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Household and Community Determinants of Infants' Nutritional Status in Argentina[**]

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Abstract

About twenty five percent of Argentine children living in urban areas are stunted —ten percent of them severely stunted. In this paper we use the theoretical framework of an infant health production function to estimate the determinants of children's nutritional status there. Our main objective is to establish the role of household and community characteristics in the determination of infant nutritional status; the objective is thus to identify the kind of public policies and investments that have a potential for curbing urban infant malnutrition. We estimate the household production function as well as the household demand for the inputs that enter into that production by resorting to a two-stage probit least square procedure. Our main results are that household access to refuse collection services, maternal access to health care during pregnancy, and the fertility record and age of the mother are the main household determinants of infants' nutritional status. Access to health care, access to refuse collection, fertility, and age of mother at birth of child in turn depend not only on family characteristics —such as parents' education, household income, mother's access to health insurance, and distance to nearest medical facility—, but also on community characteristics such as the rate of unemployment, the supply of medical services, and the disease environment in their communities. We are thus able to identify and discuss the policies which should be promoted to curb infant malnutrition in urban areas of Argentina.

JEL classification: I12, I18, D13

Resumen

Casi un cuarto de los niños que habitan zonas urbanas de Argentina sufren desmedro o baja talla para su edad –10% de ellos la sufre de manera severa. En este trabajo usamos el marco conceptual de una función de producción de salud infantil para estimar los determinantes del estado nutricional de los niños argentinos. Nuestro principal objetivo es estimar la importancia de las características del hogar y de la comunidad en la determinación del estado nutricional de los niños; el objetivo es entonces identificar las políticas públicas con potencial para disminuir la incidencia de la desnutrición. Usando un modelo probit MCO en dos etapas estimamos la función de producción de salud infantil y las demandas por los insumos de salud de los hogares. Nuestros resultados indican que el acceso de la madre a los servicios de salud durante el embarazo, el acceso de la familia a un sistema de recolección público de basuras, una baja fecundidad de la madre *y una mayor edad de ésta afectan positivamente la salud infantil. Acceso a salud, higiene pública, baja fecundidad y mayor edad están a su vez determinados no sólo por las características del hogar —como el nivel de educación de los padres, el ingreso familiar, el acceso a seguros de salud y la distancia a la unidad médica más cercana— sino también por las características de la comunidad como la tasa de desempleo, la oferta de servicios médicos, y las tasas de mortalidad infantil. Podemos identificar de esta manera las políticas públicas que deberían ser promovidas para reducir la tasa de desnutrición infantil.*

Clasificación JEL: I12, I18, D13

Introduction

One in every four infants suffers from malnutrition in urban areas of Argentina. The gradual impoverishment of the urban population has been one of the main phenomena of Argentine society and economy in the last fifty years. Urban poverty started to grow in the mid 20th century; the urban poor account nowadays for about 50% of the total population. The areas where the urban poor live are characterized by inadequate housing, insufficient urban infrastructure, and soaring crime and unemployment rates; a large portion of this population is under direct assistance (and political control) of the government. This situation coexists, sometimes side by side, with enclaves of high income households living in guarded communities.

In this situation it is not clear which the main determinant of infant malnutrition is, the impoverished household or the chaotic community. Rightist politicians tend to put the blame on household organization while leftist politicians tend to put the blame on the way the community is organized; their public policy proposals follow from these beliefs.

In order to design a sound policy to curb malnutrition among urban infants we thus need to clearly establish the role of the community and the household in the determination of infants' nutritional status. For instance, what is the role of community-wide characteristics such as the health system and the sanitary infrastructure in the determination of infant nutritional status? Are they important at all, or is it a problem that must be dealt with at the level of the household? Is the overall unemployment rate what matters for infant malnutrition or is it the employment status of the head of the family which matters more?

The objective of this paper is therefore to establish the impact of household and community characteristics on the nutritional status of urban children in Argentina. In our analysis we follow the economic theory of household production There have been few attempts to estimate home production functions of infant health in developing countries, and this is the first one done for the case of Argentina.

When applied to the analysis of the determinants of the nutritional status of infants, household production theory considers infant health status as the "product" obtained by operating a home production technology with "inputs" such as parental time and goods and services purchased in the market —medical services, housing, food and clothing, etc.— together with biologically-determined variables —mother's age and health status, etc.

The demand for these inputs depends in turn on several measures of "prices" and "incomes" which are not at all uniform across households; in this sense it is that we speak of "shadow prices" and "shadow incomes". These price and income measures depend mainly on the household and the community characteristics wherein infants dwell, and are proxied by these characteristics in the econometric estimation of the household production function.

The main household characteristics that one would expect to influence the demand for the inputs used in the home production of health are parental income, educational attainment, and access to health insurance and medical services. Among the main community characteristics we could list public health spending; the quality and quantity of public health services and sanitary infrastructure, as well as socio-economic conditions such as the unemployment rate and the quality of the disease environment.

In other words, household production theory dictates that certain types of demand and production functions should be estimated in order to understand the role of household and community characteristics on the determination of infants' nutritional status.

The technical challenge that this prescription poses is daunting. The main problem is that we cannot use OLS (Ordinary Least Squares) to directly estimate the relation between production and its inputs for a cross-section of households. The estimated parameters would be biased because both infant health and the inputs that enter into its production are arguments in the utility function (preferences) of the household. Moreover, as many variables are actually unobservable —*e.g.* mother's health status, infants' physical and psychological traits, and other family "endowments"— the demand for inputs might vary from one household to another for reasons unrelated to the shadow prices and incomes mentioned above and thus originate an heterogeneity that could affect the robustness of the results. Summarizing, the variables "on the right hand side" of the regression are *endogenous* to the model and OLS does not produce unbiased estimations of the parameters.

As a consequence we must resort to IV (Instrumental Variables) schemes to estimate home production models. The unavoidable reference here is Rosenzweig and Schultz (1983). The key to correctly estimate these models is the availability of a set of instruments for the endogenous variables. For developing countries, like Argentina, it was not until the early 1990s that socio-economic surveys render household level data accessible to researchers. Thus, there is no previous literature on the topic for the case of Argentina. There are, no doubt, empirical studies of the determinants of infant health but they do not distinguish between endogenous and exogenous determinants nor do they deal explicitly with the relation between them.

We estimate our infant health home production function from data collected in the Social Targets Module (Módulo de Metas Sociales) that was added exceptionally to the regular forms of Argentina's Urban Labor and Income Survey (EPH) of May 1994. We also resort to National Health Statistics for the case of community-wide variables.

The paper is organized as follows. Section 1 discusses the economic model we introduce to study the determinants of infants' nutritional status in Argentina; the specification of the model; and the variables involved in the analysis. Section 2 contains a more detailed description of the data and a preliminary discussion of the relation between our measure of nutritional status and the inputs in the home production technology. In Section 3 the estimated demand for inputs area discussed. The same is done in section 4 for the case of the production function of nutritional status. Section 5 concludes with a summary of the overall results and a discussion of public policies as determinants of nutritional status.

1. The model

In this section the empirical model to be estimated is introduced and the strategy for its estimation is discussed.

The household production of infant nutritional status

Our indicator of infant nutritional status is height-for-age so we assume that the following inputs are involved in its production:

- Home features and infrastructure. We proxy the quality of housing with a vector of variables which include the degree of access to potable water, modern sanitation, and refuse collection, and the quality of construction.
- Child care and medical services. We proxy the quantity and quality of child care and medical services with the number of medical appointments of the mother during pregnancy; the month of pregnancy at the time of the initial appointment; and also by taking into account whether the delivery was supervised by a qualified doctor.
- Intra-household income distribution. The availability and distribution of resources within the household is captured by the number of live births per household.
- Parental health and other "endowments". The physical and psychological characteristics of the mother are captured (quite crudely) by her age at the time of the child's birth.

The demand functions for the inputs

Following the theory, we assume that the demands for the inputs that enter into the production of infant health depend on different measures of prices and incomes which vary from one household to another. We proxy these *shadow* prices and incomes with two types of variables: variables measured at the individual or household level and variables measured at the aggregate or community level.

At the household level we assume that inputs' demands are determined by family income, parents' level of education, employment status of household head, maternal access to health insurance, distance from home to nearest medical facility, and the family's reliance on food aid.

At the aggregate level we assume that inputs' demands are affected by public health spending per capita, infant mortality rates, supply of medical services (population per doctor), and the unemployment rate. All these variables are measured at the level of the province corresponding to the urban area wherein the child dwells, except for the unemployment rate which is an urban measure. The sources of these data are INDEC (Argentina's National Institute of Statistics and Census) and Argentina's Ministry of Health. Table 1 shows the complete list of variables and summary statistics of the sample.

Specification problems of the model

Specification problems arise naturally in the context of household production functions because: *i)* households demand goods and services such as potable water, quality housing, and medical services both as inputs in the production of child health and as consumption goods; *ii)* household fertility decisions are taken together with decisions regarding the quality of infants (their health, education, etc.) and thus the number of infants is an endogenous variable; and *iii)* the age of the mother at the time the baby is born is a choice variable as well.

To this *endogeneity problem* an additional one is added: the problem that some of the determinants of infants' nutritional status are unobservable to the researcher but not to the mother. As a consequence the demand for the inputs in the production of infant health, *e.g.* medical services, are correlated with the error term in the estimation of the home production function. For instance, the OLS estimate of the impact on infant health of medical services demanded by the mother during pregnancy is usually smaller than the IV estimate. The reason for this result is that mothers seek medical services during pregnancy not only to improve the future health of their infants but also because they know their own health status and act correspondingly.

Instrumental variables and estimation strategy

The estimation strategy involves the use of instrumental variables and it is implemented in two steps. In the first step we estimate the households' demands for the inputs to be used in the production function of infant health. In the second step we estimate the home production function using as instruments the predicted values for the inputs obtained from the regressions run in the first step.

As can be observed in Table 1, with the exception of the age of mother all inputs are binary variables, *i.e.* they either take the value 0 or 1. For instance, input variables take the value 1 whenever the household has access to potable water, refuse collection services, and so on, and take the value 0 otherwise. This feature of the input variables prevents us from using OLS in both stages of the estimation. Therefore, in the first step we estimate the demands for inputs using a maximum likelihood *probit* specification, and in the second step we compute the production function using OLS and the estimated values of inputs as instruments.[1]

2. The data

Our indicator of nutritional status is the z-score of height-for-age. This indicator captures the evolution of the nutritional status of infants from birth to the time they are surveyed. A low value of the z-score indicates chronic malnutrition and the existence of permanent health problems.

The z-score of height-for-age is a measure of height normalized to the standards of an equivalent reference population. In the computation of the z-scores we have used the EPI Info software of *US Center for Disease Control and Prevention* for the year 2000. This is the universally accepted procedure for the computation of the z-scores since it has been scientifically proved that differences in the mean height of two populations of equal age and sex can be fully explained in terms of environmental factors rather than genetic ones.

We interpret the values of this index as follows: If the z-score of height-for-age is equal or larger than -1.00 the infant has a normal height for his age and sex; if the z-score falls between -1.01 and -2.00, the infant has low height for his age and sex and therefore is *mildly* stunted; if the value of the index falls between -2.01 and -3.00, the infant suffers from a *moderate* degree of stunting; and if the z-score is below -3,00, the malnutrition is *severe*. We thus link low height-for-age to chronic malnutrition following the findings in Auxology.

Our data is from The Social Targets Module of the EPH of May 1994. In Table 2 we summarize the nutritional status of infants in our sample in terms of their z-score. About 25% of Argentine infants suffer from chronic malnutrition, 10% of them severely. The extent of malnutrition is higher among boys than among girls. The actual percentage varies across urban areas of Argentina. For instance, in Resistencia (Chaco) malnutrition affects 35% of infants; in Santiago del Estero it affects 31% of infants; in the Metro Area of Buenos Aires malnutrition affects 26% of infants; 23% in Tucumán; 17% in San Luis and 15% in Salta, etc.

[1] Following the discussion in Maddala (1983), chapter 8, and in Alvarez and Glasgow (1999) at this stage we must correct the estimated standard errors.

The extent of malnutrition among infants is similar to that found in other countries of Latin America. For example in Mexico —a country with a standard of living similar to Argentina's— stunting affected about 18% of infants in 1999. This percentage is of course only an average; among households in the first decile of income the incidence of low height-for-age reached 40% of infants; 28 % in the fourth decile; and only 5% in the tenth decile. About 70% of Mexican infants live in households with incomes in the fourth decile or lower and malnutrition affects 33% of them [Mexican Commission on Macroeconomics and Health (2004)].

Form *IV* of The Social Targets Module of the EPH collected information on mothers' access to medical services and insurance and household living conditions. From this form we gather information on 3229 mothers and their infants of 0-3 years of age; the birth date of the infant is reported in only 2187 cases, however. Form *VI* of the survey collected the information on the weight and height of infants between 2 and 5 years of age.

Note that from Form *IV* we have data on the birth date and sex of infants between 0 and 3 years of age, and from Form *VI* we have data on height, weight and sex for infants between 2 and 5 years of age; we are thus left with only a subset of infants —those who are 2 and 3 years old— for whom we know the values of the three variables needed to compute the z-score (birth date, sex, and height). This feature of the survey reduced the number of usable observations to 750 mothers and their infants: 68% of age 2 and 32% age 3. Some further usable observations were lost because of lack of data for some of the variables / infants, and the sample was additionally reduced to 715 observations.

The z-score and its determinants

In the previous section we listed the inputs that we assume enter in the household production of infant nutritional status. Which is the motivation for choosing these variables as the inputs? One way to answer this question is to take advantage of the binary nature of the chosen variables and show that the mean z-score of height-for-age of infants with access to a given input is significantly higher that the mean z-score of the infants without access to that input. For instance, we can test the hypothesis that the mean z-score is higher for infants with access to potable water than for those without access.[2]

[2] It is convenient here to clarify why we have defined the binary input variables in this form. We can distinguish two types of binary variables: *a)* those which are binary by nature, *b)* those which, despite not having a binary nature, were converted binary. Among variables of the "b" type, we have for instance the number of appointments during pregnancy, the month in which mother had her first appointment, and the number of live births. For the first two variables we follow the conventional wisdom in medical sciences that pregnant women ought to have at least five appointments with her doctor during pregnancy and the first one of them must take place during the first quarter of pregnancy; for the last variable, the number of live births, we felt that what really matters is whether the family follows a one-child policy or not.

Table 3 shows the sample average and standard deviation of the z-score of height-for-age for infants with and without access to each of the inputs. The value of the *t* statistic indicates (at a significance level of 5%) that the averages z-scores are different for both groups. We find that the groups with access to the inputs have an average z-score of height-for-age significantly larger than the average for the group that does not have access to the input. Even though Table 3 is clear in its implications, we find it useful to mention here some of its most important implications.

Ten percent of the infants in the sample live in houses with no access to potable water and have, on average, a worse nutritional condition than the group with access to potable water; 41% of the infants live in houses without wooden, mosaic, carpeted or plastic floors, and have on average a lower level of nutrition than those who do have all those inputs; 19% of the infants live in houses that do not have access to a regular service of refuse collection and suffer a worse nutritional condition than those who do have access to it.

Regarding prenatal and delivery care, 22% of the infants' mothers had less than 5 appointments with a doctor during pregnancy; 21% had the first appointment after the first quarter of pregnancy had passed; and 20% of the deliveries were not attended by a doctor. The infants born from these mothers have on average a significantly worse nutritional condition than the infants born from mothers who had more and earlier medical appointments during pregnancy and a qualified doctor supervising the delivery.

As for the number of live births, 83% of infants have at least one sibling and their z-score of height-for-age is significantly lower on average than the corresponding one for infants with no siblings.

These results show that our list of inputs is correct. When we discuss the results of the econometric analysis in Section 4, however, we will learn that not all these associations live up to the estimations with instrumental variables.

3. Estimation of the demand for inputs

In this section we discuss the results of our econometric estimation of the household demands for the inputs that enter in the production of infant health. As we have mentioned before, inputs such as potable water, quality of construction, access to refuse collection service, number of appointments with a doctor during pregnancy, month of pregnancy at her first appointment, number of live births, and delivery supervised by a qualified doctor are binary variables. The age of the mother is the only continuous variable (See Table 1 for a definition of these variables)

We use a maximum likelihood probit model to estimate the demand for each of the binary inputs. The probit model allows us to estimate the results in terms of probabilities; we estimate, for instance, the probability that a household has access to quality housing, medical services during pregnancy, and so on, as a function of the household and the community characteristics.

When estimating these regressions, several specifications of the empirical model were tested; in order to simplify the discussion of the results and to convey a better understanding of the complex relations between the input demand and its determinants, in Table 4 we just outline the nature of the results of our estimations rather than show the outputs of the regressions, as it is usually done.

In Table 4 we assign inputs to rows and their determinants -individual or aggregate- to columns. Symbols "+" and "-" in a given cell indicate the sign of a significant coefficient in the estimated regression. Cells in blank correspond to coefficients that did not turn out to be statistically significant.

Potable water

The only household characteristic that is significantly associated with the probability of access to potable water is total household income (positive sign). The community variables have significant effects; public health spending per capita and infant mortality rate in the province are positively associated with the probability that potable water is demanded by the household, while population per doctor and the unemployment rate tend to be negatively associated with this probability.

If one thinks, after the theory, in terms of causations, the following interpretation follows. A higher public health spending per capita may free private resources that are then allocated to potable water. An alternative interpretation is that a higher public health spending per capita generates availability of goods that are complements to potable water in the production of infant health.

The effects of both mortality and unemployment rates are the expected ones. The higher infant mortality is and the lower unemployment is the higher the probability that households demand potable water. In the first case, it is a response to a higher cost of producing infant health (a substitution effect); in the second, it is a response to a relaxation of budget restrictions (an income effect).

The negative association between the number of inhabitants per doctor and the demand for potable water suggests that health care and potable water are complements. The higher the ratio of inhabitants to doctors, the less efficient the health system is, and if public health care is a complement to potable water in the production of infant health, then a *reduction* in the ratio of inhabitants per doctor would *increase* the demand for potable water.

Quality of construction

The probability of having access to a home with good quality of construction increases with household income, the level of education of the head of the household, and with maternal access to health insurance; being unemployed and receiving food aid is associated negatively with this probability. At the community level, public health spending per capita is positively and the unemployment rate negatively associated with the probability that households will demand homes with good quality of construction.

Thinking again in terms of causation we can interpret these results as follows. The effects of public health spending per capita and unemployment on quality of construction are similar to those discussed for the case of potable water. The effects of family characteristics deserve a further analysis. Total household income has an obvious positive effect. The education of the head of the household, which was not relevant in the demand for potable water, is relevant for case of a home with quality of construction. Having health insurance seems to free resources that are used to invest in a better home.

Being unemployed and receiving food aid lower the probability that the household will demand a home with quality of construction. In the first case, the effect works through a reduction in the resources available to improve the home's quality; in the second, receiving food aid might be a signal that there are resource constraints not captured by household income.

Refuse collection

The probability that a household demands access to a refuse collection services increases with the total household income and with the education of the head of the household but diminishes if he or she is unemployed or if the mother has health insurance. It is this last relation that requires further analysis, since the others have an obvious explanation. Access to health insurance should free resources to be invested in the access to a refuse collection service, but the sign is negative. An interpretation is that access to health insurance reduces the (positive) impact that access to refuse collection has on infant health and therefore, the probability that refuse collection is demanded decreases in the margin.

Community variables affect the probability that the household demands access to a refuse collection service. As was expected, the unemployment rate and the number of inhabitants per doctor are negatively associated with the probability of household access to refuse collection, while the mortality rate is positively associated with this probability. Public health spending per capita seems to be a substitute of refuse collection services in the production of infant health as the association between public spending and access to refuse collection is negative.

Sanitation

The probability of having access to sanitation increases with total household income and with parental education; it also increases with the distance to the nearest medical facility, which suggests that sanitation might compensate somewhat for lack of medical services. The community variables seem to affect the demand for sanitation in the same way they affect the demand for refuse collection.

Medical care and supervision during pregnancy and delivery

Community variables do not seem to be associated with the probability that households demand the recommended quantities of these inputs. Household characteristics such as the level of education —elementary for the mother and college for the head of the household— and mother's access to health insurance are the relevant determinants. Total household income and the distance to the nearest medical facility are also important determinants; the first one is positively associated with the number of appointments with a doctor during pregnancy, and the second is negatively associated with the probability of having a delivery supervised by a qualified doctor.

Number of live births

The probability of having two or more live births increases with the reception of food aid and decreases with the level of (secondary) education of mother. In terms of a causal interpretation, what we observe in the first case is an income effect of food aid, while in the second case is a clear example of a substitution effect. The only community variable which affects the demand for children is population per doctor, with a positive effect. This means that as the number of doctors per person increases the probability that households demand two or more children decreases.

The mother's age

Since the age of the mother is a continuous variable the regression for this variable was estimated using OLS.

The household characteristics which affect the age at which the mother gave birth are access to health insurance and education. Having access to health insurance delays the age at which the mother gave birth. The effect of education is ambiguous: those who achieve an elementary level of education tend to have their infants in an older age, but those who achieve a secondary level of education tend to be younger in the moment of delivery. Since the opportunity cost of having infants increases with education, we expected that the opposite effect would hold.

Of the community variables, only mortality rates seem to be associated with the age of mother at birth, but the sign is ambiguous: age at birth is positively associated with the infant mortality rate but negatively associated with the neonatal mortality rate. This differentiated response makes sense; the causes of infant mortality differ from the causes of neonatal mortality. Infant mortality is sensitive to the quality of care infants received during their first year of life. If infant mortality is the dominant concern, a more mature mother would be in better conditions to isolate her infant from a negative environment. Neonatal mortality is sensitive instead to maternal health problems and a poor medical attention during pregnancy and delivery. If neonatal mortality is the dominant concern, then it makes sense that mothers will tend to give birth at younger ages.

4. Estimation of the infant health production function

We approximate the household production function with a translog function; we do this in order to estimate the direct effects of inputs on infant health as well as the second order effects resulting from interactions between themselves. We estimate, therefore, a regression of the z-score of height-by-age on the inputs and on their crossed products.

As was the case for the inputs' demands, we estimated several specifications of the production function. Table 5 reports the most robust findings and highlights the relations found between inputs. In the first column of Table 5 we report the direct effect of each input over infant health production, the rest of the columns report the second order effects.

The "+" and "-" symbols indicate the sign of a coefficient that resulted statistically significant in the estimated regression; the cells left blank correspond to statistically insignificant coefficients. Some coefficients turned out to be significant in all estimated specifications; whereas others resulted significant only in some of them; in order to distinguish them we use bold type for the former ones.

Three of the inputs turned out to have significant coefficients and the signs of these coefficients remained the same in all the specifications estimated; these inputs are access to a refuse collection service; delivery supervised by a qualified doctor, and the mother's age. The direct impact of these three variables on the nutritional status of infants is positive.

If we take into account the indirect effects, Table 5 shows that the positive effect of refuse collection services is increasing in the probability of accessing the service. On the contrary, age has a positive but decreasing effect, since the coefficient of age squared is negative. The probability of having a delivery supervised by a qualified doctor has a positive but decreasing effect on infant health as well; but the impact of this input is larger the older the mother at the time of delivery.

Table 5 also shows which inputs were less robust to changes in the model specification. The quality of construction has a positive impact on infant nutritional status, although it interacts negatively with the access to refuse collection service and with the number of medical appointments during pregnancy. That is, the positive effect of living in a home with high quality of construction is relatively less important as the probabilities of having access to refuse collection and having five or more medical appointments during pregnancy increase.

The number of medical appointments during pregnancy has a positive and increasing effect on infant health —this second order positive effect being robust to changes in the specification of the model.

As it was expected, the number of live births has a negative effect on individual infant health, but this negative effect is lower the older the mother.

5. Infant Nutritional Status and Public Policies

We started this article by asking what role the community and the household play in the determination of infant nutritional status in Argentina. We have been providing partial answers to this question from sections 1 to 4. The best way to conclude, however, is to invert the order of the analysis. Starting from the inputs of the production function (Table 5) we can look for their determinants in Table 4 and conclude about the role played by household and community.

If we proceed in this way we find that parents' level of education, mother's access to health insurance, and distance to the nearest medical facility are the most relevant determinants of infant health at the household level; household income is also relevant but not as important as education and health insurance.

The policy implications are straightforward: if public policies are successful in rising the number of years of education in the population and the proportion of the population with access to health insurance, and reducing the mean distance from the household to the nearest medical facility, future generations will make better decisions regarding the inputs that ought to be used in the production of their infants' health, and this will in turn lead to a considerable reduction in infant malnutrition.

Today only about 62% of the Argentine population has access to health insurance (Delajara *et al.*, 2004), and several indicators of the Argentine education system have deteriorated during the last decades (Llach and Montoya, 1999). Thus, there is a large scope for improving the nutritional status of infants by adopting better education and health policies in the medium and long-run.

Government policies may have a more immediate effect by targeting some community and regional variables that affect family decisions regarding the use of inputs in infant health production. Table 4 shows which policies should be promoted.

We first note that reducing unemployment rates in urban areas will increase significantly the probability that families demand good quality homes and access to refuse collection services, and this action will have a positive impact on infant health.

Increasing the efficiency of the health system by reducing the population per doctor will have a positive effect on the probability that households have access to good quality homes and refuse collection services, and a negative effect on the probability that households have more than two live births; all these changes will positively affect the nutritional status of infants.

Regarding public health spending per capita the results in Table 4 are ambiguous. Our analysis is unable to determine the effect of changes in public health spending on infant health.

From Table 4 we concluded that higher mortality rates increase the demand for inputs that have a positive effect on infant health; this does not mean, however, that governments should try to maintain high mortality rates, which would make no sense. On the contrary, the reduction of mortality rates would allow families to reallocate resources from defending their infants against an epidemiological threat to the purchase of other goods and services (*e.g.* medical services and home quality) and thus improve their welfare.

Summarizing, we find evidence that household characteristics such as parent's education, mother's access to health insurance, distance to nearest medical facility and family income are important determinants of infant nutritional status. We also find, however, that community-wide characteristics such as the rate of unemployment, the efficiency of the health system, and the disease environment are important determinants of infant nutritional status as well. The policy problem here is not whether policies should target either households or communities but rather the timing of policies targeting households and communities. What emerges from our analysis is that the public policies with the potential to curb infant malnutrition in the short-run are those labor and health policies which promote economic inclusion —*e.g.*, by reducing the unemployment rate— and efficiency of the health system —*e.g.*, by reducing the ratio of population to doctors. In the medium- and long-run, the policies with larger potential to curb malnutrition are those educational and health polices which seek to increase the number of years of education of the adult population and to promote social inclusion in health by increasing the proportion of pregnant women with access to health insurance.

TABLE 1. VARIABLES AND SUMMARY STATISTICS

Variables	Definition	Mean (or proportion)	Standard Deviation
Dependent Variable			
z-score of height-for-age	Normalized deviation from an equivalent reference population (Centers for Disease Control and Prevention – USA - 2000)	-0.299	1.234
Inputs in health production			
Access to potable water	1=access through public system; 0=otherwise	0.900	0.300
Quality of construction	1=brick, wood, ceramic, or carpet floor and walls; 0=otherwise	0.587	0.493
Refuse collection	1=regular publicly provided; 0=otherwise	0.809	0.393
Medical appointments during pregnancy	1=5 or more; 0=otherwise	0.784	0.412
Month of pregnancy at first appointment	1=third or before; 0=otherwise	0.790	0.407
Person supervising the delivery	1=qualified doctor; 0=otherwise	0.796	0.403
Live births	1=two or more; 0=one or none	0.829	0.376
Age of mother	Age of mother at the time the infant was born	26.861	6.508
Determinants of inputs' demand			
Individual characteristics			
Health insurance	1=mother has health insurance. 0=otherwise	0.529	0.499
Distance to nearest medical facility	1= less than 2 km; 0 = otherwise	0.525	0.500
Food aid	1= receives supplementary milk; 0= otherwise	0.162	0.368
Mother's level of education (Finished elementary school omitted)	Quitted elementary school	0.131	0.338
	Quitted non-technical high school	0.221	0.415
	Finished non-technical high school	0.165	0.372
	Quitted technical high school	0.024	0.154
	Finished technical high school	0.018	0.132
	Quitted college	0.075	0.263
	Finished college	0.093	0.291
Head of household's level of education (Finished elementary	Quitted elementary school	0.178	0.383
	Quitted non-technical high school	0.137	0.344
	Finished non-technical high school	0.105	0.307

Variables	Definition	Mean (or proportion)	Standard Deviation
school omitted)	Quitted technical high school	0.063	0.243
	Finished technical high school	0.040	0.195
	Quitted college	0.059	0.236
	Finished college	0.045	0.208
Total household income	Argentine pesos of 1994	756.553	706.984
Employment status of household's head	1=employed; 0=unemployed or inactive	0.808	0.394
Aggregate characteristics			
Infant mortality	Per 1000 live births	27.084	3.739
Neonatal mortality	Per 1000 live births	10.376	2.778
Perinatal mortality	Per 1000 live births	21.591	3.040
Population per doctor	Province level. 1998	520.472	75.949
Public health spending	Argentine pesos of 1997 per capita, in 1993	99.902	29.776
Unemployment rate	May 1994	8.914	3.330

TABLE 2. NUTRITIONAL STATUS OF ARGENTINE INFANTS PERCENTAGE, HEIGHT-FOR-AGE CRITERION

	All	Girls	Boys
Total Stunting	24.7	23.3	26.1
Mild	17.5	17.2	17.8
Moderate	4.4	3.6	5.3
Severe	2.8	2.6	3.1

Source: Encuesta Permanente de Hogares (EPH), Module of Social Targets, 1994. Infants, 2 and 3 years of age. Classification based on the z-score of height-for-age (Center for Disease Control and Prevention-U.S.A. 2000).

TABLE 3. INPUTS IN THE HOME PRODUCTION OF INFANT HEALTH SUMMARY STATISTICS

Inputs	Attainment (% sample)	Average z-core with input	Average z-core Without input
Home infrastructure			
Access to potable water	90	-0.2649	-0.6039
		1.249	*1.0421*
Quality of construction	59	-0.0911	-0.5937
		1.1757	*1.2552*
Modern sanitation	59	0.0562	-0.3106
		1.1112	*1.1688*
Access to refuse collection services	81	-0.2124	-0.6656
		1.2467	*1.1068*
Child care / Medical services			
Number of medical appointments during pregnancy	78	-0.1882	-0.6903
		1.1476	*1.4396*
Month of pregnancy at time of first appointment	79	-0.2176	-0.4775
		1.1943	*1.3408*
Delivery supervised by qualified doctor	80	-0.203	-0.6727
		1.2013	*1.2893*
		1.222	*1.8274*
Income distribution			
Number of live births per mother	17	-0.0529	-0.3495
		1.1898	*1.2372*

TABLE 4. DEMAND FOR INFANT HEALTH PRODUCTION

	Income	Education	Employ-ment Status	Aid	Insurance	Distance	Public health Spending	Mortality rates	Hab. Per doctor	Unemploy ment
Water	+						+	+	-	-
Construction	+	+	-	-	+		+			-
Sanitation	+	+				+	-	+	-	-
Refuse collection	+	+	-		-		-	+	-	-
Pregnancy (Appointments)	+	+			+					
Pregnancy (Month)		+			+					
Supervised delivery		+			+	-				
Live births		-		+					+	
Age of mother		+ -			+			+ -		

TABLE 5. THE HEALTH PRODUCTION FUNCTION

	Direct effects	Second order effects								
		Water	Construction	Sanitation	Refuse collection	Pregnancy (Appointments)	Pregnancy (Month)	Supervised delivery	Live births	Age of mother
Water										
Construction	+				-	-				
Sanitation			+							
Refuse collection	+				+					
Pregnancy (Appointments)	+					+				
Pregnancy (Month)										
Supervised delivery	+							-		+
Live births	-									+
Age of Mother	+									-

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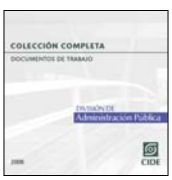
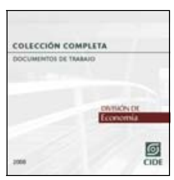

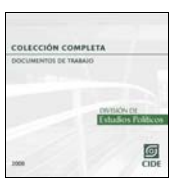
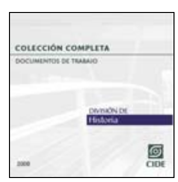
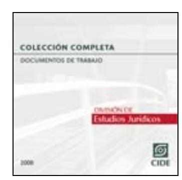

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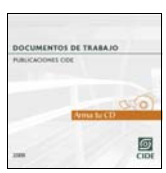

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