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ALLOCATION OF GOODS THROUGH NON-PRICE MECHANISMS

Evidence on Distribution by Willingness to Wait

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This paper discusses a model of market clearing when prices are rigid. The estimated model is one in which the waiting time necessary to obtain the scarce goods brings the excess demand in line with current supply in a manner of a flexible price The mechanism of such a market has been discussed by Barzel and by Nichols, Smolensky and Tideman, but little empirical evidence has been reported. Estimation of consumer demand in such a market is presented here. Heckman's approach to truncated sample estimation has been employed. The approach allows modelling of time costs as a two-part tariff. The results confirm that consumer's response to waiting time is measurable and in the same order of magnitude as expected from response to changes in prices. The study also indicates that rationing by willingness to wait does not necessarily distribute goods to the poor.

1. Introduction

In recent years, a number of economists have explored the implications of disequilibria.[1] In such situations, consumers may demand more of a commodity at price P_t than suppliers bring forth, or suppliers, including laborers, may offer more than buyers demand. This occurs because, for a variety of reasons, P_t is sticky. This is surely the case for a number of markets in planned economies where frequently supply is determined by a complex system of bureaucratic allocative decisions. Such conditions may also be produced when price ceilings for consumer goods or industrial and agricultural inputs are enforced.

While not denying the usefulness of a disequilibrium approach for studying market clearing, this study maintains that consumer behavior in disequilibrium situations can generally be studied with basic extensions of constrained maximization. Existing models of quantity rationing [Neary and Roberts (1980)] and of time allocation and searching [Becker (1965), Rothschild (1973)] have application in disequilibrium conditions. This is not

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[1]For a review, see Quandt (1982).

a new approach. It was stated by Barzel in 1974:

> '... the term "rationing" is traditionally identified with disequilibrium, a condition under which individuals are unable to equate costs and values on the margin, as seems apparent when the price imposed is not at the intersection of demand and supply. But time is costly, waiting provides an additional route whereby individuals can again equate on the margin. Adding the time constraint allows us to apply "equilibrium" analysis to this form of ration'.

This study expands upon that approach, primarily by offering evidence on consumer behavior in a market clearing with fixed cash prices and flexible time prices and, secondarily, with evidence on the distributional impacts of such a market. The study examines consumer cooperatives in Egypt where the supply of subsidized food items is less than the market demand. There is a specific issue in the distribution of these benefits as well as a general issue as to whether consumers react to time 'prices' similar to their response to cash prices. The econometric technique employed is one adopted from a model for wage determination [Heckman (1976, 1979)] which allows for measurement on market entry distinct from market intensification.[2]

2. The theory of allocation of goods by willingness to wait

In the basic model incorporating time into a household's utility function, attributed to Becker (also, see Gronau), the household's endowments include time. The total time budget is allocated between productive activities and consumption. A straightforward derivation of this theory is that the time required to produce or consume a good serves a role in a consumer's utility maximization analogous to cash prices.

While assumptions on the nature of labor markets and the ability of an individual to trade off between goods and leisure allow for simplification and measurement of such a full income model, such assumptions are not necessary for a model of demand in which the marginal cost of an item, including the marginal time cost, is equated to the marginal utility of a good. It is such a model which underlies the analysis of allocation of goods by willingness to wait.

Fig. 1 illustrates a demand schedule in which time is incorporated. If quantity is restricted to Q_R and price set at P_0, then there is an excess demand of $Q(P_0) - Q_R$. If willingness to wait is the mechanism which is used to allocate goods, then the resource cost to obtain the goods will rise to $P_0 + wt_0$, where w is the opportunity cost of time and t_0 the time necessary to

[2]A similar study of lines at gasoline stations has recently been reported by Deacon and Sonstelie (1985).

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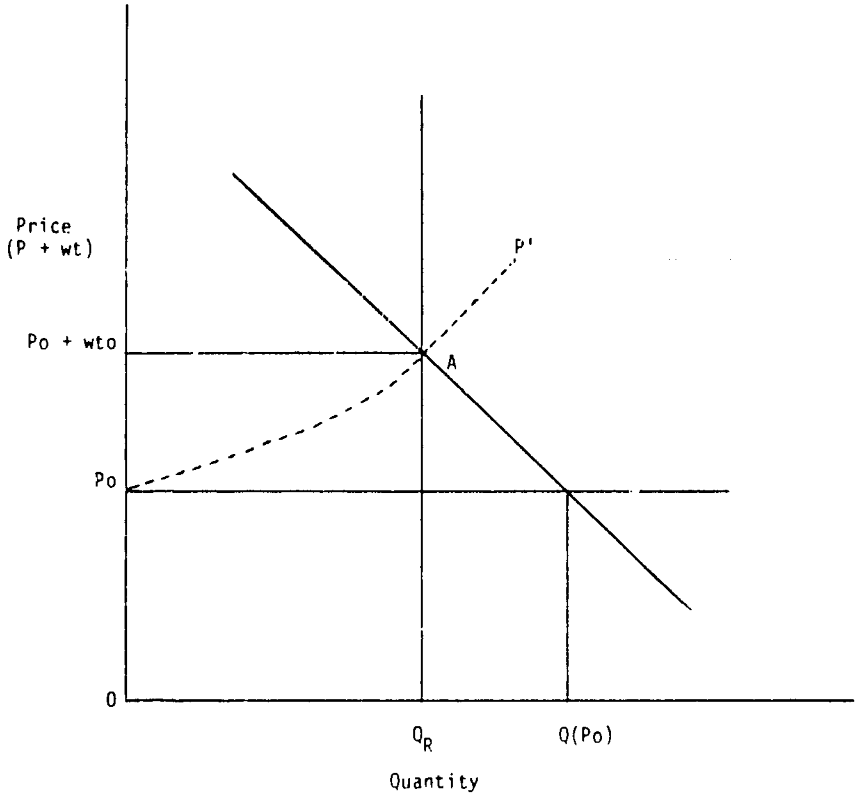

Fig. 1. Deadweight loss in time clearing markets.

obtain a unit of Q. Barzel (1974) points out that the size of the queue is not determined by the time taken in distribution, but the consumer's interest in gaining priority rights (first-come-first-served) to the scarce commodity. The totality of these resource costs, however, is not captured by any producers, hence there is a deadweight loss relative to a conventional price equilibrium. Whether cash prices or time prices rise with quantity fixed at Q_R, consumers allocate $Q_R*(P_0+wt_0)$. However, when the market clears by time prices, suppliers – including the government – receive only Q_R*P_0, so there is a deadweight loss equivalent to Q_R*wt_0 relative to a fixed quantity rationed position with the price at P_0.

The problem is different if there is no limit to the quantity purchased per visit. Consider the case in which no resale is permitted or the individual transaction costs make such sales unprofitable. This is an example of a two-part tariff [Oi (1971)]; the consumer enters the queue if the consumer surplus of the entire purchase exceeds the costs of queuing and then makes purchase according to the marginal costs. Otherwise, there is no entry.

Assuming queuing only for the kth good which is unavailable elsewhere, demand is expressed as

$$Q_{hj}=f(P_j,P_k,Y) \quad \text{when} \quad \int_{P_k}^{\infty} f(P_j,P_k,Y)\,\mathrm{d}P_k \geqq wt \tag{1}$$

and

$$Q_{hj}=f(P_j,Y),\, j\neq k \quad \text{otherwise,}$$

$$Q_{hk}=0.$$

If the kth good is also available elsewhere at a higher price, P_k, then

$$Q_{hj}=f(P_j,P_k,Y) \quad \text{when} \quad \int_{P_k}^{P'_k} f(P_j,P_k,Y)\,\mathrm{d}P_k \geqq wt \tag{2}$$

and

$$Q_{hj}=f(P_j,P'_k,Y) \quad \text{otherwise.}$$

Note that if resale is permitted and carries no transaction costs, then the first consumer would purchase all the quantity and sell it at the market clearing price P'_k. This is because the average cost per unit purchased would decline monotonically with quantity, creating a situation analogous to a natural monopoly. Models with some mixture of limits on per visit purchases (quantity rations of a sort) or transaction costs for resale, then, seem most plausible.

3. Distribution of benefits

Nichols, Smolensky and Tideman (1971) reasoned that equity considerations apparently motivate the institutional arrangements that result in this deadweight loss. They observe that the asset of time is more equally distributed than financial assets. Furthermore, they argue that opportunity costs of time are likely positively correlated with wages or income. If there are marginal external benefits to the consumption of a particular good – merit goods in their study – then it may be efficient to subsidize the costs of that good in cash terms and let the waiting time target the limited supply of the subsidized good. This may be particularly advantageous in developing countries which desire to target welfare programs but lack the administrative capacity to monitor incomes or similar criteria of targeting.

Barzel (1974) challenges the results of Nichols et al. He presents a simple example of a 'free good' where cost is only the time cost, yet the benefits of a subsidy are mainly obtained by the rich. Barzel's results are due to the marginal propensity to consume dominating the price response. He, however, assumes away a parallel market in which goods have higher cash costs and lower time costs, which is inherent in the model of Nichols et al. If such markets exist – even if the good available in the queue cannot be retraded itself (for example, public and private beaches or medical clinics) – then although the rich may have a high income elasticity, they have the potential to satisfy those demands in the higher price market. Differences in opportunity costs of time are indicated in fig. 1 by the curve P_0P'. Prices vary across consumers, although the market clearing price will still be P_0+wt_0. On the aggregate, the consumer gain relative to a cash price is the area bounded by P_0, (P_0+wt_0), and A. Individual benefits depend on both the institutional arrangements that prevent one consumer from capturing all the quantity, as discussed above, and the distribution of opportunity costs of time.

The efficacy of using waiting times to target benefits to the poor is not, however, proven. The correlations of wages and incomes or of opportunity costs and incomes are not perfect. This may reflect disequilibrium in the labor market as well as factors other than education and assets that influence the reservation wage of an individual engaged in household production – for example, the number of children. Moreover, when a household consists of a number of individuals, it is quite possible that opportunity costs differ, further weakening the relationship between household income and propensity to queue. These problems are compounded by the possibility of two-part tariffs which make the level of demand a determinant of the propensity to join a queue. The distributional impacts of a market which clears by time, then, deserve empirical investigation.

4. Approach to measurement

In this study, no a priori assumptions are made about the value of time or whether labor markets are in equilibrium. Instead, the impact of queuing and searching is directly measured under the analogy with cash prices. As discussed below, the opportunity cost of time is implicitly measured, but not identified, with the parameter estimates. The approach used here is a two-stage estimation that is a modification of a technique developed by Heckman (1976, 1979) and by Griliches, Hall and Hausman (1978). In the Egyptian case to be studied, some consumers are observed to queue to obtain certain commodities at a fixed subsidized price while others seek the same goods at a higher open market price where presumably queuing is negligable. If the choice to accept the higher prices is to be viewed as rational, it should reflect different assessments of the total costs of the subsidized goods. This particular market structure is also distinguished by the presence of fixed quantity rations at a low subsidized price, which being inframarginal and assured can be considered income transfers.[3] Demand for a given commodity then can be expressed as

$$Q_{hjT} = Q_{hjo} + Q_{hjc} + Q_{hjr} = f(P_h, Y_h, Time_h, Z_h), \tag{3}$$

where the subscripts T, o, c, and r indicated the total quantity of the jth good demand by the h household, and the quantity obtained from the open market, cooperative, and rationed system, respectively. P_h is a vector of prices and $Time_h$ a vector of waiting time faced by the household. Z is a vector of household characteristics and Y is income. Virtually no consumer purchased a given good at both the cooperative and the open market in the study period, and few declined the rationed component. Consequently, one can net out the inframarginal and exogenously determined ration and study excess demand in the forms

$$Q_{hjc} = f\left(P, Y_h + \sum_i [(P_{io} - P_{ir}) * Q_{hir}], T\right) - Q_{hjr}, \tag{4}$$

$$Q_{hjo} = f\left(P, Y_h + \sum_i [(P_{io} - P_{ir}) * Q_{hir}], T\right) - Q_{hjr}. \tag{5}$$

The approach includes the value of the ration as income.[4] However, it introduces an econometric problem associated with entry phenomena.

The problem of estimating demand when a sizable percentage of the sample are non-consumers was first pointed out by Tobin (1958).[5] If one observes $Q_{hj} = X_j\beta + u_j$ when $X_j\beta + u_j > 0$ and 0 when $X_j\beta + u_j \leq 0$ and u_j is $\sim N(0, \sigma^2)$, then the expected value of Q can be calculated as

$$E(Q) = X\beta F(z) + \sigma f(z), \tag{6}$$

where z is $X\beta/\sigma$, $F(z)$ is the unit normal density, and $f(z)$ is the cumulative normal density. One notes then that the expected value of Q^*, the value of Q when $X_j\beta + u_j > 0$, is

$$E(Q^*) = X\beta + \sigma f(z)/F(z). \tag{7}$$

Both estimates of $Q_h = X_j\beta + u_j$ based on the full sample or of the sample for which $u > -X\beta$ violates the OLS assumption that the error is normally

[3]Details are presented below and in Alderman and von Braun (1984) and Alderman (1984).

[4]It also allows one to determine if rations – for which there is no price variation – substitute one to one for open market goods. This is discussed in Alderman and von Braun (1984).

[5]While the technique was first applied to durables, Pitt (1983) has recently used a Tobit approach for food consumption.

distributed with a mean of zero. Essentially, in the latter case there is a missing variable bias if $f(z)/F(z)$ is correlated with both Q^* and X. While Tobin's approach deals with the former case, his maximum likelihood estimator is not fully appropriate as his technique constrains the determinants of entry to be the same as those which influence response conditional upon entry. This would not be the case, for example, if time costs are an entry tariff and not a variable cost.

The approach of Heckman and Griliches et al., essentially estimates $f(z)/F(z)$ with a probit estimator, and then uses the term, called the inverse of the Mills ratio, as a regressor in an estimation of Q on X, conditional on Q being positive.

Note that the two-step approach does not give direct estimates of the population parameters. Following McDonald and Moffit (1980), the change in the entire population can be broken down into two components,

$$\partial Q/\partial X = F(z)(\partial Q^*/\partial X) + E(Q^*)(\partial F(z)/\partial X). \tag{8}$$

The total change in Q is composed of the change in Q conditional upon Q being above the limit, weighted by the probability of being above the limit plus the change in the probability of being above the limit weighted by the expected value of Q if above the limit. For the model employed in the study of the total marginal change in consumption,

$$\begin{aligned}\partial Q_T/\partial X = {} & F(z_c)(\partial Q^*_c/\partial X) + E(Q_c)(\partial F(z_c)/\partial X) + F(z_o)(\partial Q^*_o/\partial X) \\ & + E(Q_o)(\partial F(z_o)/\partial X).\end{aligned} \tag{9}$$

The first step of the measurement then is the estimation of the probability of market participation with the dependent variable being one if the family consumes the good in the particular market and zero otherwise (omitting household subscripts),

$$\begin{aligned}PR_{j,c,o} = {} & \alpha + \beta^1\,TXN + \beta^2\,Number + \beta^3_j\,Price\ Open_j \\ & + \Sigma\beta^3_k\,Price\ Open_k + \beta^4_j\,Waiting\ Time_j + \Sigma\beta^4_k\,Waiting\ Time_k \\ & + \beta^5\,Waiting\ Time * Class + \beta^6\,Search\ Time + \beta^7\,Search \\ & Time * Class + \beta^8\,Ration\ Dummy_j + \beta_{zi} Z_i, \quad j \neq k,\end{aligned} \tag{10}$$

where

PR = a zero-one dummy variable for purchase at the open market or cooperative,

TXN = per capita household expenditures including the implicit value of transfers embodied in the rations in *LE* per month,

Number = household size,
Price Open = open market price for the ith good in piasters per kilo,
Waiting Time = the time waiting for the good at the cooperative, in minutes,
Search Time = time searching for the good at the cooperative, in minutes,
Class = a zero-one dummy defined as one if the family is in the poorest quartile.
Ration Dummy = a zero-one dummy defined as one if the good was available at the ration store in the previous month,
Z = a group of regional and demographic variables, including the number of family members, proportion of children, and degree of urbanization.

The conditional demand equations then are

$$\begin{aligned} Q^*_{jo} = {} & a + \beta^1 LTX + \beta^2 (LTX)^2 + \beta^3 NTX + \beta^4 CTX + \beta^5_j LPrice_j \\ & + \Sigma \beta^5_k LPrice_k + \beta^6_j LPrice_j * Class + \Sigma \beta^7_k LWaiting\ Time_k \\ & + \beta^7 Q_{jr} + \beta_{zi} Z + \beta_m Mills\ Inverse \end{aligned} \tag{11}$$

and

$$\begin{aligned} Q^*_{jc} = {} & a + \beta^1 LTX + \beta^2 (LTX)^2 + \beta^3 NTX + \beta^4 CTX + \beta^5_j LWaiting\ Time_j \\ & + \Sigma \beta^5_k L\,Waiting\ Time_k + \beta^6_j L\,Waiting\ Time_j * Class + \beta^7 Q_{jr} \\ & + \Sigma \beta^8_k L\,Price_k + \beta_{zi} Z + \beta_m Mills\ Inverse, \quad j \neq k, \end{aligned} \tag{12}$$

where

LTX = logarithm of *TXN*,
NTX = number * *LTX*,
CTX = the percentage of children less than 5 in the household * *LTX*,
LPrice = logarithm of the ith price,
LWaiting Time = logarithm of the ith waiting time at the cooperative,
$Q_{jc,o,r}$ = per capita quantities of goods from the respective outlets measured in grams, and
Mills Inverse = 1/Mills ratio from (10).

Note that β^4_j *Waiting Time* in eq. (10) is equivalent to $(\beta^3_j * w) *$ *Waiting Time*, by the analogy of time and cash prices. If β^3_j can be identified with accuracy, then β^4_j will give an estimate of $\bar{w}$, but it is not necessary to do so in order to test the theory of allocation by willingness to wait. Estimates of eq. (10) using a subsample for which wages were observed indicated that there were no significant differences between estimates of eq. (10) and a variant in which waiting time was replaced by a product of that variable and wage rates [Alderman (1984)].

The analysis does not assume that opportunity costs are equal for all consumers; even the assumption that time is measured by market wages is not employed. The specification of eq. (10) also allows for differences in the response to increased waiting times to vary by income class – this includes both differences in wage rates and possible differences in price responses. Furthermore, the terms in the Z-matrix allow for differences in the response if a neighbor or servant does the shopping. This effect was studied by including an intervention between a bivariate dummy variable for a non-family member doing the shopping and the waiting time variable. This effect, however, proved insigificant.

The difference in eqs. (11) and (12) reflects the asymmetry in the decision-making process. Once the decision to purchase at the cooperative is made, the open market price for that commodity is not relevant, although other prices clearly are. Furthermore, as the cooperative price does not vary, cooperative purchases can be used only to study the effect of income, demography, and time. Similarly, once the decision to purchase in the open market is made, the time of waiting at the cooperative is not relevant, although price variations can be useful in investigating price responses. The complexity of the estimation and the degree of disaggregation explored make the costs of a system of demand – in terms of dubious restrictions and in computation – exceed the expected benefits.

In this approach, time is treated as analogous to price. As in other measurement of consumer demand, the question of whether the variables are exogenous must be considered. Waiting times and other prices are actually determined by demand and supply conditions. Ideally, one would estimate demand response as part of a system which includes supply response.

Unfortunately, the supply to a community is unobserved. Nevertheless, although the magnitude of the simultaneity bias is related to the unknown covariance structure of the community supply and individual demand equations, the bias is expected to be positive if supply is positively related to price. Assuming that if bureaucratic response to larger waiting times exists at all, it is to increase deliveries when queues increase, then the time responses reported will be less negative than the true response [Maddala (1977)]. We will further assume that this bias is small.

Furthermore, when a household chooses between labor and non-wage earning activities, income is not strictly exogenous. In principle, changes in wages or in prices – including queuing times – will influence labor decisions, at least in the long run. This is a vexing problem for many aspects of demand measurement, not just the case in point, and is difficult to tackle in the framework employed in this study. However, for our purposes, we are principally concerned with waiting times as a price rather than with the income response. Accordingly, the assumption that income is exogenous in the short run appears an acceptable simplification.

One should note that the above model relates to a disequilibrium approach in that it models the probability of supply being insufficient for individual demand as being a decreasing function of the consumer application of search time. While markets may be in disequilibrium, an individual is assumed to be able to bring his demand in equilibrium with supply at the appropriate resource price. In any given period, however, the stochastic nature of the search and the distribution of waiting times will result in ex post departures from ex ante budget allocations. The two-step approach to estimation employed here is intended to minimize the bias in results that may come from local nonavailability of a good.

5. The context of the study

If the approach outlined in the previous section seems complex, it should be pointed out that the institutional arrangements of the markets in Egypt are complex. There are open markets, cooperatives, separate ration shops, government licensed bakeries and flour shops. All but the first have fixed prices. Only in the ration shops are there enforced quotas per household or per individual. The other outlets, however, receive quantity allotments per shop which effectively fixes local supply. As this study is intended to be less about Egypt than the role of time in consumer allocation, details about marketing and consumption in Egypt will be kept minimal. More information can be found in the references cited.

Six commodities are available in ration shops – sugar, oil, tea, rice, beans, and lentils. There are slight variations of quotas by region but virtually no variation by income. A family can purchase goods at neighborhood cooperatives without membership or at cooperatives at certain places of work, if members. Table 1 indicates purchases of these goods as indicated in a survey of 980 urban households conducted in Egypt in 1981–82 which is the basis of this study. This confirms that rations are generally inframarginal and the decision to purchase a specific good at one type of outlet or another is apparently an either/or decision.

While the commodities in the open market differ little from those in the cooperatives, the nominal prices do. On the average, goods cost 25–40 percent more in the open market. The average waiting time which one presumably avoids if one purchases on the open market is presented in table 2. As a point of reference, purchasing a 5 kilo bag of rice from the cooperative will save a consumer 0.30 to 0.35 LE compared to an open market purchase. The average wage ranged from 0.36 Egyptian pounds (LE = US$1.22) per hour for the poorest quartile to 0.71 LE for the richest.[6]

[6] Wages were calculated using reported hours and weekly earnings of *those who claimed to do the shopping*. For those who held two jobs, the second job was used to determine the marginal wage. However, recall that these wages are *not* introduced into the estimation.

Table 1
Percent of families purchasing commodities in open markets and cooperatives, and quantities.

	Urban expenditures quartiles:				
	1st	2nd	3rd	4th	Total
Per capita monthly expenditures	14.5	25.3	38.1	82.5	36.3
Sugar					
Coop	52.6	60.0	54.7	58.4	55.4
Open mkt	24.1	22.9	29.0	30.8	26.5
Both[a]	4.9	7.3	4.5	7.8	6.1
Share of total purchase provided by coop	16.1	21.9	22.2	30.9	22.5
Share of total purchase provided by open mkt	7.9	8.8	11.9	15.3	10.8
Total purchase, including ration (g)	1860	2047	2130	2457	2092
Oil					
Coop	22.4	24.9	32.2	35.5	28.8
Open mkt	14.3	16.3	20.0	23.7	17.6
Both	0.8	2.0	2.4	2.0	1.8
Share of total purchase provided by coop	14.3	17.3	21.2	27.9	20.0
Share of total purchase provided by open mkt	9.1	9.9	12.3	17.9	12.2
Total purchase, including ration (g)	572	640	683	790	680
Tea					
Coop	5.7	8.2	9.6	9.2	8.2
Open mkt	55.9	64.5	69.0	69.8	64.8
Both	0.4	3.3	2.9	2.4	2.2
Share of total purchase provided by coop	1.8	2.3	3.7	2.9	2.7
Share of total purchase provided by open mkt	22.7	34.5	36.6	48.6	35.5
Total purchase, including ration (g)	101	122	126	150	121
Rice					
Coop	21.2	25.3	28.2	31.4	26.5
Open mkt	24.1	29.8	34.7	35.1	30.5
Both	2.0	2.9	3.7	4.1	3.2
Share of total purchase provided by coop	8.7	12.5	14.8	18.6	13.7
Share of total purchase provided by open mkt	22.9	34.0	33.8	37.6	32.3
Total purchase, including ration (g)	1669	2240	2379	2642	2183
Beans					
Coop	6.9	9.4	6.5	7.3	7.6
Open mkt	13.5	18.8	18.0	20.8	17.8
Both	0.4	0.4	0.8	0.4	0.5
Share of total purchase provided by coop	13.9	13.8	13.2	10.5	12.8
Share of total purchase provided by open mkt	45.8	60.8	61.5	72.8	63.3
Total purchase, including ration (g)	205	253	265	381	281
Lentils					
Coop	15.5	22.0	22.0	20.2	20.3
Open mkt	10.6	11.8	11.0	13.1	11.6
Both	0	0.8	0.8	0.4	0.5
Share of total purchase provided by coop	55.2	54.3	49.8	53.5	53.1
Share of total purchase provided by open mkt	26.9	32.2	35.7	31.2	31.7
Total purchase, including ration (g)	106	146	157	204	148

[a]The percentage of families not purchasing in either market would be (100 − coop − open + both) to avoid double counting.

Table 2

Average perceived waiting time for selected commodities at cooperatives (in minutes, standard deviations in parentheses).

	Public cooperative	Workplace cooperative
Sugar	54 (49.4)	37 (44.5)
Oil	50 (45.6)	31 (34.0)
Rice	93 (70.3)	55 (56.4)
Frozen beef	105 (81.6)	48 (57.0)
Frozen chicken	46 (56.0)	23 (25.8)
Frozen fish	56 (58.4)	29 (39.8)

Bread and flour are available nationwide at authorized outlets. The breads and flour are available as either 82 percent extraction (balady) or 72 percent extraction (fino). No parallel market for these goods occurs in urban areas, but licensing procedures make for some local excess demand which is manifested by queuing at bakeries. Furthermore, with only a limited number of merchants authorized to sell flour, the distance between outlets becomes a determinant of purchases. For bread, as well as frozen commodities, no own-price parameters can be estimated as there is no observed variance.

For this study, waiting times are taken as the reported expected time in line necessary to obtain various commodities, whether or not the consumer actually purchased the item. Search times are defined as the reported distance to the outlet divided by the probability that the good was available in the community. This latter figure was calculated by summing the number of reported monthly purchases within a census tract ($n=50$ in the survey) and dividing by the total number of reported attempts to obtain the good. Waiting times and travel times, then, are household measurements while probability is a market measurement.

6. Results and discussion

For each commodity there are at least two and generally four regressions. Consequently, only income, price, and time parameters are reported in tables 3 and 4.[7] The income parameters are standard and plausible; the price

[7]Complete results are available from the author. A number of cross-price and cross-time variables were included in the regression, but seldom proved significant. For brevity they are excluded from the tables. While standard errors are available with the regression coefficients, the covariance matrices for combinations of parameters used to calculate the parameters in tables 3 and 4 were not generated by the statistical package employed. Parameters that were not significant were presumed zero for the construction of the table. The following examples are reported as an indication of the size of the standard errors for the waiting time. The coefficient of bread waiting time had a t-statistics at -3.1 in the bread entry equation and -3.7 in the balady flour equation. Similarly, the coefficient of sugar waiting time had a t-value of -7.7 in the cooperative entry equation and 8.4 in the open market entry equation. While not all coefficients had this narrow a confidence interval, the majority of these which were significant at 5 percent were so that the 1 percent level as well.

Table 3

Income, price, and time elasticities for bread and flour.

	Weighted entry elasticity	Weighted response elasticity	Total elasticity
Balady bread			
η14.5*	−0.018	−0.002	−0.020
η45	−0.054	0.008	−0.047
Bread waiting time	−0.047	0.065	0.018
Fhouslab	−0.050	—	−0.050
Balady flour price	0.721	—	0.721
Fino bread			
η14.5	0.052	0.194	0.246
η45	0.084	0.121	0.205
Bread waiting time (class 1)	−0.358	0.212	−0.146
Bread waiting time (others)	0.053	0.111	0.164
Fhouslab	−0.149	—	−0.149
Balady flour price	—	−0.755	−0.755
Balady flour			
η14.5	−0.040	0.127	0.087
η45	−0.020	−0.045	−0.065
Bread waiting time (class 1)	0.220	—	0.220
Fhouslab	0.235	—	0.235
Balady flour price	−3.791	1.195	−2.593
Fino flour price	1.241	1.460	2.701
Fino flour			
η14.5	0.032	0.556	0.588
η45	0.061	[illegible]	0.217
Bread waiting time (class 1)	−0.290	—	−0.290
Balady flour price	0.713	—	0.713

*η14.5 indicates income elasticity for lowest expenditure quartile with average monthly per capita expenditure of 14.5 LE, 6.44 members and 15 percent of household being 5 years old or less.

η45 is for others with expenditures of 45 LE, 5.16 members and 15 percent of household being 5 years old or less.

Parameters that are non-significant at 5% level are indicated by dash; these are assumed zero in the summation.

Elasticities are estimated at the mean of the appropriate group. The total elasticity corresponds to the derivative on the left-hand side of eq. (9). The entry elasticity is from the weighted derivative of the probit equations and the response from the conditional demand. Fhouslab indicates the number of females above the age of 10 in the household not employed full-time outside the house.

parameters for staples are generally insignificant and reflective of low cross-sectional variance of the independent variables. Demographic variables including family composition and interactions with income were included but are not reported. The remainder of this report will concentrate on time response.

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Table 4

Income price and time elasticities for cooperative and open market commodities.

	Weighted entry elasticity		Response elasticity		
	Cooperative	Open market	Cooperative	Open market	Total elasticity
Sugar					
η14.5	0.006		0.074	0.056	0.136
η45	0.018	-	0.159	0.028	0.205
Waiting time (class 1)	−0.106	0.081	—	NA	−0.025
Waiting time (other)	−0.090	0.076	—	NA	−0.014
Search time	−0.060	0.046	—	NA	−0.01[illegible]
Rice					
η14.5	—	—	0.067	0.297	0.364
η45	—	—	0.049	0.083	0.132
Waiting time (class 1)	−0.185	0.124	0.021	NA	−0.040
Waiting time (other)	−0.094	0.087	0.015	NA	0.008
Search time	−0.042	—	—	NA	−0.042
Frozen chicken					
η14.5	—	NA	0.552	NA	0.552
η45	—	NA	0.407	NA	0.407
Waiting time (class 1)	−1.235	NA	—	NA	−1.235
Waiting time (other)	−0.752	NA	—	NA	−0.752
Search time	−0.397	NA	—	—	−0.397
Oil					
η14.5	0.011	—	0.028	0.037	0.076
η45	0.027	—	0.036	0.034	0.097
Waiting time (class 1)	−0.127	—	—	NA	−0.127
Waiting time (others)	−0.105	0.043	—	NA	−0.062
Search time	—	—	—	—	—
Beans					
η14.5	—	0.040	0.013	0.036	0.089
η45	—	0.084	0.013	0.043	0.140
Search time	−0.097	—	−0.046	—	−0.143
Lentils					
η14.5	—	0.002	0.237	0.091	0.330
η45	—	0.001	0.134	0.052	0.184
Search time (class 1)	−0.407	—	—	—	−0.407
Search time (other)	−0.098	—	—	—	−0.098

Table 4 (continued)

	Weighted entry elasticity		Response elasticity		
	Cooperative	Open market	Cooperative	Open market	Total elasticity
Frozen meat					
η14.5	−0.127	NA	0.199	NA	0.072
η45	−0.452	NA	0.302	NA	−0.150
Waiting time (class 1)	−0.332	NA	—	NA	−0.332
Waiting time (other)	−0.579	NA	—	NA	−0.574
Search time	−0.419	NA	—	NA	−0.419
Frozen fish					
η14.5	−0.080	NA	0.287	NA	0.206
η45	−0.228	NA	0.036	NA	−0.192
Waiting time (class 1)	−1.068	NA	—	NA	−1.068
Waiting time (other)	−0.624	NA	—	NA	−0.624
Search time	−0.445	NA	—	NA	−0.445
Fresh chicken					
η14.5	NA	—	NA	0.680	0.680
η45	NA	—	NA	0.313	0.313
Frozen product waiting time (class 1)	NA	0.637	NA	0.213	0.285
Frozen product waiting time (other)	NA	0.214	NA	0.071	0.285
Fresh fish					
η14.5	NA	0.060	NA	0.831	0.891
η45	NA	0.063	NA	0.295	0.358
Frozen product waiting time (class 1)	NA	0.063	NA	—	0.063
Waiting time (other)	NA	—	NA	—	—

Notes: NA indicates not applicable.
Non-significant parameters indicated by dash; these are assumed zero in the summation.

First and foremost among the general conclusions that can be drawn from the estimates presented is that time matters. There are eight possible coefficients for own-waiting time in the estimates for entry equations, seven of which are significant at the 5 percent level and negative and the other (fino bread) is negative for the lowest income group. Similarly, there are eight estimates for search time – including beans and lentils, for which there is no information on waiting time, and excluding breads – out of which seven are negative and significant while the estimate for oil is negative but not significant. In addition, four of the eight estimated 'cross-time' parameters for entry in the open market are significant and positive (sugar, oil, rice, fresh chicken with frozen chicken wait); a fifth (fresh meat with frozen meat wait) is positive and significant at about the 0.15 level (two-tailed test). Similarly, bread purchases are positively, but not significantly, associated with waiting times for rice. Finally, the (unreported) variables for local availability for bread and flour, which can be considered proxies for search time, also have the expected own- and cross-time effects in the entry equations. As expected, the probability of purchasing balady bread was positively associated with the availability, although families who purchase this bread, despite its not being locally available (31 percent of the total purchases), do not have a different purchase pattern than the rest of the sample. When bread is not sold in the neighborhood, there is also a statistically higher probability of purchasing flour. The opposite pattern is observed with flour availability.

Of course, that time matters is not really surprising, although it is gratifying that it can be measured. The more interesting questions are how and how much does it matter. One notes that for all six cooperative commodities for which there are observations on both search and waiting times, the coefficient of search time is less than that of waiting. This is logical. The price of waiting in line is, at the margin, a real individual cost, either in terms of own time or compensation to be paid to another. It is quite likely, however, that the consumer obtains information about the current availability of a good at a lesser cost than measured in the calculated term. For example, suppose that the individual only has to go halfway to the cooperative to obtain information from a neighbor. The variable search cost would then equal twice the real search costs and the estimated derivative would be half the real derivative, although the sign and significance would be unaffected. In effect, the coefficient includes an unidentified discount as well as the average cost of time.

A dummy variable for membership in a workplace cooperative was included in the entry regressions. It was significant and positive for five cooperative market commodities and positive in the other three. Similarly, it was negative and generally significant in the open market estimates. Even after accounting for differences in waiting times and the probability of availability, consumers who are members of a cooperative at the workplace are more likely to buy at the cooperative than their neighbors. This reflects both the reduced price costs of waiting if done on company time and the likely flow of information about availability which would reduce search costs.

The variable fhouslab in the bread and flour results refers to the number of women above the age of 10 in the household not employed full time outside the house. As women do the baking in Egyptian households, available labor influences the choice between purchasing bread and flour for home baking.[8]

As discussed above, the estimated coefficients are not the coefficients of the opportunity cost of time but of time itself. Under the original assumption of the direct analogy of time and cash prices, $\partial Q/\partial P = \partial Q/\partial(w * time)$. One could, in principle, obtain the estimate of w by taking the ratio of $(\partial Q/\partial P)/(\partial Q/\partial t)$. Unfortunately, with limited variance of the independent variable, the price parameters proved difficult to obtain reliably. Nevertheless, the elasticities in tables 3 and 4 are unaffected as the unknown w term cancels out in the calculations. The *net* waiting time elasticities are plausible. They are small but negative for sugar, oil, and rice, and are much larger for chicken, fish, and meat. The orders of magnitude are close to the expected orders of magnitude for price elasticities for the frozen commodities and oil, but perhaps a bit low for rice and sugar.

The results reveal another important pattern; there is little observed response to time or search in the conditional response equations. Most of the effect of time is due to entry into either the cooperative or open market. The effect of time, conditional upon entry, can be used to given information on whether time is a per visit or a per unit cost, and also some information on hoarding. Three distinct possibilities are noted:

(1) Time costs are fixed costs and at the margin they are irrelevant, hence, $\partial(Q_j|\text{conditional upon entry})/\partial T_j = 0$.

(2) Since, however, the larger the purchase the lower the unit costs in terms of time, when time is a fixed cost, consumers may choose to make less frequent but larger purchases, taking advantage of the fortuitous opportunity when a product is available. If so, $\partial(Q_j|\text{conditional upon entry})/\partial T_j > 0$. The total effect from entry and quantity estimates should still be negative, as some dropouts are expected. It could, however, be virtually zero or even positive if hoarding or unrecorded resale occurs.

(3) If cooperative managers impose per visit limits on purchases in order to serve a greter number of customers and prevent the buildup of stocks by only a few households, then time costs are variable costs. Accordingly, one would expect $\partial(Q_j|\text{conditional upon entry})/\partial T_j < 0$.

Looking first at bread, for which by both statute and practice there are no limits on quantities purchased, the larger waiting times are associated with larger purchases once one enters the queue. The net effect for balady bread is virtually negligible, the two effects cancelling each other. The total effect for

[8]In the long run, fhouslab reflects household decisions as well as community custom and employment possibilities and is, therefore, susceptible to simultaneity bias. Exclusion of the variable does not change the time coefficients, although the restriction is rejected by the likelihood ratio test.

fino bread is negative for the poor but positive for the rest of the population, implying on face value a form of overcompensation or hoarding. As fino bread stores better than balady bread, this may be a response of increasing purchases of this bread in lieu of balady bread. If so, it would be a type of cross time effect somewhat masked by the fact that the variable for bread waiting time is not distinguished by type of bread.

Similarly, the coefficient of waiting time for rice in the conditional equation is positive; consumers apparently compensate but not sufficiently to offset the other effects of waiting time. The other coefficients for search time or waiting time in the conditional cooperative equations are negative but insignificant. There is, then, no evidence that waiting or search times serve as variable costs as opposed to fixed entry costs. There is some problem in interpretation as the coefficient of variance of the regressor for waiting time is relatively smaller in the conditional equations, this is a result of the self-selection of consumers. It is, therefore, possible that a negative association of waiting time and conditional purchases exists but could not be captured in the regression. However, the more likely interpretation is that waiting time is the first of a two-part tariff.

The interaction term for the time variables and class in eqs. (10) and (12) was included to test whether the poor were more likely to stand in line to obtain the limited supply of goods at the cooperative than were the rest of the population. A comparison of the elasticities for time in tables 3 and 4 reveals that there is no statistical evidence to support the view that the poor (class 1) are ardent queuers. There is some, albeit weak, evidence that they are actually less likely to queue. In the case of rice, fish, and lentils, they are statistically more responsive as measured by the time elasticities, although for lentils the evidence comes from search costs and not waiting time. Furthermore, the poor are discouraged from buying fino bread with larger waiting times while the general population is indifferent. Similarly, the poor have an observed cross-time response for balady flour with the expected positive sign while the general population is unresponsive.

Since the time response is a product of opportunity costs and price response, which may plausibly differ by income group, the difference in time response by income group is not sufficient to test differences in opportunity costs.[9] However, the evidence that as waiting times increase, the poor are no less likely to forego purchases is evidence that rationing by queueing does not serve to distribute the benefits of the cooperative system to the poor. Since targeting by waiting time presumes that waiting time is a variable cost,

[9]Elsewhere [Alderman (1984)] it is indicated that the model fits better when a constant average opportunity cost is used rather than market wages. This, of course, does not prove or even imply that the average wage used for the constant is the best estimator of opportunity costs – it can be discounted by an unknown factor – but only that observed individual market wages are not necessarily valid proxies.

the evidence that the cooperative system in Egypt serves as a two-part tariff is the likely explanation why the poor do not gain disproportionately from this mode of distribution.[10]

To summarize, it should be apparent that such a tariff is sufficient to bring demand into line with supply. The distributional consequences of such a market and the inference of shadow prices for time in such a situation, however, are not identical to the more common variable cost approach to commodity prices. Consumers still equate the benefits from waiting to the costs, and the costs are still the product of the actual wait and the opportunity cost of the individual in the line. However, the benefits are the product of the per unit surplus gained – in this case the difference between the open market and cooperative prices – and the number of units obtained. These are a function of both household size and income. Nevertheless, the essential feature, that time maps the short side of the market supply to the long, remains valid and measurable.

[10] I am indebted to a reviewer for pointing out that if the costs were variable and the poor were in fact more price-responsive, equal time responses would imply a net gain for the poor over a pure price mechanism.

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