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Subsidized Health Care and Food Security: Evidence from Colombia

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Subsidized Health Care and Food Security: Evidence from Colombia

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Abstract

In 1993, the Colombian Government created a subsidized health care regime (SR) in order to increase coverage among the poorest population. Using data from the 2008 and 2012 Colombian Living Standards Survey, I estimate the association between SR participation and household food insecurity. Enrollment into the SR is not exogenous due to self-selection from potentially eligible households, discretionary municipality-level policies that affect eligibility, and manipulation of the assignment process for electoral purposes. Therefore, I use the proportion of lifetime the household head has resided in the current municipality as an instrumental variable. Taking the uninsured population as the comparison group, the two-stage least squares regression estimates reveal that participation in the SR is associated with a reduction of the probability of being food insecure, principally in rural areas. This result is robust to different specifications and, moreover, prevails after implementing an imperfect instrumental variables approach.

Keywords: Colombia, food security, public health care
JEL Classification: D12, I15, I38

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Salud Subsidiada y Seguridad Alimentaria: Evidencia para Colombia

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Resumen

En 1993, el gobierno colombiano creó un régimen de salud subsidiada (RS) con el objetivo de mejorar la cobertura de salud sobre la población más pobre y vulnerable. Usando datos de la Encuesta de Calidad de Vida (ECV) para los años 2008 y 2012, estimo la asociación entre la participación en el RS y la seguridad alimentaria de los hogares colombianos. El proceso de enrolamiento en el RS no es exógeno, porque se encuentra sujeto a auto-selección por parte de los hogares potencialmente elegibles, políticas discrecionales por parte de los municipios con respecto a la focalización del programa, y la manipulación del puntaje que determina la asignación por parte de políticos locales debido a motivos electorales. Por lo tanto, uso la proporción del tiempo de vida que el jefe de hogar lleva residiendo en el municipio como variable instrumental. Tomando la población no asegurada como el grupo de control, las estimaciones por medio de mínimos cuadrados en dos etapas muestran que la participación en el RS está positivamente correlacionada con una reducción en la inseguridad alimentaria de los hogares colombianos, principalmente en áreas rurales. Este resultado es robusto a varias especificaciones econométricas y, más aún, después de implementar una metodología para instrumentos imperfectos.

Palabras clave: Colombia, salud pública, seguridad alimentaria
Clasificación JEL: D12, I15, I38

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1 Introduction

The rights to food and health care (social security) are enacted by the United Nations' International Covenant on Economics and Cultural Rights of 1976. Despite the enormous progress in increasing worldwide food production and improving health care coverage on the most vulnerable population, there is still about 815 million people that experience hunger (FAO, 2017), and almost half of the world population lack access to essential health care services (World Health Organization and The World Bank, 2017). There is evidence, however, that providing subsidized health care to the poorest have significant effects on people's wellbeing—including nutrition, by allowing households to release income that can be used in essential goods like food. (Banerjee, Deaton, and Duflo, 2004; Kaestner and Lubotsky, 2016).

This paper explores the potential income effect that comes from reducing the price of health on household food expenditure in Colombia, a developing country with a publicly-funded health care insurance scheme for the poor. In 1993, the Colombian Government undertook a major reform of its health care system. Before that year, a series of fragmented insurance packages jointly coexisted, mostly covering public workers and the military. Private workers and the unemployed had to pay out of their pockets. The current health care system can be described as a two-tiered regime. The Subsidized Regime (SR), mostly publicly funded, targets the poorest households, where eligibility is given through a proxy means test.[1] The middle and upper classes are intended to belong to the Contributive Regime (CR), which is funded through payroll taxes from formal employment. Despite the efforts

[1] According to Grosh and Baker (1995), the concept of *proxy means test* comes from the idea of ranking potentially eligible households by measuring wellbeing not only based on household income—collected from administrative data, and usually subject to underreporting—but also on other observables that are less prone to measurement error, like the materials used to build dwellings, ownership of durable goods, employment status, and schooling level of the household members. This additional information usually comes from living standards or national household surveys.

of the government in providing universal health care coverage, there still exists a relevant proportion of the population—mostly poor—that remains uninsured.

Several articles have addressed the positive effect of the SR on health care utilization in Colombia (Bitrán, Giedion, and Muñoz, 2004; Camacho and Conover, 2013; Gaviria, Medina, and Mejía, 2006; Miller, Pinto, and Vera-Hernández, 2013; Panopoulus and Vélez, 2001; Trujillo, Portillo, and Vernon, 2005). There is little evidence, however, on the effects of the SR on household consumption of other goods. Moreover, no previous work has addressed the impact of participation in the SR on achieving the minimum level of food consumption required for daily activities—my definition of food security in this work.

In this paper, I use the Colombian Living Standards Survey (LSS) of 2008 and 2012 to estimate the association between enrollment in the SR on household food security, by comparing households under the SR with the uninsured population. Literature has addressed food insecurity using a diverse set of indicators, ranging from calorie availability, dietary diversity, monetary poverty, to subjective responses from questions that aim to capture behavioral and psychological aspects of this problem (Barrett, 2010; Headey and Ecker, 2013; Maxwell, Vaitla, and Coates, 2014). In this paper, I follow the behavioral approach, measuring food insecurity as a binary indicator (i.e., one if a household is food insecure, zero otherwise), based on self-reported answers from a questionnaire that addresses daily-life situations when households fell into food insecurity episodes during a certain period of time.

There are two important caveats that limit the scope of standard regression analysis. First, enrollment into the SR is not exogenous, is subject to measurement error, and selectivity is contingent on discretionary policies and political manipulation (Bitrán, Giedion, and Muñoz, 2004; Camacho and Conover, 2011; Jaramillo, 2001; McGee, 1999; Miller, Pinto, and Vera-Hernández, 2013; Panopoulus and Vélez, 2001; Trujillo, Portillo, and Vernon, 2005).

Second, the researcher only observes households' health care insurance status, not the original score from the proxy means test that determines participation. As a consequence, OLS-based estimates on the impact of participation on the SR may be biased.

Given these constraints, this paper follows Gaviria, Medina, and Mejía (2006) in relying on an instrumental variables (IV) approach that uses as exclusion restriction the proportion of lifetime that the household head reports having resided in the current municipality at the time of the survey. This IV aims to capture the extent of political and social networks within households that may help to increase the probability of enrollment to the SR. The exclusion restriction relies on the assumption that longer spells at the current municipality are not directly related with higher household income or a greater probability of gathering food through other sources, like in-kind transfers or their own business or harvest. The regression estimates will show the potential existence of these additional channels, but without affecting the association between participation in the SR and household food insecurity. Given these minor drawbacks, I follow Nevo and Rosen (2012) by estimating bounds of the potential casual effect under the presence of an imperfect instrumental variable. The estimates from this approach are quite close from those obtained by standard two-stage least squares. In overall, the results show that enrollment to the SR is associated with a reduction of household food insecurity. This result principally prevails in rural areas, and is robust to several econometric specifications.

The remainder of this paper is organized as follows: Section 2 provides background about the current health care system in Colombia, as well as for the definition of food insecurity used in this work. Section 3 describes the data used in this paper, whereas Section 4 explains the identification strategy. Section 5 reports and analyzes the estimates, while Section 6 presents some robustness checks, and Section 7 concludes.

2 Background

2.1 The Colombian Health Care System

Law 100 of 1993 established and currently regulates the health care system in Colombia. This legislation aimed to expand health care coverage, improve the efficiency and equity in service delivery, and to increase funding. According to Miller, Pinto, and Vera-Hernández (2013), this system is a typical case of a "managed competition" model of health care (Enthoven, 1978a,b), in which the nature of the competition is determined by the different sizes of the medical networks (composed of hospitals, clinics, and primary care centers) and the quality of the services that each provider can offer. Providers always have to ensure the provision of the basic package of benefits and services indicated by the law. In the main cities, it is usual to find a variety of large-size networks, but in small municipalities and in rural areas is more likely to find only one provider.

Table 1 summarizes the current organization of the Colombian health care system since 1993. Three pillars hold this structure, which is based on targeting and eligibility criteria, funding sources, and benefits. On one side, the Subsidized Regime (SR)—fully publicly funded throughout general taxes and contributions from formal workers via payroll taxes—aims to cover the poorest and most vulnerable population, as well as the unemployed. On the other hand, all non-poor families and formal workers are intended to belong to the contributive regime (CR), totally funded by payroll taxes from employers and employees. Public workers and those serving the military have their own special regimes, with unique health care plans.

Despite the efforts made during the last years to increase health care coverage in Colombia through both the SR and CR, a relevant fraction of the population remains uncovered by any

Table 1: **Current Health Care System in Colombia (since 1993)**

Regime	Uninsured	Subsidized	Contributive	Special
Target		Poorest and vulnerable (unemployed, working with no written contract, displaced)	Middle and upper classes	Public workers, military
Funding	Public		Private	By own institution
Eligibility		SISBEN score	All formal workers, self-employed earning more than 1 minimum wage	
Benefits	Emergency / basic services in public hospitals	Full access to the Obligatory Health Plan. Equal benefits (at least, mandated by law)		Case-wise

formal type of insurance. These are called *vinculados* (associated), and, according to the law, they have the right to use public clinics and hospitals for emergency assistance. According to Miller, Pinto, and Vera-Hernández (2013), in 1993, just 25 percent of the Colombian population had formal health insurance. That proportion grew to 80 percent in 2007. By 2018, almost 95 percent of the Colombian population had any type of health care insurance.

Beneficiaries from both the CR and SR have to pay out of pocket for some services. The system provides free access to a limited package of medicines (mostly generic) and preventive medical care. Usage of curative services and visits to specialists require a co-payment. These costs are lower for the users of the SR, and in the case of curative services they are capped at half the monthly minimum wage. With respect to the uninsured, co-payments correspond to 30 percent of the total cost, but capped six times greater than for those under the SR. Both CR and SR were designed to cover and provide the same type of benefits and services (Miller, Pinto, and Vera-Hernández, 2013).

Eligibility for the SR is determined by the *Sistema de Identificación de Beneficiarios* (SISBEN, in Spanish), a proxy means test composed of a series of variables that capture the main characteristics of households in terms of wellbeing, such as housing features (quality of the construction materials of the dwelling and access to utilities), ownership of durable goods (e.g., TV, car, washing machine), demographic composition, educational attainment, and labor force participation. The Registry of the Poor is the corresponding survey that collects that information. This survey is conducted by local authorities through door-to-door interviews in the poorest areas. The first version of the SISBEN score came in 1993, with subsequent changes in 2003 and 2011.[2] The score ranges from 0 (poorest) to 100 (least poor). Initially, urban households with scores of 47 or less were eligible for the SR, whereas in rural areas the threshold was set at 30 points. Since 2003, due to the changes in methodology, thresholds changed to 22 and 32, respectively. The SISBEN score is also used to determine eligibility for other welfare programs, like access to a social pension for retired persons who did not make contributions to social security during their time as active workers, unemployment insurance, or nutrition and social assistance for children—conditional on school attendance—known as *Familias en Acción* (FA).[3]

Budgetary and political reasons have altered eligibility criteria throughout time. For example, as explained by Panopoulus and Vélez (2001), Bitrán, Giedion, and Muñoz (2004), and Trujillo, Portillo, and Vernon (2005), municipalities that are not able to guarantee the minimum funding to cover all of the eligible population should give priority to the poorest households, and, also, to those located in rural areas or with pregnant women, children under the age of five, elderly, female heads, indigenous population, or disabled members. Likewise, as described by Camacho and Conover (2011), local politicians used to manipulate

[2] In 2017, the government announced the implementation of a new version of the SISBEN score, which would be ready by 2020.

[3] Cuesta and Olivera (2014) explain in more detail the eligibility to these additional welfare programs.

the SISBEN score for electoral purposes. To minimize the risk of score manipulation, in 2003 the national government, in addition to the introduction of changes to the algorithm, stipulated that the new version and any further revision would not be publicly available.

2.2 Assessing Food Insecurity: The Latin American and Caribbean Food Security Scale

The Latin American and Caribbean Food Security Scale (ELCSA for its acronym in Spanish) is a joint effort between academics from several countries and the Food and Agriculture Organization of the United Nations (FAO) to construct a harmonized measure that identifies food insecurity across the region. The ELCSA was based on the Food Security Supplement of the Current Population Survey of the United States (FSS–CPS), as well as from other nationally-based measures of food insecurity (e.g., Brazil, Colombia, and Venezuela). Like the United States Department of Agriculture (USDA), the ELCSA defines food insecurity as the household-level condition of limited or uncertain access to sufficient and adequate food products.[4]

The original questionnaire of the ELCSA consists of 15 questions—eight for households without children—addressing situations in which households would have experienced problems with having balanced and enough food due to the shortage of money, during a given period of time. All questions are constructed in such a way that each household answers either "yes" or "no". The cutoff points that determine food insecurity under the ELCSA slightly differ these of the USDA. Table 2 displays that households between zero and two affirmative answers on the FSS-CPS—with or without children—are categorized by the USDA as food secure, whereas for the ELCSA only households with zero affirmative questions fall

[4] Comité Científico de la ELCSA (2012) describes in more detail the construction of the ELCSA.

into this category. Moreover, the USDA only disaggregates food insecurity into two categories: low and very low (severe) food insecurity. On the other hand, the ELCSA divides food insecurity into three categories—low, moderate, and severe.

Table 2: **Cutoff Points for Determining Food Security Status, Based on the Number of Affirmative Answers from the Food Security Questionnaires**

	USDA cutoffs		ELCSA cutoffs	
Type of household	**With children**	**Without children**	**With children**	**Without children**
Food Secure	0-2	0-2	0	0
Low food insecurity	3-7	3-5	1-5	1-3
Moderate food insecurity	Not defined	Not defined	6-10	4-6
Severe food insecurity	8+	6+	11+	7+

2.3 A Theoretical Framework on the Effects of Participation in the SR on Household Food Security

Following Tuttle (2013)—which estimates the effects of energy price shocks on household food insecurity in the United States—this section illustrates a simple theoretical framework that addresses the effects of participation in the SR on food expenditure and, consequently, food insecurity. Consider a household with no access to a formal health care insurance, whose utility is derived from the utilization of health care services or goods and food consumption ($U(H, F)$), and maximize such that utility subject to its budget constraint ($m = p_h H + p_f F$). The combination of health care utilization and food consumption that maximizes household's utility is given by the point in which the marginal rate of substitution (MRS)—the ratio between the marginal utility of health care utilization and food consumption—equalizes the relative prices of health care and food.

In addition, suppose a critical level of food consumption required by the members of this

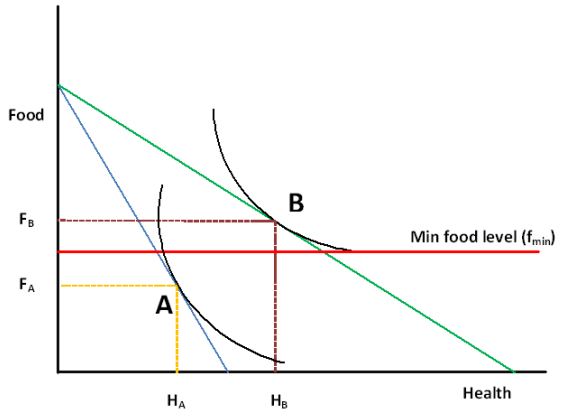
household for their daily activities (f_{min}). Any food consumption below f_{min} categorizes the household as food insecure. Therefore, a reduction in the relative prices or an increase in its disposable income, while holding their consumption preferences constant, would help to raise food consumption and, consequently, to overcome food insecurity. This theoretical framework is described by Figure 1.

As explained in section 2.1, the purpose of the SR is to increase the access to health care to the poor, as well as to improve participants' health condition, by offering products and services at no cost or at subsidized prices. Thus, for a food insecure household without insurance (represented by point A of Figure 1), enrollment to the SR has two main implications: on one side, assuming no change in the price of food, it relaxes the budget constraint, since the price of health care is lower. On the other hand, it would increase household income by having healthier and, consequently, more productive working-age members. The overall shift of the budget constraint generates two effects: first, the reduction of the price of health care would induce the household to increase the utilization of health care products and services provided by the SR. This is the *substitution effect*. Second, the household faces more disposable income, and would increase the consumption of food, which is the *income effect*. That increase on food consumption would be enough that household overcomes f_{min} and, therefore, becomes food secure. This situation is represented by point B of Figure 1.

Previous works have already addressed the effects of participation in the SR on a wide set of health and labor-related variables in Colombia. These studies have used different methodologies in order to assess the endogeneity of enrollment in the SR: instrumental variables (Panopoulus and Vélez, 2001; Gaviria, Medina, and Mejía, 2006), propensity score matching (Trujillo, Portillo, and Vernon, 2005), or regression discontinuity (Camacho and Conover, 2013; Miller, Pinto, and Vera-Hernández, 2013). In summary, these articles have found a positive effect of the SR on utilization of medical services (e.g., preventive care, outpatient

visit, hospital utilization) and a reduction on inpatient spending. Also, the SR reduces the absence of children from normal activities. With respect to labor-related outcomes, these previous articles have found that enrollment to the SR decreases labor force participation. On the other hand, this paper aims to evaluate if there is evidence of an income effect of the enrollment on the SR, and if that effect helps to reduce food insecurity in Colombian households. But, as described in section 2.1, the SISBEN scores also determines participation in other public-funded programs beyond the SR, and such those programs could have a more direct effect on food consumption, and, consequently, food insecurity. This "participation" effect is not addressed by the theoretical framework described in this section.

Figure 1: **The Effects of Participation in the Subsidized Regime on Household Food Security**



Based on Tuttle (2013).

3 Data

I use the 2008 and 2012 waves of the Living Standards Survey (LSS)—collected by the National Administrative Department of Colombia (DANE, in Spanish), that aims to capture detailed information about participation in social programs as well as household wealth

and wellbeing. These waves contains all the information required to answer the research question stated in Section 1. The LSS provides very detailed information about monthly household expenditures in food and non-food goods. Aditionally, it includes an annual supplement regarding different topics (e.g., child care or personal safety), and in 2008 referred to food security for the first time. The food security questionnaire consists of 17 questions, 10 for households without children, that address daily life episodes where the households could have experienced lack of enough and varied alimentation due to the lack of monetary resources. This supplement was also included in 2012 and 2017. Due to sampling issues (i.e., the LSS was only representative at the urban level), the 2017 wave is not included in the final database. Appendix A.1 list the questionnaire from LSS that address household food insecurity.

After removing households with missing values in at least one of the controls or the outcome of interest, the final sample comprises $20,409$ observations ($8,006$ for year 2008, $12,403$ for 2012), including $18,243$ households under the SR—the treatment group—and $2,166$ from the uninsured—the comparison group. As described in Section 2.1, it is likely to expect that uninsured households and those enrolled in the SR share similar socio-economic characteristics. Thus, they might differ principally in the treatment status (participation in SR), due to inadequate targeting or budget constraints from the local authorities. Table 3 presents the descriptive statistics of the household-level characteristics of interest by health care insurance status. This table displays statistically-significant differences in the mean values among several categories (e.g., average years of education, presence of either children or elderly members, self-reported health conditions, some dwelling unit's characteristics, and income quintile position). According to these statistics, uninsured households tend to be wealthier than those under the SR. The potential presence of outliers would be the result of measurement error from the LSS. In Section 6, I report the results of the econometric

models only for households that belong to the lowest income quintiles (i.e., 1 to 3).

The LSS food security questionnaire follows the guidelines from the ELCSA, with some changes: the battery of questions is greater (17 questions instead of 16), and the period of reference is shorter (last 30 days instead of the last three months). Table 4 reports the most frequent episodes of food insecurity for all food insecure households using the ELCSA–based threshold (one or more affirmative answers). According to the estimates, the most recurrent episode is when the household head or any other household member felt that food would have run out at some point during the last 30 days. Consequently, under the ELCSA–based threshold, a household could be considered as food insecure just because of a hypothetical situation (i.e., feeling that food would run out does not mean that it actually ran out), and not by explicitly real episodes of food insecurity. Therefore, I will use both the USDA (three or more affirmative answers) and ELCSA-based thresholds, as well as an intermediate threshold (two or more affirmative answers) to categorize households by food insecurity conditions. Table 5 provides descriptive statistics for the outcomes of interest, in addition to the number of affirmative questions in the food security supplement of the LSS, comparing households between the SR and the uninsured. According to these numbers, households in the SR are more likely to be food insecure, compared with uninsured households. As with the descriptive statistics for the controls of interest reported in Table 3, measurement error might be driving the differences.

Table 3: **Descriptive Statistics, Controls of Interest**

	Total		Subsidized		Uninsured		Diff. Means	
Controls	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**t-stat**	**P-value**
Household head characteristics								
= 1 if household head is male	0.665	0.472	0.660	0.474	0.700	0.458	3.720	0.000
age	47.700	15.922	48.082	15.987	44.478	14.990	−9.984	0.000
Squared age	2528.786	1634.789	2567.475	1647.498	2202.930	1484.400	−9.835	0.000
= 1 if household head is single	0.115	0.319	0.107	0.309	0.186	0.389	10.896	0.000
Years of education of HH head	4.851	3.813	4.725	3.721	5.910	4.374	13.731	0.000
Squared years of education	38.069	50.552	36.172	48.200	54.044	65.027	15.649	0.000
= 1 if employed	0.757	0.429	0.754	0.431	0.782	0.413	2.856	0.004
Household characteristics								
Household size (persons)	3.715	2.012	3.779	2.009	3.171	1.957	−13.358	0.000
HH median age	32.549	19.014	32.516	19.098	32.827	18.291	0.718	0.473
Squared HH median age	1420.960	1580.466	1422.023	1587.495	1412.003	1520.296	−0.279	0.780
= 1 if at least one child member in HH	0.680	0.466	0.691	0.462	0.586	0.493	−9.946	0.000
= 1 if at least one elder member in HH	0.220	0.414	0.229	0.420	0.141	0.348	−9.334	0.000
= 1 if HH lives in urban area	0.645	0.479	0.636	0.481	0.717	0.450	7.510	0.000
= 1 if at least one HH member reports regular/bad health cond.	0.587	0.492	0.597	0.490	0.498	0.500	−8.889	0.000
Dwelling unit characteristics								
Number of rooms	3.042	1.321	3.057	1.312	2.914	1.385	−4.772	0.000
= 1 if primary walls are made of brick, stone, or smooth wood	0.695	0.460	0.690	0.463	0.741	0.438	4.946	0.000
= 1 if floor material is not sand or soil	0.861	0.346	0.858	0.349	0.884	0.320	3.317	0.001
= 1 if gets water for consumption and cooking from direct aqueduct	0.494	0.500	0.485	0.500	0.568	0.495	7.362	0.000
= 1 if has sewerage or connection to septic tank	0.783	0.412	0.783	0.412	0.789	0.408	0.667	0.505
= 1 if has garbage collection service	0.541	0.498	0.531	0.499	0.625	0.484	8.254	0.000
Household income								
IHS of per capita household income	11.462	3.595	11.452	3.557	11.547	3.901	1.158	0.247
= 1 if household belongs to income quintile 2	0.270	0.444	0.276	0.447	0.219	0.414	−5.659	0.000
= 1 if household belongs to income quintile 3	0.205	0.403	0.206	0.404	0.194	0.396	−1.239	0.215
= 1 if household belongs to income quintile 4	0.131	0.338	0.124	0.330	0.191	0.393	8.752	0.000
= 1 if household belongs to income quintile 5	0.058	0.233	0.050	0.219	0.118	0.322	12.778	0.000
Number of observations	20,409		18,243		2,166			

Own estimates. Source: 2008 and 2012 Colombian LSS

Table 4: **Most Frequent Episodes of Food Insecurity (Percentage of food insecure households)**

	Total	**2008**	**2012**
Households without children			
Food would run out	87.03	86.57	87.29
Had unbalanced meals	65.85	66.62	65.40
Had unvaried meals	65.63	65.58	65.66
Ate less than usual	56.62	55.41	57.31
Ran out of food	44.48	40.68	46.67
Households with children			
Food would run out	90.48	89.43	91.26
Had unbalanced meals	63.93	67.16	61.56
Had unvaried meals	63.91	65.34	62.84
Ate less than usual	57.28	57.96	56.78
Children had unvaried meals	53.48	53.45	53.50

Food insecure households were categorized under the ELCSA threshold (= 1 if one or more affirmative answers) Own estimates. Source: 2008 and 2012 Colombian LSS

Table 5: **Descriptive Statistics, Outcomes of Interest**

	Total		**Subsidized**		**Uninsured**		**Diff. Means**	
Outcomes	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**t-stat**	**P-value**
USDA threshold	0.496	0.500	0.501	0.500	0.457	0.498	−3.864	0.000
Intermediate threshold	0.563	0.496	0.568	0.495	0.523	0.500	−4.001	0.000
ELCSA threshold	0.708	0.455	0.713	0.453	0.672	0.470	−3.906	0.000
# affirmative answers	4.387	4.881	4.413	4.884	4.163	4.848	−2.262	0.024
Observations	20,409		18,243		2,166			

Own estimates. Source: 2008 Colombian LSS

4 Empirical Framework

4.1 Identification Strategy

Consider the following linear equation which describes household food security status as a function of a set of observed characteristics and a zero-mean error term that captures unobserved factors:

$$Y_i = \alpha^{'} X_i + \beta S_i + u_i \tag{1}$$

where Y_i represents either an indicator variable equal to one whether a household is considered food insecure (under any of the aforementioned thresholds) or the number of affirmative questions in the food security supplement of the LSS; X_i is a vector of household-level controls; S_i is a binary indicator variable of enrollment to the Subsidized Regime (SR), and u_i is a zero-mean error term.

There are four aspects that undermine the exogeneity of S_i. First, households can manipulate the SISBEN score—and, therefore, participation into the SR—by providing inaccurate information to the interviewers when filling out the Census of the Poor. Households that are just slightly better off than those that are categorized just below the eligibility threshold, have the incentives to lie about their socio-economic conditions to increase the probability of enrollment. Second, score manipulation can also come from political authorities seeking electoral benefits (Camacho and Conover, 2011). Third, participation into the SR is also determined by discretionary policies due to budget constrains, when municipalities are not capable to cover the totality of the eligible population into the SR (Panopoulus and Vélez, 2001; Bitrán, Giedion, and Muñoz, 2004; Trujillo, Portillo, and Vernon, 2005; Gaviria, Medina, and Mejía, 2006). Thus, they have to limit their scope of action by covering some specific groups, leaving the rest uninsured. Last, but not least, targeting issues (e.g., providing enrollment to non-poor households) also affect the exogeneity of S_i (Gaviria, Medina, and Mejía, 2006).

Given the endogeneity of the explanatory variable of interest, I follow Gaviria, Medina, and Mejía (2006) by using the ratio between the time the household head has been residing in the current municipality and her age as an instrumental variable (IV). This IV seeks to

correct for unobserved heterogeneity and measurement error. It helps to explain the variation in Y_i that cannot be attributed to S_i after controlling for observed household characteristics (X_i) that also affect enrollment to the SR, like participation due to administrative, budgetary, or political issues.

The authors build the argument that supports the relevance of IV on two pillars. First, municipalities manage the SR by targeting the potentially eligible population, selecting the beneficiaries, and making the payments (premiums) to the intermediary companies that provide the services. Second, enrollment to the SR is also related with political connections and social networks within the municipalities. Previous articles and studies cited by Gaviria, Medina, and Mejía (2006) have provided qualitative and quantitative evidence regarding how these networks work. For example, Ruiz et al. (1999) describes for a small municipality by the Pacific Coast how the authorities selected some of the beneficiaries by personal whims, or just because they were public workers, of the hospital, or the insurance company. Likewise, BDO International and CCRP (2000), based on a series of surveys, report that beneficiaries tend to not knowing their rights from participation to the SR. Additionally, beneficiaries report that selection of the intermediary company was based following recommendations from friends, relatives, politicians, or social leaders, or was just determined by the municipality. Therefore, according to Gaviria, Medina, and Mejía (2006), longer residence spells at the current municipality (as a proportion of lifetime) expands the extent of political connections and social networks within the community, that should increase the probability of enrollment to the SR.

In this paper, the two-stage equations to estimate are the following:

$$S_i = \gamma' X_i + \delta Z_i + v_i \tag{2}$$

$$Y_i = \theta' X_i + \omega \hat{S}_i + u_i \tag{3}$$

where Z_i corresponds to the instrumental variable.

4.2 Validity of the Instrumental Variable

The IV should fulfill three properties in order to be valid: exclusion restriction, relevance, and monotonicity. If these hold, the parameter of interest—ω—can be interpreted as a local average treatment effect (LATE), which captures the effect of participation in the SR on food insecurity for those households in which the instrument induced them into treatment. Unlike OLS, in which the parameter of interest identifies the average treatment effect (ATE) for all treated observations, ω captures the ATE only for households in which their own extent of political and social networks had a key role in determining enrollment in the SR (i.e., the compliers). In the context of this paper, the IV is continuous. Therefore, I assume that higher values of Z increase the probability of enrollment in the SR by having greater networks.

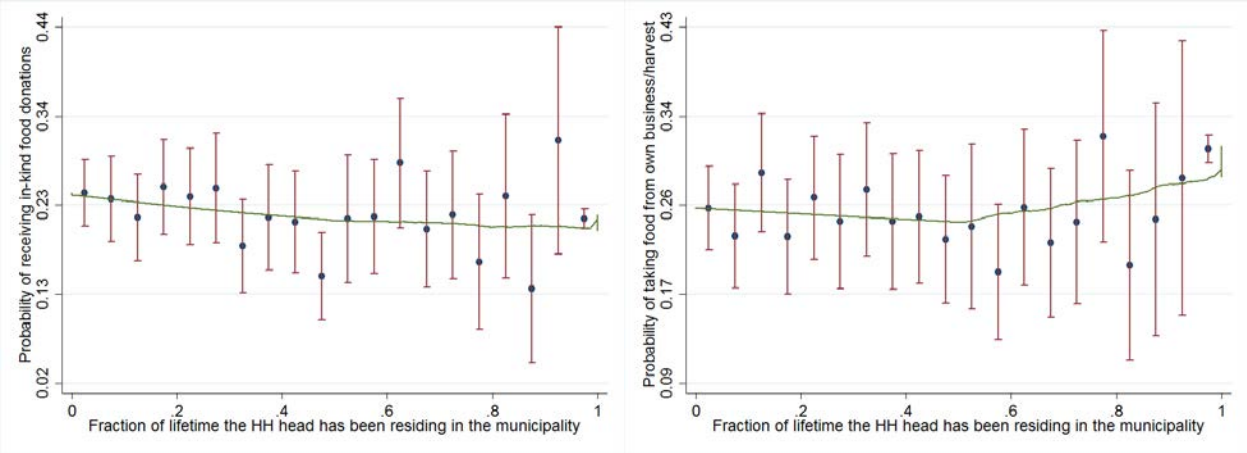
First, the IV has to fulfill the exclusion restriction, which means that Z_i affects Y_i only through S_i. Additionally, it implies that Z_i is not correlated with u_i. Technically, this assumption is hard to test and, at the same time, is the most complicated to validate using either empirical or theoretical arguments. Some issues will put under risk the validity of the exclusion restriction. First, the household decision of remaining at the same municipality may be influenced by location-specific characteristics that might also affect food insecurity status (e.g., job opportunities, housing conditions, quality of education, access to utilities, health conditions of the household members). The battery of controls included in X_i intend to capture the aforementioned features. For those that are unobserved, the inclusion of

municipality-level fixed effects becomes an optimal solution. Unfortunately, due to data anonymity policies from the Colombian Statistics Department, the public version of the LSS does not include municipality identifiers. Given the available data, I interact department identifiers with an indicator variable that is equal to one whether the household resides in an urban area, zero otherwise.

Additionally, greater political or social connections may help to reduce the likelihood of food insecurity, not only through participation into the SR, but also, for example, via donations. Figure 2a displays the probability of receiving in-kind donations, conditional on the instrumental variable, for the year 2008 subsample.[5] The visual evidence indicates a negative association between the variables, as illustrated by the slope of the locally weighted scatter plot smoothing line. At the same time, longer residence spells at the municipality may be the result of owning or working at well-established grocery neighborhood stores, or having more experience with farming the land. Therefore, these households could take food products from their own business or harvest, reducing the probability of being food insecure. Figure 2b illustrates the probability that households take food from their own business or harvest, conditional on the instrumental variable. For households with short spells at the current municipality, the association between the two variables is negative. But, when that spell is greater than 0.5, is possible to observe a positive slope of the locally weighted scatter plot smoothing line. Thus, households that have been residing in the current municipality for a relevant proportion of their lifetime are more likely to take food products from their own business or harvest. To rule out any possibility that the association between participation in the SR and food security fades out after controlling by the probabilities of receiving in-kind food donations or taking food from their own business or harvest, I estimate equations 2 and 3 including these two variables. As reported later in Section 6, the main findings do not

[5]For year 2012, the LSS did not include information about household expenditure on food.

Figure 2: **Probability of Receiving In-kind Food Donations or Taking Food from Own Business or Harvest, Conditional on Instrumental Variable**



(a) **In-kind food donations** (b) **Own business or harvest**

Vertical lines represent 95 percent confidence intervals. Source: 2008 Colombian LSS.

vary after the inclusion of these variables.

Second, the IV should be be relevant. As stated in Angrist and Pischke (2009), a weak instrument might reduce the precision of the IV estimator in the second stage, even worse than the estimates under OLS. This is easily evaluated during the first-stage estimation, computing the F-statistic for testing $H_0 : \delta = 0$. The results reported in Section 5 will rule out the possibility of having a weak instrument, robust on different specifications.

Third, the IV should fulfill the monotonicity property. This condition assumes the instrument would not have any effect on the treatment status for some observations, but requires the instrument to impact in the same direction on those who are effectively affected by it. This assumption implies to rule out the existence of defiers (e.g., individuals that did not participate into treatment after being induced to participation throughout the IV).

Nevertheless, as explained by DiNardo and Lee (2011), when the instrumental variable is continuous, for any given value of Z, it is possible to allow the treatment status to be

probabilistic. In other words, conditional on unobserved factors, it is possible to allow the probability of participation to increase as the value of the instrument goes up. Consequently, the proportion of compliers has to outnumber the proportion of defiers, as the value of Z rises. This assumption is known as *probabilistic monotonicity*. In the context of this paper, the assumption implies that as the residence spell at the same municipality increases, the probability of enrollment to the SR should also rise. Figure 3 illustrates such that probability for the sample used in this paper, conditional on the instrumental variable. As seen, the locally weighted scatter plot smoothing line always exhibits a positive slope for all values of Z_i.

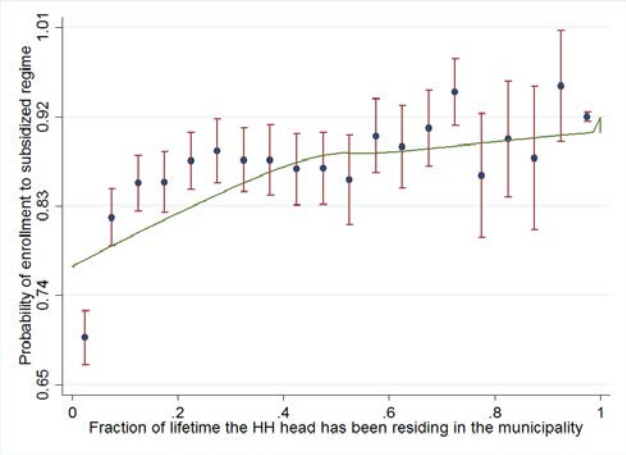
5 Results

Table 6 reports the results of the estimates of Equation 2, corresponding to the first stage of the IV system. This stage characterizes the determinants of enrollment in the SR, according to a set of household characteristics (X_i), fixed effects that capture heterogeneity at the state-urban level, and the proposed instrumental variable (Z_i) that aims to correct for the endogeneity of S_i. All the standard errors were corrected for heteroskedasticiy using the estimator proposed by White (1980).[6]

The results display the coefficient associated with the fraction of lifetime the household head has been residing in the current municipality is positive and statistically significant. Since this variable is defined in the range $[0, 1]$, the regression coefficient can been directly interpreted as the percentage-point difference in the probability of enrollment to the SR between a household head that has been living the entire life in the current municipality and

[6]Full results, including the estimated parameters for the battery of controls, are reported on Table A1 of the Appendix.

Figure 3: **Probability of Enrollment to Subsidized Regime, Conditional on Instrumental Variable**



Vertical lines represent 95 percent confidence intervals. Source: 2008 Colombian LSS.

a newcomer, holding other characteristics constant. For example, in column 4, a life-long resident is $0.115 \times 100 = 11.5$ percentage points more likely to be part of the SR than a newcomer. This parameter, for all the specifications displayed in Table 6, is close to the estimated by Gaviria, Medina, and Mejía (2006) using the 2003 LSS, which is 0.119.

Table 6: **First Stage Estimates**

Variable	**(1)**	**(2)**	**(3)**	**(4)**
Fraction of life HH head	0.126***	0.125***	0.113***	0.115***
has been residing in municipality	(0.007)	(0.007)	(0.007)	(0.007)
Number of observations	20,409	20,409	20,409	20,409
R-squared	0.021	0.036	0.053	0.064
Weak Identification F-statistic	308.240	297.185	252.103	258.315
Socio-demographic Controls			YES	YES
Department x Urban Fixed Effects		YES		YES

Significant at *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Own estimates. Source: 2008 and 2012 Colombian LSS

Regarding the relevance of the instrument, the F-statistic is greater than the accepted threshold ($F \geq 23$), for all specifications. Under the presence of robust standard errors, Montiel-Olea and Pflueger (2013) and Pflueger and Wang (2014) encourage econometricians

to use a larger threshold for rejecting the null hypothesis $H_0 : \delta = 0$, unlike the general rule of thumb ($F \geq 10$) based on Stock and Yogo (2002), which is for conditionally homoscedastic and serially uncorrelated errors. Therefore, a weak instrumental variable is not a concern here. Henceforth, the remaining econometric estimations will correspond to the model in column 4, which includes both the observable household-level characteristics and department-urban-level fixed effects.

Table 7 presents the results for the second stage (Equation 3), which estimates the association between enrollment in the SR on the set of measures of food insecurity—USDA-based threshold, intermediate threshold, and ELCSA-based threshold, as described in Section 3—and the number of affirmative answers in the food security supplement of the LSS, after correcting for the endogeneity of the treatment variable (S_i). The results provide evidence that participation in the SR has a significant association in reducing the incidence of food insecurity between 12.9 (column 2) and 19.6 (column 4) percentage points, and almost by 2 (column 8) the number of affirmative answers, for those households in which the instrument had an implication in program participation. Overall, there is a systematic correlation between enrollment into the SR and a reduction in the incidence of household food insecurity.

As described in section 4, the extent of social and political networks—captured by the instrumental variable—is expected to have a greater impact in enrollment to the SR in small municipalities and rural areas. Additionally, it is important to remark the visible differences in wellbeing between urban and rural areas in Colombia. Improvements in job conditions and opportunities in greater cities, and, most important, the persistence of a 50-year armed conflict—which impact has mostly taken place in the countryside—have propitiated a gap in living conditions between rural and urban areas.

Due to the lack of municipality indicators (which would allow to split the sample into

small and big municipalities), I estimate separate regression models for rural and urban areas, as displayed by Tables 8 and 9. First-stage estimates on the effect of the instrument on SR participation display the same sign and statistical significance for both sub-samples, but the coefficient is greater for rural households (0.126, compared with 0.106 for the urban sub-sample). The second-stage estimates display that enrollment to the SR is positively correlated with the mitigation of food insecurity, but only for rural households. More precisely, there is an association with a reduction of the incidence of food insecurity between 37.2 (column 5 of Table 8) and 40.5 (column 7) percentage points. As displayed in Table 9, the coefficient associated with participation in the SR is also negative for all the three different 2SLS specifications, but they are not statistically significant for urban households.

Table 7: **Second Stage Estimates**

	USDA Threshold		**Intermediate Threshold**		**ELCSA Threshold**		**# Affirmative Answers**	
	OLS	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
I[subsidized regime = 1]	-0.024^{**}	-0.129	-0.024^{**}	-0.196^{**}	-0.022^{**}	-0.170^{**}	-0.458^{***}	-1.832^{**}
	(0.011)	(0.081)	(0.011)	(0.081)	(0.010)	(0.075)	(0.099)	(0.766)
Number of Observations	20,409		20,409		20,409		20,409	
Average outcome for the uninsured	0.457		0.523		0.672		4.163	

All regression models include socio-demographic controls (see Table A1) and fixed effects at the department x urban level

Significant at *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Own estimates. Source: 2008 and 2012 Colombian LSS

Table 8: **IV Estimates, Rural Households Only**

	First Stage	**USDA Threshold**		**Intermediate Threshold**		**ELCSA Threshold**		**# Affirmative Answers**	
		OLS	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Fraction of life HH head residing in municipality	0.126^{***}								
	(0.012)								
I[subsidized regime = 1]		-0.051^{***}	-0.379^{***}	-0.047^{**}	-0.372^{***}	-0.029	-0.405^{***}	-0.546^{***}	-2.463^{**}
		(0.020)	(0.131)	(0.019)	(0.131)	(0.018)	(0.123)	(0.179)	(1.147)
Number of Observations	7,255	7,255		7,255		7,255		7,255	
Average outcome for the uninsured		0.520		0.593		0.716		4.395	
Weak Idetification F-statistic	111.870								
First Stage R-squared	0.070								

All regression models include socio-demographic controls (see Table A1) and fixed effects at the department level

Significant at *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Own estimates. Source: 2008 and 2012 Colombian LSS

Since there might exist some scenarios in which the exclusion restriction might fall, as explained in Section 4.2, I follow Nevo and Rosen (2012) by relaxing the exclusion restriction and estimating bounds of the effect of participation in the SR on food insecurity. This

Table 9: **IV Estimates, Urban Households Only**

	First Stage	USDA Threshold		Intermediate Threshold		ELCSA Threshold		# Affirmative Answers	
		OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Fraction of life HH head residing in municipality	0.106***								
	(0.009)								
I[subsidized regime = 1]		−0.006	−0.040	−0.008	−0.161	−0.013	−0.109	−0.338***	−1.494
		(0.012)	(0.107)	(0.012)	(0.107)	(0.012)	(0.101)	(0.118)	(1.048)
Number of Observations	13,154	13,154		13,154		13,154		13,154	
Average outcome for the uninsured		0.432		0.495		0.655		4.071	
Weak Idetification F-statistic	140.113								
First Stage R-squared	0.067								

All regression models include socio-demographic controls (see Table A1) and fixed effects at the department level

Significant at *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Own estimates. Source: 2008 and 2012 Colombian LSS

approach relies on two main assumptions: first, the correlation between the error term and the endogenous explanatory variable is of the same sign as the correlation between the (imperfect) instrumental variable and the error term, and, second, the instrumental variable can have some degree of endogeneity, but it has to be smaller—in absolute terms—that the endogeneity of the explanatory variable.[7]

In the context of this paper, the correlation between the imperfect IV and the endogenous explanatory variable is positive, as displayed by all the different first-stage estimates. Likewise, the presence of measurement error on both the instrumental variable and the endogenous regressor implies they are negatively correlated with the error term (i.e., $\rho_{Se} \times \rho_{Ze} > 0$). Assuming the degree of endogeneity is smaller for the IV than for the explanatory variable (i.e., household heads have less incentives on lying about their age and time residing in the current municipality than their health care insurance status), I implement the Nevo-Rosen approach for imperfect instrumental variables to estimate upper bounds of the effect of participation in the SR on household food insecurity.

Table 10 reports the results of the Nevo-Rosen estimates, compared with the 2SLS estimates for equations 2 and 3. For all the different samples (full sample, rural and urban subsamples as well), the upper-bound estimates are consistent with the results obtained from

[7] Appendix A.2 explains in more detail this methodology.

the standard 2SLS (Tables 7 to 9). That is, using both methodologies, I find an association between participation in the RD an a reduction in household food insecurity that principally takes place in rural areas.[8]

Table 10: **Imperfect Instrumental Variables Estimation (Nevo-Rosen Approach)**

	Full Sample		Rural		Urban	
Outcome	**2SLS estimate**	**Nevo-Rosen estimate**	**2SLS estimate**	**Nevo-Rosen estimate**	**2SLS estimate**	**Nevo-Rosen estimate**
USDA Threshold	−0.129	0.028	−0.379	−0.087	−0.040	0.039
Intermediate Threshold	−0.196	−0.014	−0.372	−0.076	−0.161	0.052
ELCSA Threshold	−0.170	−0.006	−0.405	−0.130	−0.109	0.038
Number of Observations	20,409		7,255		13,154	

Each cell corresponds to the second-stage estimate for the coefficient associated with participation in the SR, when using the corresponding outcome variable. All regression models include socio-demographic controls (see Table A1) and fixed effects at the urban-department (full sample) or department (rural and urban subsamples) level.

Significant at *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Own estimates. Source: 2008 and 2012 Colombian LSS

6 Robustness Checks

6.1 Testing for Alternative Channels

To rule out the possibility the IV affects the probability of being food insecure through other channels, as explained in Section 4.2, I estimate Equations 2 and 3 including indicator variables that account whether a household received in-kind food donations or took food from their own grocery business or harvest. These variables are only available for the 2008 wave of the LSS. Table A2 displays the second-stage coefficient associated with the probability of enrollment to the SR is no longer significant for almost all specifications (excepting when using the USDA-based threshold for categorizing food insecurity). Nevertheless, the

[8]The results from the Nevo-Rosen estimates can be interpreted as not significant when the upper bound is positive and, thus, zero can be overlapped.

association between participation in the SR and household food insecurity remains negative and statistically significant for the rural subsample, as reported in Table A3. On the other hand, the estimates for the urban subsample—displayed in Table A4—resembles the findings reported for the whole sample.

6.2 Heterogeneous Effects

As described in Section 3, almost 17 percent of households under the SR belong to the richest income quintiles (4 and 5). For the uninsured, more than 30 percent fall into this category.[9] Due to the fact that the SR aims to cover poor households, these shares seem to be greater than expected. Measurement error on the income variable or the presence of self-selection might be driving these results. Additionally, it is likely to expect that participation into the SR would have a small or no impact in mitigating food insecurity in richer households. Tables A5, A6, and A7 display the regression estimates for the sub-sample of households between belonging to income quintiles 1 to 3, and disaggregating by rural and urban households. In summary, participation in the SR is associated with less food insecurity only in rural households, resembling the results from Table 8. More precisely, the estimated parameter indicates that enrollment to the SR is associated with a reduction in the incidence of food insecurity between 39.5 (column 3) and 54.1 (column 7) percent, considering a food insecurity rate that ranges between 59.5 (USDA-based definition) and 78.2 (ELCSA-based definition) percent for uninsured poor households in rural areas.

Households with vulnerable members (e.g., children or elderly) are more prone to be food insecure, as reported by Table A8. Therefore, one can expect the potential effects of participation into the SR on reducing food insecurity could be greater for those households.

[9]The income distribution was estimated using the complete LSS sample, that is, including the remaining households that belong either to the contributive regime or the special health care regimes.

To validate that fact, I estimate equations 2 and 3 for each one of these subsamples. With respect to households with (or without) children, the estimates from Tables A9 to A14 surprisingly show a consistent pattern of a positive association between enrollment to the SR and mitigation of food insecurity for households without children, principally in rural areas. However, the magnitude of such estimated correlations from 2SLS seem to be extremely big, when compared with the proportion of food insecure households that are uninsured. For example, as displayed by column 3 of Table A13, the estimate for ω is about 0.87 (or 87 percentage points)—using the USDA-based threshold, whereas the percentage of uninsured food insecure households without children residing in rural areas is almost 46 percent. A similar situation takes place when I use the intermediate threshold (2 or more affirmative answers), as reported by column 5 of table A13. Regarding households with (or without) elderly, the results from Tables A15 to A17, reflects a similar situation for the subset of households residing in rural areas.

The previous results might be the consequence of estimating a linear probability model on both first and second stages, where there is no restriction for the predicted values (i.e., they can lie out of the $[0, 1]$ range). Nevertheless, as stated by Angrist and Pischke (2009), this situation is more desirable compared to implement a non-linear solution (i.e, estimate a non-linear first stage) for an endogenous dummy variable, known as the *forbidden regression*. Nevertheless, one can rely on the sign and statistical significance of the estimated coefficients from standard 2SLS. Therefore, it is possible to infer a positive association between participation in the SR and a reduction in food insecurity for households without children (contrary from what was expected) and households with elderly members, principally in rural areas, although the magnitudes should be taken with caution.

6.3 Testing for Potential Mediators

As explained in Sections 2.1 and 2.3, the effect of participation in the SR on household food security could not only come in the way of just belonging to that health care regime (i.e., income effect from lowering the price of health care via subsidized or free services), but also on participating in other SISBEN-eligible programs (i.e., "participation" effect). These other programs, like *Familias en Acción*, unemployment insurance, or subsidies for the elderly could act as mediators—i.e., variables that are caused or affected by a treatment variable, that also affect the outcome of interest. Following Dippel et al. (2017, 2019), I conduct a mediation analysis with a single IV. According to the authors, it is necessary to assume that the unobserved heterogeneity from the regression of the outcome on the endogenous treatment variable (T) also affects the determinants of the mediator (M). Thus, this assumption helps to implement a 2SLS approach with a single IV (Z) to achieve full identification of the system of equations. In the context of this paper, this approach seems to be adequate, since participation in other welfare programs also depend on the SISBEN score, which is the main determinant for enrollment into the SR. Consequently, any unobserved heterogeneity that affect participation in the SR should also affect participation in those other programs and, therefore, the IV could help to correct for all that endogeneity of T and M.

Tables A18 and A19 report the results from the mediation analysis using two SISBEN-eligible welfare programs (available in the LSS): *Familias en Acción* and subsidy to the elderly. As explained in Section 2.1, these programs aim to very vulnerable populations (e.g., children and elderly, respectively), which are more prone to experience food insecurity. Nevertheless, the results present no evidence of any mediation effect from these programs, contradicting previous evidence. For example, Attanasio and Mesnard (2006) and Lopez-Arana et al. (2016) provide evidence that *Familias en Acción*—a cash transfer program for

very poor households that also provides supplemental nutrition to children, conditional on school attendance and regular medical check-ups, has a positive effect on food consumption. The estimates from Tables A18 and A19 do not necessarily rule out the existence of any mediator between the SR and food security, including the ones already analyzed. These two programs were the only available in the LSS and, additionally, they might be subject to underreporting.

7 Conclusions

This paper addresses whether the Colombian subsidized health regime is associated with an income effect in household food expenditure and plays a role on mitigating food insecurity. Enrollment in the SR is determined by a proxy means test—the SISBEN score. Nevertheless, this score is not available for the econometrician. Additionally, there is evidence that the SISBEN score and, thus, participation to the SR, is subject to self-selection, municipality-level discretionary policies that affect eligibility, and manipulation for political purposes. Therefore, standard OLS estimates are biased due to measurement error and unobserved heterogeneity. To correct for that endogeneity, I use the fraction of lifetime the head of the household has been residing in the current municipality as an instrumental variable. The logic behind this instrument is that longer spells in the current place increases the probability of enrollment to the SR, due to extent of political and social networks that households can develop.

Using data from the Colombian LSS for the years 2008 and 2012, I find that enrollment in the SR has an association with mitigating food insecurity among households. The results display that households under this publicly-funded health care insurance would reduce the probability of being food insecure between 17 and 20 percentage points, comparing with

their uninsured counterparts. These results principally take place in rural areas. When considering this sub-sample only, the regression estimates of the coefficients of interest indicate an average reduction between 37 and 40 percentage points. Additionally, rural households without children or with elderly are more prone to be benefited from reducing food insecurity throughout participation in the SR

In summary, the estimates provide evidence of a association between participation in the SR and a income effect by allowing rural households to use the disposable income—as a result of facing lower prices on health care services—to achieve or overcome the minimum level of food expenditure that satisfies their daily needs. Presumably, the SR is acting as the main gate for participation to other SISBEN-eligible programs that can affect household food consumption, and, thus, will help to reduce the probability of being food insecure, despite the fact that the mediation analysis did not find such that effect, presumably due to the presence of measurement error. In other words, this paper has presented evidence on the (potential) causal relationship between participation on a welfare program and household food insecurity, but is not yet indicative of the mechanisms in which such that participation works towards that mitigation.

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Appendix

A.1 Food Security Questionnaire from the Colombian Living Standards Survey

1. In the last 30 days, did you ever worry that food would ran out in your household due to the lack of money?
2. In the las 30 days, did your household run out of food due to the lack of money?
3. In the last 30, did some adult in your household stopped having a nutritional diet due to the lack of money (i.e a diet composed of meat, milk or dairy products, fruits, eggs, vegetables, cereals, grains, tubercles and plantains)?
4. In the last 30 days, did you or some other adult in your household stop having breakfast, lunch or supper due to the lack of money?
5. In the last 30 days, did you or some other adult in your household could not change the diet due to the lack of money?
6. In the last 30 days, did you or some other adult in your household eat less than he is used to due to the lack of money?
7. In the last 30 days, did you or some other adult in your household feel or complain about hunger and did not eat due to the lack of money?
8. In the last 30 days, did you or some other adult in your household only eat once in a day or stopped eating in a day due to the lack of money?
9. In the last 30 days, did someone in your household have to do something that would have preferred not to do in order to obtain food? (only for 2008)
10. In the last 30 days, did an adult in your household sleep with hunger because there was not enough money for food?
11. In the last 30, did a child or a teen in your household stop having a nutritious diet due to the lack of money (i.e., a diet composed of meat, milk or dairy products, fruits, eggs, vegetables, cereals, grains, tubercles and plantains)?
12. In the last 30 days, did a child or teen in your household could not change the diet due to the lack of money?
13. In the last 30 days, did a child or teen in your household eat less than is used to due to the lack of money?

14. In the last 30 days, did you had to decrease the amount of food served in meals for some child or teen in your household due to the lack of money?
15. In the last 30 days, did a child or teen in your household complain of hunger but could not buy more food due to the lack of money?
16. In the last 30 days, did a child or teen in your household go to bed with hunger because there was not enough money for food?
17. In the last 30 days, did a child or teen in your household only eat once in a day or stop eating in a day due to the lack of money?
18. How many pounds of rice were consumed in the past week in the household? (only for 2012)
19. In the case of a food shortage due to the lack of money, which member of your household would get food with priority? (only for 2008)
    - Household head
    - Children under 18 years old
    - Sick people
    - Elderly
    - All the same
    - It is a single-member household

A.2 Nevo and Rosen (2012) Approach on Estimating Casual Effects with Imperfect Instrumental Variables

When there is suspicion that the proposed instrumental variable might not fulfill the exogeneity (i.e., exclusion restriction) assumption, the methodology proposed by Nevo and Rosen (2012) allows estimating bounds of the casual effect of the endogenous explanatory variable on the outcome of interest, after controlling for the observed variation of that explanatory variable based on the imperfect instrumental variable. This approach relies on two main

assumptions: first, the correlation between the error term and the endogenous explanatory variable (ρ_{Se}) is of the same sign as the correlation between the imperfect instrumental variable and the error term (ρ_{Ze}). Therefore, $\rho_{Se} \times \rho_{Ze} > 0$. Most importantly, this assumption is looser than the exclusion restriction assumption under standard instrumental variables ($\rho_{Ze} = 0$). The second assumption states that the instrumental variable can have some degree of endogeneity, but it has to be smaller—in absolute terms—than the endogeneity of the explanatory variable. In consequence, $|\rho_{Se}| > |\rho_{Ze}|$.

According to Nevo and Rosen (2012), it is possible to define a new instrumental variable as $V = \sigma_S Z - \lambda \sigma_Z S$, where σ_S and σ_Z are the standard errors of the endogneous explanatory variable and the instrumental variable, respectively, and $\lambda = \rho_{Ze}/\rho_{Se} \in [0, 1]$. When the imperfect instrumental variable is negatively correlated with the endogenous explanatory variable, is possible to construct two-sided bounds of the parameter. Otherwise, one can only construct one-sided bounds. More precisely, when $\rho_{Ze} > 0$ is assumed, the one-sided bound corresponds to $\beta \leq \min[\beta_V, \beta_Z]$—a lower bound, where β_V is the second-stage estimator using the Nevo-Rosen approach, and β_Z is the 2SLS when using the imperfect instrumental variable. On the other hand, if $\rho_{Ze} < 0$ is assumed, the estimated upper bound is $\beta \geq \max[\beta_V, \beta_Z]$.

A.3 Dippel et al. (2019) Approach on Mediation Analysis with a Single Instrumental Variable

Dippel et al. (2019) proposes a mediation analysis approach under the presence of instrumental variables. In this scenario, it is not possible to establish a casual chain (mechanism) if the treatment variable and the corresponding outcomes generate an additional outcome

of interest. When the treatment variable is endogenous, it is likely to expect the subsequent outcome to be endogenous as well. In the presence of two endogenous variables, one should need at least two instrumental variables to achieve full identification. Nevertheless, Dippel et al. (2019) assures that if the unobserved heterogeneity of the treatment variable (T) also affects the mediator (M), one can use a single IV to obtain full identification from the system of equations by using only one instrumental variable (Z)

According to Dippel et al. (2019), in addition to the standard 2SLS system (e.g., see equations 2 and 3), this mediation analysis also comprises the estimation of the following 2SLS systems:

$$T = \beta_T^Z Z + e_T \tag{A1}$$

$$M = \beta_M^T \hat{T} + e_M \tag{A2}$$

and:

$$M = \gamma_M^Z Z + \gamma_M^T + T + e_T \tag{A3}$$

$$Y = \beta_Y^M \hat{M} + \beta_Y^T T + e_Y \tag{A4}$$

where equations A1 and A2 correspond to the 2SLS estimates of the mediator on the treatment variable, after controlling on the variation of (T) caused by the instrumental variable (Z), and equations A3 and A4 relate the effect of the mediator on the outcome variable, after controlling for both the correlation between that mediator and partialling out the relation

of the treatment variable on the mediator.

As explained by Dippel et al. (2019), the *direct effect* (DE) of participation in the SR on mitigating food insecurity is given by β_Y^T, while the *indirect effect* (IE) is $\beta_M^T \times \beta_Y^M$, which corresponds to the effect of the mediator on food insecurity (β_Y^M) after partialling out the effect of the treatment variable on the mediator (β_M^T), and the total effect is given by the sum between the DE and the IE, corresponding to the second-stage estimate of the regression of household food insecurity on participation in the SR.

Table A1: **First Stage Estimates, Full Results**

Controls	**(1)**	**(2)**	**(3)**	**(4)**
Fraction of life HH head has been residing in the municipality	0.126***	0.125***	0.113***	0.115***
	(0.007)	(0.007)	(0.007)	(0.007)
Household head characteristics				
= 1 if household head is male			−0.027***	−0.026***
			(0.005)	(0.005)
age			−0.001	−0.001
			(0.001)	(0.001)
Squared age			0.000*	0.000
			(0.000)	(0.000)
= 1 if household head is single			−0.039***	−0.040***
			(0.008)	(0.008)
Years of education of HH head			0.009***	0.009***
			(0.002)	(0.002)
Squared years of education			−0.001***	−0.001***
			(0.000)	(0.000)
= 1 if employed			0.005	0.005
			(0.006)	(0.006)
Household characteristics				
Household size (persons)			0.007***	0.007***
			(0.002)	(0.002)
HH median age			0.001	0.001
			(0.001)	(0.001)
Squared HH median age			−0.000	−0.000
			(0.000)	(0.000)
= 1 if at least one child member in HH			0.034***	0.035***
			(0.007)	(0.007)
= 1 if at least one elder member in HH			0.016**	0.016**
			(0.007)	(0.007)
= 1 if at least one HH member reports regular/bad health cond.			0.012***	0.010**
			(0.005)	(0.005)
Dwelling unit characteristics				
Number of rooms			0.001	−0.000
			(0.002)	(0.002)
= 1 if primary walls are made of brick, stone, or smooth wood			−0.005	0.001
			(0.005)	(0.005)
= 1 if floor material is not sand or soil			0.004	0.001
			(0.006)	(0.006)
= 1 if gets water for consumption and cooking from direct aqueduct			−0.015***	−0.009
			(0.006)	(0.006)
= 1 if has sewerage or connection to septic tank			0.022***	0.024***
			(0.005)	(0.006)
= 1 if has garbage collection service			−0.004	0.001
			(0.006)	(0.007)
Household income				
IHS of per capita household income			0.003***	0.003***
			(0.001)	(0.001)
= 1 if household belongs to income quintile 2			−0.007	−0.004

Continued on the next page

Controls	**(1)**	**(2)**	**(3)**	**(4)**
			(0.006)	(0.006)
= 1 if household belongs to income quintile 3			−0.013*	−0.008
			(0.007)	(0.007)
= 1 if household belongs to income quintile 4			−0.050***	−0.044***
			(0.009)	(0.009)
= 1 if household belongs to income quintile 5			−0.085***	−0.079***
			(0.013)	(0.013)
Number of observations	20,409	20,409	20,409	20,409
R-squared	0.021	0.036	0.053	0.064
Weak Identification F-statistic	308.240	297.185	252.103	258.315
Department x Urban Fixed Effects		YES		YES

Significant at *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Own estimates. Source: 2008 and 2012 Colombian LSS

Table A2: **IV Estimates, Including Information Whether Households Received Food Donations or Took Food from Their Own Harvest or Business**

	First Stage	USDA Threshold		Intermediate Threshold		ELCSA Threshold		# Affirmative Answers	
		OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Fraction of life HH head	0.120***								
residing in municipality	(0.012)								
I[subsidized regime = 1]		−0.033**	−0.203*	−0.027*	−0.147	−0.016	−0.034	−0.553***	−1.971*
		(0.015)	(0.120)	(0.015)	(0.118)	(0.014)	(0.109)	(0.141)	(1.130)
I[Received food		0.065***	0.062***	0.065***	0.063***	0.062***	0.062***	0.625***	0.605***
donations = 1]		(0.013)	(0.013)	(0.012)	(0.012)	(0.011)	(0.011)	(0.123)	(0.124)
I[Took food from own		−0.033**	−0.032**	−0.026**	−0.025*	0.003	0.003	−0.595***	−0.580***
harvest or business = 1]		(0.013)	(0.013)	(0.013)	(0.013)	(0.012)	(0.012)	(0.123)	(0.124)
Number of Observations	8,006	8,006		8,006		8,006		8,006	
Average outcome for the uninsured		0.457		0.523		0.672		4.163	
Weak Idetification F-statistic	100.812								
First Stage R-squared	0.071								

All regression models include socio-demographic controls (see Table A1) and fixed effects at the department x urban level

Significant at *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Own estimates. Source: 2008 Colombian LSS

Table A3: **IV Estimates, Including Information Whether Households Received Food Donations or Took Food from Their Own Harvest or Business, Only Rural Households**

	First Stage	**USDA Threshold**		**Intermediate Threshold**		**ELCSA Threshold**		**# Affirmative Answers**	
		OLS	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Fraction of life HH head	0.142^{***}								
residing in municipality	(0.020)								
I[subsidized regime = 1]		-0.077^{***}	-0.543^{***}	-0.075^{***}	-0.386^{**}	-0.048^{**}	-0.179	-0.762^{***}	-3.248^{**}
		(0.026)	(0.183)	(0.025)	(0.174)	(0.023)	(0.157)	(0.242)	(1.565)
I[Received		0.056^{***}	0.049^{**}	0.048^{**}	0.043^{**}	0.035^{**}	0.033^{*}	0.473^{**}	0.436^{**}
food donations = 1]		(0.021)	(0.022)	(0.019)	(0.020)	(0.017)	(0.017)	(0.193)	(0.197)
I[Took food from own		-0.020	-0.007	-0.021	-0.012	-0.001	0.003	-0.579^{***}	-0.509^{***}
harvest or business = 1]		(0.018)	(0.020)	(0.018)	(0.019)	(0.016)	(0.017)	(0.164)	(0.169)
Number of Observations	2,922	2,922		2,922		2,922		2,922	
Average outcome for the uninsured		0.457		0.523		0.672		4.163	
Weak Idetification F-statistic	49.729								
First Stage R-squared	0.095								

All regression models include socio-demographic controls (see Table A1) and fixed effects at the department level

Significant at *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Own estimates. Source: 2008 Colombian LSS

Table A4: **IV Estimates, Including Information Whether Households Received Food Donations or Took Food from Their Own Harvest or Business, Only Urban Households**

	First Stage	USDA Threshold		Intermediate Threshold		ELCSA Threshold		# Affirmative Answers	
		OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Fraction of life HH head	0.106***								
residing in municipality	(0.015)								
I[subsidized regime = 1]		−0.000	−0.005	0.008	−0.021	0.011	−0.023	−0.315*	−1.724
		(0.018)	(0.169)	(0.018)	(0.167)	(0.017)	(0.156)	(0.172)	(1.631)
I[Received		0.047***	0.047***	0.049***	0.049***	0.055***	0.055***	0.501***	0.494***
food donations = 1]		(0.016)	(0.016)	(0.016)	(0.016)	(0.014)	(0.014)	(0.161)	(0.161)
I[Took food from own		−0.039**	−0.039**	−0.032*	−0.032*	0.006	0.006	−0.469**	−0.471**
harvest or business = 1]		(0.019)	(0.019)	(0.019)	(0.019)	(0.017)	(0.017)	(0.186)	(0.186)
Number of Observations	5,084	5,084		5,084		5,084		5,084	
Average outcome for the uninsured		0.457		0.523		0.672		4.163	
Weak Idetification F-statistic	49.683								
First Stage R-squared	0.080								

All regression models include socio-demographic controls (see Table A1) and fixed effects at the department level

Significant at *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Own estimates. Source: 2008 Colombian LSS

Table A5: **IV Estimates, Income Quintiles 1 to 3 Only**

	First Stage	**USDA Threshold**		**Intermediate Threshold**		**ELCSA Threshold**		**# Affirmative Answers**	
		OLS	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Fraction of life HH head residing in municipality	0.105***								
	(0.008)								
I[subsidized regime = 1]		−0.022*	−0.112	−0.022*	−0.205**	−0.021*	−0.198**	−0.487***	−1.927*
		(0.013)	(0.101)	(0.013)	(0.100)	(0.011)	(0.090)	(0.126)	(0.997)
Number of Observations	16,557	16,557		16,557		16,557		16,557	
Average outcome for the uninsured		0.544		0.612		0.757		5.093	
Weak Idetification F-statistic	184.440								
First Stage R-squared	0.047								

All regression models include socio-demographic controls (see Table A1) and fixed effects at the department x urban level

Significant at *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Own estimates. Source: 2008 and 2012 Colombian LSS

Table A6: **IV Estimates, Rural Households, Income Quintiles 1 to 3 Only**

	First Stage	**USDA Threshold**		**Intermediate Threshold**		**ELCSA Threshold**		**# Affirmative Answers**	
		OLS	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Fraction of life HH head residing in municipality	0.114***								
	(0.013)								
I[subsidized regime = 1]		−0.051**	−0.395**	−0.043**	−0.440***	−0.022	−0.541***	−0.614***	−2.684*
		(0.023)	(0.165)	(0.022)	(0.165)	(0.020)	(0.152)	(0.219)	(1.492)
Number of Observations	6,097	6,097		6,097		6,097		6,097	
Average outcome for the uninsured		0.595		0.665		0.782		5.172	
Weak Idetification F-statistic	78.083								
First Stage R-squared	0.056								

All regression models include socio-demographic controls (see Table A1) and fixed effects at the department level

Significant at *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Own estimates. Source: 2008 and 2012 Colombian LSS

Table A7: **IV Estimates, Urban Households, Income Quintiles 1 to 3 Only**

	First Stage	**USDA Threshold**		**Intermediate Threshold**		**ELCSA Threshold**		**# Affirmative Answers**	
		OLS	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Fraction of life HH head residing in municipality	0.096***								
	(0.010)								
I[subsidized regime = 1]		−0.002	−0.034	−0.006	−0.173	−0.016	−0.099	−0.326**	−1.659
		(0.015)	(0.138)	(0.015)	(0.136)	(0.014)	(0.123)	(0.153)	(1.395)
Number of Observations	10,460	10,460		10,460		10,460		10,460	
Average outcome for the uninsured		0.522		0.589		0.746		5.058	
Weak Idetification F-statistic	96.599								
First Stage R-squared	0.050								

All regression models include socio-demographic controls (see Table A1) and fixed effects at the department level

Significant at *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Own estimates. Source: 2008 and 2012 Colombian LSS

Table A8: **Food Insecurity Rates by Household Composition**

	USDA Threshold	**Intermediate Threshold**	**ELCSA Threshold**
Households without children	42.18	49.94	64.27
Households with children	53.13	59.34	73.91
Households without elderly	48.84	55.29	70.13
Households with elderly	52.45	60.06	73.29

Own estimates. Source: 2008 and 2012 Colombian LSS

Table A9: **IV Estimates, Only Households with Children**

	First Stage	**USDA Threshold**		**Intermediate Threshold**		**ELCSA Threshold**		**# Affirmative Answers**	
		OLS	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Fraction of life HH head residing in municipality	0.118***								
	(0.008)								
I[subsidized regime = 1]		−0.016	−0.058	−0.014	−0.148	−0.010	−0.112	−0.473***	−1.728*
		(0.014)	(0.094)	(0.013)	(0.094)	(0.012)	(0.086)	(0.144)	(0.986)
Number of Observations	13,885	13,885		13,885		13,885		13,885	
Average outcome for the uninsured		0.504		0.565		0.717		5.064	
Weak Idetification F-statistic	202.038								
First Stage R-squared	0.057								

All regression models include socio-demographic controls (see Table A1) and fixed effects at the department x urban level

Significant at *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Own estimates. Source: 2008 and 2012 Colombian LSS

Table A10: **IV Estimates, Rural Areas, Only Households with Children**

	First Stage	**USDA Threshold**		**Intermediate Threshold**		**ELCSA Threshold**		**# Affirmative Answers**	
		OLS	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Fraction of life HH head residing in municipality	0.132***								
	(0.014)								
I[subsidized regime = 1]		−0.042	−0.204	−0.027	−0.253*	−0.022	−0.344**	−0.620**	−1.744
		(0.026)	(0.150)	(0.026)	(0.151)	(0.023)	(0.140)	(0.273)	(1.467)
Number of Observations	4,833	4,833		4,833		4,833		4,833	
Average outcome for the uninsured		0.571		0.619		0.748		5.369	
Weak Idetification F-statistic	87.431								
First Stage R-squared	0.058								

All regression models include socio-demographic controls (see Table A1) and fixed effects at the department level

Significant at *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Own estimates. Source: 2008 and 2012 Colombian LSS

Table A11: **IV Estimates, Urban Areas, Only Households with Children**

	First Stage	**USDA Threshold**		**Intermediate Threshold**		**ELCSA Threshold**		**# Affirmative Answers**	
		OLS	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Fraction of life HH head residing in municipality	0.110***								
	(0.010)								
I[subsidized regime = 1]		−0.003	−0.042	−0.006	−0.157	−0.004	−0.055	−0.355**	−1.668
		(0.016)	(0.125)	(0.016)	(0.124)	(0.015)	(0.113)	(0.168)	(1.341)
Number of Observations	9,052	9,052		9,052		9,052		9,052	
Average outcome for the uninsured		0.480		0.545		0.705		4.955	
Weak Idetification F-statistic	111.785								
First Stage R-squared	0.059								

All regression models include socio-demographic controls (see Table A1) and fixed effects at the department level

Significant at *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Own estimates. Source: 2008 and 2012 Colombian LSS

Table A12: **IV Estimates, Only Households without Children**

	First Stage	USDA Threshold		Intermediate Threshold		ELCSA Threshold		# Affirmative Answers	
		OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Fraction of life HH head residing in municipality	0.098***								
	(0.014)								
I[subsidized regime = 1]		−0.031*	−0.274	−0.037**	−0.321*	−0.040**	−0.377**	−0.338***	−1.043
		(0.017)	(0.173)	(0.017)	(0.175)	(0.017)	(0.172)	(0.114)	(1.097)
Number of Observations	6,524	6,524		6,524		6,524		6,524	
Average outcome for the uninsured		0.391		0.464		0.609		2.885	
Weak Idetification F-statistic	50.978								
First Stage R-squared	0.087								

All regression models include socio-demographic controls (see Table A1) and fixed effects at the department x urban level

Significant at *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Own estimates. Source: 2008 and 2012 Colombian LSS

Table A13: **IV Estimates, Rural Areas, Only Households without Children**

	First Stage	**USDA Threshold**		**Intermediate Threshold**		**ELCSA Threshold**		**# Affirmative Answers**	
		OLS	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Fraction of life HH head residing in municipality	0.113***								
	(0.022)								
I[subsidized regime = 1]		−0.074**	−0.870***	−0.081***	−0.719**	−0.043	−0.588**	−0.541***	−3.768**
		(0.030)	(0.295)	(0.030)	(0.280)	(0.028)	(0.259)	(0.200)	(1.678)
Number of Observations	2,422	2,422		2,422		2,422		2,422	
Average outcome for the uninsured		0.459		0.563		0.677		3.233	
Weak Idetification F-statistic	25.921								
First Stage R-squared	0.093								

All regression models include socio-demographic controls (see Table A1) and fixed effects at the department level

Significant at *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Own estimates. Source: 2008 and 2012 Colombian LSS

Table A14: **IV Estimates, Urban Areas, Only Households without Children**

	First Stage	**USDA Threshold**		**Intermediate Threshold**		**ELCSA Threshold**		**# Affirmative Answers**	
		OLS	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Fraction of life HH head residing in municipality	0.088***								
	(0.018)								
I[subsidized regime = 1]		−0.001	0.084	−0.004	−0.132	−0.029	−0.282	−0.181	0.674
		(0.020)	(0.234)	(0.021)	(0.239)	(0.020)	(0.237)	(0.138)	(1.559)
Number of Observations	4,102	4,102		4,102		4,102		4,102	
Average outcome for the uninsured		0.360		0.420		0.579		2.728	
Weak Idetification F-statistic	24.908								
First Stage R-squared	0.097								

All regression models include socio-demographic controls (see Table A1) and fixed effects at the department level

Significant at *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Own estimates. Source: 2008 and 2012 Colombian LSS

Table A15: **IV Estimates, Only Households with Elderly Members**

	First Stage	**USDA Threshold**		**Intermediate Threshold**		**ELCSA Threshold**		**# Affirmative Answers**	
		OLS	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Fraction of life HH head residing in municipality	0.077***								
	(0.015)								
I[subsidized regime = 1]		−0.004	−0.960***	0.006	−1.101***	−0.003	−0.625**	−0.293	−7.623**
		(0.029)	(0.357)	(0.028)	(0.371)	(0.026)	(0.294)	(0.251)	(2.960)
Number of Observations	4,482	4,482		4,482		4,482		4,482	
Average outcome for the uninsured		0.457		0.523		0.672		4.163	
Weak Idetification F-statistic	25.448								
First Stage R-squared	0.047								

All regression models include socio-demographic controls (see Table A1) and fixed effects at the department x urban level

Significant at *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Own estimates. Source: 2008 and 2012 Colombian LSS

Table A16: **IV Estimates, Rural Areas, Only Households with Elderly Members**

	First Stage	**USDA Threshold**		**Intermediate Threshold**		**ELCSA Threshold**		**# Affirmative Answers**	
		OLS	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Fraction of life HH head residing in municipality	0.129***								
	(0.027)								
I[subsidized regime = 1]		−0.019	−0.801**	−0.029	−0.643**	0.022	−0.466*	−0.348	−6.356**
		(0.047)	(0.338)	(0.044)	(0.320)	(0.040)	(0.278)	(0.392)	(2.657)
Number of Observations	1,778	1,778		1,778		1,778		1,778	
Average outcome for the uninsured		0.457		0.523		0.672		4.163	
Weak Idetification F-statistic	22.645								
First Stage R-squared	0.079								

All regression models include socio-demographic controls (see Table A1) and fixed effects at the department level

Significant at *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Own estimates. Source: 2008 and 2012 Colombian LSS

Table A17: **IV Estimates, Urban Areas, Only Households with Elderly Members**

	First Stage	**USDA Threshold**		**Intermediate Threshold**		**ELCSA Threshold**		**# Affirmative Answers**	
		OLS	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Fraction of life HH head residing in municipality	0.043**								
	(0.018)								
I[subsidized regime = 1]		0.022	−1.483	0.045	−2.126*	0.001	−1.119	−0.048	−11.998
		(0.036)	(0.921)	(0.036)	(1.122)	(0.033)	(0.760)	(0.325)	(7.738)
Number of Observations	2,704	2,704		2,704		2,704		2,704	
Average outcome for the uninsured		0.457		0.523		0.672		4.163	
Weak Idetification F-statistic	5.855								
First Stage R-squared	0.057								

All regression models include socio-demographic controls (see Table A1) and fixed effects at the department level

Significant at *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Own estimates. Source: 2008 and 2012 Colombian LSS

Table A18: **Mediation Analysis Estimates Using *Familias en Accion* as Mediator**

	USDA Threshold			**Intermediate Threshold**			**ELCSA Threshold**			**# Affirmative Answers**		
	Full Sample	**Only Rural**	**Only Urban**	**Full Sample**	**Only Rural**	**Only Urban**	**Full Sample**	**Only Rural**	**Only Urban**	**Full Sample**	**Only Rural**	**Only Urban**
Total effect	−0.098	−0.343**	−0.015	−0.159*	−0.328**	−0.130	−0.135*	−0.383***	−0.066	−1.741**	−2.288*	−1.452
	(0.084)	(0.137)	(0.112)	(0.084)	(0.137)	(0.112)	(0.078)	(0.128)	(0.105)	(0.801)	(1.204)	(0.112)
Direct effect	0.196	−3.285	−0.018	0.365	−3.174	−0.171	0.305	−3.914	−0.085	3.102	−19.765	−1.826
	(0.458)	(41.457)	(0.149)	(0.732)	(40.085)	(0.233)	(0.618)	(49.779)	(0.162)	(6.763)	(246.609)	(0.233)
Indirect effect	−0.295	2.943	0.004	−0.524	2.845	0.042	−0.440	3.531	0.019	−4.843	17.477	0.374
	(0.642)	(37.808)	(0.039)	(1.033)	(36.557)	(0.155)	(0.872)	(45.398)	(0.077)	(9.545)	(224.898)	(0.155)
First Stage S $\rightarrow Z$ F-stat	236.307	102.431	127.068	236.307	102.431	127.068	236.307	102.431	127.068	236.307	102.431	127.068
First Stage FA $\rightarrow Z\|S$ F-stat	0.312	0.006	0.784	0.312	0.006	0.784	0.312	0.006	0.784	0.312	0.006	0.784
Number of Observations	20,409	7,255	13,154	20,409	7,255	13,154	20,409	7,255	13,154	20,409	7,255	13,154

The total effect refers to the impact of enrolment in the SR (S) on household food security (FI), after the endogenous explanatory variable has been instumented (Z). Direct effect is the impact of S on FI, after partialling out the effect of the mediator, participation in Familias en Accin (FA). The indirect effect—or mediation effect—addresses the impact of FA on FI through S

Significant at *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Own estimates. Source: 2008 and 2012 Colombian LSS

Table A19: **Mediation Analysis Estimates Using Subsidy to the Elderly as Mediator**

	USDA Threshold			**Intermediate Threshold**			**ELCSA Threshold**			**# Affirmative Answers**		
	Full Sample	**Only Rural**	**Only Urban**	**Full Sample**	**Only Rural**	**Only Urban**	**Full Sample**	**Only Rural**	**Only Urban**	**Full Sample**	**Only Rural**	**Only Urban**
Total effect	−0.098	−0.343**	−0.015	−0.159*	−0.328**	−0.130	−0.135*	−0.383***	−0.066	−1.741**	−2.288*	−1.452
	(0.084)	(0.137)	(0.112)	(0.084)	(0.137)	(0.112)	(0.078)	(0.128)	(0.105)	(0.801)	(1.204)	(0.112)
Direct effect	−0.001	0.071	−0.000	0.013	0.072	0.028	0.010	0.114	0.006	−0.147	0.171	−0.039
	(0.022)	(0.101)	(0.031)	(0.024)	(0.098)	(0.036)	(0.022)	(0.114)	(0.031)	(0.222)	(0.696)	(0.036)
Indirect effect	−0.097	−0.414	−0.014	−0.172	−0.400	−0.158	−0.145	−0.497	−0.072	−1.593	−2.459	−1.413
	(0.108)	(0.404)	(0.141)	(0.121)	(0.392)	(0.174)	(0.110)	(0.465)	(0.140)	(1.141)	(2.688)	(0.174)
First Stage S → Z F-stat	236.307	102.431	127.068	236.307	102.431	127.068	236.307	102.431	127.068	236.307	102.431	127.068
First Stage SE → $Z\|S$ F-stat	11.629	2.011	3.907	11.629	2.011	3.907	11.629	2.011	3.907	11.629	2.011	3.907
Number of Observations	20409	7255	13154	20409	7255	13154	20409	7255	13154	20409	7255	13154

The total effect refers to the impact of enrolment in the SR (S) on household food security (FI), after the endogenous explanatory variable has been instumented (Z). Direct effect is the impact of S on FI, after partialling out the effect of the mediator, receiving subsidies to the elderly (SE). The indirect effect—or mediation effect—addresses the impact of SE on FI through S

Significant at *** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Own estimates. Source: 2008 and 2012 Colombian LSS


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