income panel members are often at the age extremes, earning less, with a high consumption-to-income ratio. This reduces the observed cross-section income elasticity. Again, when the city averages are observed, these transitory effects cancel, and the measured income elasticity increases.

Demographic variables and relative price can also account for shifts in the rent-to-income ratios across cities. The Ando-Modigliani model focuses

---

4/ Most writers assume this stability; a more general relative income model could obviously allow for non-unitary demand elasticities in the long run.

on one demographic variable in particular, age of household head, but consumption can also vary with household size. However, if housing consumption increases with household size and household size decreases with income, then any positive relationship between housing consumption and development is reduced. Alternatively, at large household sizes food could crowd out housing consumption. It is not clear from the household estimates that this is the case, but in any event this effect is easily controlled for. All comparisons in Figures 3 and 4, and in the next few pages, are done at a single arbitrary household size of five.

Relative housing prices also increase with development (see Annez and Wheaton, and the data appendix), so a model which does not include relative prices has a downward biased income coefficient. Figures 3 and 4 are not price adjusted, but the next few pages present several models which are.

3. A Simple Cross-Country Model

Tables 17 and 18 present a set of cross-city Engel curves, estimated separately for owners and renters. For each tenure type and specification, the estimates are presented separately for developing countries alone, and for the total sample (including Pittsburgh and Phoenix, U.S.A.). The dependent variable is predicted housing expenditure for a five-person household at each city's mean income or its logarithm; these predictions are from the household level equations presented in Tables 2 and 3, above. The income variables are based on the city averages. Incomes and rents are converted to 1981 U.S. dollars by using local CPIs and official 1981 exchange rates. Price, and its

Table 17

Cross-Country Housing Demand Estimates for Renters

Dependent Variable	Log	Log	Log	Log	Log	Log	Linear	Linear	Linear
Sample	Total	Total	LDCs	Total	Total	LDCs	Total	Total	LDCs
Log Income	1.23	1.61	1.60						
	.12	.18	.18						
	.001	.001	.001						
Income				.0087	.0080	.0149	.182	.086	-.092
				.0013	.0014	.0038	.073	.048	.138
				.001	.001	.002	.025	.096	.517
Income Squared				-3.4E-6	-1.6E-6	-1.4E-5	-2.6E-5	2.1E-4	5.3E-4
				6.0E-7	1.5E-6	6.6E-6	3.4E-5	5.1E-5	2.4E-4
				.001	.301	.056	.458	.001	.047
Log Price	.53	.15	.15	.26	.23	.09			
	.29	.29	.29	.34	.34	.31			
	.092	.610	.613	.456	.500	.783			
Price							26.7	21.2	24.9
							19.6	12.0	11.9
							.195	.101	.058
United States (dummy)		-1.27			-5.07			-676.3	
		.48			4.02			135.9	
		.020			.229			.001	
Intercept	-3.42	-5.40	-5.39	1.24	1.29	.58	-32.4	-21.7	-7.6
	.70	.96	.98	.30	.30	.46	18.2	11.3	15.0
	.001	.001	.001	.001	.001	.224	.097	.077	.619
R-Squared (adjusted)	.89	.92	.90	.88	.89	.88	.89	.96	.86
DF, Error	15	14	13	14	13	12	14	13	12
SSE	2.977507	1.989792	1.933157	2.880380	2.565938	1.966973	8480.154	2918.157	2521.953
SSE, adjusted	2.977507	1.989792	1.933157	2.880380	2.565938	1.966973	685.45	235.87	203.84
ϵ_p P=.5	-.47	-.85	-.85	-.74	-.77	-.91	-.64	-.72	-.59
P= 1	-.47	-.85	-.85	-.74	-.77	-.91	-.47	-.57	-.42
P=1.5	-.47	-.85	-.85	-.74	-.77	-.91	-.37	-.47	-.32
ϵ_y $222	1.23	1.61	1.60	1.60	1.62	1.93	1.13	1.37	1.38
$322	1.23	1.61	1.60	2.10	2.24	1.89	1.06	1.45	1.88
$422	1.23	1.61	1.60	2.46	2.81	1.30	1.02	1.52	2.05
Turning Point	N.A.	N.A.	N.A.	$1279	$2500	$532	$3500	N.A.	$87

Table 18

Cross-Country Housing Demand Estimates for Owners

Dependent Variable	Log	Log	Log	Log	Log	Log	Linear	Linear	Linear
Sample	Total	Total	LDCs	Total	Total	LDCs	Total	Total	LDCs
Log Income	.98	1.38	1.38						
	.18	.34	.35						
	.001	.002	.003						
Income				.0081	.0075	.0063	.327	.261	-.166
				.0018	.0019	.0067	.146	.136	.433
				.001	.002	.372	.045	.082	.711
Income Squared				-3.3E-6	-1.3E-6	9.1E-7	-8.8E-5	1.2E-4	9.1E-4
				8.5E-7	1.8E-6	1.2E-5	6.9E-5	1.3E-4	7.7E-4
				.003	.482	.940	.225	.350	.264
Log Price	1.03	.64	.65	.67	.62	.65			
	.41	.48	.50	.43	.42	.47			
	.025	.205	.223	.144	.171	.196			
Price							87.8	79.2	87.27
							34.4	31.5	32.31
							.026	0.29	.022
United States (dummy)		-1.18			-5.81			-653.3	
		.86			4.86			341.5	
		.192			.256			.082	
Intercept	-1.44	-3.57	-3.57	2.04	2.05	2.18	-87.9	-79.0	-43.64
	1.04	1.84	1.92	.43	.42	.80	30.6	28.1	44.08
	.188	.076	.090	.001	.001	.021	.014	.017	.345
R-Squared (adjusted)	.78	.80	.76	.83	.84	.80	.85	.88	.80
DF, Error	13	12	11	12	11	10	12	11	10
SSE	4.721139	4.071022	4.052442	3.420485	3.026050	3.015042	19744.239	14814.483	13375.861
SSE, adjusted	4.721139	4.017022	4.052442	3.420485	3.026050	3.015042	1147.34	860.86	777.27
ϵ_p P=.5	.03	-.36	-.35	-.33	-.38	-.35	-.16	-.31	.07
P= 1	.03	-.36	-.35	-.33	-.38	-.35	-.09	-.18	.03
P=1.5	.03	-.36	-.35	-.33	-.38	-.35	-.06	-.13	.02
ϵ_y $222	.98	1.38	1.38	1.48	1.54	1.49	.94	1.09	1.02
$322	.98	1.38	1.38	1.94	2.15	2.22	.91	1.13	1.60
$422	.98	1.38	1.38	2.28	2.70	2.98	.87	1.16	1.87
Turning Point	N.A.	N.A.	N.A.	$1227	$2885	N.A.	$1858	N.A.	$91

logarithm, are constructed from the rental price series devised by Kravis, Heston and Summers (1982).[5/]

Log-linear models were estimated for consistency with the household level estimation, and quadratic models for comparison with the Burns and Grebler results. A third model (log of rent, linear and quadratic income) was also estimated.

The bottom rows of the tables include calculated income and price elasticities for several income and price levels. The range of observed relative prices corresponds roughly to the range presented in the tables (.5 to 1.5), and as noted above, the relative price of one corresponds to the U.S. relative price of a unit of housing services. The median of the city average incomes is $322 per household, and the range of income elasticities are calculated at that median and at a hundred dollars above and below the median. The turning point, where applicable, is the point where housing consumption begins to fall with income (with an exception to be noted later).

The key results are straightforward: in a very long run, housing consumption is income elastic, or at least of unit elasticity. Price elasticities are lower than income elasticities in absolute value. Interval estimates of price elasticities are quite wide. In this sample, which is dominated by developing countries, it does not appear that owners have higher

---

5/ The construction of the price index is explained in detail in the data appendix; the appendix also explains our choice of this index over two other candidate indexes. Several shortcomings of this index deserve mention: being a rental index, it includes all factors of production in housing services, but it is also a country specific, while a city and tenure specific index would be preferred. No city-tenure specific index exists, to our knowledge. This price index is a relative price index; it is the rental price of a unit of housing services in a country, relative to the price of a composite of all goods and services. The U.S. relative price has been chosen for normalization.

long-run responsiveness to changes in incomes and prices; if anything, the reverse is true. Eight out of nine specifications yield a higher median income elasticity for renters than owners; the differences are not great. This does not mean that within a market renters consume less than owners, but that as cities' economies develop over a very long run, owner and renter consumption patterns increase at a similar pace, ceteris paribus. However, as will be discussed in Chapter 4, because prices rise with income and estimated renter price elasticities are also higher than owner elasticities, the net effect of both incomes and prices rising as development proceeds is to increase owner consumption faster than renter consumption through most of the range of the data.

Another obvious result is that Pittsburgh and Phoenix are quite different from the rest of the data. There are considerable differences in fit and in coefficients between models with and without these cities in the sample, and dummy variables for the cities have large effects. This is not surprising, since the Burns and Grebler and related research lead us to expect turning points in relative if not absolute consumption as city incomes rise, and because the U.S. tax code distorts housing consumption.[6/] These U.S. cities are the only cities in our sample which are past the Burns and Grebler turning point. Since the Burns and Grebler turning point is for macro investment, not household consumption, and because it is a relative measure (share in GDP), direct comparison is difficult. In addition, the samples are

---

6/ Numerous studies document the effect of the U.S. tax code on housing markets, e.g. Aaron (1972), deLeeuw and Ozanne (1981), Follain (1981), and many others. In general, tax policy reduces the user cost of housing capital for both owners and renters, although more for owners. This after tax price is not well captured in the price index we have used. Given this, the low predicted rents for the U.S. cities are somewhat surprising.

obviously quite different. For this reason little confidence can be placed in having estimated a precise turning point until this analysis is extended with additional cities, particularly developed country cities.

The fits of the logarithmic models and the semilogarithmic models are broadly similar, although the fits are noticeably improved when the U.S. cities are dropped from the samples or "dummied out." The linear models, estimated to be consistent with the Burns and Grebler specification, are clearly inferior to the logarithmic fits, as can be seen by examining the adjusted sum of squared errors from the different models.7/

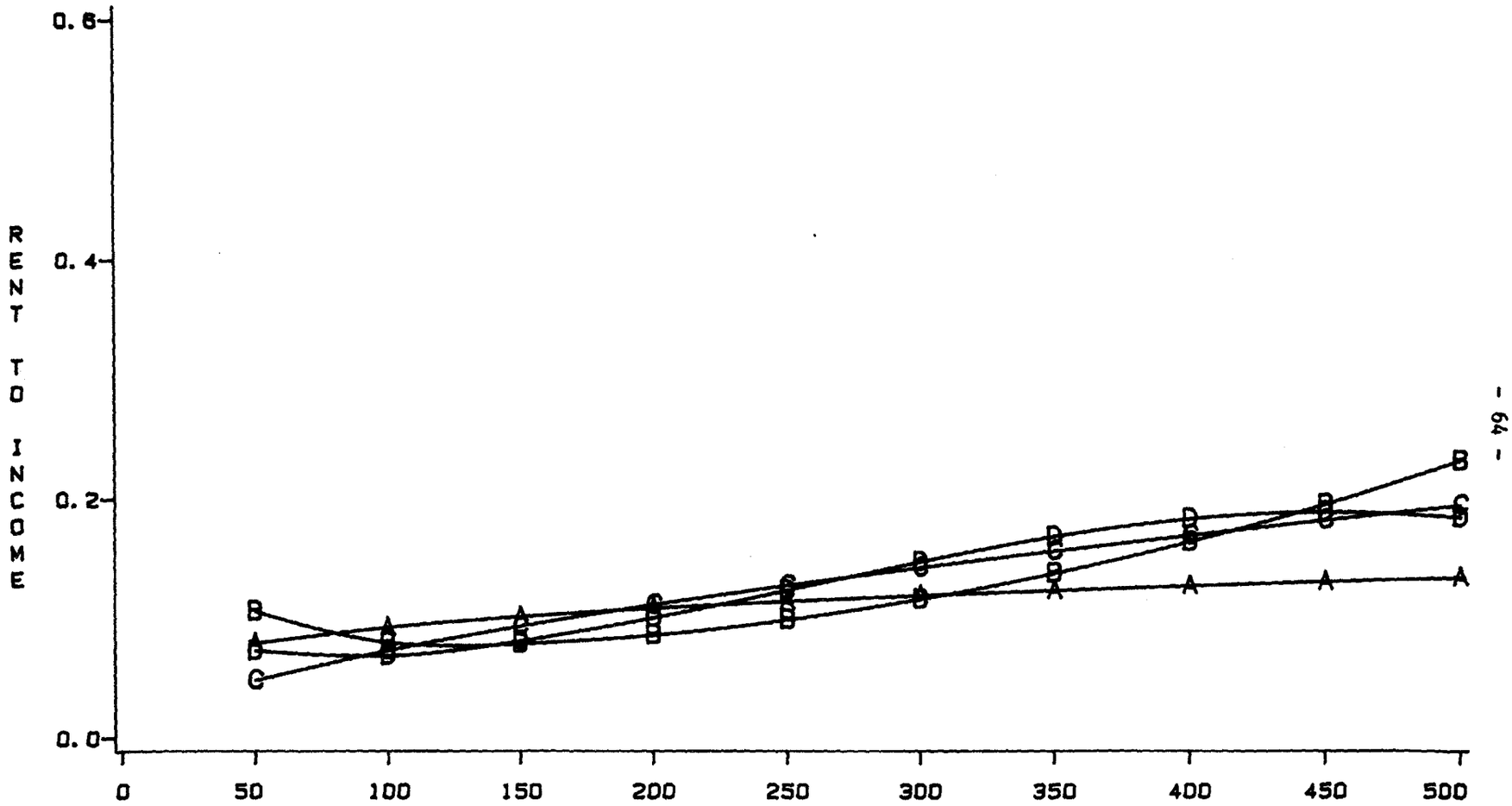
Since factor proportions probably vary between tenure groups, and also because in at least the U.S. the user cost of homeowner capital is much less than the unadjusted rental rate used here, the renter price elasticities are more reliable than the owner price elasticities. As noted in Chapter 2, the micro estimates of price elasticities from three cities are probably biased towards one, from errors in variables; here, the same econometric problem may bias the owner price elasticity towards zero. Also, it is dangerous to draw strong conclusions from point estimates with such large standard errors. Any interval estimate would contain elasticities which imply radically different behavior, and owner and renter intervals would overlap considerably. The conclusion that very long-run renter price elasticities are greater than owner price elasticities is therefore tentative.

For a better feel for the qualitative differences in the estimates, Figures 6 and 7 present graphs of the long-run cross-country Engel curves from

---

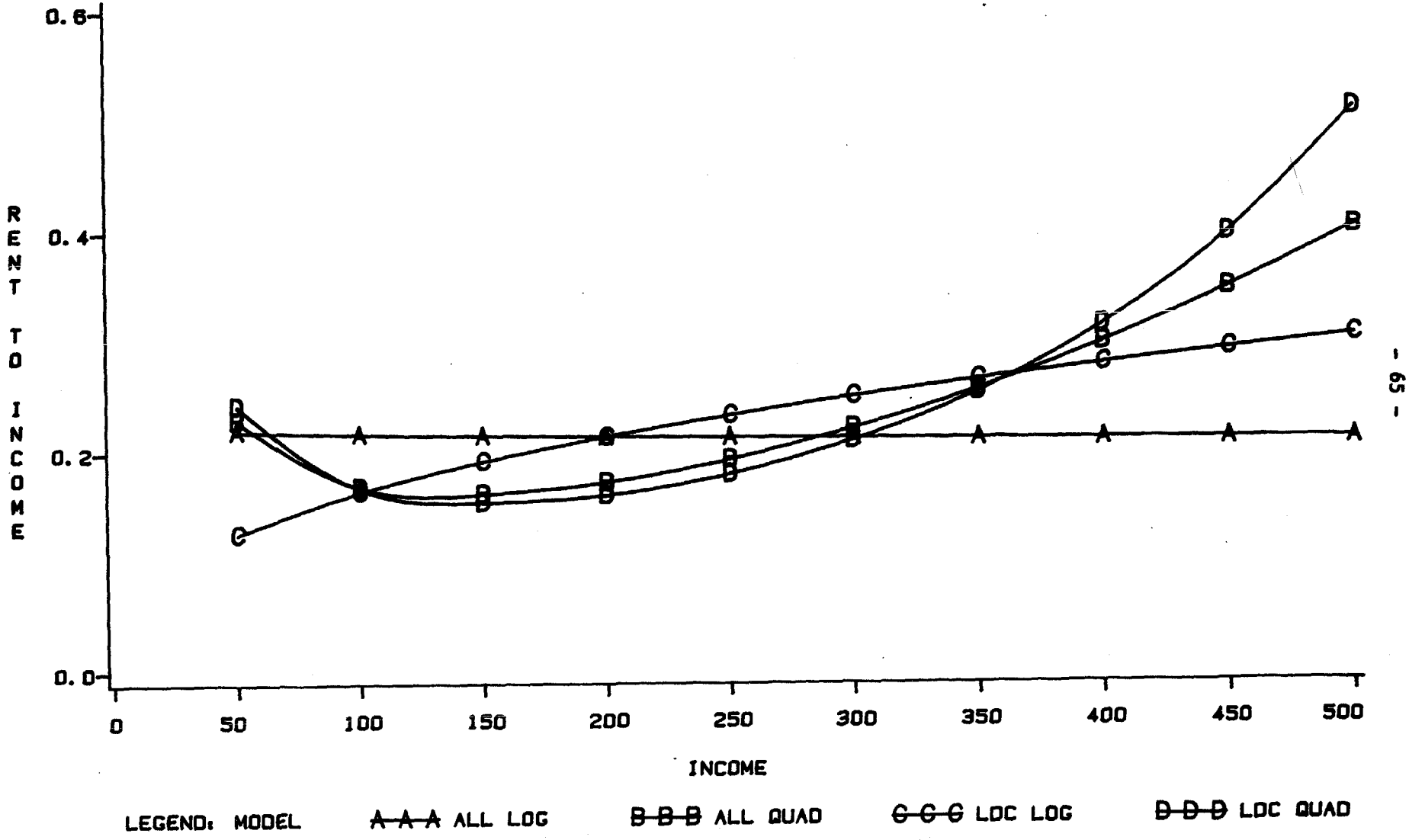
7/ Adjusted R-squared value can be compared across logrithmic and semi-logarithmic models, because the dependent variable is the same. To compare log and linear models, the sum of squared errors must be adjusted to account for the different variance in the dependent variables. See Rao and Miller (1971), pp. 1070-1111.

FIGURE 6
CROSS COUNTRY ENGEL CURVES, RENTERS



MODEL REFERS TO SAMPLE, AND INCOME SPECIFICATION

FIGURE 7
CROSS COUNTRY ENGEL CURVES, OWNERS



MODEL REFERS TO SAMPLE, AND INCOME SPECIFICATION

four of the models of Tables 16 and 17, respectively. The four models represent the simple log model on all data, with relative price set to one, denoted "A" on the figures (column 1 of Tables 16 and 17), the quadratic model on all cities ("B," corresponding to column 7), the log model on developing countries only ("C," column 3), and the quadratic model on LDC cities ("D," column 9). The range of the data displayed in the graphs is limited to developing country values. Through this range, the relationship between housing consumption and income is remarkably robust for renters; for owners the estimates diverge, particularly at higher incomes. Much of the divergence depends on whether or not the U. S. is included in the sample. Since the U.S. drives these results so strongly, it is essential that future cross-country work include data from more high and middle income countries, in order to obtain more precise estimation of the relationship between housing consumption and development. However, within a reasonable range--within 100 to 200 dollars of the median household income, $322--the results are robust.

Price elasticities are less robust with respect to specification and sample. Figures 8 and 9 graph demand curves for the four models described above, at a typical income (U.S. $322). Note that adding the U.S. data flattens the demand curve, especially for the logarithmic owner model.

These four figures highlight the following: slight changes to model and sample do not radically alter the long-run income elasticity estimates. The income estimates are more robust than price elasticities. Renters appear to be more responsive to income than owners, but the opposite holds for price. This conclusion is tentative because, as was discussed above, the owner price elasticities are probably more affected by errors in variables than are the renter price estimates. Adding the U.S. to the sample reduces

FIGURE 8
CROSS COUNTRY DEMAND CURVES, RENTERS

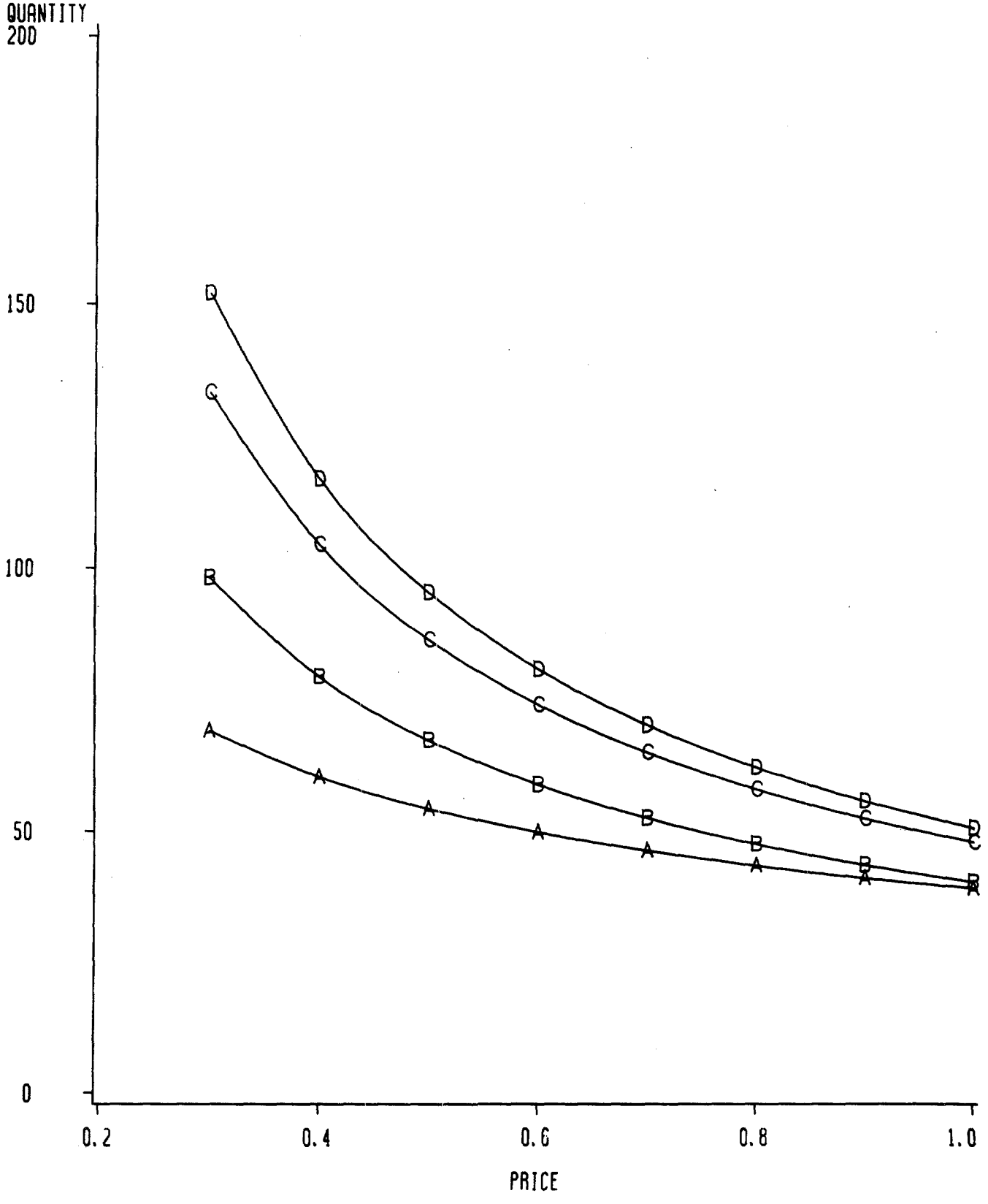
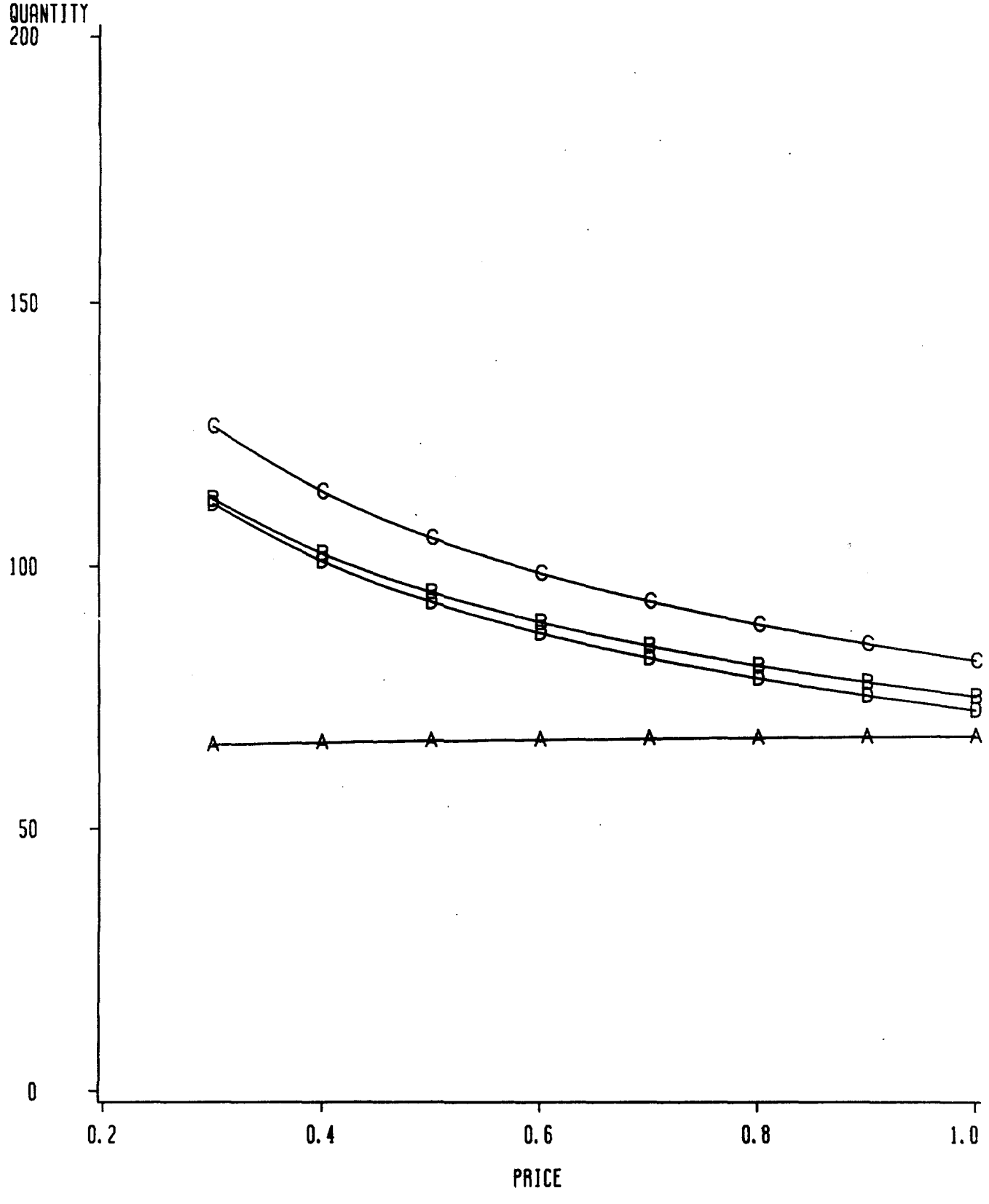


FIGURE 9
CROSS COUNTRY DEMAND CURVES, OWNERS



the estimated reponsiveness of the consumption to both incomes and prices, but especially the latter. Adding more middle and high income countries, and constructing city and tenure specific price indexes which account for taxes, rent control, expected inflation and the like are natural extensions of this work.

IV. DIFFERENCES IN HOUSING DEMAND BY TENURE

Chapter 3 discussed some of the differences that exist in housing consumption between renters and owners, e.g., that both marginal and average propensities to consume housing are generally greater for owners. This chapter elaborates on differences that are found between the two groups in consumption of real housing services, as measured by rents and imputed rents, and focuses also on examining whether or not a premium exists for homeownership per se. It is likely that most owners pay for more than just the flow of housing services offered by their dwellings; they also pay for a number of aspects of housing that accompany ownership of property rights in their dwellings. Among these are: (i) freedom from inflation in rents which would occur were they not to own (e.g., housing's value as a "hedge against inflation"); (ii) the right to generate income from subletting commercial or residential space; and (iii) the right to receive future income in the form of capital gains realized upon sale of the property. It may be seen that all of these motivations for placing a premium on housing (above a payment for its rental value) are subject to the influence of both general economic conditions and the conditions of particular housing markets. It is conceivable, in fact, that under certain conditions (e.g., a depressed real estate market with high vacancies, falling real rents, and net population out-flow) there could be a discount for ownership. Similarly, there are conditions under which renting is less risky than owning. It is important, therefore, not only to measure the magnitude of any ownership premium but also to understand the factors associated with its magnitude. Important policy implications follow from knowing each.

In this chapter the focus of our explanation of cross-tenure differences is an attempt to disentangle two features of renters' and owners' housing consumption; the first is the difference in consumption of housing services; the second, the premium (if any) paid by owners for homeownership per se.

A key simplifying assumption made for most of this section is that the simple rent-own classification is a useful one. In fact, tenure is a continuum of property rights even within a country. For example, in the U.S. the simple rent-own dichotomy is a simplification accepted by almost all analysts, but in fact actual tenure rights vary greatly from tenant to tenant because of the effects of zoning laws, length of tenure, rent control, laws concerning tenant occupancy rights, housing standards, financial considerations such as due on sale clauses, and many other possible easements.[1/] Later in this section we will evaluate this simple model by comparing results from the simple own-rent model to results from more disaggregated models. But first a brief discussion of the user cost of capital will introduce the basic tools of analysis; then differences in consumption by tenure will be estimated and explained.

1. The Concept of User Cost

The user cost of capital is the income foregone from the best alternative use of that capital. The user cost of a unit of housing capital is straightforwardly measured for renters: neglecting transactions costs, it is the monthly rent paid for the unit(s) of housing capital from which the tenant receives a flow of housing services. For owners, user cost is the

---

1/ See Furbotn and Pejovich (1975) for a survey of the economic analysis of property rights, and Hirsch (1979) for applications to housing markets.

opportunity cost of the household's owned asset, structure and land.[2/] The gross differences in housing consumption (rents) observed in Chapter 3 could be due to differences in real consumption (quantities) or differences in user cost (prices). Why would differences in user cost persist? Households would presumably have incentives to arbitrage by changing tenure. Why would systematic differences in housing consumption persist? Certainly tastes can be said to differ across tenure groups but this is not an informative explanation. Much of the observed difference can be attributed to long lags in housing markets. Developing country cities are growing very fast, with severe supply side constraints (e.g. poor financial system, lack of infrastructure). Under these conditions differences in user cost will not be quickly arbitraged away. Tables 19 and 20 present summary explanations of how user cost differences and quantity differences can arise. The existence of so many potential explanations of price and quantity changes (and hence, differences in observed rents) means that there is little possibility that empirical work with a dozen or so cities will clearly sort out the relative

---

2/ For both renters and owners, consider structural capital as undistinguished from land in this section; also, ignore other inputs to the production of housing services, and the existence of leases.

Table 19

First Order Effects of Market Conditions on User Cost

	Owner's Real User Cost	Renter's Real User Cost
General Price Inflation (Real Rents Constant)	in absence of taxes, neutral, if alternative assets appreciate equally	neutral
Real Inflation in Rents (unanticipated)	decreases, through capital gains	increases; as nominal house values bid up, landlord's opportunity cost rises, and is passed on to tenants in a competitive market
Rent Control	decreases income foregone by not renting but may increase demand in owner occupied sector; in long-run rental price adjusts back up	decreases user cost initially but landlords adjust by decreasing maintenance or charging key money
Tax Treatment Favorable to Homeownership	initially lowers after tax cost of capital; in long run, may be offset by increase in house values if supply not perfectly elastic	roughly neutral, but may decrease over intermediate run if tax treatment causes shift to homeownership and landlords do not sell out to homeowners

Table 20

Alternative Explanations for Cross Tenure Differences in Relative Real Housing Consumption

	Effect on Owner/Renter Real Consumption	Explanation
Security of Tenure	positive	secure tenure is *per se* a good for which households pay a premium
Property Rights	Positive	Ownership comprises additional property rights which have some implicit market value; secure tenure is only one of these
Alternative Investment Opportunities	negative	developing countries with thin capital markets have few alternative vents for savings and remittances
Transactions Cost	positive	consumption changes with income, life cycle but larger transaction costs for owners implies less tendency to adjust downward in response to changed circumstances

contribution of each, but it is important to identify them as clearly as possible.[3/]

The first focus is on prices. Table 19 presents some hypotheses about the effects of changes in market conditions on user costs for each tenure group. They are first order in the sense that they are considered independently from other market conditions in a partial equilibrium framework. In long-run general equilibrium many of these hypotheses would have to be qualified, especially if the supply of capital to each submarket is elastic. Also, interactions between market conditions (for example, inflation and the tax code) are not discussed here.[4/]

Recall that the user cost for renters is the monthly rental paid for the dwelling. In the absence of leases (or for leases sufficiently short), rents paid adjust quickly to the landlord's cost of capital, which lies behind the renters user cost. An owner's implicit user cost, like a landlord's, can be derived from a simple model:

$$c = V_0(r + d) - \frac{dV}{dt} + m$$

where c is user cost,

V_0 is the purchase price of the asset,

r is the opportunity cost of capital,

d is the depreciation rate

3/ For ease of exposition changes which may be roughly neutral with respect to tenure differences, such as population or income growth, or changes in depreciation, are not considered here. Of course such changes are not always neutral in the presence of other market conditions, notably taxes.

4/ See the U.S. literature cited above for analysis of interactions between the tax code and market conditions.

$\frac{dV}{dt}$ is the real appreciation of the asset, and

m are monthly operating costs.

In developed countries the tax treatment of owner occupied housing radically affects user cost, but this is a problem which can be ignored when using data from developing countries. Specifically, the user cost expression is simplified because the tax treatment of imputed rent, capital gains, mortgage interest and property taxes are irrelevant. Since taxes can be ignored and mortgage financing is uncommon in developing countries, user cost consists of the opportunity cost of the equity in the house, plus operating costs (e.g. utilities) and depreciation, and less expected real appreciation. In a riskless world, expected real appreciation depends on the expected future rents the house will command.5/

The first and the last effects of Table 19 will not be discussed in detail: the neutrality of general inflation is straightforward, and the effects of income tax treatments are not relevant in developing countries. If there is a real increase in rents which is unanticipated, a renter's user cost increases, although with lags due to leases. User cost decreases for sitting owner occupants because unanticipated rental increases will be capitalized

---

5/ Adding resale to the model doesn't really change anything because resale prices are also simply discounted present values. Parenthetically, existing owner occupied houses trade less frequently in developing countries than in developed countries. This may lead to a downward bias in our estimates of user cost, as argued in Follain and Malpezzi (1981).

into increased house values. These capital gains are a potential source of income offsetting part of the ex ante user cost.[6/]

Housing market policy interventions can have quite complex effects on user cost. For example, rent controls decrease user cost to renters to the extent that they are effective price controls, but that is a big if. Landlords can reduce the quantity of housing services produced by a unit to negate the initial price decrease; the time path of renter's user cost in a controlled market may even exceed the competitive price at some point (see Malpezzi [1984 b], and the references therein). Even in the case where the reduction in housing services exactly balances the original price decrease, rent control regimes typically have winners and losers among tenants; long-term tenants often have much lower user costs than recent movers, for example (Ibid.). For owners, the effect on user cost of a controlled rental market is uncertain, since it can be shown that real rents in the uncontrolled sector can rise or fall after the imposition of controls (Fallis and Smith [1984]), although they are more likely to rise (Ibid., and Malpezzi [1984 a]).

Table 20 lists some plausible explanations for differences in quantities consumed by tenure. In general, property rights can be treated as goods, and an owner living in a unit otherwise identical to a renter's actually receives additional units of housing services, if such services are broadly defined to include those generated by property rights. Alternatively, they could be analyzed as a motivation for willingness to pay a price premium for a unit with additional property rights, but treating the right as a good

---

6/ Of course in practice imperfect capital markets make it difficult to actually turn the increased value into a stream of income without selling the entire unit; but households certainly could conceptually equate a given capital gain to some notional income stream, and such a flow is easier to handle in the user cost model.

per se seems natural. Security of tenure is one of many possible property rights inherent in owning.

Transactions costs are greater for owners than for renters. Under plausible additional assumptions this can lead to a systematic divergence between renter and owner consumption at different stages of the life cycle. For example, as incomes decline late in life, renters will likely adjust housing consumption downward faster than owners, leading to observed larger consumption for owners at a given income level. However, counter examples which work in the other direction are easily thought of (low-income earners buying more housing in anticipation of future income growth), so the net effect is uncertain. But given the difficulty of financing, there is an interesting assymetry: young wage earners cannot easily borrow against their expected future income, so they rent; older workers can easily hold onto an already owned asset. This could yield a higher observed average consumption for owners at a particular income level.

Finally, in countries which lack alternative investment opportunities, housing becomes a vent for savings, and investment demand fuels additional consumption by owners. Egypt is a clear example of such a phenomenon, where large remittances from workers abroad have fueled a real estate boom in Cairo in recent years.[7/]

2. Rent-to-Income Ratios by Tenure

Table 21 illustrates differences in housing consumption for owners and renters at similar income levels. These are based on estimated housing expenditure functions presented in Tables 2 and 3, where consumption for

---

7/ Mayo et al. (1981).

TABLE 21
RENT-TO-INCOME RATIOS BY INCOME ($US PER MONTH)

		$50	$100	$150	300	CITY AVERAGE
COLOMBIA						
BOGOTA	(OWNERS)	0.32	0.27	0.24	0.20	0.20
	(RENTERS)	0.33	0.26	0.23	0.18	0.18
	(RATIO)	0.95	1.01	1.05	1.12	1.13
						($ 320)
CALI	(OWNERS)	0.28	0.22	0.20	0.16	0.17
	(RENTERS)	0.47	0.32	0.25	0.17	0.19
	(RATIO)	0.59	0.70	0.78	0.92	0.89
						($ 259)
EGYPT						
BENI SUEF	(OWNERS)	0.22	0.15	0.12	0.08	0.18
	(RENTERS)	0.11	0.08	0.06	0.05	0.09
	(RATIO)	2.02	1.89	1.82	1.71	1.95
						($ 74)
CAIRO	(OWNERS)	0.19	0.11	0.08	0.04	0.10
	(RENTERS)	0.10	0.07	0.06	0.04	0.07
	(RATIO)	1.82	1.49	1.33	1.09	1.47
						($ 104)
EL SALVADOR						
SANTA ANA	(OWNERS)	0.09	0.10	0.10	0.11	0.10
	(RENTERS)	0.17	0.12	0.09	0.07	0.08
	(RATIO)	0.53	0.82	1.06	1.63	1.22
						($ 188)
SONSONATE	(OWNERS)	0.30	0.26	0.24	0.21	0.24
	(RENTERS)	0.15	0.11	0.09	0.06	0.08
	(RATIO)	2.02	2.47	2.78	3.41	2.87
						($ 167)
INDIA						
BANGALORE	(OWNERS)	0.33	0.22	0.18	0.12	0.25
	(RENTERS)	0.12	0.09	0.08	0.06	0.10
	(RATIO)	2.69	2.42	2.28	2.06	2.50
						($ 81)
KOREA						
BUSAN	(OWNERS)	1.31	0.90	0.72	0.49	0.41
	(RENTERS)	0.68	0.42	0.32	0.20	0.16
	(RATIO)	1.93	2.13	2.25	2.48	2.60
						($ 416)
KWANGJU	(OWNERS)	2.16	1.44	1.13	0.76	0.66
	(RENTERS)	0.46	0.35	0.30	0.23	0.21
	(RATIO)	4.68	4.07	3.75	3.26	3.12
						($ 375)
OTH. K. C.	(OWNERS)	0.61	0.53	0.48	0.42	0.41
	(RENTERS)	0.38	0.28	0.23	0.17	0.16
	(RATIO)	1.61	1.90	2.10	2.48	2.53
						($ 323)
SEOUL	(OWNERS)	1.40	0.95	0.76	0.51	0.40
	(RENTERS)	0.77	0.52	0.42	0.29	0.22
	(RATIO)	1.82	1.81	1.80	1.79	1.79
						($ 469)
TAEGU	(OWNERS)	1.41	0.98	0.79	0.55	0.50
	(RENTERS)	0.53	0.36	0.28	0.19	0.18
	(RATIO)	2.67	2.74	2.77	2.84	2.85
						($ 349)

TABLE 21
RENT-TO-INCOME RATIOS BY INCOME ($US PER MONTH)

		$50	$100	$150	300	CITY AVERAGE
PHILIPPINES						
DAVAO	(OWNERS)	0.04	0.04	0.04	0.04	0.04
	(RENTERS)	0.09	0.09	0.08	0.08	0.08
	(RATIO)	0.45	0.49	0.51	0.55	0.51
						($ 142)
MANILA	(OWNERS)	0.68	0.51	0.42	0.31	0.27
	(RENTERS)	0.23	0.17	0.14	0.10	0.09
	(RATIO)	3.02	3.03	3.03	3.03	3.03
						($ 432)
U.S.						
PHOENIX	(OWNERS)	3.49	1.98	1.42	0.81	0.17
	(RENTERS)	3.05	1.73	1.24	0.70	0.15
	(RATIO)	1.14	1.15	1.15	1.15	1.17
						($1972)
PITTSBURGH	(OWNERS)	2.71	1.53	1.10	0.62	0.14
	(RENTERS)	1.47	0.88	0.65	0.39	0.10
	(RATIO)	1.84	1.73	1.68	1.58	1.37
						($1845)

NOTES:
(1) CITY AVERAGE INCOME IS SAMPLE AVERAGE FOR BOTH RENTERS AND OWNERS.
(2) RENTS ARE PREDICTED FROM NET RENT EXPENDITURE EQUATIONS.
(3) ALL NUMBERS ARE CONVERTED TO 1981 U.S. DOLLARS USING LOCAL CPI AND OFFICIAL EXCHANGE RATES.

renters is in terms of net rents and, for owners, in terms of net imputed rents. Imputed rents are based either on owners' direct imputation, hedonic imputation, or capitalized value as discussed in Chapter 2.[8/]

Note the results for Pittsburgh and Phoenix. The rent-to-income ratios predicted by the regression results are believable for the city average income, but extrapolation to low incomes not observed in the sample yields very high ratios. Prediction so far out of sample often leads to such nonsensical results.

The table illustrates three major points regarding housing consumption by renters and owners: first, owners consume more housing than do renters in almost all cities at almost all income levels. The median ratio of owners' consumption relative to renters' for the cities portrayed (evaluated at respective city mean incomes) is 1.86--owners consume 86 percent more housing than renters at comparable incomes. Second, the relationship between income and the relative housing consumption of both owners and renters is generally positive, although the relationship is not particularly strong. This is a product of the general similarity in renters' and owners' estimates of the income elasticity of housing demand. That is, even though owners are estimated to have generally higher demand elasticities, elasticities are not so much higher that relative consumption increases markedly for owners as incomes rise. Third, relative housing consumption by renters and owners is highly variable from place to place, bearing only statistically weak relationships to the market conditions discussed above.

8/ It should be noted that owners' imputed rents are not counted as part of owners' income; thus the ratios of rent to income shown for renters and owners represent housing consumption relative to cash income rather than housing expenditure to total income (including the implicit return on housing assets).

Figure 10 explores the simple relationship between the consumption differential and the (log of) city average income. The regression line omits the two U. S. cities, which are the right-most points on the graph. Note that if the U.S. cities are deleted, the consumption differential increases with income. Is this consistent with the earlier statement that long-run income elasticities were similar for owners and renters? Yes, because relative housing prices also increase with development; and as prices rise renter consumption falls faster than owner consumption (recall that the renter price elasticities were consistently smaller in Tables 16 and 17), thereby increasing the ratio of owner to renter consumption.

3. Testing the Relationships Among User Cost, Market Conditions, and Tenure Choice

More careful modeling requires that the sample be restricted to observations where imputed rents are observed for owners, either directly or predicted from a rental hedonic index. Imputations from amortized house values are misleading in this modeling because a single amortization rate was used in each market, so relationships between rents and asset prices are fixed by construction. Unfortunately this restricts our sample size to only 10 cities.

Table 22 presents approximations to user cost of housing capital by city. The first column presents the ratio of homeowner's imputed rent to income at the city's sample mean income. The second column is the opportunity cost of owning housing (mean value times a discount rate) divided by income, again at the city's average income. Note that the first column is from rent net of utilities. Since the full user cost cannot be calculated without knowing expectations, depreciation, etc., we chose to compare simply the

FIGURE 10
RATIO OF OWNER R/Y TO RENTER R/Y BY LOG OF INCOME

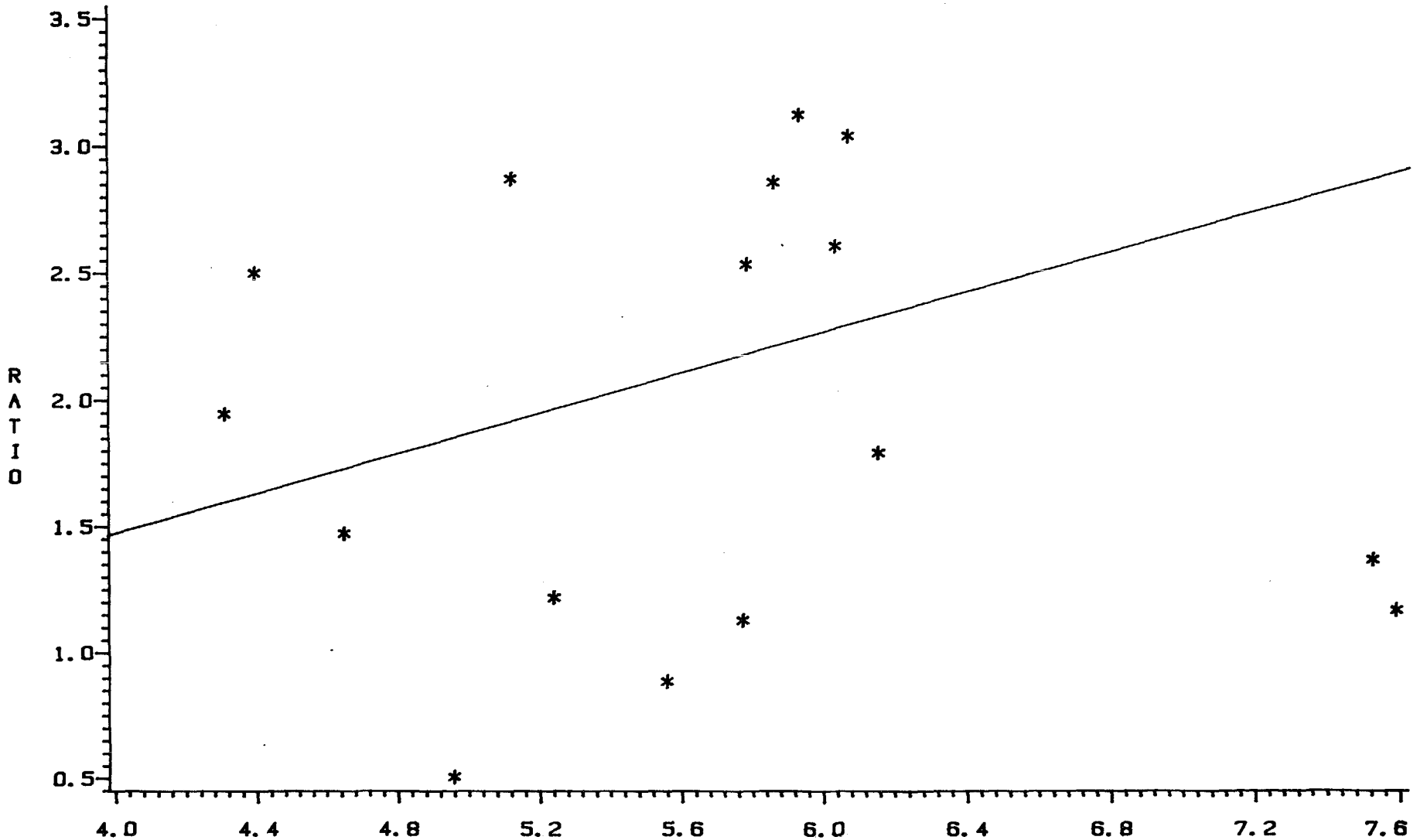


TABLE 22
IMPUTED RENTS, OPPORTUNITY COST, AND VALUE, TO INCOME
WITH HOMEOWNERSHIP RATES IN SAMPLES, AND RECENT INFLATION

	NET IMPUTED RENT / INCOME	OPPORTUNITY COST / INCOME	RATIO COL2 / COL1	AVG VALUE TO INCOME RATIO	INFLATION RATE	HOMEOWNERSHIP RATE
COLOMBIA						
BOGOTA	0.19	0.53	2.81	4.4	23.5	45
CALI	0.16	0.39	2.50	3.2	23.5	50
EGYPT						
CAIRO	0.10	0.90	9.12	7.5	12.9	31
EL SALVADOR						
SANTA ANA	0.11	0.09	0.82	0.7	13.0	56
SONSONATE	0.22	0.21	0.93	1.7	13.0	25
INDIA						
BANGALORE	0.21	0.30	1.42	2.5	13.2	17
PHILIPPINES						
DAVAO	0.04	0.09	2.14	0.7	9.6	59
MANILA	0.28	0.54	1.90	4.5	12.7	56
U.S.						
PHOENIX	0.17	0.24	1.39	2.0	6.7	71
PITTSBURGH	0.14	0.20	1.43	1.7	6.7	72

NOTES:
(1) ALL RATIOS CALCULATED AT AVERAGE OWNER INCOME FOR EACH CITY.
(2) RATIOS ARE RATIOS OF AVERAGES, RATHER THAN AVERAGE RATIOS.
(3) OPPORTUNITY COST EQUALS 1 PERCENT OF HOUSING VALUE.
(4) HOMEOWNERSHIP RATES ARE UNWEIGHTED SAMPLE MEANS AND THEREFORE APPROXIMATE
(5) INFLATION RATE IS ANNUAL CHANGE IN CPI FOR 5 YEARS PRECEDING THE SURVEY.
(6) ALL NUMBERS ARE ADJUSTED BY LOCAL CPI TO 1981 U.S. DOLLARS.

opportunity cost of the structure and land to the current rent for that structure and land. The ratio of opportunity cost to current rent (column 3) is then a measure of the total ownership premium. What has not been done is to estimate how much of this total premium is based on expectations of future rents and how much is a payment for security per se. Future work can explore how these two components are related in a risky asset model.

The other columns of Table 22 are self-explanatory. The value-to-income ratio is an alternative measure of the strength of asset demand in each city. Recent inflation (column 5) is often hypothesized to be positively related to asset demand. The homeownership rate may interact with asset demand in several ways. Cities with high homeownership rates may have deeper housing markets, i.e. markets with more frequent trades; this should keep the premium down at any given level of asset demand. On the other hand, high homeownership rates may be an indicator of high asset demand.

The most striking result from Table 21 is the extreme divergence of Cairo from the pattern found elsewhere. The large apparent difference in consumption is in part explained by the existence of rent control in Cairo.[9/] Controlled monthly rents there are extremely low relative to opportunity costs; more detailed analysis elsewhere shows that the apparent price discount to renters is illusory, and is offset by side payments such as utilities, renter maintenance expenditures, and key money.[10/]

Strong patterns are difficult to discern with only a few cities, but there is a slight positive association between the ratio in column 3 and inflation. Multivariate models relating the ratio to market conditions

---

9/ Bogota, Cali and Bangalore also have rent control, but Cairo's rent control law is the most restrictive.

10/ See Malpezzi (1984 b) for detailed analysis of Cairo rent control.

(inflation, income, relative prices, climate, rent control) were not able to discriminate among alternative explanations for differences, which is not surprising given the sample size.

An alternative test is to examine the relationship between the ratio and homeownership. Large ratios of opportunity cost to current rent should discourage homeownership, ceteris paribus, or equivalently provide incentives to switch tenure. Such a relationship is found to exist, but is not statistically discernible from zero, so numerical results are not reported here.

Future research can profitably focus on careful modeling of these relationships with additional data. These data can also be improved on by computing the various measures of user cost separately for each household in a set of samples, rather than relying on ratios of averages as was done here.

4. Tenure as a Set of Property Rights, and Disaggregated Results.

Most housing studies focus on differences between owners and renters (see Table 1, and Lim et al.), and that is the approach adopted so far in this paper. However, a few studies have examined the more complicated tenure arrangements found in developing countries (e.g. Doebele [1983], Jimenez [1984]) and the next few paragraphs explore how further disaggregation of tenure into (1) renters, (2) formal owners, (3) informal owners (squatters, or those without legal title to land or without legal authority to build), and (4) government subsidized or provided units affect the basic results.[11/] This does not exhaust all possible tenure breakdowns; tenure can be argued to be a continuum of property rights rather than several mutually exclusive

---

11/ It can be argued that simple disaggregation schemes which do not account for the simultaneity of the tenure and demand decisions bias the elasticity estimates (as discussed in Section 2.2). However, simple models were estimated in Cairo, Seoul, and Manila using pooled owner and renter samples, and income elasticities were found to be robust.

categories. Current research (Jimenez [1983], and Friedman, Jimenez and Mayo [1985]) is exploring these breakdowns in more detail; here the purpose is simply to indicate the robustness of the results presented above to further sample stratification.

Two models were estimated with data from Cairo and Manila (Table 23). The first model is the simple model of Section 2 (log income, household size and its square), and the second model is similar to the "large" model of Section 3. It contains additional demographic variables but no price term, and is called the "medium" sized model. Table 23 presents the income elasticities and fits from these models; complete results are available upon request.

In Cairo, the new renter sample (less public housing) has about the same income elasticity as the combined sample in Table 2, but in Manila the income elasticity goes down. This is because the original Manila renter sample contains some households who rent land and own their structure, and these are now in the informal owner sample. The key result is the difference between formal and informal owners: do formal owners have higher marginal propensities to consume? The answer is yes in both markets, although the difference is more striking in Manila. This is plausible because even these disaggregated tenure classifications mask important differences in the details of the arrangements in different markets. Manila informal owners include people who rent land and own the structure, whereas few people have this arrangement in Cairo; informal owners there are predominantly those who build on land that they "own" without legal title or that they are proscribed from building on by law.

Another key result is that government provided or subsidized housing is consumed without relation to the usual determinants of demand. The lowest income elasticities and the poorest fits are for this tenure group.

Table 23

Income Elasticities from Demand Equations by Disaggregated Tenure

	Cairo			Manila		
	Simple Model	Medium Model	Sample Size	Simple Model	Medium Model	Sample Size
(Elasticity)	.39	.36	274	.66	.64	615
(Std Err)	.050	.049		.047	.045	
(Prob>T)	.001	.001		.0001	.0001	
(Adj R-2)	.18	.25		.27	.33	
(Typical R/Y)	.13	.14		.15	.13	
(Elasticity)	.18	.13	50	.29	.26	180
(Std Err)	.187	.198		.111	.110	
(Prob>T)	.349	.504		.011	.020	
(Adj R-2)	.06	.03		.04	.06	
(Typical R/Y)	.13	.16		.09	.05	
(Elasticity)	.26	.22	35	.80	.77	625
(Std Err)	.099	.109		.053	.051	
(Prob>T)	.015	.055		.0001	.0001	
(Adj R-2)	.10	.24		.27	.33	
(Typical R/Y)	.13	.20		.14	.08	
(Elasticity)	.04	.04	24	.34	.35	255
(Std Err)	.193	.197		.068	.069	
(Prob>T)	.828	.825		.0001	.0001	
(Adj R-2)	-.14	-.16		.09	.09	
(Typical R/Y)	.08	.05		.07	.07	

Log of rent explained by log of income, household size, household size squared.

Simple model plus length of tenure, sex and age of household head.

Estimated rent-to-income ratios, for 5-person household, male head age 30, in unit 10 years, with monthly income of 80 pounds (Cairo) or 2400 pesos (Manila).

When average propensities to consume are examined (Table 23), the conclusions about differences between formal and informal sector consumption and about the public sector are broadly reinforced. At typical income levels, formal sector owners spend perhaps a little more than informal owners, but the difference is more pronounced in Manila than Cairo. Public sector tenants spend only a fraction of the amounts spent in other sectors.

V. CONCLUSIONS, AND DIRECTION FOR FUTURE RESEARCH

1. Summary Results

This paper has presented an abbreviated discussion of a larger comparative study of housing demand in developing countries. Using a number of high quality household-level data sets, a number of empirical regularities have been found within and among developing country cities. Among these are, at the household level:

1. Income elasticities of demand among renters are generally small (on the order of 0.3 to 0.6); income elasticities of demand among owners are somewhat larger (on the order of 0.4 to 0.8); these results are generally consistent with findings for developed countries.

2. Owners generally consume a good deal more housing than renters at given income levels; this is not primarily a result of differences in income elasticities of demand but rather a result of differences in expenditure equation constant terms. This suggests that variables such as tastes and assets play important roles in causing consumption differences between renters and owners.

3. Permanent income elasticities of demand for housing are somewhat greater than current income elasticities, although in reasonably "complete" models of demand including price terms and demographic variables, permanent income elasticities are only moderately higher than current income elasticities in simpler models.

4. Price elasticities of demand for cities analyzed here are on the order of -0.8 to -1.0, considerably higher than estimates produced elsewhere in the literature. However, these estimates may have an upward bias because of a specification problem.

Important results at the city level include:

1. Rent-to-income ratios rise across cities as income increases, a result of upward-shifting Engel curves. This phenomenon appears to be associated with increases in the relative price of housing, with differences between current and permanent income elasticities of demand, and with differences in the time period associated with the two levels of analysis. The city level analyses presumably model very long-run behavior.

2. Very long-run (cross-city) income elasticities of demand are estimated to be one or greater. Very long-run price

elasticities are less than one in absolute value. Income elasticities are measured with better precision than price elasticities.

3. Owners generally pay a significant premium for ownership per se. This premium, equal to the difference between the opportunity cost of housing capital and the imputed rental value of housing, is highly variable from place to place depending on market conditions. In particular, ownership premia are high in cities with high rates of housing inflation and significant rates of asset formation through savings or workers' remittances. Security of tenure also influences the magnitude of the premium paid for ownership.

Comparing household level and city level results leads to the following:

1. Income elasticities are much greater in the very long run than within a market. The cross-section results are directly relevant to behavior within a market, while the very long-run results can be applied to make predictions as a country develops. Both are necessary for correct analysis of projects, as will be outlined below. This is not surprising, as it a sound general principle that behavior is more responsive to changes over longer periods of time.

2. Long-run price elasticities from the city level estimation are lower in absolute value than the cross-section price elasticities. This is at variance with the principle just enunciated. The price elasticity estimates suffer from more severe errors in variables problems than the income elasticities; because of the specifications used, the cross-city specifications are probably biased towards zero, and the household level estimates are likely biased towards one.

2. Policy Implications

Policy implications of these and other results from the housing demand research project will be spelled out in detail in forthcoming reports.[1/] Here several obvious policy implications will be briefly mentioned.

Affordability calculations for target populations are a critical element of project design. Until now, such projects relied on rules of thumb,

---

1/ Mayo and Gross (1985).

often, for example, an assumption that households can spend between 20 and 25 percent of income on housing. The results described above demonstrate the inadequacy of any single ratio to predict consumption for different income and tenure groups in different places. In many respects the best solution is to do a careful household survey which includes the target population, and to proceed with simple econometric models like the ones described here to get project-specific estimates. If constrained, a second best solution can be to estimate a variable rule of thumb from the results in this paper. Using the elasticities for the relevant tenure group, the cross-city model can be used to predict the city's average consumption given only an estimate of city average income and a few readily available country level variables such as GDP per capita. Income elasticities within samples do not vary by much from city to city, so a typical cross-section elasticity can be chosen (say the average), or the elasticity from a city deemed similar to the project location. This elasticity can be used to move along the city specific Engel curve to locate an estimate of the affordability ratio of the target population in the target city.[2/]

Most current public sector housing projects contain subsidies, implicit or explicit. How inefficient these subsidies are depends critically on the demand and price elasticities of the participants. In general, larger price elasticities imply larger benefits to participants to housing programs, ceteris paribus, although it is well known that private benefits from a subsidy are always less than the benefit from equivalent income transfers. Larger income elasticities imply that unconstrained transfers will have larger housing consumption effects, ceteris paribus. The current research has not

---

2/ See Mayo and Gross (1985).

nailed down a single set of numbers which can be used to reliably estimate precise measures of program efficiency, but future work can use a range of estimates to examine costs and benefits of alternative programs qualitatively.

The findings on tenure specific differences have several important implications which will be spelled out in more detail in forthcoming work. Note, for example, that affordability calculations that do not account for tenure differences will be seriously biased in many cities. It is currently common practice to use renter samples to make direct inferences about affordability in owner occupied projects without adjustment for these cross tenure differences; this is probably not a bad approximation if project target groups are limited to current renters.[3/] Another implication is that the existence of highly variable homeownership premia suggests that, in some markets, schemes that focus on increasing the rental stock are appropriate and desirable, while in others high premia suggest that the focus should be on increasing the homeowner stock.[4/]

3. Ongoing and Future Research Directions

Two general directions for future research are suggested by an analogy to the well used capital widening-capital deepening dichotomy in development economics. Clearly there are large gains to expanding the present work to more countries, especially to adding more developed countries to obtain a clearer picture of how housing market behavior changes throughout the range of development. From a purely statistical point of view, additional

---

3/ Homeowners in developing countries consume more housing at given income levels than renters (Chapter 4), but many have required long periods to build up equity. See Mayo and Gross (1985) for more on this point.

4/ See The Urban Edge (1984) and Gilbert (1983).

cities in the sample will enable careful empirical analysis of the effects of market conditions and housing policies on consumption. More work on the correct specification of prices is essential, both within cross sections and across cities.

Capital deepening can be represented by more intensive analysis of particular policies in one or several countries. The effects of financial markets, rent control, and tenure systems is being studied concurrently. Results from these studies are being applied to project design issues and to policy analysis in the following areas:

Housing demand estimates and project design. Mayo and Gross (1985) apply the demand model of Chapter 3 in an evaluation of World Bank financed shelter projects. They find that the rules of thumb used in affordability calculations can be much improved, and that projects often have larger implicit subsidies than is commonly assumed.

Housing finance. Struyk and Turner (1985), and Mayo, Struyk and Turner (1985) estimate behavioral models of the joint demands for housing and associated finance. Both formal and informal financing mechanisms are included. Among other findings, access to formal finance per se is shown to have a positive effect on housing consumption even after controlling for household characteristics that affect both access and housing demand. Informal finance and formal finance are not perfect substitutes, but the demand for formal finance is shown to be sensitive to interest rates; at market rates some substitution does occur.

Demand for individual housing characteristics. Follain and Jimenez (forthcoming a, forthcoming b) survey the literature on the demand for housing character and present estimates of such models for several developing country cities. Gross (1984) shows how these kinds of estimates can be integrated into computerized planning models currently used for project design. Ozanne and Malpezzi (1984) examine the robustness of characteristic demand models, and their findings suggest (as do Follain and Jimenez's, and Gross's) that further study of the stability of these models is needed for reliable use in project design.

Tenure security. Jimenez (1984) models and estimates the premium paid for secure tenure by both owners as renters in Davao, the Philippines. Formal sector units are priced 18 percent (renters) to 58 percent (owners) more than equivalent units in the informal sector. A theoretical paper by Jimenez (forthcoming) shows that some punitive government actions designed to reduce squatting may actually increase it under certain conditions. Additional work by Hoy and Jimenez (1984) suggests that increasing security of tenure represents a net efficiency gain to society, not just a transfer to participants.

Rent control. Malpezzi (1984 b) has provided a detailed empirical analysis of the rent control regime of Cairo, with a focus on explicit estimation of the role of key money and other side payments by tenants. On average these side payments largely equilibrate the market; when they are included, average rental prices are almost identical to the average of estimates of the long-run competitive price. However, these averages mask large welfare gains and losses to individual tenants. Malpezzi (1984 c) provides a framework for ongoing comparative work which studies alternative ways markets adjust to rent control, and the implications of different adjustment mechanisms for alternative methods of decontrol.

DATA APPENDIX

1. Household Data Sources

The empirical findings of this study are based on household surveys conducted in Colombia, El Salvador, Egypt, Ghana, India, Jamaica, the Philippines, and the United States between 1974 and 1983. Following is a brief description of surveys conducted in each of these countries.

Colombia. The 1978 Colombian household survey covering Bogota and Cali was conducted as a part of the regularly scheduled quarterly household survey by the Colombian Statistical Office (DANE). The City Study research team from the World Bank assisted DANE in updating the sample frame for Bogota from 1973 to 1978, and also in designing a more detailed questionnaire with added sections on housing and transport.

The interviewed households were selected by a two-stage random sampling technique. Using an updated 1973 Census frame, the cities were first divided into geographic units containing ten or more dwelling units. In the first stage, a sample of these was chosen with equal selection probabilities. Ten dwelling units were then selected randomly from each section to be interviewed. Each unit was assigned an appropriate weight based on the total number of households in the section in order to allow reweighting to obtain population statisitics.

The survey originally produced 3,062 household records from Bogota and 980 records from Cali. Of these, 1,446 households in Bogota and 498 in Cali were owner households. Each record contains detailed data on building and dwelling unit characteristics, infrastructure, transportation mode, household characteristics with information on each household member, employment, income, and housing expenditure.

El Salvador. The 1980 El Salvador household survey covering Santa Ana and Sonsonate was a part of three-period longitudinal surveys conducted by the Salvadorean Low Cost Housing Foundation (FSDVM) under the guidance of the World Bank.

The quasi-experimental design with a mixed panel sample of the survey covered a random sample of 196 project households and 326 control group households in Santa Ana. The stratified non-proportional sample of the control group was chosen from the three main types of low-income settlements in the city. These are mesones (tenement houses), colonias illegales (extra-legal subdivisions), and tugurios (illegal squatter settlements). Approximately 100 households were chosen from each group.

For Sonsonate, 180 randomly selected project families and 140 control group households were covered by the survey. The survey includes information on dwelling units, housing costs, the construction process,

household characteristics, income and expenditure, and health. Only control group data are used in the analysis presented here.

Egypt. The 1981 Egyptian household survey was conducted jointly by Abt Associates, Inc., Dames and Moore, and the General Organization for Housing, Building, and Planning Research (GOHBPR) with assistance from the Central Agency for Mobilization and Statistics (CAPMAS).

The survey was conducted as a two-stage probability sample of dwelling units in Cairo and in the city and principal villages surrounding Beni Suef. In the first stage, 50 CAPMAS census enumeration districts in Greater Cairo and 20 in Beni Suef were randomly chosen as the sample frames for the second stage. The probability of an enumeration district being chosen was proportional to the 1976 enumeration district population of dwelling units. There were 12,986 dwelling units in 3,386 buildings in the enumeration districts chosen in the first stage sample for Cairo and 4,452 dwelling units in 3,131 buildings in Beni Suef.

The household survey (occupant survey) was a simple random sample with ten households chosen in each enumeration district based on the above sample frame. In Cairo, 500 households were sampled; in Beni Suef, 250 households were interviewed. Of Beni Suef households, 130 were in Beni Suef city and 120 in nearby villages. Of these, 154 households in Cairo and 184 households in Beni Suef were owner households. The survey contains detailed information on household characteristics including data on income, expenditure, consumer durables, housing financed, demographic characteristics, mobility and migration, attitudes and preferences regarding housing and infrastructure, and informal sector attitudes and behavior. Also included in the survey are detailed housing characteristics such as building characteristics, access to infrastructure services, housing costs and cost elements, process of land and building acquisition, and construction processes. In all, data were collected on up to 420 data elements for each household and dwelling unit.

In addition to the household level information, aggregate characteristics of housing and infrastructure in each sampled enumeration district are included. Further documentation is contained in Mayo et al. (1981).

Ghana. A survey of 1,534 households in Kumasi was collected by Dr. Graham Tipple of the University of Newcastle upon Tyne. Data were collected on housing and household characteristics; the sampling unit was the house, and the frame was stratified by housing sector: tenement, indigenous, government, and high cost. The tenement sector is comprised mainly of multistory compound housing (about 20 percent of the stock); the indigenous sector is by far the largest, and is mainly single story compound houses of traditional design. The remaining sectors, much smaller, are the high cost sector (European style single family design), and the government sector (bungalows and row houses). The data are fully documented in Tipple (1982).

India. A survey of 1,745 households in Bangalore for the Bangalore City Survey Project conducted by the Institute for Social and Economic Change, Bangalore. The sample frame was constructed from updated census records in two stages: first, 150 sample frame blocks were chosen, then households from

within blocks. The survey has quite good information on income, assets, and demographic variables, and some information on housing characteristics. Professor V. K. Tewari is currently working on supplementing this survey with additional data on structure age and type of rent control regimes. The data are documented further in Prakasa Rao and Tewari (1979).

Jamaica. These data are from the Jamaican Government's 1975 Household Expenditure Survey. The survey contains detailed expenditure data, but little information on housing characteristics. There are over 3,000 households in the total survey, but the estimates reported in this paper are restricted to renters residing in either Kingston or its adjacent parish. Monthly housing expenditures by renters was used as a proxy for rent.

Korea. The Korean household survey was conducted during November of 1979 by the National Bureau of Statistics of Korea on behalf of the Korea Housing Bank.

The survey used 1975 census tracts as its sampling frame. The sampling unit, household, was selected by a systematic sampling from the urban households participating in the labor force which were first stratified by the types of occupation. The survey covered around 2,000 dwellings in 36 cities. The data contains records for 5,935 households, of which 2,315 were owner households. Of the total households, 41.5% were in Seoul.

The survey contains 99 variables for each household pertaining to household characteristics, income, savings, total expenditure, expenditure on housing, dwelling unit characteristics, infrastructure, and desired housing characteristics.

Due to the use of the 1975 sample frame, the survey might not have captured some areas where rapid growth has taken place since 1975. In particular, a rapid increase in apartment units in the latter half of the 1970s (as occurred) might have resulted in some undersampling of such units.

Philippines: Davao. The 1979 Davao household survey was conducted by the Davao Action Information Center, a non-profit foundation directed by Professor Robert A. Hackenberg of the University of Colorado. The sample is taken from a random drawing of 4,161 households from a sampling frame derived by updating master lists of the Philippine Census. All socio-economic strata, including squatters, were represented in the sample.

Of the 4,161 original households, 3,517 were classified as renters or owners. The homeownership rate was 51 percent. Among 3,392 respondents who reported non-zero rents or assessed sale values, 1,570 households were squatting households.

Philippines: Manila. This survey of 1,688 households was conducted in 1983, under the direction of Professor Mila Reforma of the University of the Philippines, with inputs from World Bank staff and the National Housing Authority. The sample was stratified by barangay (a neighborhood designation which typically contains up to several thousand residents). One hundred fifty of Metro Manila's 1,692 barangays were chosen randomly in the first stage; then a sampling frame was constructed for each barangay, and a sample (average

about 10 units) was drawn from each. The exact number depended on the population of each barangay, so that the sample is self-weighting.

The survey questionnaire has particularly detailed information on the construction process and housing finance, in addition to the usual questions on household characteristics, income, expenditures, and housing characteristics.

United States. Pittsburgh and Phoenix (1974) were chosen as representative U.S. cities from the 59 metropolitan areas covered by the metropolitan Annual Housing Survey (AHS), which was carried out by the U.S. Bureau of the Census for the Department of Housing and Urban Development. Pittsburgh is an older, "slow growth" metropolitan area with a declining industrial base; Phoenix is a fast growing "sunbelt" city.

Each metropolitan sample comprises about 5,000 households. The sampling scheme is a stratified cluster design which is rather complex, but described in U.S. Bureau of the Census (various issues). The samples for these cities are roughly self-weighting, although the cluster sampling leads to some unknown bias in the usual estimates of variances.

The survey has quite good data on housing characteristics (except for location), and some data on household incomes. The AHS has undergone numerous changes since the 1974-75 round of sampling, and current surveys, when publicly available, will have more detailed information on housing finance.

2. Macro Data Sources

Many of the city level variables are constructed from the household survey data, and these are obvious from the context. This section describes the sources of other city and country level variables, with particular emphasis on the relative price of housing.

Three candidates were considered for the relative price index: the constuction cost index developed by Annez (1981), and two indexes from the work of Kravis et al., namely a rental index and an index of the cost of residential capital. All three share an important drawback: they are only available by country, rather than by city (even finer breakdowns would be desirable, see Polinsky 1977). The Annez index and the residential capital index do not account for land, which accounts for a large share in housing production. The rental index does not account for differences in price

between tenure groups (neither do the other three), but it has the virtue of including the land and other inputs as well as capital.

The construction of the rental price index using hedonic techniques is described in detail in Kravis et al. The index was constructed as the ratio of two purchasing power parity indexes, residential rent and total GDP, from Table 6.3 of Kravis et al. The index was unavailable for Egypt, Ghana, and El Salvador so an instrument was employed for these countries. The Kravis et al. sample of countries was used to estimate the following equation:[1/]

Relative Price = 1.748
(1.088)

-.068 Log Population
(.069)

-.004 Percent Urban
(.007)

+.127 Urban Population Growth Rate
(.063)

+.044 Log GDP Per Capita
(.134)

-.180 (Exports + Imports)/GDP
(.414)

-.020 Average Temperature, Centigrade, Coldest Month
(.009)

with an adjusted R-square of .19, and 21 degrees of freedom. This yielded predicted relative prices of .88 for Egypt, .88 for El Salvador, and 1.09 for Ghana.

Sources of other variables include the following:

Population, percent urban GNP per capita, exports, imports: World Bank, World Development Report, various issues.

1/ Standard errors in parentheses. Several socialist countries were found to be outliers and were dropped from the sample.

Climate: Average temperature over 5 years, coldest month, from Clayton and Clayton (1947). In some cases, the nearest city with recorded temperatures was used.

Urbanization rates: Dillinger (1979).

Exchange rates: International Monetary Fund, International Financial Statistics, various issues. The single exception was Ghana. During the sample period the Ghanaian cedi was so grossly overvalued that we used a conservative unofficial estimate of the exchange rate, 22 cedis to the dollar.

DATA APPENDIX
CITY LEVEL DATA

COUNTRY	CITY	POPULATION	RELATIVE RENT INDEX	AVERAGE INCOME	RENTER R TO Y AT AVERAGE CITY INCOME	OWNER R TO Y AT AVERAGE CITY INCOME	HOME OWNERSHIP RATE	AVG. ANNUAL CPI CHANGE OVER 5 YRS.	LOCAL CPI CHANGE TO 1981	EXCHANGE RATE (1981)
COLOMBIA										
	BOGOTA	3.440	1.16	320	0.18	0.20	45	23.5	2.01	59.00
	CALI	1.100	1.16	259	0.19	0.17	50	23.5	2.01	59.00
EGYPT										
	BENI SUEF	0.300	0.88	74	0.09	0.18	71	12.9	1.00	0.70
	CAIRO	5.890	0.88	104	0.07	0.10	31	12.9	1.00	0.70
EL SALVADOR										
	SANTA ANA	0.110	0.88	188	0.08	0.10	56	13.0	1.15	2.50
	SONSONATE	0.038	0.88	167	0.08	0.24	25	13.0	1.15	2.50
GHANA										
	KUMASI	0.590	1.09	79	0.03	.	32	68.4	2.16	22.00
INDIA										
	BANGALORE	2.700	0.41	81	0.10	0.25	17	13.2	1.50	9.10
JAMAICA										
	KINGSTON	0.600	1.29	502	0.27	.	11	13.8	3.05	1.78
KOREA										
	BUSAN	3.160	1.63	416	0.16	0.41	36	16.6	1.56	700.5
	KWANGJU	0.730	1.63	375	0.21	0.66	35	16.6	1.56	700.5
	OTH. K. C.	.	1.63	323	0.16	0.41	42	16.6	1.56	700.5
	SEOUL	8.370	1.63	469	0.22	0.40	39	16.6	1.56	700.5
	TAEGU	1.610	1.63	349	0.18	0.50	33	16.6	1.56	700.5
PHILIPPINES										
	DAVAO	2.160	0.59	142	0.08	0.04	59	9.6	1.32	8.20
	MANILA	6.000	0.59	432	0.09	0.27	56	12.7	0.79	8.20
U.S.										
	PHOENIX	1.240	1.00	1972	0.15	0.17	71	6.7	1.69	1.00
	PITTSBURGH	2.330	1.00	1845	0.10	0.14	72	6.7	1.69	1.00

NOTES:
(1) POPULATION IN MILLIONS
(2) INCOME IN 1981 U.S. DOLLARS

REFERENCES

Aaron, Henry J. Shelter and Subsidies: Who Benefits from Federal Housing Policies? Washington: The Brookings Institution, 1972.

Ando, Albert and Franco Modigliani. The Life Cycle Hypothesis of Saving: Aggregate Implications and Tests. American Economic Review, March 1963, 53, pp. 55-84.

Annez, Philippe. Housing Investment: A Cross Country Comparison. Ph.D. Thesis, Massachusetts Institute of Technology, 1981.

Annez, Philippe and William C. Wheaton. Economic Development and the Housing Sector: A Cross-National Model. Economic Development and Cultural Change, 32(4), July 1984, pp. 749-766.

Bamberger, Michael, Edgardo Gonzalez-Polio, and Umnuay Sae-Hau. Evaluation of Sites and Services Projects: The Evidence from El Salvador. World Bank Staff Working Paper No. 549, 1982.

Betancourt, Roger. Household Behavior in Chile: An Analysis of Cross-Section Data. Lluch, et al. (eds.), Patterns in Household Demand and Saving. New York: Oxford University Press, 1977. Chapter 8.

Bradbury, Katherine and Anthony Downs. Do Housing Allowances Work? Washington: The Brookings Institution, 1981.

Branson, William H. Macroeconomic Theory and Policy (Second Edition). New York: Harper and Row, 1979.

Buckley, Robert M. and Ranjana G. Madhusudhan. The Macroeconomics of Housing's Role in the Economy: An International Analysis. Paper presented to the American Real Estate and Urban Economics Association, December 1984.

Burns, Leland S. and Leo Grebler. Resource Allocation to Housing Investment: A Comparative International Study. Economic Development and Cultural Change, 25(1), October 1976, pp. 95-121.

Clayton, H. Helm and Frances L. Clayton. World Weather Records. Washington: The Smithsonian Institution, 1947.

de Leeuw, Frank. The Demand for Housing: A Review of Cross Section Evidence. Review of Economics and Statistics. February 1971, 53(1), pp. 1-10.

de Leeuw, Frank, and Larry Ozanne. Housing, in H. Aaron and J. Pechman, eds., How Taxes Affect Economic Behavior. Washington: The Brookings Institution, 1981.

Diamond, Douglas B., Jr. A Note on Inflation and Relative Tenure Prices. Journal of the American Real Estate and Urban Economics Association, 6, 1978, pp. 438-450.

Dillinger, William. A National Urban Pattern Data File for 114 Countries. Urban and Regional Report No. 79-5, The World Bank, September 1979.

Doebele, William. Selected Issues in Urban Land Tenure. In H. Dunkerley (ed.), Urban Land Policy: Issues and Opportunities. New York: Oxford University Press, 1983.

Duesenberry, J. S. Income, Saving, and the Theory of Consumer Behavior. Cambridge: Harvard University Press, 1949.

Falke, Caj. Growth of Effective Demand for Housing in the Federal Territory 1975-80. Urban Development Authority, Kuala Lumpur. Mimeographed, May 1976.

Fallis, George and Lawrence B. Smith. Uncontrolled Prices in a Controlled Market: The Case of Rent Controls. American Economic Review, 74(1), March 1984, pp. 193-200.

Follain, James R., Jr. Does Inflation Affect Real Behavior: The Case of Housing. Southern Economic Journal, January 1982.

Follain, James and Emmanuel Jimenez. Estimating the Demand for Housing Characteristics: A Survey and Critique. Regional Science and Urban Economics (forthcoming, a).

Follain, James and Emmanuel Jimenez. The Demand for Housing Characteristics in Developing Countries. Urban Studies (forthcoming, b).

Follain, James and Stephen Malpezzi. Dissecting Housing Value and Rent: Estimates of Hedonic Indexes for Thirty-Nine Large SMSAs. Washington, D.C.: The Urban Institute, 1980.

Follain, James and Stephen Malpezzi. Are Occupants Accurate Appraisers? Review of Public Data Use, 9, June 1981, pp. 47-55.

Follain, James, Gill-Chin Lim and Bertrand Renaud. The Demand for Housing in Developing Countries: The Case of Korea. Journal of Urban Economics, 7(3), May 1980, pp. 315-336.

Freeman, A. Myrick. The Benefits of Environmental Improvement: Theory and Practice. Resources for the Future, 1979.

Friedman, Joseph and Daniel Weinberg. The Great Housing Experiment. Sage Publications, 1983.

Friedman, Joseph, Emmanuel Jimenez, and Stephen K. Mayo. The Demand for Secure Tenure in Developing Country Cities. Mimeographed, 1985.

Friedman, Milton. A Theory of the Consumption Function. Princeton, N. J.: Princeton University Press, 1957.

Furubotn, Eirik G. and Svetozar Pejovich. Property Rights and Economic Theory: A Survey of Recent Literature. Journal of Economic Literature, June 1975.

Gilbert, Alan. The Tenants of Self-Help Housing: Choice and Constraint in the Housing Markets of Less Developed Countries. Development and Change, 14, 1983, pp. 449-477.

Grimes, Orville F., Jr. Housing for Low-Income Urban Families: Economics and Policy in the Developing World. Washington: The World Bank, 1976.

Gross, David J. Designing a Suitable Housing Project: Integration of a Demand Module into a Supply Side Planning Model. Presented at the 31st Annual Meetings of the Regional Science Association, November 1984.

Hamer, Andrew. Households and Housing: Residential Mobility, Tenure Choice, and Space Consumption in the Developing Metropolis. World Bank Urban and Regional Report No. 80-20, December 1981.

Hanushek, Eric and John Quigley. An Explicit Model of Intra-Metropolitan Mobility. Land Economics, November 1978, pp. 411-29.

Hausman, Jerry A. Exact Consumer's Surplus and Deadweight Loss. American Economic Review, (71:4), September 1981, pp. 662-675.

Hirsch, Werner Z. Law and Economics: An Introductory Analysis. New York: Academic Press, 1979.

Howe, Howard and Philip Musgrove. An Analysis of ECIEL Household Budget Data for Bogota, Caracas, Guayaquil, and Lima. Lluch, et al. (eds.), Patterns in Household Demand and Saving. New York: Oxford University Press, 1977.

Howenstine, E. Jay. Appraising the Role of Housing in Economic Development. International Labor Review, 75, January 1957.

Hoy, Michael and Emmanuel Jimenez. Analytical Issues in Urban Land Tenure in Developing Countries. Mimeographed, 1984.

Ihlanfeldt, Keith Ray. An Empirical Investigation of Alternative Approaches to Estimating the Equilibrium Demand for Housing. Journal of Urban Economics, 9, 1981, pp. 97-105.

Ingram, Gregory. Housing Demand in the Developing Metropolis: Estimates from Bogota and Cali, Colombia. World Bank Staff Working Paper No. 663, 1984.

Jimenez, Emmanuel. The Economics of Self-Help Housing: Theory and Some Evidence from a Developing Country. Journal of Urban Economics, 11, 1982, pp. 205-228.

Jimenez, Emmanuel. Tenure Security and Urban Squatting. Review of Economics and Statistics, 66(4), November 1984, pp. 556-567.

Jimenez, Emmanuel. Urban Squatting and Community Organization in Developing Countries. Journal of Public Economics (forthcoming).

Jimenez, Emmanuel, and Douglas Keare. Housing Consumption and Permanent Income in Developing Countries: Estimates from Panel Data in El Salvador. Journal of Urban Economics, 15, 1984, pp. 172-194.

Keare, Douglas and Emmanuel Jimenez. Progressive Development and Affordability in the Design of Urban Shelter Projects. World Bank Staff Working Paper No. 560, 1983.

Korea Research Institute for Human Settlements. Interim Report on Housing Policy Development Research. Seoul, Korea, 1982.

Kravis, Irving B., Alan Heston, and Robert Summers. World Product and Income: International Comparisons of Real Gross Product. Baltimore: Johns Hopkins University Press, 1982.

Kuznets, Simon. Quantitative Aspects of the Economic Growth of Nations. VI. Long-Term Trends in Capital Formation Proportions. Economic Development and Cultural Change, 9(4), July 1961.

Lee, Lung-fei and Robert Trost. Estimation of Some Limited Dependent Variable Models with Application to Housing Demand. Journal of Econometrics. December 1978, pp. 357-382.

Lim, Gill-Chin, James Follain and Bertrand Renaud. Determinants of Homeownership in a Developing Economy: The Case of Korea. Urban Studies, 17, 1980, pp. 13-23.

Linneman, Peter. The Demand for Residence Site Characteristics. Journal of Urban Economics, 1981.

Lluch, Constantino, Alan Powell, and Ross Williams. Patterns in Household Demand and Saving. Oxford University Press, 1977.

Malpezzi, Stephen. Rent Control and Housing Market Equilibrium: Theory and Evidence from Cairo, Egypt. Mimeographed, 1984 (a).

Malpezzi, Stephen. Economic Analysis of Alternative Rent Control Policies, With an Application to Cairo, Egypt. Presented at the 31st Annual Meetings of the Regional Science Association, November 1984 (b).

Malpezzi, Stephen. Rent Controls: An International Comparison. Paper presented to the American Real Estate and Urban Economics Association, December 1984 (c).

Mayo, Stephen K. Housing Expenditures Under a Percent of Rent Housing Allowance. Abt Associates, 1977.

Mayo, Stephen K. Theory and Estimation in the Economics of Housing Demand. Journal of Urban Economics, July 1981, 10(1), pp. 95-116.

Mayo, Stephen K. and David J. Gross. Applications of Housing Demand Research to Project Design and Economic Analysis. Mimeographed, 1985.

Mayo, Stephen K. and others. Informal Housing in Egypt. Abt Associates, 1982.

Mayo, Stephen K., with Stephen Malpezzi and Sungyong Kang. Housing Demand in Developing Countries. World Bank, Water Supply and Urban Development Department. Mimeographed 1983.

Mayo, Stephen K., Raymond Struyk, and Margery Austin Turner. Housing Finance and Household Behavior in Devloping Countries. Paper presented to the American Real Estate and Urban Economics Association, December 1984.

Mayo, Stephen K., Shirley Mansfield, David Warner and Richard Zwetchkenbaum. Housing Allowances and Other Rental Housing Assistance Programs--A Comparison Based on the Housing Allowance Demand Experiment, Part 1: Participation, Housing Consumption, Location, and Satisfaction. Abt Associates, 1980.

Mieszkowski, Peter and Mahlon Straszheim (eds.). Current Issues in Urban Economics. Baltimore: Johns Hopkins University Press, 1979.

Muth, Richard. The Demand for Non-Farm Housing. The Demand for Durable Goods, ed. by Arnold Harberger. University of Chicago Press, 1960.

Muth, Richard. The Derived Demand for Urban Residential Land. Urban Studies, 1971.

Olsen, Edgar and David Barton. The Benefits and Costs of Public Housing in New York City. Journal of Public Economics, 20(3), April 1983, pp. 299-332.

Ozanne, Larry and Stephen Malpezzi. The Efficacy of Hedonic Estimation with the Annual Housing Survey: Evidence from the Demand Experiment. Mimeographed, 1985.

Phlips, Louis. Applied Consumption Analysis. North Holland, 1974.

Polinsky, A. M. The Demand for Housing: A Study in Specification and Grouping. Econometrica, 42, March 1977, pp. 447-61.

Pollak, Robert and Terence Wales. Demographic Variables in Demand Analysis. Econometrica, 49(6), November 1981, pp. 1533-1551.

Quigley, John. What Have We Learned About Urban Housing Markets? in Mieszkowski and Straszheim (eds.), Current Issues in Urban Economics. Baltimore: Johns Hopkins University Press, 1979, pp.391-429.

Quigley, John. Nonlinear Budget Constraints and Consumer Demand: An Application to Public Programs for Residential Housing. Journal of Urban Economics, 12, 1982, pp. 177-201.

Rao, Potluri and Roger Miller. Applied Econometrics. Belmont, California: Wadsworth Press, 1971.

Renaud, Bertrand. Resource Allocation to Housing Investment: Comments and Further Results. Economic Development and Cultural Change, 28(2), January 1980, pp. 389-99.

Renaud, Bertrand. Housing and Financial Institutions in Developing Countries. World Bank Staff Working Paper No. 658, 1984.

Rosen, Harvey. Housing Decisions and the U.S. Income Tax: An Econometric Analysis. Journal of Public Economics, 11, February 1979, pp. 1-23.

Rosen, Sherwin. Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition. Journal of Political Economy, January 1974.

Shefer, Daniel. The Demand for Housing and Housing Characteristics in Indonesia. Center for Urban and Regional Studies, Technion (Haifa, Israel). Mimeographed 1983.

Strassmann, W. Paul. The Construction Sector in Economic Development. Scottish Journal of Political Economy, (17), 1970.

Strassmann, W. Paul. Housing Improvement in an Opportune Setting: Cartagena, Colombia. Land Economics, May 1980.

Straszheim, Mahlon. An Econometric Analysis of the Urban Housing Market. New York: National Bureau of Economic Research, 1975.

Struyk, Raymond and Margery Austin Turner. Housing Finance and Housing Quality in the Philippines and Korea. Working Paper No. 3401-02. The Urban Institute, Washington, D. C., January 1985.

The Urban Edge. Rental Housing: A Rediscovered Priority. Vol. 8, No. 2, February 1984.

U.S. Bureau of the Census, Annual Housing Survey: 1974 (various issues).

Villani, Kevin. The Tax Subsidy to Housing in an Inflationary Environment: Implications for After-Tax Housing Cost. C. F. Sirmans, ed., Research in Real Estate (Greenwich, Connecticut: JAI Press), 1981.

Weicher, John. Urban Housing Policy, in Mieszkowski and Straszheim (eds.), Current Issues in Urban Economics. Baltimore: Johns Hopkins University Press, 1979, pp. 469-508.

Weicher, John and David Hartzell. Transactions in New and Existing Homes. Urban Institute Contract Report 1291-2, 1980.

Weinberg, Daniel, Joseph Friedman, and Stephen Mayo. Intraurban Residential Mobility: The Role of Transactions Costs, Market Imperfections, and Household Disequilibrium. Journal of Urban Economics, 9(3), 1981, pp. 332-348.

The World Bank. World Development Report (various years).

Yotopoulos, Pan A. and Jeffery B. Nugent. Economics of Development: Empirical Investigations. New York: Harper and Row, 1976.

The World Bank

Headquarters
1818 H Street, N.W.
Washington, D.C. 20433, U.S.A.

Telephone: (202) 477-1234
Telex: WUI 64145 WORLDBANK
RCA 248423 WORLDBK
Cable Address: *INTBAFRAD*
WASHINGTONDC

European Office
66, avenue d'Iéna
75116 Paris, France

Telephone: (1) 723-54.21
Telex: 842-620628

Tokyo Office
Kokusai Building
1-1 Marunouchi 3-chome
Chiyoda-ku, Tokyo 100, Japan

Telephone: (03) 214-5001
Telex: 781-26838

I[illegible]5/ISBN 0-8213-0539-5