level equations discussed above. The income variables are based on the city averages. Incomes and rents are converted to 1981 US dollars by using local CPI and official 1981 exchange rates. Price, and its logarithm, are constructed from the rental price series devised by Kravis et al. (1982).

M&M estimate several variants of this model. 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 the M&M sample, which is dominated by developing countries, it does not appear that owners have higher long-run responsiveness to changes in incomes and prices; if anything, the reverse to 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, 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.

Further evidence on the cross-country price and income elasticities of demand for housing is provided by the UN. International Comparisons Project (ICP, see Kravis et al., 1982). 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. 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). Kravis et al. found demand to be slightly inelastic with respect to price, and slightly elastic with respect to income demand.

2.3. Housing supply

In this section, we will examine aggregate descriptive supply (e.g., Burns and Grebler, 1976, 1977; and related work by Renaud, 1980; Chang and Linneman, 1990; Buckley and Madhusudan, 1984). We also examine certain behavioral evidence on aggregate supply elasticities, and their determinants using data from Korea, Thailand and Malaysia. Finally, we examine supply from the existing stock and filtering (Ferchiou, 1982).

2.3.1. *Early cross-country research*

Several previous studies have documented cross-country differences in housing investment, notably Howenstine (1957), Kuznets (1961), Burns and Grebler (1976), Strassman (1977), 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 (1976, 1977), the extensions of their model by Renaud (1980) and Buckley and Madhusudhan (1984), the shelter results of the UN's ICP reported in Kravis et al. (1982), and the model of Annez and Wheaton (1984).

Burns and Grebler's (1976, 1977) 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 $1600 per capita GDP (1970 US dollars). Furthermore, 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 measured with apparently reasonable precision.

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. Presumably there is a direct cross-country relationship between housing investment and consumption, since housing investment is a derived demand. Formal models of the relationship between housing demand and investment could be undertaken in the future, to make the link more precise.

Studies by Renaud (1980) and Buckley and Madhusudhan (1984) have shown the Burns and Grebler (1976, 1977) 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. 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 (1984) 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. 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).

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. Because of data problems, Burns and Grebler (1976, 1977), 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 because there is no explicit behavioral model used to justify the estimating equations.

Annez and Wheaton (1984) 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 (1976, 1977) 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 (1984) assembled data from 24 nonsocialist 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. 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, 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.

2.3.2. Market wide effects on supply

To examine links between the microanalysis of incentives above and aggregate outcomes, M&M (1997a) investigated the aggregate supply of housing in Malaysia, and compared these results to those in two other rapidly growing Asian countries, Korea and Thailand. Generally, Korea has a highly restrictive regulatory framework, especially with respect to land use, redevelopment and finance (Kim K.-H., 1990a, b, 1993; Hannah et al., 1993; Greenet al., 1994). Thailand has a liberal regulatory environment (Angel and Chuated, 1990; Dowall, 1989a, 1991c). The US has a generally liberal regulatory environment (albeit with restrictive environments in selected metropolitan areas, see Malpezzi, 1995b). Thus, M&M (1997a) expected price elasticities of supply to be low in Malaysia and Korea, and high in Thailand and the US.

In all three countries, income per capita grew substantially over the period. M&M (1997a) documented that the relative asset price of housing grew substantially over time in Malaysia and Korea, but not in Thailand. This is consistent with the prior that aggregate supply would be inelastic in the first two countries and elastic in the third. M&M's formal test is based on a simple three-equation supply and demand model, using prior information on demand elasticities to identify the price elasticity of supply from the reduced form coefficients. M&M calculate this elasticity for a range of assumptions, assuming the price elasticity of housing demand to lie in the interval -0.5 and -1, and following M&M (1987), assuming the long-run income elasticity of demand to be alternately 1.0 and 1.5.[8]

The calculated housing supply elasticities are presented in Table 2. For comparison, supply elasticity estimates for the US based on a similar reduced form estimation procedure using Malpezzi and Maclennan's (1996) results for the US are also provided in Table 2. Again results are as expected. In general, Malaysia and Korea have inelastic supply curves for housing, and Thailand and the US have elastic supply.

Certainly additional research could be undertaken along these lines. M&M use a limited dataset (annual data for three developing countries from 1970 to 1986, and some US data). Analysis of additional countries would be straightforward, given the data. Longer time series would permit examining hypotheses about (e.g.) properties of the errors over time, and coefficient stability. Malpezzi

[8] As noted above, M&M (1987) estimated cross-sectional elasticities within markets, and long-run elasticities across markets. Since we are examining long-run phenomena, M&M (1997) used the latter results.

Table 2

Estimated price elasticity of supply, four countries

	Long-run income demand elasticity = 1.0		Long-run income demand elasticity = 1.5	
	Price elasticity of demand=-0.5	Price elasticity of demand = −1.0	Price elasticity of demand = −0.5	Price elasticity of demand = −1.0
Restrictive regulatory environments				
Malaysia	0.07	0[a]	0.35	0[a]
Korea	0[a]	0[a]	0.17	0[a]
Liberal regulatory environments				
Thailand	∞[b]	∞[b]	∞[b]	∞[b]
US	13.09	12.59	19.88	19.38

[a] Point estimate of price elasticity was negative, market deemed inelastic (see text).
[b] Point estimate of γ_1 was negative, market deemed elastic (see text).
US estimates constructed using results from Malpezzi and Maclennan (1994), others from Table 1.
For discussion of bounds on income and price elasticities of demand see Malpezzi and Mayo (1987).

and Maclennan (1996) demonstrated that results from such models can be sensitive to time period chosen. Other fruitful extensions would be to develop a stock adjustment model and to disaggregate such analysis by region or metropolitan area.

2.3.3. Supply from the existing stock of housing

Another under researched area is housing from the existing stock. Other than the few studies surveyed in Ferchiou (1982) and Johnson (1987), very little has been done on filtering and other changes in utilization of the existing stock. There is a useful literature on upgrading, for example, Jimenez (1982). Analysis of the utilization of the existing stock is particularly important in understanding rental markets, as will be discussed below.

In common parlance, as units "filter down", they pass from richer households (owners or tenants) to lower income households. Units can also "filter up", i.e., pass from poor to richer households, if a neighborhood is undergoing "revitalization" or "gentrification". Actually there are at least three different definitions of filtering: (1) change in the income of households living in the unit; (2) changes in price per unit of housing services from a unit; and (3) changes in quantity of housing services from a unit. Green and Malpezzi (1997) elaborate and provide further references.

Most studies of developing country /transition economy filtering fall into categories (1) or (3). Most such studies actually *labelled* filtering are chains of move

studies related to filtering concept (1). A number of studies have been done on the upgrading process, which is clearly central to (3), although incomplete. Studies of the relative price of housing at different quality levels (2) are are rare in general and almost unkown in developing/transition economies.

Ferchiou (1982) examines data from Tunisia and Mexico, looking at chains of moves, following Lansing et al. (1969) methodology. Generally Ferchiou finds these chains are of limited duration; he finds that a little over two families take part in a chain of moves before it terminates. Ferchiou notes that this is probably a lower bound estimate, partly because of the limited size of the study area. He also notes that construction of more expensive units initiate longer chains.

Hegedus and Tosics (1991) undertake a similar study for Hungary. Generally, they find short chains, usually less than two moves on average. They find little systematic difference by location or by state/private construction. A conjecture (by this author) is that the shortness of these chains may unsurprising give the shifts in employment and population and repressed demand for housing in formerly socialist Hungary.

Several studies examine filtering using some version of the so-called "stock-user matrix" (Strassman, 1977). These basically cross-tabulate households by income category and dwellings by value or rent. A number of these studies are surveyed by Johnson (1985). Baer and Koo (1994) examine Korea.

2.3.4. Housing upgrading

A number of papers have investigated the determinants of upgrading behavior in developing countries. Struyk and Lynn (1983) estimate several simple reduced form linear probability models for upgrading squatter housing in Manila's Tondo Foreshore area. Generally, increases in income are associated with higher probabilities of upgrading, and (dichotomously measured) improvement of tenure security increases the probability of upgrading by 0.12–0.27 depending on the model. Increasing income by a standard deviation increases the probability of upgrading by about 0.04.

Struyk (1982) presents a simple reduced form model estimated using metropolitan level data from Korea in the late 1970s. The dependent variable used as a proxy for upgrading behavior is the percentage change in average floor area in the housing stock built prior to the baseline period. Struyk's simple reduced form has a series of variables reflecting the cost of upgrading (proxied by shared units in detached dwellings and population density), and a larger set of variables proxying the potential return on expansion: crowding in the baseline year, growth in households, demolitions, the extent of new construction and conversion, and change in household size.

Generally Struyk (1982) found that the variables reflecting potential return had the expected sign and were significant, but the cost of proxies (such as type or density) were generally not significant. One variable, the extent of new construction, was significant but of the wrong sign; that is high rates of new construction were associated with greater upgrading of the existing stock. Struyk notes that this is consistent with a world in which regulatory and financial constraints impede new construction as an adjustment mechanism, so that in active markets new construction is insufficient to meet demand, and upgrading is a gross complement to new construction rather than a gross substitute for it. The crowding variables work particularly well; for example, a 10% increase in an initial crowding measure is associated with about a 10% increase for upgraded area. Elasticity of average floor area to households is 0.5 and of household size is about 1.5.

Strassman (1980b) presents another upgrading study using data from Cartagena, Columbia. Strassman's paper contains several related analyses. To begin, he assumes a cross-section unitary income elasticity and sets up what is referred to in the literature as a stock-user matrix. That is, households are arrayed by rows where income doubles in each row, and dwellings are arrayed in columns, where the value of the unit doubles in each column. If the elasticity were truly unity and if there were no households out of equilibrium, cells along the diagonal would contain most households matched in corresponding housing units. Unsurprisingly, Strassman found large numbers of households off the diagonal elements. This is consistent with M&M's findings discussed at length above that these elasticities are much lower than 1.

Strassman (1980b) also undertook a simple logit tenure choice model that was based on an ad hoc reduced form of the presence or absence of pipe water and sewage; whether relatives were forwarding remittances, household size, age of household add-in income from sales of property. As in much of the developing country literature, no measure of relative tenure prices was available. Strassman implicitly argues that the availability of infrastructure (water and sewer) is largely exogenous. He finds that the probability of owning is negatively associated with the presence of piped water but positively associated with sewage. He interprets this as evidence that "rather than build an owner a waterless shack on land reclaimed from a marsh, those who can afford it will rent a house or apartment with plumbing". While Strassman does not draw this out further, he seems to be suggesting that very low income households will be owners, albeit of units with little in the way of housing quality or property rights; as their income rise they move first into the formal rental sector, and finally into the formal homeowner sector with infrastructure and utilities. We will return to this hypothesis

later. Daniere (1992) and Malpezzi (1986) also find a nonmonatonic relationship between tenure and income.

Other upgrading studies of note include Rakodi (1987).

2.4. *Tenure choice, tenure security and mobility*

This section is closely related to the discussions of property rights and housing demand from above. We will examine forms of housing tenure, the value of tenure (Jimenez, 1982; Hoy and Jimenez, 1991), and tenure choice (Lim et al., 1980; Tipple and Willis, 1992; Strassman, 1982; Zorn, 1988). Having examined one method of changing consumption, upgrading, we examine the other—moving (Strassman, 1991; Zorn, 1988).

2.4.1. *Forms of tenure*

In much of this review, as in much of the housing market literature in both developed and developing countries, households are classified as either homeowners and renters. As always there is a tradeoff between simplicity and analytical tractability, and realism. Whether, or not, such a gross simplification is sensible depends on the purpose at hand.

There are many elements to consider in tenure as implied by our property rights discussion above. Households can own or rent structures and/or land. Usage rights can be fee simple or leased for short or long terms. Households may or may not hold title or customary rights over adjacent property and common space; they may rent from relatives or the government as well as private landlords. Long-term tenants may be treated differently from recent movers, rent may be paid in cash or in kind, periodically or in a lump sum, or some combination of the two. Lump sum payments may or may not be returned, with or without interest, on leaving the unit. Tenants may or may not receive utilities, maintenance and other services as part of the package. Tenants from family or kinship groups may have different rights than strangers. There are a thousand kinds of informal tenure if there is one.

The above list is confusing but by no means exhaustive. A number of schemes can be suggested to try to categorize tenure forms, or put them in a spectrum. Anglo-American lawyers refer to a "bundle of sticks", that is, that any property right can be broken down into component rights. Particular tenures in particular places can be described in terms of the property rights they comprise. This can facilitate comparison and even ranking. Malpezzi (1992) presents a few simple examples of how such an index of tenure rights can be constructed. Unfortu-