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The Affordability of Child Day Care in Massachusetts: A Technical Report

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I. INTRODUCTION

There has been growing recognition of the fact that child care has become an expensive necessity for many families. The Child Day Care Affordability Study was commissioned by the Massachusetts Office for Children in partnership with the United Way of Massachusetts Bay to collect and analyze information about the extent of the child care affordability problem in Massachusetts and to review options for addressing the problem. A report of the findings of this study is available from the Office for Children. This technical report describes the research methods used.

A team of researchers at the Wellesley College Center for Research on Women, working with the Center for Survey Research at the University of Massachusetts, was commissioned to conduct the Affordability Study.

The Affordability Study Team conducted three surveys:

1. Parents Survey: a telephone survey of a random sample of 750 Massachusetts families with one or more children under the age of 13.

2. Survey of Center-based Care Providers: a telephone survey of a random sample of licensed centers.

3. Survey of Licensed Family Day Care Providers: a telephone survey of a random sample of licensed family day care providers.

II. THE PARENT SURVEY

From June 4 to July 2, 1987, the Center for Survey Research conducted a random digit dial, probability sample survey of households in Massachusetts with telephone service that had at least one child age 12 or younger. The 750 telephone interviews were designed to obtain information about the child care arrangements, costs of child care, demand for child care, and affordability of child care in Massachusetts.

Sample

The sample was drawn in a two-stage process developed by Waksberg (1978) that increases the efficiency of the random digit dial survey. In the first stage, a sample of random digits is added to a sample of exchanges. These numbers are called, and interviewers ascertain whether or not the selected number serves a residential household. If so, the cluster defined by the exchange and the first two digits of the telephone number (542-12--) are retained as a cluster. A fixed number of occupied residential housing units is then identified within the hundred possible numbers defined by that cluster (542-1200 to 542-1299). Specifically, a fixed series of random two digit pairs are added to the root so defined. Interviewers call such numbers. If the number so created is found not to serve a residential number, it is dropped and another two digit ending is added and tried until a residential number is found.

Even though the number of working residential numbers in any particular exchange is not known in advance, the basic principle of equal probability or known probability throughout the State is maintained. The only basis on which a number is dropped and substituted is if it is specifically ascertained that a selected number does not lead to a residential unit. If a selected number produces a ring and no answer after repeated calls, the phone company is contacted to find out whether or not the phone is residential. If a number is not definitely determined to be nonresidential or not a working number, it is maintained in the sample and every effort is made to complete the interview with a designated person in the household linked to that number.

At the first stage of selection, all of the exchanges in Massachusetts were included. To each exchange, one 4-digit number was added to create a complete telephone number. These numbers were screened to ascertain whether or not they were residential. The residential numbers were retained. This process produced 449 primary clusters consisting of an exchange plus two digits. Then eight occupied housing units were randomly selected in each cluster, so the sample consisted of 3592 housing units.

Response Rate

The response rate calculations are shown in Table 1 and 2. There are several ways of calculating response rate for this study. First, we can ask in how many of the eligible households were interviews obtained. Of the 809 households that were screened and determined to be eligible, interviews were completed in 737 or 91 percent of them. However, we were unable to complete the screening process to determine eligibility for 172 of the numbers in our

sample. The best available estimate of the eligibility rate for those households is the eligibility rate in the households we did screen. Of those contacted, 23.7 percent had children under 13 and were eligible.

This is probably a high estimate of percent of unscreened households because we were not ever able to contact most of those households despite making more than ten attempts spread across the month. There is reason to suspect that households with children under 13 tend to have someone at home more often than households without children. Regardless, we will use this conservative estimate to calculate response rate. Assuming that the same percent of the unscreened households would be eligible, then 23.7 percent of the 172 households (41 households) should be considered to be eligible and added to the 809 households known to be eligible for an estimated eligible sample size of 850. With 850 as the denominator, the estimated response rate for households is then 86.7 percent.

Of the households we screened, 15 had more than one family with children age 12 or under -- 13 had two families, 1 had three families, and 1 had four families. We were able to conduct interviews with 13 of the 18 additional families, so of the 827 families identified in the sample, interviews were obtained from 750 (90.7 percent). Using the estimation procedure, we can assume that one of the unscreened households would have had an additional family. So the estimated number of eligible families in the sample is the 850 estimated households plus the 18 additional families plus the one estimated additional family. The number of completed interviews with families was 750, so the estimated response rate for families is 86.3 percent.

Table 1
Screening Results and Estimates of
Eligible Households and Families

TOTAL SAMPLE		3592
TOTAL UNSCREENED (5%)		172
Refusal	53	
Language	2	
No Contact	117	
TOTAL SCREENED (95%)		3420
Not eligible (76.3%)	2611	
Eligible (23.7%)	809	
TOTAL ESTIMATED ELIGIBLE HOUSEHOLDS		850

[Unscreened HH X Eligibility Rate]
172 X 23.7% = 41

[Screened Eligible & Estimated Eligible HH]
809 + 41 = 850

Table 2
Response Rate

By Household:

TOTAL ESTIMATED ELIGIBLE HOUSEHOLDS		850
NON INTERVIEWS	113	
Refusal	58	
Ill	1	
Limit	13	
Unscreened	41	
INTERVIEWS		737
RESPONSE RATE		86.7%

By Family:

TOTAL ESTIMATED ELIGIBLE HOUSEHOLDS		869
NON INTERVIEWS	119	
Refusal	59	
Ill	1	
Limit	14	
Other	3	
Unscreened	42	
INTERVIEWS		750
RESPONSE RATE		86.3%

Pretest

Two pre-tests were conducted; one on May 20 and one on May 28. Four interviewers collected a total of 25 pretest interviews.

Briefing

The study briefing took place on June 4, 1987. Twenty-nine interviewers were briefed on the study.

Quality Control

Several steps are taken to maximize the quality of the interviewer's work. All of the interviewers receive a minimum of four days training in general interview techniques. The more experienced interviewers working on the study had also had additional, advanced seminars and have passed written and interviewing tests.

During phone shifts, a supervisor is always present in the room. The supervisor does no interviewing. A systematic sample of each interviewer's work was monitored by the supervisor every shift to ensure the quality of the data collection.

Interviewers called back a minimum of ten times at different times of the day and days of the week in order to contact a difficult-to-reach household or respondent. When we were unable to make any contact with a household after five calls, the number was verified with the telephone company to determine that it was a working residential number. If it was not a working residential number, a new number was selected to replace it. If it was a residential telephone, the number was held until the next week, after which an additional five telephone calls were made to reach the household. We substituted only for numbers which were verified as non-residential telephones or as non-working numbers. We made no other replacements in the sample.

Coding

Survey instruments were set up for direct data entry. Trained coders reviewed the completed interview schedules for completeness, filled in missing data codes, and coded open ended answers. Data were entered directly using a program that checks for wild codes and contingencies. All data were one-hundred percent verified, which means that a second person independently re-entered the data. Any discrepancies between the value at first entry and second entry require a third, confirming entry to be accepted. This means that all data were independently check coded. The coders were closely supervised by the Center for Survey Research Research Assistant on the project.

Sample Characteristics

Survey interviewers spoke with a parent who was knowledgeable about the child's care; 82% of the respondents were female, 18% were male. Families from around the state were interviewed. Eighty eight percent of the respondents were white, 5% were Black, 5% were Hispanic, and 2% were Asian, American Indian or a member of another racial or nationality group. For more information about the data obtained in this survey, see the Report of the Child Care Affordability Task Force, available from the Office for Children.

III. THE DEMAND CURVE

The data from the Parent Survey were used to estimate a demand curve to examine the factors that predict demand. When we ask what determines the demand for child care, we are actually asking three separate questions:

1. Why do some parents use child care, while others do not? That is, what predicts entry into the child care market?

2. What is the demand for different forms of child care, such as center-based care, or family day care?

3. Once parents are using child care, what determines how much child care they consume?

The answers to these three questions are different. While many of the same factors are involved in answering each of these questions, their relative significance, and the ways in which they influence demand, vary. Entry into the child care market seems to be largely a function of maternal employment -- as maternal employment has risen, more families have started to use child care for their children. When mothers are not employed, there is still a demand for child care, primarily for preschool age children, because many parents believe that preschool education is a good educational and/or social experience for their children. Other factors are probably also involved, at least in as much as they influence maternal employment, such as the age of the child, the number of children, the family's income, and the cost and availability of satisfactory child care.

The second question -- what is the demand for different forms of child care -- is not so easily answered. The type of child care a family uses is most likely a function of several factors, including the availability of a given form of care, the cost of any available care, the family's beliefs about what is good care for their child given the age and needs of their child, and general family preferences. Simply knowing a family's preferences is not enough, because families tend to modify their preferences in response to their perceived options, and to change their preferences as their options, and their child's needs, change over time.

The third question -- once parents are using child care, how much child care do they consume -- is one that we have examined in depth, using the information from our parent survey. To answer this question, we will draw on economic theory about consumer behavior. Economics focuses on consumer choices about how much of each market good or service to buy. The consumer is presumed to make purchase decisions, subject to the constraints upon him or her, that will give the consumer more happiness than any other set of feasible choices. The standard constraints which restrict all consumers are income, i.e., how much money we have to spend, and time. The assumptions that consumers desire the maximum attainable happiness allows us to apply constrained optimization mathematical methods to the consumer's general problem, and thus to "derive" a relation between the quantity purchased of each commodity and the elements of the constraints that are important to that particular choice. Ordinarily, the quantity demanded of any commodity depends

and usually the mother) is employed or in school it is very likely that the demand for child care will be greater.

It is sometimes argued that all other things being equal, parents with more education will be more likely to view nursery school or preschool as desirable because of the socialization skills the child will learn there, while parents with less education will be more likely to value relatives as substitute care providers. Therefore, we included parents' education as a variable of theoretical interest.

The age of the child will clearly affect the child's need for care, especially since the sample includes all children under 13, since children 5 and older will be in school programs. Similarly, the number of children under 13 in the household may reduce the demand for child care, since, all other things being equal, families with more children may find it makes more economic sense for the mother to stay home than to go to work.

Other factors may influence how much care is demanded as well. The amount of extra time required to deliver and retrieve the child each commuting day is an additional element of the "price" of child care. Economists measure such an "opportunity cost" as the value of the time lost if it had been spent in another way. The simplest way to arrive at such a value is to imagine that it would have been spent working, so the opportunity cost of a unit of time is the amount of money one could have earned during that time. The argument for using this as a additional cost of child care is that since the adult chose not to work during that time, the adult clearly valued the non-work allocation of time at least as much as the money foregone. Otherwise, the adult would have worked one more hour, or whatever. Thus the adult gave up something of value in order to do the delivery/retrieval that was at least equal to her in foregone wage income.

Finally, the perceived quality of child care will likely influence the willingness of parents to put their children in it for extended periods of time. Table 3 is a more detailed description of the variables we use.

Table 3: Variables in Center Demand Curve

Theoretical Variable	Empirical Measure (Acronym)
QCENT	The total number of hours of center-based care consumed in one week
PCENT	The price of center-based care per hour
HHISTAR	The total income of the household in which the child lives
HHED	The average education level of all the adults in the household
REDS	A binary variable equal to one of the respondent in the survey (the adult knowledgeable about the child's care) is employed or in school
CAGE	The age of the child consuming child care
NKIDS	The number of children under 13 in the household
QL2CENT	A measure of quality, and index of the respondent's rating of 6 dimensions of the child's child care program: the cleanliness of the facilities, the activities of the child while in care, the amount of indoor space, the amount of outdoor space, the way the staff treats the child, and the way the staff treats the respondent. The index is constructed to be larger the happier the respondent is with the program.
PSUBIND	An index of the price of substitute modes of child care (in-home care and family day care). The weights for the index are based on the proportion of children in each type of care. An index of the two major substitutes for center-based care was necessary since the separate substitute prices were so highly correlated that statistical estimation of their separate effects was impossible. The price for each component of PSUBIND was the average price for that type of care in the same OFC region as the respondent.

Table 4 provides summary statistics on the variables used in the center-based demand equation.

Table 4: Summary Statistics for Center-based Demand

Variable Name	Mean	Standard Deviation	Minimum	Maximum
QCENT	16.82	13.25	1.00	47.00
PCENT	2.47	1.31	0.20	8.33
HHISTAR	49.16	26.98	11.00	137.75
REDS	0.73	0.44	0.00	1.00
CAGE	4.02	1.95	0.00	11.00
NKIDS	2.09	0.76	1.00	5.00
QL2CENT	49.39	8.71	13.00	62.00
PSUBIND	2.51	0.67	1.72	3.38

To test these hypothesized determinants of demand, we estimated a center-based demand curve. Table 5 shows the best regression estimate of the demand curve. This estimate of the demand curve for center-based care is quite good, given the combination of relatively few cases and the large number of hypothesized predictors. We are able to explain 42% of the variation in the quantity of care consumed by different children; the overall model is significantly different from zero at the $p < 0.0001$ level of confidence (that is, there is less than one chance in a hundred thousand that the model is not different from zero) and is not due to chance. As further confirmation of the validity of the model, we find that, consistent with the prediction of economic theory, consumers buy more child care as the price declines.

TABLE 5: Estimation Results
for Demand for Center-based Care

F VALUE: 10.608; PROB > F: 0.0001 ADJUSTED R-SQUARE: 0.377

VARIABLE	PARAMETER ESTIMATE	T-TEST	PROB > |T|
Intercept	2.98	4.82	0.0001
LNPCENT	-0.46	-4.14	0.0001
LNHHI	0.25	2.23	0.03
REDS	0.63	4.71	0.0001
CAGE	-0.13	-4.20	0.0001
NKIDS	-0.28	-3.34	0.001
QL2CENT	-0.02	-2.61	0.01
PSUBIND	0.21	2.31	0.02

The price elasticity of demand, a measure of the degree of responsiveness of consumers to price changes, is low, only 0.459%. This means that a 10% decline in price will bring about only a 4.59% increase in demand for center-based child care. This finding suggests that price, while statistically significant in the expected way, is by no means the only or even the most important determinant of the demand for child care. It also suggests that lowering the effective price to consumers will do little to increase the demand for child care, unless the price is lowered by quite a bit.

Other factors are important predictors of demand, including household income, household education, whether or not the respondent (usually the mother) is employed or in school, the age of the child and the number of children under 13 in the household. Household income is significantly positive, with an elasticity of 0.25%. This means that higher income people consume more center-based child care, all other things being equal, but not very much more. The elasticity means that a 10% increase in income will lead to an increase of 2.5% in the number of hours of center-based care consumed.

The average education level of the parents was left out of the final demand equation because it was so highly correlated with income that when both variables were included, neither was significant (a statistical artifact), yet when either was dropped, the other was highly significant and positive. This kind of statistical result can occur when the independent variables are correlated among themselves. However, our best guess is that education does indeed increase the demand for center-based care, but its impact is inseparable from the effect of income.

Other factors were also related to the quantity demanded. If the respondent was employed or in school, the child consumed significantly more child care. Older children had less need for child care, and the households with more children under the age of 13 consumed less center-based child care for any given child.

While we had expected that children in programs that parents evaluated as higher in quality would consume more hours of care, we found instead that, the higher the parent's quality rating the fewer the hours of care consumed. We suspect this reflects the fact that parents who use nursery schools (by definition, part-time care) are more satisfied with the quality of the program than are parents who use full-time day care centers. Because the same parents (with children in nursery schools) use few hours of care and are more satisfied with the quality of care, we find a statistically significant relationship between lower demand (as measured by number of hours of care used) and higher quality; this is not the same as saying that lowering the quality of center-based care would increase the number of hours of care parents would want for their children. It should also be noted that most parents were very satisfied with the quality of the care their children received in center-based care; their major concern was with the amount of indoor space available.

Many other factors were tested and dropped from the final demand equation because they appeared to have no significant effect on the demand for center-

based care. These insignificant factors included the age of the oldest child under 19 in the household, whether or not the child in care received some kind of child care subsidy, the opportunity cost of delivery/retrieval time the price of housing (originally thought to be a complementary good for child care), a quality measure of the adult/child ratio in the child care program, and the region of the state in which the family resides. We believe the factors reported above, and the demand curve based on them, is the best estimate of the factors that are important to parents' decision about how much center-based child care to consume.

The Demand for Family Day Care The determinants of the demand for family day care as suggested by economic theory and the special features of the child care market are identical to those we tested in the center-based analyses. Table 6 is a more detailed description of the variables we use that were not explained above.

Table 6: Additional Variables in Family Day Care Demand Curve

Theoretical Variable	Empirical Measure (Acronym)
QFAM	Number of hours of family day care consumed in one week
PFAMILY	The price of family day care per hour
PH	The price of in-home care -- a substitute for family day care. The price used was the average price of in-home care by a sitter in the OFC region of the state in which the respondent lives
PC	The price used was the average price of center-based care in the same OFC region of the state as the respondent -- a substitute for family day care.

Table 7 provides summary statistics on the variables used in the family day care demand equation.

Table 7: Summary Statistics for Family Day Care Demand

Variable Name	Mean	Standard Deviation	Minimum	Maximum
QFAM	21.73	13.83	4.00	50.00
PFAMILY	1.78	1.03	0.13	4.75
HHISTAR	45.15	26.57	12.00	200.00
HHED	3.94	1.12	1.00	6.00
REDS	0.96	0.19	0.00	1.00
CAGE	3.87	3.33	0.00	12.00
PH	2.74	0.86	2.00	4.43
PC	4.62	4.47	0.28	17.31

While many of the variables are the same as those in the center-based demand curve, the empirical results have some variations on the basic theme emanating from the center-based demand curve that are worth highlighting.

We begin with a brief description of the basic similarities with center-based demand. The overall model for family day care is significantly different from zero at the $p < 0.0001$ confidence level, and 69% of the variation in the number of hours of family day care consumed is explained by the model. Price is significant; more hours of care are consumed at lower prices. These results lead us to conclude that we have an economically reasonable, robust model of the factors influencing the demand for family day care. Table 8 shows the estimation results for demand for family day care.

TABLE 8: Estimation Results
for Demand for Family Day Care

F VALUE: 13.082; PROB > F: 0.0001 ADJUSTED R-SQUARE: 0.642

VARIABLE	PARAMETER ESTIMATE	T-TEST	PROB > |T|
Intercept	-7.66	-1.32	0.19
LNPFAM	-0.17	-1.72	0.09
LNHHI	-0.04	0.27	0.79
HHED	-0.22	-3.47	0.001
REDS	1.38	3.47	0.001
CAGES	-0.11	-5.44	0.0001
PH	0.21	2.64	0.01
PC	0.14	1.81	0.08
OPPCTIME	0.04	2.45	0.02

The price elasticity is 0.171, which means that a 10% reduction in price will induce only a 1.71% increase in the quantity of family day care consumed. Thus family day care consumers are even less responsive to price changes than are consumers of center-based care.

The respondant's employment or school attendance significantly increased the child's consumption of family day care, more than twice as much as it did for center-based child care. Older children consume less family day care at practically the same rate as for center-based care.

There are six differences between family day care and the center-based demand relation. First the prices of substitute care are not collinear in a statistically debilitating way, so were able to discover that child care in centers is considered to be a much closer substitute for family day care than is care in one's own home. We make this deduction on the basis of our estimate of the responsiveness of family day care demand to changes in the prices of center-based care and in-home care. We computed the cross-elasticity of the demand for family day care with respect to the prices of each of these substitute modes of care. We found that the cross-elasticity of

family day care demand with respect to centers is 9.94%, while the cross-elasticity of family day care demand with respect to in-home child care is 0.58%. These elasticities imply that a 10% increase in the price of center-based child care would lead to a 99.4% increase in demand for family day care, while a similar 10% increase in the price of in-home child care would lead to a mere 5.8% increase in the demand for family day care. Thus our equation suggests that family day care consumers are much more responsive to changes in the price of center-based care than they are to changes in the price of in-home care.

The most important differences between family day care and center-based child care demands occur in the effects of household income and household education. First, it appears that income and education are less strongly related to each other among consumers of family day care, that is they are less collinear. This fact allows us to estimate their separate effects simultaneously. Surprisingly, the effect of income is insignificantly different from zero in the family day care equation. This suggests that there is no systematic relation between household income and the quantity of family day care consumed, all other relevant factors being held constant. Our preferred interpretation of this is that the population of family day care consumers is more heterogeneous than that of center-based care consumers. That is, among both high income and low income families using family day care, there are families using many hours of care and families using only a few hours of care.

Interestingly, higher levels of household education are associated with a lower demand for family day care. We suspect this is because of the complex relationship between income and education among family day care consumers. This is best illustrated by examining high income families in detail, since almost all low income families consuming family day care have high school or less education, so there is little variation in demand associated with education. When households with lower levels of education have high incomes, it is only because both parents are working - and therefore need more hours of child care. When households with higher levels of education have high incomes, this can be either because both parents are working, or because one parent can earn a high income alone. These higher education families therefore have more discretion in maternal employment and in the amount of child care consumed. Therefore, we find that higher education families are the only ones who use reduced hours of family day care, explaining the negative statistically significant relationship between education and the quantity of family day care consumed.

There are other differences between family day care demand and center-based demand. First, the number of children in the household under 13 does not affect the demand for family day care in the same significant way as it did for center-based care. Second, no explicit measure of quality appeared to matter to consumers of family day care. Third, the opportunity cost of time spent delivering and retrieving the child <u>did</u> significantly affect the demand for family day care, but not in the way that was expected. A higher opportunity cost of transportation time, which should mean the effective price of day care is higher, apparently <u>increases</u> the demand for family day care. One way of interpreting this result is that travel time is actually a proxy

for the parents' perceptions of quality family day care. Parents, especially higher income parents whose opportunity costs are by definition higher since they forego higher wages, are perhaps willing (and able) to drive a little longer than the average to ensure their child is in a high quality family day care setting. Another possible interpretation is that family day care homes are less likely to be located in higher income neighborhoods, so that higher income parents (with higher opportunity costs) are forced to drive further to find family day care for their child. Both of these hypotheses are consistant with the data, but must be considered tentative at this stage of our understanding of family day care markets.

We examined the importance of other factors as well. Relatively few respondents knew if their family day care provider was licensed, but among those who did, the fact of licensure made no statistical difference in the amount of family day care consumed. As in the center-based equation, we tested for the effect of regional differences in family day care consumption across the state and found none. Finally, whether the family day care provider care only for the respondent's children was tested and found to be insignificant. We believe the factors reported above, and the demand curve based on them, is the best estimate of the factors that are important to parents' decision about <u>how much</u> family day care to consume.

<u>Summary</u> We were able to identify several factors that determine <u>how much</u> child care will be consumed. In general, when the price of care is lower, when the respondent (usually the mother) is employed or in school, and when the child is younger, children consume more hours of center-based care or family day care. In addition, among users of center-based care, children use more hours of care when their family income is higher, and they use less care when there are more children under the age of 13 in the family. Equally important, we found no differences in the amount of care consumed, other things being equal, between the different regions of the state. In addition, receiving a subsidy did not increase the number of hours consumed by individual center-based users, and using a licensed provider did not increase the amount of care consumed by individual family day care users, all other factors being equal.

IV. THE PROVIDER SURVEYS

The provider surveys consisted of telephone interviews during the months of June and July to collect the data that we needed to estimate cost functions for centers and family day care. Data for centers were collected mainly in June; data for family day care providers were collected mainly in July. Our sampling frames were the list of licensed centers and licensed family day care provided to us by the Office for Children (OFC). The lists from OFC covered all six regions in Massachusetts.

To obtain our sample for centers, we took a ten percent random sample of centers on the OFC list excluding centers affiliated with Head Start. This gave us a sample of 170 centers. Out of the 170 centers in our sample, 11% were closed for the summer, and therefore could not be included in our survey. We interviewed 76% of the remaining centers; 11% refused to be interviewed and 11% could not be contacted for an interview for a variety of reasons.

To obtain our data for family day care providers, we took a 2% random sample from the OFC list of licensed family day care providers. Out of the sample of 178 family day care providers, 35% could not be interviewed due to a change in address, exit from the day care business, or possession of a license, but failure to begin operations. We were able to achieve a solid response rate of 84% for the remaining providers in our sample. Only two percent of the providers remaining in our sample refused to be interviewed. Another 14% could not be reached.

It is necessary to stress that our sampling frame covered only licensed day care providers; hence, it does not accurately reflect the total market supply.

Center-based Care

According to our survey of centers, the average center has 51 children attending. Almost all surveyed centers (94%) serve preschoolers and almost half (42%) serve toddlers. Only 1 in 5 serve infants, and 1 in 5 serve kindergartners. Fourteen percent of surveyed centers also provide care for school age children.

The average center has 7 full-time staff and 3 part-time staff; labor costs constitute approximately 76% of the budget. On average, 13% of a child care center's staff have master's degrees, 36% have bachelor's degrees, 15% have associate's degrees, and 36% have high school educations or below. However, over half of all centers do not have any staff with associate's degrees; similarly over one fourth of centers do not have any staff with a master's degree. On average, sixty five percent of the staff have completed four college level courses in early childhood education. Seventeen percent of the staff have 1 to 2 years of experience in child care, 33% two to five years, 25% five to ten years and 25% have less than one year of experience in child care.

Licensed Family Day Care

The typical licensed family day care setting provides care for 5 children, for an average of 22 hours of care each week for each child. The average family day care provider cares for one child under the age of 2, three preschoolers and one school age child. The provider has eight years of experience in child care, including experience as a parent as well as experience as a day care provider, and a high school education. She has two children of her own, one of whom is at home during the day.

Overall, 58% of licensed family day care providers care for preschoolers, 28% care for children under the age of 2, and 14% care for school age children. About 1 in 5 have less than 4 years experience with children, including experience as a parent; one third have from 4 to 12 years of experience, and 44% have 12 years or more of experience.

V. THE SUPPLY CURVES

To model the supply of day care, we begin with the economic theory of cost and production. This economic model of production indicates that the level of output produced will be a function of the level of inputs (e.g., capital and labor) used and the nature of technology. The economic model of firm costs is intimately related to the theory of production. Production and cost functions are said to be dual to one another or in lay terms to be two sides of the same coin. One can learn all important facts regarding production technology (e.g., information on economies or diseconomies of scale) either by estimating the cost or the production function. We chose to study the way in which child care is produced using a cost function since it is in the costs of day care that we are primarily interested.

A total cost function relates the level of total expenditures (denoted TC) of the firm to the cost of inputs (denoted p), the level of output (denoted Q) and the nature of the technology used in production (reflected in the functional form f). Formally,

$$TC = f(Q,P).$$

This very simple cost model must be altered in order to reflect important aspects of day care provision. The model assumes that firm output is homogeneous and that all differences in factor inputs are fully reflected in their prices. Further, the model implies that technology is not embodied in the factors of production. Neither output nor inputs can be considered homogeneous where the day care industry is concerned. A better educated and experienced staff may imply different total costs than a less educated staff, even when we have controlled for wage level. The output of day care providers is not homogeneous. The way in which day care is provided (the technology of day care production in economic jargon) may depend critically on the level of education and experience of the staff, i.e., the technology of day care production may be embodied.

Economic theory suggests that only certain functional forms are admissable for a cost function. Specifically, it suggests that we use a functional form that will allow returns to scale to be at first increasing and then decreasing. To allow for this possibility we enter the level of output (i.e., the number of hours of child care provided) in a linear, quadratic and cubic form. Economic theory also suggests that we enter factor prices in a form that will allow for diminishing marginal physical product. To reflect this we enter the price of labor and the price of capital as logged variables. We enter all other variables in our model in a simple linear form.

Center-based Care

Due to the radical differences in the way in which centers and family day care operate, we estimate separate models for these two types of day care provision.

We derived total costs for every center after consulting each center's director in order to construct a yearly budget constituted of food, supplies, labor, capital, transportation, utilities, phone, liability insurance, and other miscellaneous expenses. To obtain total costs we sum all budget items.

Our measure of the output of a center is the total number of child hours provided by the center during a year. One child hour consists of one hour of care one child receives. Total child hours are represented by the summation of the total hours each child spends at the day care center during the year. The price of labor is the center's total labor expenses which consist of personnel costs, fringe benefits, and payroll taxes divided by total paid staff hours. This variable appear in the cost function in logged form.

The total cost of capital for a center includes the rent or mortgage payment, utilities, and maintenance and repair costs for those rooms used for center operation. We derive a per room capital cost by dividing total capital costs by the total number of rooms in use. In computing capital costs, additional weight is given to classrooms, while reduced weight is given to office space. We do this by running a regression using the rent or mortgage payment as the dependent variable, and the number of classrooms and offices as independent variables. We enter the log of this measure of the price of capital in our cost function.

Since a fairly large portion of day care centers receive capital subsidies through the donation of free or low-cost space in churches, schools, etc., and/or free utilities, we create a variable that takes into consideration whether a center is receiving a capital subsidy. Subsidies would be expected to lower an operation's costs and increase its profits if the operation were seeking to maximize profit. It is not clear how such subsidies will affect nonprofit operations which are the primary type of centers which receive capital subsidies. Nonprofit centers may use subsidies to provide higher quality care or to increase the number of children they serve or in any number of other possible ways.

Following previous studies, we measure the quality of center care provision by the ratio of paid staff hours per week in the classroom to the number of weekly child hours. However, we depart from previous studies in recognizing that child hours are not all equal. To reflect this, child hours are weighted according to the group ages of the children at the center by regression analysis using paid staff class hours as the dependent variable and the total in-class hours of infants, toddlers, preschoolers, kindergartners, and school age children, individually.

We also include measures for the education and the experience of center personnel. These variables may relate either to the quality of day care provided or to the way in which day care is provided (i.e, they may reflect embodied technology).

Since costs depend on the degree of special and attentive care required, it is necessary to account for the type of children cared for by the center. We control for the proportion of children who are infants, toddlers, preschoolers

and school age children. Further, we control for the proportion of special needs children at the center.

It has been suggested that contracting with the state increases the administrative costs of centers. To evaluate this suggestion we include a variable reflecting the proportion of children at the center in Department of Social Service (DSS) slots.

One would expect effective parental participation in a program to decrease the costs of operation. However, we do not know how effective parental participation is nor do we know how a center responds to parents participation in or contributions to a center. To explore issues related to parental participation, we have created a variable that accounts for the number of hours a week parents contribute to a day care program. This variable is a ratio of the number of hours parents volunteer their time plus the number of volunteer hours other people contribute to the program divided by weekly paid staff hours. We also include a dummy variable for whether parents provide food for their children when the children are at the center.

A for profit center would be expected to operate differently than a non-profit center. Consequently, we include a dummy variable for whether the center is non-profit or for profit.

Costs may also depend on the location of the center. Since we have controlled for the price of capital and labor, regional affects would have to come through the price of other inputs or differences in technology that we have not controlled for with other variables in our model. Table 9 is a more detailed description of the variables we use in the estimation of the cost equation for center-based care.

Table 9: Variables in the Cost Equation for Centers

Theoretical Variable	Empirical Measure (Acronym)
Total Costs	Total costs of each center per year (totexp)
Child Hours	Summation of the total number of hours each child spends at the center (chrs, chrs2, chrs3)
Price of labor	Personnel costs including fringe benefits and payroll taxes per hour (llabor)
Price of capital	Capital costs including rent or mortgage, maintenance and repairs, and utilities per room (lcapital)
Capital subsidy	A binary equal to one if the center has either zero building or utility cost and zero otherwise (csubsidy)
Quality	Ratio of paid staff class hours to child hours, weighted for the ages of the children (quality)

Master's degree	Ratio of number of staff with master's degree to total number of staff (rmas)
Bachelor's degree	Ratio of number of staff with bachelor's degree to total number of staff (rbach)
Associate's degree	Ratio of number of staff with associate's degree to total number of staff (ras)
Early childhood ed.	Ratio of staff with four college level courses in early childhood education to total number of staff (rfour)
Experience of staff	Ratio of the staff with between 1 and 2 years of experience to total staff (exp2)
	Ratio of the staff with between 2 and 5 years of experience to total staff (exp5)
	Ratio of the staff with between 5 and 10 years of experience to total staff (exp10)
	Ratio of the staff with over 10 years of experience to total staff (expov10)
Proportion of infants	Number of infants / total number of children (rinf)
Proportion of toddlers	Number of toddlers / total number of children (rtod)
Proportion of preschoolers	Number of preschoolers / total number of children (rpre)
Proportion of school age children	Number of school age children / total number of children (rsch)
Proportion DSS slots	Ratio of number of DSS slots to total number of slots (rdss)
Proportion of special needs children	Ratio of number of special needs children to total number of children (rspec)
Volunteer hours	Ratio of unpaid hours to paid staff hours (volhrs)
Non-profit	A binary equal to one if the center is non-profit and zero otherwise (nprof)
Parents provide food	A binary equal to one if the parents provide food for the children while they are at the center (fpar)
Regions	A set of binaries for location of center. E.g., A binary equal to 1 if in Region 1 (reg1), A binary equal to 1 if in Region 2 (reg2), and so on.

The Determinants of Center Providers' Costs

In this section, we explore the determinants of the costs facing day care center providers. It is important to emphasize that we are not examining the determinants of the fees charged to parents (or to the state), but the actual costs faced by providers. This is an extremely important topic if one is to understand the price that parents must pay for day care.

To date there has been very little research regarding day care providers. By conducting original surveys, we are able to explore the factors affecting the costs of day care providers. The research reported here is exploratory. However, we are convinced that it is the best work conducted to date.

Our results for centers indicate that the costs of providing day care will be higher if the quality of day care (as measured by the total number of hours the providers spend in the classroom per child hour -- weighted for the age of the child), the proportion of toddlers, the proportion of DSS slots, the proportion of special needs children and the wage rate are higher. Costs are also higher in the western region of the state (Region 1). Costs for all other regions of the state are not significantly different from one another once differences in the cost of capital and labor are controlled.

We also examined whether costs were lower for centers that were located in space for which they paid no rent or for centers where parents provide food. In fact, these two characteristics of centers are related to higher costs. It is possible that providers use the savings from not paying rent to cover other costs, rather than to reduce the price to parents. These other costs may be reflected in higher quality care -- which our measures of quality were not able to adequately pick up -- and parents are willing to pay more for higher quality care.

We found that only one characteristic of center employees has a significant effect on center costs. Specifically, a higher proportion of staff with an associate's degree will lower the costs of the center, all other factors held constant. The proportion of the staff with bachelors and masters degrees and with various levels of experience in child care has no significant affect on center costs.

We found a curvilinear relationship between center costs and the number of hours of child care provided annually. Estimated center costs per child hour (average costs to economists) range from an estimated $2.15 for a small center providing only 40,000 child hours per year to a low of $1.84 for a center providing approximately 80,000 hours of child care per year[2]. For centers providing more than approximately 80,000 child hours per year, costs rise. For example, a center providing approximately 200,000 child hours per year will have average costs per child hour of approximately $2.30. We can say nothing

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[2] As an example, a center providing care for 20 children for 40 hours a week each, for 50 weeks a year would be providing 40,000 child hours of care per year (20 x 40 x 50).

definitively about the costs of very large child care centers (those providing more than approximately 200,000 child hours per year) since we had only one such center in our sample.

After considering all of these factors, we found that for-profit centers' costs are not significantly lower than non-profit centers' costs, nor are the proportion of total staff hours provided by volunteers significantly related to costs.

In summary, for day care centers, higher costs are associated with higher quality (as evidenced in a higher staff/child ratio), serving a higher proportion of toddlers, providing DSS contracted care, serving a higher proportion of children with special needs, and higher unit labor costs. There are economies of scale for centers providing fewer than 80,000 hours of child care per year[3] -- after that point, larger centers actually mean higher costs per unit of service.

Marginal Cost Curve for Center

We are interested in the supply of child care by centers. If center based child care is operating as if it were in a competitive market, the supply of child care would be equal to the marginal cost curve for centers. Figures 3 and 4 give the marginal cost curve implied by our total cost function for centers. Note that this marginal cost curve is upward sloping as one would expect a supply curve to be. Note that marginal costs start at below $.10 per child hour and rise to a high of $2.90 per child hour. At the median, the marginal cost curve implies an elasticity of supply of approximately 1, indicating that a 10 percent increase in the quantity of child care will lead to a 10 percent increase in price.

All of the above seems reasonable and consistent with our use of the marginal cost curve as the center supply curve. However, there is one disquieting note. Under the competitive model, firms are seen as equating marginal costs and average revenue. For the centers in our sample, this is clearly not occurring, at least at higher levels of average revenue. The minimum average revenue received for an hour of care by a center was $.28 and the maximum received was $12.81. For higher receipts, firm marginal costs are clearly below firm average revenue. This suggests that the competivis model is not fully applicable for day care centers and that a full understanding of the supply of day care by centers will require simultaneous estimation of supply and demand. However, for the purposes of the Affordability Study, we have assumed that the center supply curve is equivalent to its marginal cost curve.

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[3] As an example, a center providing care for 40 children for 40 hours a week each, for 50 weeks a year, would be providing 80,000 child hours of care per year (40 x 40 x 50).

Family Day Care

It is much more difficult to study the costs and supply of family day care than it is to study these matters for centers. One reason is that family day care is often very informally organized and there is seldom a pre-established budget. In addition, since care takes place in the home of the provider, it is often difficult to separate those costs attributable solely to day care production from those which would exist even if there were no provision of day care.

In family day care, the distinction between non-profit versus for profit is not made. The revenues that the provider takes in through parent fees, state food subsidies, and from state agencies are used to pay out of pocket costs with any remaining revenues going to the day care provider. These revenues can be conceived of as composed of labor payments (to the provider), capital payments (for the use of the provider's home and equipment) and economic profit (or loss). It is very difficult to separate out labor and capital payments from economic profit or loss, and, thus, to obtain any sort of meaningful price for capital or labor. We begin by assuming that the totla revenue of the day care provider are equal to costs. When doing this we are implicitly assuming that there are no economic profits or losses.

As in the center-based empirical equation, in the family day care equation we include the variables: child hours, child hours squared, and child hours cubed for the measurement of output. We began by calculating a price of labor by subtracting all of the provider costs, including relevant housing costs, from her total revenues. This approach did not prove reasonable. Of the 97 family day care providers in our sample only five providers would have had positive labor income if we include relevant housing costs in total expenditures.

It is evident that family day care providers do not account for the capital costs of running a day care business in their homes. Most family day care providers have an additional source of income, and often the main reason a provider decides to go into the family day care business is simply to stay home with their own children while they are young. Indeed, 56% of the providers in our sample have children under twelve. Because of these peculiarities in family day care, we decided to estimate a "cash flow" or "out-of-pocket" cost equation which only includes the extra expenses a provider incurs as a result of day care production.

Our measurement for quality is slightly different for family day care providers. We use the number of years the provider has been a parent and the number of children the provider has in order to measure quality. If the provider has no children, we use the number of years the provider has taken care of other people's children. We also use the educational level of the provider as an indicator of quality.

Licensed family day care providers are only allowed to care for six children at one time. If any of their own children are under twelve and are at home for more than three hours a day while the other children are present, they must be included among the six children in care. We include a dummy

variable for whether the provider's children are at home, since the joint production between "own" child care and "market" child care is believed to drive down the equilibrium wage rate. We also include three variables for the proportion of infants, the proportion of preschoolers, and the proportion of school age children.

In order to avoid paying income taxes, some family day care providers do not report their earnings from their day care business on their tax returns. Out of 97 providers in our sample, 11 did not report their earnings. A dummy variable has been created to reveal whether or not a provider reports her earnings. Another dummy variable is included describing whether the provider has received any donated equipment in the last six months since donations should decrease the cost of operation.

As in center-based care, the area in which the business is located affects the costs to the provider. We have included five variables to indicate the various regions where day care providers in our survey are located. These regional binaries are defined precisely as they were for centers and, hence, are not defined in the table that follows.

Table 10 includes the theoretical variables for family day care, empirical measures, and the acronyms when the variable for family day care is not defined precisely as it was for center based care.

Table 10: Variables for Family Day Care

Theoretical Variable	Empirical Measure (Acronym)
Total Costs	Total out-of pocket costs per year of operation (totexp)
Child Hours	Summation of total number of hours each child spends in the provider's home per year (chrs, chrs2, chrs3)
Price of Labor	Revenues minus out-of-pocket day care expenses per hour (llabor)
Experience	Number of years provider has been a parent or number of years provider has taken care of other people's children (experch)
Number of children of caregiver	(ownch)
Education	A binary variable equal to one if the provider has less than a high school education (lthseduc)
	A binary variable equal to one if the provider has a high school education (hsgrad)
	A binary variable equal to one if the provider has some college but has not graduated from college (scoll)
Infants	The proportion of infants (rinf)
Preschoolers	The proportion of preschoolers (pre)
School age children	The proportion of school age children (sch)
Provider's children at home	A binary equal to one if the provider's children are at home during the day (ownhome)
Donations	A binary variable equal to one if the provider has received donated equipment in the last six months (donate)
Taxes	A binary variable equal to one if the provider pays income taxes from earnings from day care business (taxes)

The Family Day Care Supply Curve

We tried a number of different approaches to modeling the provision of family day care, none of which proved successful. We began our analysis of

family day care by estimating an equation in which the total payments to the provider (denoted totexp) was the dependent variable. The results of this analysis imply an average cost curve which is unreasonable.

We next estimated a "variable" cost function in which the dependent variable was the providers out-of-pocket costs. Our results suggest that the out-of-pocket costs of the family day care provider will increase as the number of hours of child care increases, but at a decreasing rate. This total variable costs function does not imply a reasonable form for the average variable cost function; it also implies an unreasonable form for the marginal cost function which is declining throughout the range of observed child hours. This would imply that an increase in the number of child care hours would actually decrease price which is not admissable by economic theory nor observed in the market.

In a final attempt to understand the supply of day care for family day care providers we attempted to estimate a supply curve directly. Our results imply a negatively sloped supply curve. We attribute the results to bias as a result of the simultaneous determination of supply and demand. The coefficient on price in the "supply" equation is negative which is not consistent with either economic theory or casual observation of the way markets operate.

It is quite clear that we do not at this time understand the provision of family day care. We believe that an adequate model for this type of care is most likely to come from the labor economics, a model for joint production, the educational production function, or the entrepreneurial or rationing literatures. It appears that estimation of the supply curve for family day care will require the use of a sample of matched suppliers and demanders and a simultaneous estimation technique. Time and budget constraints did not allow us to do so in this study.

Start-up Costs

Although the primary purpose of this study is to predict a family day care provider's total operating costs, something should be said about a provider's start-up costs. As part of our interviews with family day care providers, we collected data on the start-up and equipment costs of family day care providers. Because some providers started operations only a year ago and others almost 27 years ago, we decided to estimate what providers can expect to pay, in 1987 dollars, if beginning a family day care operation today. Utilizing data only for those providers beginning operations since 1981, we calculated the net present value of all equipment costs and start-up costs for 67 family day care centers, using the long-term 20 year risk-free bond rate (9.16%) as the interest rate and taking into account an average inflation rate for the period from 1981-1987. Our results show that an average family day care provider's fixed costs are approximately $830, although there is a fairly large variation in fixed costs. Half of the providers reported costs of $335 or less (including 12 providers with no costs); 25% of the providers reported costs of $975 or more.

VI. THE BENEFIT ANALYSES

Child care services are, like most other services, contracted for and exchanged in a market. The child care market has some unusual features -- (1) the ultimate consumers, children, are neither paying for nor choosing the services; (2) there is a large non-profit sector supplying child care services for pay and thus competing with for-profit enterprises -- but the purchase of child care is a market exchange nonetheless. This fact allows us to use the tools of economic theory, supplemented with adjustments for the unusual features, to analyze the basic features of the child care market and to predict the outcome of alternative options for making child care affordable.

The steps of this analysis are:

1) Use economic theory and the data from the survey of parents with children under 13 to derive a demand curve, i.e., develop an understanding of which factors influence the decision to purchase child care, and by how much;

2) Use economic theory and the data from the surveys of providers to derive a supply curve, i.e., develop an understanding of which factors influence the costs of providing child care, and by how much, in order to predict the willingness to supply child care services under various policy options;

3) Combine the knowledge of the demand and supply relations and simulate the impact of various policy options on individual consumers' choices and on market prices in general;

4) Estimate the dollar value of those policies to consumers of child care.

Policy Options

To examine the economic benefits to individuals, we selected three options of particular interest: two versions of an expanded sliding fee subsidy program like DSS' contracted care and Employment and Training's Voucher Day Care, and a Massachusetts income tax credit for child care. Sliding fee subsidy programs, like the two examined here, are generally acknowledged to be an effective tool for making child care affordable for income eligible families, while tax credits are considered to be particularly useful to moderate income families.

Sliding Fee Scale Subsidy Program #1

The current Sliding Fee Scale used by the Department of Social Services (DSS) for its contracted care slots covers families whose incomes are below 70% of the median income for their family size; once families are in contracted care, they may stay in until their incomes rise above 115% of the median. Sliding Fee Scale Subsidy Program #1 (hereafter Subsidy #1) is just the current sliding fee scale from DSS, except that <u>all</u> families with less than or equal to 115% of the median income for their family size are assumed to be eligible, regardless of whether or not they were participating in the

program when their income was below 70% of the median. The same maximum payments by the state per day for each age of child and type of care that are currently in effect are presumed to remain in effect.

Sliding Fee Scale Subsidy Program #2

The second Sliding Fee Scale Subsidy Program (hereafter Subsidy #2) is a hypothetical extension of the current maximum sliding fee rates to households less than or equal to 135% of the median income, adjusted for family size.

Income Tax Credit Program

The tax credit program is modeled on the federal child care expense tax credit schedule, with 1/3 of the federal tax credit allowed against the household's Massachusetts state income tax bill. If the allowable tax credit exceeds the household's state income tax bill, the difference is assumed to be refunded to the household. Details of the Federal Child Care Tax Credit can be found in Appendix E. Of particular note are the eligibility requirements. If both parents are present, then both must work or be full time students to be eligible, and the amount of the credit claimed cannot exceed the income of the lower earning spouse. If only one parent is present in the household, then the amount of the credit claimed cannot exceed the income of that parent. These eligibility restrictions reduce the effectiveness of the tax credit in helping lower income families, especially those with spouses who work part-time, despite the progressive nature of the tax credit schedule. It should also be noted that the tax credit program applies to consumers of in-home and any work or school related child care, not just to the consumption of center-based and family day care.

The three alternative policy options that we will discuss are obviously different, but there is one common feature of each analysis that bears mentioning at the outset. Each of the three options is a price subsidy. They lower price to the eligible consumers of child care by assuming the state government or some other third party will make up the difference to the providers of child care services. The "real world" complication is that this effective lowering of the price of child care to consumers will engender some increase in the demand for child care. The difficulty with this is that providers cannot be expected to supply increased quantities, in general, without an increase in price. We factor this into our analyses by bringing the information we learned about the supply and demand for child care together, and predicting the extent of the net market price increase. That increase is factored into the net benefit calculations for all consumers, especially those not eligible for the subsidies. For those who are ineligible for the sliding fee scale subsidy programs, the implementation of these programs will reduce their economic welfare, since they will have to pay higher prices for child care than they did before the subsidies were made available to the target groups.

We draw on economic theory and mathematics to derive the measure of net economic benefits -- an estimate of the dollar value of those policies to consumers of child care. See Hausman (1981) for a careful explanation of why this measure is preferred to other measures typically used in cost-benefit

studies. In practical terms, the main advantage of the measure of economic benefits that we employ is that it allows us to discover the net economic effect on each consumer; thus we can tell which policies help various income classes, and by how much. The other measures, aside from being seriously inaccurate for items that make up as large a percentage of the typical household budget as child care, can only tell us the value of economic benefits in the aggregate for all citizens in the commonwealth.

Essentially what we can do with our data is to infer an answer to the following question for each consumer: "IF we subsidize child care, how much income would you have to forfeit/receive to remain as happy as you are now, that is, how much is the subsidy worth to you?" Those consumers who were eligible for the subsidy will be better off after the subsidy and those who were ineligible will be hurt by the subsidy. The economic benefit to individual consumers from the policy as a whole is the summation across the entire child care consumer population of each person's answer to this question.

Methods

Computer algorithms using Fortran 77 language were written to make the cost and benefit calculations on the relevant observations in our data set. But to extrapolate from these checkable calculations to the population at large in order to estimate commonwealth-wide costs and benefits requires some important assumptions. The purpose of this section is to make those assumptions and the steps actually followed explicit. Similar procedures were followed on each policy option, so a general description of the process is possible. We will use a subsidy option to illustrate.

First the subsidy policy algorithm was run with the consumer data set (all children for whom we had complete information) to get an estimate of the net increase in demand that would be forthcoming from the subsidy if there were no increase in price due to increased aggregate demand. The algorithm was designed to discover how much the price would change for each consumer, and the estimated elasticity of demand (for center-based care or family day care, which ever was appropriate) was used to predict that consumer's gross increase in quantity demanded. These increases were summed across all consumers to discover the gross increase in aggregate demand.

Second, this gross percentage increase in demand was factored into the estimated supply elasticity to discover our best estimate of the increase in market price, as distinct from the subsidized price, of child care. This is an important effect for three reasons. First, all consumers not eligible for the subsidy will have to pay this higher price, and this is the source of their reduced economic wellbeing. Second, some consumers who are eligible may find that the degree of their subsidy is reduced by this price effect. This could happen with the sliding fee scales if a market price went above the state maximum payment level for that consumer, causing the consumer to have to make up the difference to the provider. It In fact, exactly this would happen to everyone in the tax credit program. Third, it will definitely matter to the state's costs, for the state will on most occasions pay the difference between the market price and the sliding fee scale price charged the parent.

Because the cost function was appropriately estimated as a non-linear function, the supply elasticity varies at each level of output. Two natural choices are to assume the increase in demand occurs at either the median-sized provider or the mean. In each policy's case, the gross percentage increase in aggregate demand was less than the percentage difference in size between the mean and the median provider. Therefore we used the average elasticity of supply between the mean and median-sized center. Since the supply function for family day care turned out to be too complicated to enable us to get reasonable results with a simple economic model, we used the center's elasticity of supply in our estimate of the price effect of family day care as well. The alternative was to assume that there would be no price effect if demand increased for family day care. For this to be true, existing providers must all be willing to expand the number of children they care for at no increase in price per child hour. We feel this happy occurrence is highly unlikely, and so we used the center-based elasticity of supply as a proxy.

Once the estimate of the net increase in market price is determined, another algorithm was employed to compute the costs to the subsidizing agent if the policy in question applies only to the consumers in our sample. This second algorithm also set the final price appropriate for each consumer. With the final prices likely to be faced by each consumer and the information from the estimated demand curve, a final algorithm was invoked to determine the amount of economic benefits for each consumer, by income category.

At this point we have computed the costs and benefits of a particular policy option for our sample. We extrapolated to the population at large in the following way. We calculated a weight per child, based on the sampling techniques used and 1986 Census figures, adjusted for noninterviews. Our algorithm produced a calculation of what this subsidy cost on average for the children in our sample, for each income category. Using the weights, we then estimated the number of consumers in Massachusetts (children) in each income category using center-based care (or family day care, as appropriate), and multiplied this number by the average cost per child in that category. We repeated this procedure to extrapolate the benefits for the entire state, based on the average benefit for a consumer in a given income category in our sample.

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