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Welfare analysis of rent control with side payments: a natural experiment in Cairo, Egypt[1]

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Abstract

Anecdotal evidence suggests that bribery is a common means of obtaining rent controlled apartments. Increased tenant maintenance is a less often noted, but potentially important, phenomenon in controlled markets. Previous empirical studies of the effects of rent control have neglected these side payments, presumably for lack of data. This paper presents evidence on their size and incidence for the controlled market of Cairo, Egypt, as well as estimates of effects such side payments have on welfare gains and losses from controls.

Keywords: Rent control; Bribery; Side payments; Egypt

1. Introduction

Anecdotal evidence suggests that bribery is a common means of obtaining rent controlled apartments. Increased tenant maintenance is a less often noted, but potentially important, phenomenon associated with controls. Previous empirical studies of the effects of rent control have neglected these side payments, presumably for lack of data. Cairo, Egypt is a market with enforced controls on monthly rent, but where side payments, including key money, are often paid. Cairo can thus be viewed as a ''natural experiment'' for the study of controls in general

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and the effects of side payments in particular. This study uses a model developed by Schwab (1985) to estimate the effects such side payments have on welfare gains and losses from controls, and is to my knowledge the only study to include key money and other side payments in such estimation.[2]

Cairo is, of course, the capital and largest city of the Arab Republic of Egypt. About 10 million of Egypt's total population of over 50 million live in the metropolitan area. Moreover, Cairo's population is increasing rapidly, although the rate of increase is declining. Since 1970 Cairo's population has been growing at about 2 to 2.5% per annum, down from 4% in the 1950s.

Rent control was introduced in Cairo in 1944. Controls were applied only to houses built before 1944, in order to avoid discouraging housing production. Major changes in the law took place gradually between the start of the Egyptian revolution in 1952, and 1965. During this period rent controls were extended to cover newer units, and rents set previously were further reduced, until by 1962 controls were extended to new construction as well as the existing stock.

In the late 1970s, legal rents per annum were set at 8% of the assessed value of the land, plus 5% of the assessed construction cost of the structure. Actual costs were used for new units, and estimated construction costs for units built before that date. Just before the primary data collection for this study was completed in 1981, a new housing law was promulgated.[3] The law fixed the legal rate of return at 7% of the combined value of the land and cost of construction of the structure. Luxury and furnished units are exempt from controls, but the number of such units is strictly controlled, so rents for these units exceed their production costs. In practice, furnished (and therefore uncontrolled) units are rented mainly to foreigners.

There are provisions that if a landlord undertakes a major renovation or upgrading (the definition of ''major'' is unclear) then the rents are reassessed at the current cost of construction. A unit built 10 years ago has its rental value determined by construction costs 10 years ago, so clearly there is an incentive to upgrade units in order to have the rent reset. Other key provisions include the following. Rental tenure in Cairo is far more secure than in many other controlled markets. The only legal reasons for eviction are: (1) if the tenant converts the unit to non-residential use without the owner's permission (2) if the tenant sublets without permission (3) if the tenant fails to pay the controlled rent for 15 days after it is due (4) if the building collapses.

Clearly, renters in Cairo receive a much greater property right than simply renting the unit. In fact, the right of tenure can be passed onto heirs. The nature of

[2]Hardman (1987) independently analyzed some effects of side payments in Cairo but did not directly estimate changes in landlord and tenant welfare as did this study. Her study is discussed briefly in Malpezzi and Ball (1991). Malpezzi (1986), (1993) and other papers contained in this volume review the literature on rent controls, so we will not review much literature here.

[3]A translation of the law can be found in Mayo et al. (1982).

this tenure right, or from another point of view an easement on the property rights of owners, has been implicitly recognized by the 1981 Housing Law. Article 9 apportions the responsibility for maintenance and upkeep between landlord and tenant as follows. For a unit built before 1965, the tenant pays two-thirds of the maintenance and repair costs, and landlords are responsible for the remainder. For units built between 1965 and 1977, costs are split evenly between landlord and tenant. For units built after 1977, the landlord is responsible for two-thirds, the tenant one-third. Such an apportionment may be viewed as an implicit recognition of the easement provided by the rent control law.

A key institutional feature of the Cairo housing market not found in the housing laws is the system of key money payments to landlords. Since official rents are below the long-run cost of capital for housing, landlords demand and receive additional side payments before permitting occupancy. Key money takes the form of an up-front payment, because once the tenant has moved in, the landlord has no legal recourse to compel the tenant to pay a monthly payment in addition to the official rent.

2. Housing tenure and consumption

Cairo is primarily a rental market. Almost two-thirds of the households rent in the private market, and another 7% rent public units or participate in government rental subsidy programs. Of the 63% of Cairo's population that rent in the private market, a third rent in the formal market, two-thirds in the informal market. Informal units are those built in violation of housing codes, land use regulations, or without building permits. In Cairo squatting is practically unknown; being in the informal sector does not entail living on public or private land without permission from the authorities or from the owner. In fact, most new construction – rental or owner occupied – is in the informal sector, and it has more than kept pace with population growth.[4]

Rents are defined as net and gross in this paper. Net rents of renters are the periodic payments directly to landlords for the services provided by the unit.[5] Gross rents for renters are monthly net rents plus side payments: utility payments,[6] flow measures of key money and upgrading expenditures,[7] and monthly repair expenditures by renters. Net rents for owners are based on an imputation procedure explained below (briefly in the text and in detail in Appendix A). Here we simply note that they are a fraction of owners' estimates of what their units would rent for

[4]See Mayo et al. (1982). They find a rental vacancy rate of 5.5% in 1981.

[5]Currency units are Egyptian pounds per month. At the time the primary data were collected (1981), the official rate was £E1 = U.S.$1.43, while the market rate was approximately one for one.

[6]Electricity, water, sanitation, gas, and trash collection.

[7]A discount rate of 1% per month is used, over an infinite time horizon.

in the furnished (and hence uncontrolled) market. A fraction of the owner's furnished rent imputation is used because we find that Cairo's rent control inflates rents in the uncontrolled sector. Gross rents for owners are adjusted imputed rents plus utility payments.

Of course there are difficulties in measuring both net and gross rents. Owner rent imputations are subject to errors which are discussed further below. Renter maintenance and upgrading expenditures are understatements of true expenditures since own labor is not included. Key money is probably understated. There is some evidence from USA data that occupants systematically underestimate periodic but variable payments like utility and repair expenditures. There is little that can be done about systematic biases but analysis of USA data shows that occupants are often surprisingly good appraisers in the aggregate (Follain and Malpezzi, 1981). That is, occupant estimates of market values of houses have high variances but are relatively unbiased. To minimize the potential impact of unusual individual errors we used order statistics where appropriate, and multivariate results from OLS were compared to results from robust estimators.[8]

Table 1 presents rent–income ratios by tenure group, using these net and gross rent measures. This table shows that there are substantial differences between median net rent–income ratios for renters and owners. These differences are considerably larger than typical differences between tenure types (Malpezzi and Mayo, 1985). The difference is much smaller for gross rents. The median gross rent–income ratio for renters is twice the net rent–income for renters.[9] Side

Table 1
Median rent–income ratios, by tenure

	Net	Gross	*N*
Formal owners	0.16	0.19	14
Informal owners	0.14	0.16	21
All owners	0.14	0.16	35
Private market renters	0.07	0.13	248
Subsidized renters	0.05	0.83	3
Public housing	0.03	0.05	20
All renters	0.06	0.12	271
Total sample	0.07	0.13	306

Source: Weighted household survey. The puzzling gross rent–income ratio for subsidized housing is not a misprint, but appears to be the result of reporting implausible data. However, these three observations will not much affect the overall medians.

[8]See Belsley et al. (1980). For compactness, few such comparisons are made in the present paper, but they are discussed in greater length in Malpezzi (1986), especially Appendix E.

[9]Note also the very low rents paid by public housing tenants. The few non-public housing subsidized tenants report anomalous values for some side payments. We drop both public and subsidized housing from our analysis sample. Welfare analysis of Egyptian public housing tenants would be a fruitful area for future work.

payments may be functioning as a partially equilibrating mechanism in the renter market. We now present a model that will allow us to test this notion more formally.

3. Theoretical basis

A standard model of the consumer postulates that a tenant maximizes utility from the consumption of housing, Q (purchased at relative price P), and the consumption of a composite commodity (whose price can be conveniently normalized at one), subject to an income constraint. However, a key feature of rent controlled markets is a set of additional constraints on the quantity of housing services. Schwab (1985) presents a model which incorporates such constraints explicitly.[10] Consider Fig. 1. At market price P_M, a consumer chooses bundle A. Suppose rent control lowers the price of housing to P_C, but that after rent controls are imposed the consumer is unable to locate a unit which enables him or her to reach their highest utility at the new price. Suppose the consumer is rationed to Q_C. Given the existence of a ration, the consumer will reach point B (in the particular case drawn, at a higher level of utility than at market rates, but lower than if supply was unconstrained at controlled prices). Point D represents an alternate consumption bundle, at the original level of utility U_0, with the same housing consumption as B. The distance BD represents the compensating surplus, or the maximum money amount that could be taken away from a household at the controlled price and rationed quantity, leaving them no worse off than before controls were imposed.[11]

Denote the level of utility attainable in the absence of rent control as U_0. The expenditure required to reach U_0 at market price P_M can be written $E(P_M, U_0)$. There is some alternative (shadow) price per unit of housing P_S and income $E(P_S, U_0)$ which would lead the household to choose D in the absence of controls. Consider Fig. 1. It can be shown that the compensating surplus BD is equivalent to:

$$E(P_M, U_0) - E(P_S, U_0) + (P_S - P_C)Q_C \tag{1}$$

Given knowledge of the expenditure function E, the indirect utility function V, controlled rents $P_C Q_C$, the market price P_M, income Y, and the controlled quantity of housing services Q_C, BD can be calculated as follows. The first term of Eq. (1), $E(P_M, U_0)$, is equal to the household's income, Y. The middle term is obtained by calculating U_0 from the indirect utility function, solving:

[10]The model which follows is due to Schwab (1985), but the exposition has been simplified along lines suggested by Edgar Olsen, in correspondence.

[11]For an elaboration of compensating surplus, and a comparison to other potential measures such as compensating variation and equivalent variation, see Freeman (1979), (pp. 34–38).

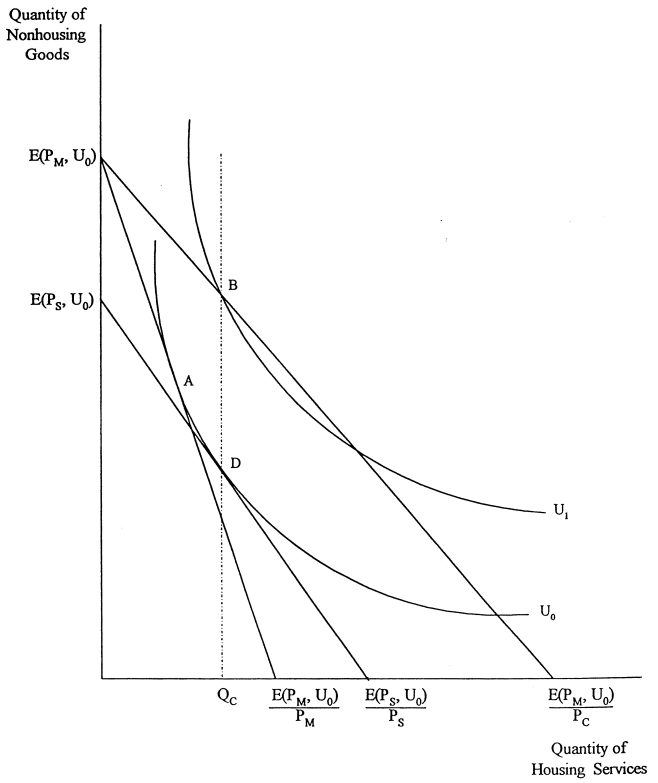

Fig. 1. The rationed consumer.

$$\frac{\partial E(P_S, V(P_M, Y))}{\partial P_S} = Q_C \tag{2}$$

for P_S, then calculating $E(P_S, U_0)$. And once P_S is calculated, the third term is straightforward arithmetic.

4. Empirical implementation

Constructing the welfare measures just described requires information on market prices in the absence of control, and market demand parameters, in addition to directly observable housing expenditures under control. We also need to know income, the indirect utility function, and the decomposition of controlled rents into P_C and Q_C. In principle we would like to compare a sample of controlled renters to an otherwise identical sample of uncontrolled renters from the same market; in

addition, we would like to maintain that the existence of controls does not affect prices or behavior in the uncontrolled submarket.

In practice things are not so simple. First, although there is an uncontrolled subsector, namely the furnished rental subsector discussed above, it is not large enough for reliable direct comparison of households in that subsector with the controlled subsector.[12] However, there are a sufficient number of imputed furnished (uncontrolled) rents from households not actually in the furnished subsector to permit estimation of market prices and expenditures. Second, as we discuss below, we find evidence that rents in this subsector are driven up by restrictions on entry. We therefore use a cross-country model of housing demand to adjust (lower) furnished rents before undertaking welfare analysis.

Once this adjustment is made, we can use an hedonic price model to estimate market prices in the absence of rent controls, and an expenditure model to estimate demand parameters. The rest of this section describes the estimation procedures and data in more detail. In this paper we present our ''best'' estimates of costs and benefits, but it should be apparent that as in all empirical work specific results depend partly upon maintained hypotheses about the nature of the uncontrolled market, demand parameters, etc. Malpezzi (1986), (pp. 129–144, 148–170, 209–236) discusses several alternative specifications and results. We will comment on robustness of results below.

4.1. Data and measurement issues

The data used are from a survey of 500 households in Cairo carried out in 1981 as a joint effort of the Egyptian Government and two consultant firms, Abt Associates and Dames and Moore. The data are described in detail in Mayo et al. (1982). Among other things, the survey collected data from each household on income, consumption, household size and other demographic variables, and housing characteristics (structure size, type, location and quality). For renters, the survey collected data on actual rents paid, as well as key money, utilities, maintenance and tenant upgrading expenditures. The survey also asked owner-occupants to estimate the rent their units could command in the furnished (uncontrolled) rental submarket.

It is important that the data used for the first stage hedonic estimation reflect market prices. The hedonic is estimated using a subsample of owner occupants, who answer questions about imputed rent. Specifically, owners are asked ''Supposing your dwelling was furnished, how much monthly rent could you get for it?'' The answer to this question is interpreted as an estimate of the rent for the unit in the uncontrolled furnished portion of the market; but with entry strictly restricted. If there were no distortions in the uncontrolled market it could also be

[12]Only two households in the Cairo sample were in the furnished subsector.

interpreted as the user cost of owners' housing capital, or what they ''spend'' in the sense of their opportunity cost, at market prices.

Malpezzi (1986) shows that this particular market rent proxy is highly correlated with expected correlates of true market rent (such as income and unit size), but also that the the price of furnished units is driven up because entry is strictly controlled. The owner occupants in our sample report that their units would rent in the furnished rental sector for 53% of their income. We estimate that these occupants would actually pay 16% of their income for this housing (see Appendix A). Since the price per unit of housing service facing owner occupants is approximately the same as the price that renters would face in the absence of rent control, we multiply the reported rents that these owner-occupied units would bring by 0.30 ($=0.16/0.53$) to obtain estimates of their rents in an uncontrolled rental market.

4.2. Estimation techniques

The actual calculation of shadow prices, costs and benefits proceeds as follows. First, measures of housing quantity and observed housing prices for each household are estimated using hedonic indexes on a sample from the uncontrolled market. Second, the parameters of the demand for housing are estimated using all households. Third, these parameters are used to calculate the welfare measures just described for a sample from the controlled market.

The hedonic for uncontrolled units can be written:

$$\ln R = X\delta + \epsilon \tag{3}$$

where R is imputed gross rent (adjusted as above), X are characteristics of the dwelling, and δ and ϵ are the hedonic regression coefficients and error term, respectively.

After the hedonic yields the implicit prices of those characteristics, those implicit prices can be used as weights to compute a composite quantity of housing services. More specifically, given the semi-logarithmic hedonic coefficient estimates, the quantity of housing services is computed by exponentiating back the prediction from the uncontrolled market hedonic for every observation. Dividing their observed rent by this measure yields an estimate of the price of a unit of housing services for that household. That is, we assume differences in rents of units with the same observed characteristics are due to price differences. The procedure is completely analogous to the more familiar time series price and quantity indexes where the hedonic coefficients are the ''base period'' prices.

After estimating the hedonic and constructing the indexes a constant elasticity demand equation can be estimated for all households as follows:

$$\ln \hat{Q} = d_0 \ln \hat{P} + d_1 \ln Y + d_2 \mathbf{Z} + \eta \tag{4}$$

where $\hat{Q}$ is the (estimated) quantity of housing services, $\hat{P}$ is the (estimated) price per unit of housing services (and $\hat{P} \equiv R/\hat{Q}$), Y is income, $\boldsymbol{Z}$ is a vector of other demand determinants (including a constant), and d_i and η are the demand parameters and a well behaved error term, respectively.[13]

The next step is to use these estimated parameters to construct welfare measures for the controlled sample. Implementing the benefit model laid out above requires some assumption about the structure of the utility function. Hausman (1981) has shown that if the demand for a good is linear in the logs, this function takes the form:

$$U = -e^{\boldsymbol{Z}d_2}\frac{P^{(1+d_0)}}{1+d_0} + \frac{Y^{(1-d_1)}}{1-d_1} \tag{5}$$

First we evaluate this expression at the uncontrolled market price to determine the level of utility attainable in the absence of rent control, U_0. Inverting this utility function yields the expenditure function:

$$E(P, U_0) = \left[(1-d_1)\left(U_0 + e^{\boldsymbol{Z}d_2}\frac{P^{1+d_0}}{1+d_0}\right)\right]^{\frac{1}{1-d_1}} \tag{6}$$

Taking the derivative with respect to price yields:

$$\frac{\partial E}{\partial P} = \left[e^{\boldsymbol{Z}d_2}\frac{1-d_1}{1+d_0}P^{(1+d_0)} + U_0(1-d_1)\right]^{\frac{d_1}{1-d_1}} e^{\boldsymbol{Z}d_2}P^{d_0} \tag{7}$$

Given U_0, the d_i, and $\boldsymbol{Z}$, the shadow price P_S is calculated by setting expression Eq. (7) equal to Q_C, and solving iteratively for P_S. Then we can construct the benefit measure Eq. (1).

5. Results

5.1. Costs and benefits

In order to test the effects of side payments, the entire empirical procedure – estimation of hedonic and demand equations, and calculation of welfare measures – is undertaken twice, once in a naive way using net rents, and once using gross rents. It happens that the hedonic and demand results do not change much except

[13]Note several strong maintained hypotheses. (1) There is assumed to be variation in price per unit of housing services even within the uncontrolled sample (e.g. by location). (2) We assume the hedonic functional form is sufficiently ''correct'' to separate price from quantity. In fact, using estimated prices biases price elasticity estimates towards zero. See Malpezzi (1986) pp. 129–138 for further discussion. (3) Other than intercept shifts captured by dummy variables, demand parameters are the same for owners and renters, recent movers and long time residents, etc. Alternative samples and specifications were estimated as discussed in Malpezzi (1986), (pp. 148–158), and results were remarkably robust.

for the intercept, which is however sufficient to change the welfare measures substantially. Both sets of hedonic and demand results are available in Malpezzi (1986). In this paper we present only the gross rent hedonic and demand results, highlighting differences from net rent results where appropriate. Then we present both sets of welfare measures.

Table 2 presents the gross rent hedonic index for Cairo owners who report the rent their unit would command on the furnished rental market. The dependent variable is 30% of that owner imputation. The rationale for such an adjustment, that restricted entry shifts the furnished sector rent up considerably, has been explained above. The numerical value of the adjustment comes from a cross country model and is explained in Appendix A. The independent variables are largely self-explanatory.

Given these coefficient estimates, the quantity of housing services is computed by exponentiating back the prediction from the hedonic for every observation.[14] Price is then straightforwardly calculated by dividing rents by this quantity index yielding a Paasche price index. The price and quantity estimates are then used in the second stage demand equation. Of course the price variable is estimated (i.e., measured with error), so the price elasticity is biased towards zero. Correlation between hedonic and demand equation errors is another possible source of bias. The reasonableness of the results in Table 3 suggests these biases are not large.

Generally, results fit with priors about housing demand from international comparisons. The log of consumption is used as a proxy for permanent income,

Table 2
Hedonic index for Cairo

Sample:	Owner occupants reporting imputed furnished rents			
Dependent variable:	Log of gross rent, adjusted (see text)			
Adjusted R^2:	0.581			
Degrees of freedom:	36			
	Coefficient	Standard error	*T*-stat	Prob$>\|T\|$
Number of rooms	0.245564	0.078665	3.122	0.0035
Number of baths	0.535930	0.317748	1.687	0.1003
Own toilet	0.479837	0.317017	1.514	0.1389
Own kitchen	0.398025	0.389209	1.023	0.3113
Structure LE 2 stories	0.411481	0.302817	1.359	0.1826
Paved road	0.380845	0.296933	1.283	0.2087
Street lights	0.470024	0.246759	1.905	0.0648
Distance from CBD	−0.059283	0.034004	−1.743	0.0898
Length of tenure	−0.005821	0.010060	−0.579	0.5665
Constant	0.838145	0.549657	1.525	0.1360

[14]With one exception – following Follain and Malpezzi (1981), the length of tenure is included to correct for bias, and it is set to zero when calculating the quantity index.

Table 3
Demand equation for Cairo

Sample:	Households reporting all required variables			
Dependent variable:	Log quantity of housing services			
Adjusted R^2:	0.317			
Degrees of freedom:	286			
	Coefficient	Standard error	T-stat	Prob$>\|T\|$
Log consumption	0.461822	0.351911	8.490	0.0001
Log price	−0.404565	0.049142	−8.233	0.0001
Length of tenure	−0.010258	0.004655	−2.204	0.0283
Age of head	0.005437	0.003350	1.623	0.1057
Household size	−0.037319	0.078800	−0.474	0.6361
HH size squared	0.001188	0.006674	0.178	0.8589
Female head	0.168805	0.105724	1.597	0.1114
Remittance dummy	0.459309	0.187192	2.454	0.0147
Owner dummy	0.197776	0.130765	1.512	0.1315
Intercept	0.519319	0.351911	1.476	0.1411

and its elasticity is generally consistent with the results surveyed in Mayo (1981) and Malpezzi and Mayo (1987). The effect of remittances from abroad are positive.[15] In their demand review, Malpezzi and Mayo have pointed out that there is less agreement in the literature on price elasticities, quite possibly due to the problems inherent in measuring price. The estimated price elasticity here, -0.4, is about in the middle of recent estimates from other countries, which range from about -0.1 to about -1.

Length of tenure and age of respondent have the only statistically discernible effects upon demand among demographic variables. Household size and sex of household head seem to make little difference. In particular, the expected effect of household size is not clear in developing countries, since it is natural to assume that consumption increases with family size, but some have hypothesized that for larger families in poor countries food consumption crowds out housing (see Malpezzi and Mayo, 1985, pp. 18–19, for more discussion of these hypotheses and evidence from several countries).

Both the hedonic and demand models estimated above were subjected to an analysis of residuals and other regression diagnostics, including identification of influential observations.[16] Robust estimators were also applied, such as Welsch (1980) bounded influence regression. Both models were found to be free from

[15]Egyptian capital markets are undeveloped. Thus, when transitory income is large and positive, the concomitant increase in savings is often in the form of incremental housing investment by the household, rather than saving in financial form.

[16]The methods largely follow Belsley et al. (1980), and results can be found in Malpezzi (1986), (pp. 221–36).

gross specification error, and were relatively robust, so only OLS results are reported here.

Many net rent results were broadly similar to gross rent results; the coefficients which changed the most are those which were measured imprecisely to begin with.[17] Income and price elasticities are quite stable, but the intercepts (and intercepts conditional on demographic variables) change between net and gross models. These differences in intercepts drive differences in welfare measures between naive net measures (side payments omitted) and gross measures (side payments included).

Table 4 presents estimates of the various welfare measures and their components, which have been explained above. All monetized variables are monthly, in Egyptian pounds, which at the time of the survey (1981), was roughly equivalent to a U.S. dollar. The first two columns are the quantity of housing services and the price of a unit of housing services, computed from the hedonic results. The next column is the implicit subsidy, defined straightforwardly as the difference between market price (normalized at one) and estimated price, times the quantity of housing services. The fourth column is the welfare cost of the ration, if

Table 4
Monthly cost–benefit measures, Cairo renters, 1981

		Quantity of housing services	Price	Implicit subsidy	Welfare cost of ration	Net benefit
Sample statistics[a]						
Based on	Q3	14.9	0.66	19.94	12.14	10.10
net rents	Med	8.2	0.38	8.24	4.78	5.76
(naive)	Q1	1.4	0.23	2.25	1.06	−0.59
	N	312	297	239	239	239
Based on	Q3	29.4	1.46	12.00	20.89	8.11
gross rents	Med	17.0	0.71	3.27	5.84	−1.04
(correct)	Q1	10.1	0.42	−3.76	1.36	−27.66
	N	312	297	237	237	237
Representative consumer[b]						
Net (naive)		8.2	0.38	5.08	0.27	4.82
Gross (correct)		17.0	0.71	4.93	0.63	4.30

[a], Notation: Q3: third quartile; Med: median; Q1: first quartile. Units: estimated equilibrium competitive price normalized at one; all other variables in Egyptian pounds. One pound was approximately one U.S. dollar in 1981 at unofficial rates. Median renter income is 85 pounds.
[b], Income, Quantity, Price set at each variable's median. For other demand determinants, use median of dot product of sample values and demand coefficients.

[17]These results, including the net rent results discussed but not presented here, are presented in full in Malpezzi (1986), (pp. 148–70).

any, to consumers. The final column is the difference between the implicit subsidy and the welfare cost of the ration, or the net benefit to renters.

In principle we can calculate each welfare measure separately for each sample observation, or we can calculate them for a ''representative consumer'' constructed using, say, medians of the components. Both approaches are found in the literature, and they do not, in general, yield the same results.[18] In particular, the rows of the result labeled ''sample statistics'' do not add up, because the sum or difference of medians (or of other statistics) is not generally the median of the sum or difference. The last few rows do add up, because they are calculated for a representative renter (using median values of housing quantity, consumption, and demand determinants).

The key result in Table 4 is the following: when net rents are used in the analysis, renters appear to pay a small fraction of market prices for housing services. The median price estimate from this incorrect or ''naive'' model is 38% of market prices; three quarters of the sample pay less than 66% of the market price. The median subsidy from these price reductions is estimated to be about 8 Egyptian pounds per month, about 9% of typical incomes. The estimated subsidy for the representative consumer is lower but still considerable (5 pounds). However, the two methods do not yield similar estimates of typical welfare costs of rations; the sample median, 4.78, considerably exceeds the aggregated estimate of 0.27. In both cases, the ration imposes a welfare cost which reduces, but does not eliminate, the overall benefit to tenants; a median of about 6 pounds, or about 5 pounds for the representative consumer.

The results are changed considerably when rents are corrected by including side payments. The median price paid is now estimated to be 71% of the market price of housing. Side payments allow landlords to recover, on average, another 33% of market prices, although there are certainly many households who pay less than market prices; for that matter, many pay more. Examine the spread of the distribution of rental prices in Table 4. The differences in interquartile ranges (IQRs) between net and gross rent results shows that prices vary much more in the gross rent sample. The IQR of price for net rents is 0.43, but for gross rents it is 1.04. The high variance in gross prices means that the median price masks large subsidies for some renters and high costs to others.

When the welfare cost of the ration and the net benefit are calculated separately for each observation, the estimates imply that the typical renter faces a ration with a welfare cost of almost 6 pounds per month; according to the sample medians, the welfare costs of the ration slightly exceeds the benefit from the subsidy. The

[18]For example, Olsen (1972) reports averages of results calculated separately for each sample observation. The average benefit is reported to be $213. If we calculate the benefit based on the reported sample averages of its components, the typical benefit is estimated to be $405. Schwab is an example of the other approach, i.e. computing averages of components then calculating the benefit. See Grunfeld and Griliches (1960) for a discussion of this type of aggregation.

median net benefit of rent control is actually a cost of about 1 pound per month, or about 1% of typical household incomes.

How robust are these results in other respects? Malpezzi (1986), (pp. 209–36) finds the results are quite robust to small changes in the data and the model, and to alternative samples (e.g. separate estimates for recent movers, corrections for selectivity bias). Key parameters such as the price and income elasticities of demand for housing are consistent with results from other countries and other methods of estimation.

Results are less than robust to changes in the estimate of the long-run equilibrium price of housing. Recall that we adjusted imputed furnished rents of owner-occupied units in line with a cross-country estimate of the equilibrium rents paid in the uncontrolled sector, using a modification of the model presented in Malpezzi and Mayo (1985), (1987). These estimates were extended to include several other countries in Malpezzi et al. (1988). That paper found predictions from alternative models to be qualitatively similar, but even the extended results are based on a limited sample and data. Given additional cross-country demand research their reliability could be much improved.[19] If the estimate overstates the true long-run owner consumption, estimated renter prices are understated, and the converse is also true.

5.2. The distribution of tenant costs and benefits

Table 5 Table 6 present simple descriptive regressions which can be used to illustrate a few points about the distribution of the subsidy and the net benefit, respectively. Visual examinations of plots suggested that logarithmic models be used to summarize these distributions. Because both subsidies and benefits are

Table 5
Distribution of rent control subsidy, Cairo renters

Sample:	Cairo renters (outliers deleted – see text)			
Dependent variable:	Log of est. market rent minus actual rent (gross), plus a scalar			
Adjusted R^2:	0.093			
Degrees of freedom:	223			
	Coefficient	Standard error	*T*-stat	Prob$>\|T\|$
Log length of tenure	0.017335	0.003402	5.095	0.0001
Log consumption	0.000020	0.004049	0.005	0.9960
Household size	−0.001307	0.001263	−1.034	0.3024
Constant	6.025903	0.019691	306.021	0.0001

[19]This can be illustrated by comparing the present results with preliminary unpublished work undertaken using a very crude cross country model (pre Malpezzi and Mayo, 1987). In that work our estimate of the market price of controlled housing was about 30% higher than our later, better estimates.

Table 6
Distribution of rent control benefit, Cairo renters

Sample:	Cairo renters (outliers deleted – see text)			
Dependent variable:	Log of estimated benefit from controls (gross), plus a scalar			
Adjusted R^2:	−0.019			
Degrees of freedom:	226			
	Coefficient	Standard error	*T*-stat	Prob>|*T*|
Log length of tenure	0.000356	0.003537	0.101	0.9200
Log consumption	0.003469	0.003787	0.652	0.5150
Household size	−0.000499	0.001312	−0.380	0.7042
Constant	7.750212	0.019347	400.597	0.0001

sometimes negative, a scalar was added to each variable before taking logs so that the minimum value for each was one (see Hu, 1972).

In both models, the original OLS results were not statistically significant, and there were a number of residual outliers and highly influential observations (see Belsley et al., 1980). The regression diagnostics and robust estimators described in Belsley et al. (1980) and Welsch (1980) were applied, and the robust estimators were judged more reliable. Tables 5 and 6 are estimates from samples without outliers.[20]

The key points are straightforward. Long-time residents receive the largest subsidies and the largest benefits; but the subsidy increases much faster with length of tenure because distortions in consumption (not reported separately here) also increase with length of tenure. These results are consistent with simple tabulations of gross rents and side payments (not reported here) which show that recent movers pay larger amounts of key money, and are more likely to pay key money, while long time tenants paid very small fractions of their incomes for shelter.

An interesting result is that there is no discernible distributive effect of subsidies or total benefits. The coefficients of the log of consumption are about zero. Finally, neither benefits nor subsidies are strongly related to household size, although there is a weak tendency for larger households to receive smaller subsidies.

5.3. Testing the hypothesis that landlords are richer than tenants

A related distributional issue is whether the implicit subsidy landlords confer

[20]Outliers were defined as observations whose own residuals were outside 1.5 interquartile ranges above and below the third and first quartiles of all residuals, respectively. See Malpezzi (1985) for discussion and details of the implementation of these models.

upon tenants in a rent controlled market equalizes the distribution of income. Few direct tests of this hypothesis are available.[21]

The owner households surveyed in Cairo were asked whether they owned only their unit or other units in the structure as well. Thus, we can divide the sample into landlords and renters. One problem is that renters who own property elsewhere are missclassified as non-landlords. This imparts a bias towards finding no difference in income between the two groups. The test is of the hypothesis that landlord and tenant income are the same, against the alternative that landlord income is greater.

Table 7 presents a summary of the results. There are 21 landlords in the sample, who report a median household consumption of 127 pounds, and 252 renters who report a median income of 87 Egyptian pounds. While the median landlord consumption is almost half again the median renter consumption, and a similar pattern holds for means, the wide variances make the test an inconclusive one. The probability of observing such a large median score under the null hypothesis is 0.117, suggesting the observed difference could be due to chance. At

Table 7
Tests of landlord versus renter incomes

Nonparametric test:	
Median renter income:	87
(Interquartile range)	(71)
Median landlord income:	127
(Interquartile range)	(94)
Test H_O: $Y_L = Y_R$, Prob$>\|Z\|$	0.117
(Nonparametric test of the null hypothesis using the median scores test, which is based on the number of observations from each sample above the combined median).	
Parametric test:	
Mean renter income	114
(Standard deviation)	(98)
Mean landlord income	137
(Standard Deviation)	(71)
Test H_O: $Y_L = Y_R$, Prob$>\|t\|$	0.295
(Parametric test of the null hypothesis using the standard analysis of variance)	

Number of renters: 252.
Number of landlords: 21.

[21] In addition to the present test, Malpezzi and Tewari (1991) present such a test for Bangalore, India, and Malpezzi et al. (1990) present such a test for Kumasi, Ghana. No such test has been performed for the United States to date. Johnson (1951) is often cited as providing evidence on this point; but as the author pointed out in his original article, the data did not permit a test of the hypothesis that landlord incomes were greater than tenant incomes. Rather, the paper presented interesting evidence that low-income households receive an important share of their incomes from rents.

a minimum, there is a lot of overlap between tenant and landlord income distributions.

6. Summary of results

Casual observation suggests that controlled units in Cairo rent for less than half of estimates of their market rent in the absence of controls. This is misleading, however. When account is taken of side payments, including key money, utilities, maintenance and repair and upgrading by tenants the discount is reduced – for the typical (median) household. And while the median price per unit of housing services differs by 29% from the estimated market price, it must be emphasized that there is a wide distribution around this median. Quite a few Cairo households do receive even larger discounts, while a few pay very high prices for housing services. These differences appear to be largely stochastic, raising questions of horizontal equity. Otherwise equal households receive quite different housing ''deals.'' Key empirical results include the following: (1) When key money and other side payments are ignored it appears that Cairo renters receive large implicit subsidies from the rent control regime, which are partly offset by welfare losses due to distortions in consumption. (2) When side payments such as key money are annualized and included in rent, the ''average'' subsidy is substantially reduced, while some distortion in consumption remains. (3) These averages mask a wide distribution of costs and benefits among tenants, which are only weakly related to socioeconomic characteristics of households. (4) Mean and median landlord incomes were higher, but the overlap in the distributions was substantial. (5) Distortions in consumption occur ''in both direction,'' i.e., some households consume much less housing than their estimated long-run equilibrium demand but others consume much more. (6) Extensive tests of the sensitivity of the results have been carried out, and the results are robust with respect to small changes in the data and model, except that they are somewhat sensitive to changes in the estimate of long-run equilibrium rents in the absence of rent controls. Improving the precision of these estimates is one important direction for future work.

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Appendix A

Adjusting Furnished Rents Using A Cross Country Model

As noted above, we use owner occupants' imputations of what their units would rent for in the furnished market as the basis of our estimates of market (uncontrolled) rents. Fallis and Smith (1984) noted generally that controls in one submarket can affect the price in related markets. In Cairo, in particular, we have a prior that rents in the furnished subsector are driven up by restrictions on entry. Taken at face value as estimates of market rents, they would thus overstate the effects of controls. We therefore use a cross-country model of housing demand to examine this hypothesis and to adjust furnished rents downward before undertaking welfare analysis.

We use a variant of the cross country housing expenditure model of Malpezzi and Mayo ((1985), (1987), hereafter M&M) as a basis for comparison and to perform the subsequent adjustment. Before proceeding further, we summarize the cross country model.

Cross Country Housing Expenditure Models

M&M began by collecting household survey data for 16 cities in 8 countries (Colombia, Egypt, El Salvador, Ghana, India, Jamaica, Korea, and the Philippines). These were used to estimate comparable housing expenditure functions for each city.

Stage 1. M&M first estimated a simple log-linear model of housing expenditures in each of the sixteen cities:

$$\ln R_{i,j,k} = a_{j,k} + b_{j,k}(\ln y_{i,j,k}) + c_{j,k}(H_{i,j,k}) + c_{j,k}(H^2_{i,j,k}) + u_{i,j,k} \qquad \text{(A.1)}$$

where R is rent or user cost; y is income; H is household size; a, b, c and d are regression coefficients, and u is an estimated disturbance. Households are indexed by subscript i, city by j and tenure (own or rent) by k. That is, separate regressions were estimated for each tenure group in each city.[22]

For renters, rent was defined as net rent, exclusive of separate utility payments. For owners, ''rent'' (user cost) was defined variously, and in order of availability, as owner imputations of net rent, hedonic estimates of net rent based on applying renter-based hedonic price equations to owners' housing characteristics, or imputed rents based on applying a fixed amortization ratio (from 1% to 1.5% per month depending on the country) to owners' estimates of housing value.

[22]It should be clear that the regression models discussed in this appendix were formulated and carried out independently from the models discussed in the body of the text.

In general the results were consistent with results from developed countries. Typical R^2 statistics were in the 0.1 to 0.3 range. The median of all renter income elasticities (one for each city) was 0.49; most clustered between 0.4 and 0.6. The median of all city specific estimates of owner income elasticities was 0.46, with most between 0.4 and 0.6. Comparing expenditure equations across countries revealed practically no systematic variation of income elasticities with country or city income level or population size, but considerable variation in dollar-adjusted intercepts, which were positively related to average city income. Rent–income ratios therefore declined systematically with income within cities, but increased with income across cities.

These relationships are shown graphically in Fig. 2 for owners in four representative cities (including Cairo).[23] The downward sloping curves represent (inelastic) within-city results;[24] the upward sloping curve represents the cross-city (elastic) result.[25] M&M explored alternative theoretical explanations for these results and then tested a series of long run cross-country housing expenditure models. We present their preferred model as Stage 2.

Stage 2. Taking the city as the unit of observation, M&M applied each market's regression coefficients from Stage 1 to city and tenure specific medians of income and household size to estimate housing expenditure for a ''median owner

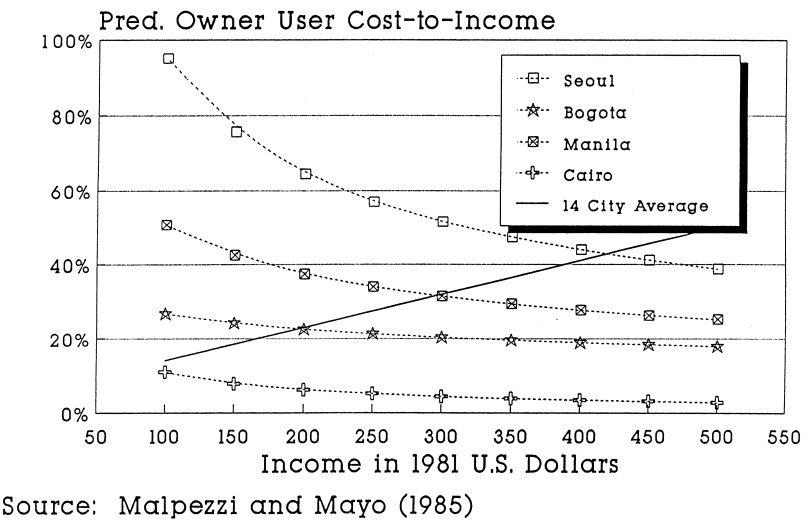

Fig. 2. User cost–income ratios by income, within and across LDC markets.

[23]From here on we only report results for owner occupants, since only these results are relevant for our purpose.

[24]There are actually 14 such curves, one representing each city, but only 4 are drawn in the Figure.

[25]There is one such curve, fit through 14 points representing owners of median income in each city.

household'' in each city. These were converted to 1981 U.S. dollars, and a cross city price index derived from the relative price of residential construction in each country from Kravis et al. (1982).[26]

These data were used in a second stage cross market regression:

$$\ln R_j = -3.57 + \underset{(0.35)}{1.38} \ln y_j + \underset{(0.50)}{0.65} \ln p_{Hj}$$

$$R^2 = 0.76$$
$$Obs. = 14$$

where R_j and y_j are city medians converted to 1981 U.S. dollars, and p_{Hj} is the Kravis-Heston-Summers price index, with the U.S. relative price normalized at one.[27]

However, the original Malpezzi and Mayo sample included two Egyptian cities, Cairo and Beni Suef, so we reestimated the model without those cities, obtaining:

$$\ln R_j = -3.53 + \underset{(0.56)}{1.37} \ln y_j + \underset{(0.62)}{0.64} \ln p_{Hj}$$

$$R^2 = 0.68$$
$$Obs. = 12$$

Interestingly, the coefficients did not change much, although standard errors (in parentheses) did. Armed with this cross country model, we can proceed.

Adjusting Furnished Rents to Estimate User Cost

Fig. 3 represents the housing demand curve of the owner occupant with median income in Cairo. P_H^A is the price per unit of housing service faced by owner occupants in the presence of rent control (their user cost). This is assumed to be the price that renters would face in the absence of rent control.[28] P_H^B is the price per unit of housing services faced by renters in the furnished sector in the presence of rent control. Q_H^A is the quantity of housing services consumed by an owner occupant with median income in Cairo. We need to estimate P_H^A/P_H^B. Obviously,

[26]Strictly speaking, the index varied by country. City-specific price proxies such as city population were also examined. It appeared prices varied so much more by country than by city within countries that the country specific index was reasonable (most of our cities were among the largest in each country). As the index was not available for all countries, an instrument was created, as described in M&M (1985), pp. 99–100.

[27]Note that in a log-linear expenditure equation the coefficient of price is equal to one plus the price elasticity.

[28]In long run equilibrium, of course, rents and user costs will be equated. Institutional features, primarily related to tax, can drive a wedge between user cost for owner occupied and rental dwellings in countries like the U.S. Such differences are small enough to ignore in Cairo.

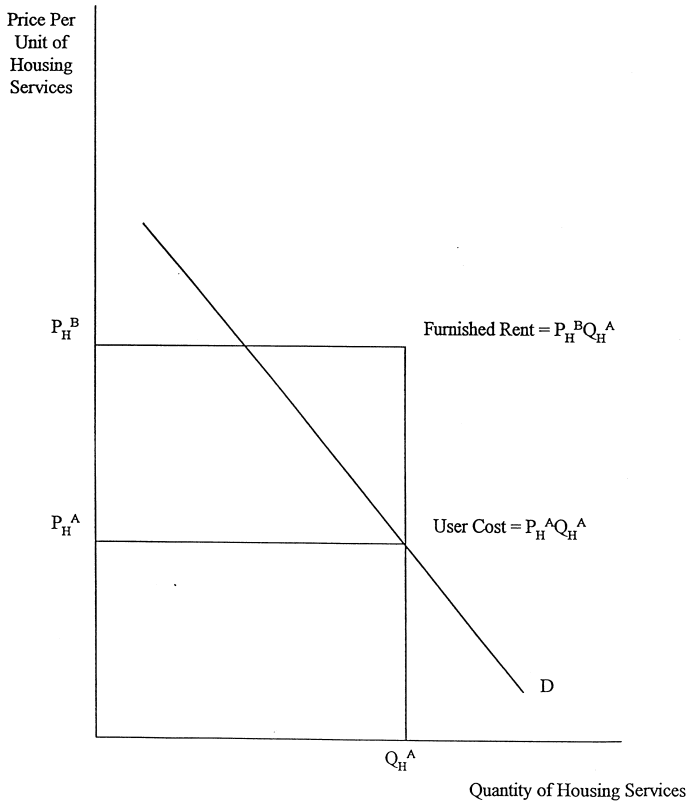

Fig. 3. A representative owner-occupant.

$$P_H^A/P_H^B = P_H^A Q_H^A/P_H^B Q_H^A$$

We use the median reported imputed furnished rent as our measure of $P_H^B Q_H^A$.[29] We use the cross country prediction of user cost for the median income owner household as our measure of $P_H^A Q_H^A$. This prediction is obtained by substituting in values of Cairo's median owner income, and the estimated Egyptian value of the Kravis-Heston-Summers residential construction price index from an instrumental variables model discussed briefly above.

Consistent with our prior, unadjusted imputed rents in the furnished sector are very high. The median furnished rent–income ratio is 0.53 for those reporting both variables. The revised cross country model predicts that the equilibrium user cost–income ratio for the typical Cairo owner in 1981 should be 0.16, so we

[29]Strictly speaking, the median imputed rent for these owner occupants is not the same as the rent for the median income owner, but in practice the two should be close.

multiply the furnished rent proxy by 0.30 to bring it in line with that estimate. Note that we multiply all furnished rents by 0.30, i.e. further assuming that any distorting effect of restricted entry shifts all furnished rents up by a constant proportion.

Particular welfare results will naturally be sensitive to the cross country prediction. While dropping Cairo and Beni Suef did not change results much, in previous work (Malpezzi et al., 1988) we found that other changes to the sample did change cross country model results. While substantial overlap remained between interval forecasts of different versions of the model, clearly additional work on such cross country models could improve estimates of the welfare measures reported in this paper. But as we note in the text, while some point estimates are sensitive to changes in the cross country model forecast, qualitative results remain robust.

References

Belsley, D.A., Kuh, E., Welsch, R.E., 1980. Regression Diagnostics: Identifying Influential Data and Sources of Collinearity. Wiley, New York.

Fallis, G., Smith, L.B., 1984. Uncontrolled prices in a controlled market: the case of rent controls American Economic Review 74, 193–200.

Follain, J.R., Malpezzi, S., 1981. Are occupants accurate appraisers? Review of Public Data Use 9, 47–55.

Freeman, A.M., 1979. The Benefits of Environmental Improvement: Theory and Practice. Resources for the Future, Washington D.C.

Grunfeld, Y., Griliches, Z., 1960. Is aggregation necessarily bad? Review of Economics and Statistics 42, 1–13.

Hardman, A.M., 1987. The Role of Side Payments in a Market in Disequilibrium: The Market for Rental Housing in Cairo. Unpublished Ph.D. Dissertation, MIT.

Hausman, J.A., 1981. Exact consumer's surplus and deadweight loss American Economic Review 71 (4), 662–675.

Hu, T.-W., 1972. The fitting of log-regression equations when some observations in the regressand are zero or negative Metroeconomica 24 (1), 86–90.

Johnson, D.G., 1951. Rent control and the distribution of income American Economic Review 41 (2), 569–582.

Kravis, I.B., Heston, A., Summers, R., 1982. World Product and Income: International Comparisons of Real Gross Product. Johns Hopkins University Press, Baltimore.

Malpezzi, S., 1985. An Introduction to Regression Diagnostics and Robust Estimation. World Bank, processed, Washington DC.

Malpezzi, S., 1986. Rent Control and Housing Market Equilibrium: Theory and Evidence from Cairo, Egypt. Unpublished Ph.D. Dissertation, The George Washington University.

Malpezzi, S., 1993. What can New York and Los Angeles learn from Kumasi and Bangalore? A comparison of costs and benefits of rent controls Housing Policy Debate 4 (4), 589–626.

Malpezzi, S., Ball, G., 1991. Rent Control in Developing Countries. World Bank discussion paper no. 129, Washington DC.

Malpezzi, S., Mayo, S.K. (with D.J. Gross), 1985. Housing Demand in Developing Countries. World Bank staff working paper No. 733, Washington DC.

Malpezzi, S., Mayo, S.K., 1987. The demand for housing in developing countries Economic Development and Cultural Change 35 (4), 687–721.

Malpezzi, S., Tewari, V., 1991. Costs and Benefits of Rent Regulation in Bangalore, India. World Bank, infrastructure and urban development department discussion paper no. 82, Washington DC.

Malpezzi, S., Tipple, G., Willis, K., 1990. Costs and Benefits of Rent Control: A Case Study in Kumasi, Ghana. World Bank discussion paper no. 74, Washington DC.

Malpezzi, S., Mayo, S.K., Silveira, R., Quintos, C., 1988. Measuring the Costs and Benefits of Rent Control: Case Study Design. World Bank, infrastructure and urban development department discussion paper no. 24, Washington DC.

Mayo, S.K., 1981. Theory and estimation in the economics of housing demand Journal of Urban Economics 10, 95–116.

Mayo, S.K., with many others, 1982. Informal Housing in Egypt. Abt Associates, Cambridge MA.

Olsen, E.O., 1972. An econometric analysis of rent control Journal of Political Economy 80, 1081–1100.

Schwab, R., 1985. The estimation of the benefits of in-kind government programs Journal of Public Economics 27 (2), 195–210.

Welsch, R., 1980. Bounded influence estimation. In: Kmenta, J., Ramsey, B. (Eds.), Evaluation of Econometric Models. Academic Press, New York, 1980.