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CCT PROGRAMS FOR CONSUMPTION INSURANCE: EVIDENCE FROM COLOMBIA.

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BY

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Abstract

This paper presents evidence of the ability of poor households in Colombia to insure consumption against idiosyncratic and covariate risks. Using longitudinal data from Familias en Acción (FA), a conditional cash transfer program (CCT) in Colombia, we test the predictions of the Pareto full risk-sharing model and estimate the parameters of a partial insurance model. Although we reject the hypothesis of full insurance, our results suggest there is a level of risk sharing in these communities, supporting the partial insurance model. In addition, we evaluate the effectiveness of FA as a risk management mechanism for beneficiary households. We find that the program serves not only as an instrument for consumption smoothing, but also for income smoothing. Particularly, FA is effective in protecting food consumption but not nonfood consumption, and it reduces consumption fluctuations in response to idiosyncratic shocks but not to covariate shocks.

Chapter 1 CCT PROGRAMS FOR CONSUMPTION INSURANCE: EVIDENCE FROM COLOMBIA

1. Introduction

Poor households in developing countries live with high levels of risk and limited access to formal financial systems for credit and insurance. To secure their levels of consumption, or smooth consumption, households have traditionally engaged in different ex-post risk coping strategies; i.e., depletion of assets, increase of labor supply, informal borrowing, or transfers from relatives. Also, risk-averse households can take ex-ante actions to mitigate the effects of negative income shocks; i.e., income smoothing. However, neither of these alternatives allows poor households to achieve an optimal allocation of risk across time, and most of these strategies are costly in terms of long-term poverty and vulnerability. In particular, ex-post consumption smoothing strategies might result in households' decreased capital accumulation, and the income-smoothing mechanism might result in reduced investments in productive assets. Thus, the inability of households to cope with risk is a channel through which they can get into a poverty trap. For these reasons, the research on risk coping behavior and consumption smoothing arrangements of poor communities in developing countries is a crucial issue in the formulation of policies aimed to reduce poverty.

The purpose of this paper is twofold. First, we analyze the degree of consumption insurance of poor households in Colombia in relation to fluctuations in their incomes due to idiosyncratic and community shocks. Second, we evaluate the effects that a conditional cash transfer program (CCTs), Familias en Acción (FA), has had on protecting households

from the negative effects of shocks. By doing this, we hope to contribute to the literature of consumption smoothing in developing countries as well as to provide new evidence of the role of CCTs as risk management instruments. A good understanding of how and which public interventions provide effective insurance is crucial for policy design.

Economics literature has broadly studied how individuals smooth consumption in response to income shocks. Two main hypotheses have dominated the literature. On one hand, the full risk-sharing hypothesis assumes that consumption is fully insured against idiosyncratic income shocks but not against community income shocks. On the other hand, the permanent income hypothesis (PIH) assumes that, under complete credit markets, self-insurance through borrowing and saving may allow inter-temporal consumption smoothing against idiosyncratic and covariate shocks. Although both hypotheses have been rejected repeatedly (e.g., Townsend 1994, Ravallion and Chaudhuri 1997, Deaton 1992, Skoufias 2003), empirical evidence has shown that consumption reacts too little to permanent income shocks to be consistent with the economic theory (Campbell & Deaton, 1989; Attanasio & Pavoni, 2006). Because these models are extreme characterizations of individual and market behavior, recent literature has addressed the issue of whether partial consumption insurance is available to agents. This paper, in addition to following the traditional approach of testing the hypotheses of complete consumption insurance, estimates partial insurance parameters from the data following the model of partial insurance proposed by Blundell et al. (2008).

In addition to identifying the relationship between consumption smoothing and income shocks, we spend special attention on how public interventions—CCTs, in particular—can play a significant role in reducing consumption vulnerability of poor

households. According to Morduch (1999), CCTs guarantee that a minimum of insurance is received in order to compensate for under-provision of safety-net services in poor areas. There are several ways in which we can expect CCT programs to reduce the risk of vulnerability: They can (1) reduce income fluctuations because they increase income irrespective of shocks and thus have the same insurance properties as permanent income; (2) displace non-desirable coping strategies, such as high-interest loans, child labor, or depletion of productive assets; (3) create a regulatory and institutional framework to scale up services through informal safety nets; and (4) counteract the government's incapacity to respond at state and local levels (Cox & Jimenez, 1992).

FA provides subsidies to families on the conditions that all household members receive periodic health check and that all children are enrolled in and attend school regularly. Given the importance of the program at a national level, a rigorous impact evaluation design has been followed since the very early stages of the program. This has allowed for the collection of repeated observations of beneficiary households surveyed before and after the implementation of the program, as well as the collection of similar data from comparable households that have not been covered by the program. Thus, this panel dataset provides an excellent opportunity for measuring consumption insurance and reveals possible roles of public interventions as risk management instruments.This study has some advantages over other similar studies because of the quasi-experimental design of the program it studies and because of the comprehensive data collected from the program's evaluation survey. First, the balanced panel dataset has detailed information on consumption, income, and shocks for a representative sample of poor households living in small villages in Colombia. Most of the datasets used in earlier studies to evaluate

consumption smoothing report either income or consumption, not both. For example, in order to estimate partial insurance parameters for the United States, Blundell et al. (2008) have to infer consumption statistically, since consumption and income data are not available for the same households in a single dataset.

Second, while some studies use changes in income as measures of shocks (Skoufias, 2003; Townsend, 2004), others use dummy variables for the occurrence of idiosyncratic shocks in a given period of time (Cochane, 1991; Mace, 1991). Although income has been criticized as a right hand side variable since it can be endogenous in the consumption equation (Cochane, 1991), if we are able to control for that endogeneity, income variance at household and community levels are very informative about the degree of consumption insurance of poor households. Furthermore, as frequency and intensity of shock events are difficult to capture in occurrence shocks data, a better understanding of the vulnerability to shocks is obtained when we are able to complement these results using income variance and shock events as measures of the risk faced by these households. The dataset used in this analysis uses both income variance and shock events to estimate consumption insurance parameters. Finally, as we have data for treatment and control households before the program was implemented, we are able to estimate an unbiased effect of the program on consumption smoothing, controlling for any pretreatment differences, and for time variant differences at the municipality level.

This paper makes three important contributions to the existing literature. First, it adds to the empirical literature on consumption insurance by providing evidence of the ability of poor households in Colombia to insure consumption against idiosyncratic and covariate shocks. Prior evidence of consumption smoothing has been limited to results

from a particular Indian dataset[1] and a few other samples collected mainly in Asia and Africa. Latin America, a region with a massive proportion of people living in poverty who are subject to income shocks, is clearly underrepresented in this literature, in large part due to the lack of suitable information for investigating risk and insurance of poor households. Second, it contributes to the social program evaluation literature by going beyond assessing the impact of the program on its main objectives to analyze the consequences of participation in other dimensions, such as the degree of informal risk sharing. Third, it is the first paper, to our knowledge, that compares consumption insurance parameters under both the full risk-sharing model and a partial insurance model.

Based on all specifications used in this research, we reject the hypothesis of complete consumption insurance and support predictions of the partial insurance model. We observe a high, but not complete, level of consumption smoothing among poor households in small villages in Colombia, with food consumption's being better insured than nonfood consumption. In addition, results suggest that FA has been effective as a risk management instrument protecting food consumption when households are faced by income shocks and has not displaced risk pooling among households in the same communities. These findings provide strong indications that households engage in risk management strategies aimed at insulating, at least partially, consumption changes from income changes. For instance, our results suggest that the introduction of this program might has enforced the use of savings and assets and has displaced transfers as informal risk-sharing arrangements. If FA have in fact crowd-out or enforce existing informal risk coping strategies and the final well being of beneficiary households are issues not

[1] A pool of cross-sectional data for the period 1975–1984 from the International Crops Research Institute of the Semi-Arid Tropics (ICRISAT).

addressed on this paper. Finally, we conclude that FA, despite not being a consumption insurance program, helps treated families to smooth consumption. Results are robust to different specifications.

The rest of the paper is organized as follows. The next section provides an overview of the program and a description of the evaluation sample used for the empirical analysis. The subsequent section examines risks faced by households in rural Colombia and describes the data used for the empirical analysis. Following is a section that presents basic predictions of the full risk-sharing model and the influential findings on risk coping behavior and consumption smoothing arrangements in developing economies. The next section contains the empirical model and results for the full insurance model. The two subsequent sections present the model used in this paper to estimate partial insurance parameters based on both Blundell et al.'s (2008) and this study's estimations, respectively. The following section presents an analysis of risk coping strategies used by households to buffer adverse income shocks, and the final section reports the conclusions and makes suggestions for future research.

2. Familias en Acción

The program Familias en Acción is a welfare program run by the Colombian government to foster the accumulation of human capital in rural Colombia. It is similar to other CCT programs, such as Progresa, in Mexico (now called Oportunidades); Red de Proteccion Social, in Nicaragua; and Bolsa Familia, in Brazil, that have been implemented in middle-income countries during the last decade in an effort to break the intergenerational transmission of poverty. The FA program is aimed primarily at improving the education,

health, and nutrition of poor families. The nutrition component consists of a basic monetary supplement that is given to all beneficiary families with children under seven years of age. The health component consists of vaccinations and growth and development checks for children, as well as courses on nutrition, hygiene, and contraception for their mothers. Participation in the health component is a precondition for receiving the benefits of the nutritional component. All children between 7 and 18 years old are eligible for the educational component. To receive the grant, they must attend classes during at least 85% of the school days in each school month as well as during the whole academic year. The size of the grant increases for secondary education and is equal for girls and boys. The amount of the subsidy on a monthly basis at the time of the baseline survey was 14,000 Colombian pesos (COP) or (US$6) for each child attending primary school and COP$28,000 or (US$12) for each child attending secondary school in 2005. The nutritional supplement[2] is paid to families with children aged between 0 and 6 years. The amount is COP$46,500 or (US$20) per family per month. The average transfer received per household is COP$61,500, which represents approximately 25% of average household income of beneficiary households. In general, all the transfers are received by the female head of the household every two months.

Familias en Acción determined household eligibility in two stages: first by identifying target communities and then by choosing low-income households within those communities. Selection criteria for target communities were based on the following conditions. The town must: (i) have fewer than 100,000 inhabitants and not be a

[2] This subsidy is an alternative to participation in a pre-existing program called Hogares Comunitarios. Beneficiaries cannot participate in both programs with the same children. However, families with children both under and over the age of 6 can choose to send the young children to a Hogar Comunitario and to participate in FA with the older children.

departmental capital, (ii) have sufficient education and health infrastructures, (iii) have a bank, and (iv) have a municipality administrative office with relatively up-to-date welfare lists and other official documents deemed important. A subset of 622 of the 1,060 Colombian municipalities qualified for the program. Eligible households were those registered at SISBEN[3] level 1 at the end of December 1999, with children under 17 years old, living in the target municipalities. SISBEN 1 households account for roughly the lowest quintile of Colombia's household income distribution (Attanasio, 2004).

The program started operating in the latter half of 2002.[4] It has benefited approximately 1,500,000 households since its beginning, and the cost has ascended to the sum of 300 thousands of millions of Colombian pesos annually (US$150 million). The cost of the program corresponds to the 0.5% of the Colombian GDP and represents approximately 10% of educational expenditures in the country.

The Evaluation Sample

For evaluation purposes, it was decided to construct a representative stratified sample of treatment municipalities and to choose control municipalities among those that were excluded from the program but that belonged within the same strata. The strata were determined by region and by an index of infrastructure based on health and education. The control towns were chosen within the same stratum to be as similar as possible to each of the treatment towns, in terms of population, area, and quality of life index. Most of the control municipalities were towns with basic school and health infrastructures but without

[3] SISBEN, Sistema Unificado de Beneficiarios, is a six-level poverty indicator used in Colombia to target welfare programs and for the pricing of utilities.
[4] In a few municipalities the program started as early as the end of 2001.

banks or, in the few cases chosen to match relatively large municipalities, just over 100,000 inhabitants. As a consequence, control towns are broadly comparable to treatment towns (Attanasio, 2004). In the end, the evaluation sample was made up of 122 municipalities, 57 of which were treatment and 65 of which were controls.

For each municipality, approximately 100 eligible households were included in the evaluation sample. The total evaluation sample consists of 11,462 households interviewed between June and October 2002 (baseline survey), 10,742 households interviewed between July and November 2003 (first wave), and 9,566 households interviewed between November 2005 and April 2006 (second wave). The attrition rate between the three rounds was approximately 16%.[5] The final longitudinal data used in this study include information from 6,519 repeated households, after excluding households that received payments before the baseline survey and households located in control municipalities[6] that received payments during the second survey.

At the household level, the sample consists of families that are potential beneficiaries of the program—that is, households with children from the poorest sector of society. Data are collected at both the household and the individual level. The available data provide a rich set of variables that allows us to measure consumption of durables and non-durables, family composition, household socio-demographic structure, labor supply, nutritional status of children, education, household assets, income, and different shocks to income, for both rural and urban households.

[5] According to Attanasio (2007), observations lost are not related to the program.
[6] A total of 13 municipalities of the control sample were converted to treatment municipalities in 2005, before the second wave of the evaluation survey.

3. Empirical Evidence on Risk and Consumption

Shocks

The variables used to identify the various shocks experienced by households are obtained from direct questions in the evaluation survey. In each of the three survey rounds, the household was asked whether during the last year it had experienced any of the following shocks: crop loss or job loss, death of a household member, illness of any household member, violent attack or displacement, or weather shock.[7] We include an additional shock, unemployment of the household head, which takes a value of one if the household head were looking for a job for more than three months during the year previous to the survey. In that way, we expect to capture a severe income shock. Although unemployment can be endogenous, I found that the program doesn't provide incentives to reduce labor supply of parents, which is discussed in another chapter of this dissertation. Therefore, for the purposes of this paper we assume that our measure of unemployment shocks is not endogenous.

For the sample of households in treatment and control municipalities, the prevalence of different types of shocks at the household level during each of the cross-section surveys are reported in Table 1. As we observe, there is no statistical difference between treatment and control households for all of the shocks, except for illness during the first round. This could suggest that participation in the program could decrease the vulnerability to disease shocks. However, this shock could be endogenous, especially for children, as the program imposes regular visits to health centers as a condition for receiving part of the transfers (Attanasio, 2004). To avoid such endogeneity, we improve

[7] Fire, floods, or other catastrophic events.

the data by identifying illness for each household member and measuring its intensity. In that way, we distinguish between illnesses of children, which can be very endogenous, and illnesses of the household head and other adults, which should be less endogenous. We find that illness of the household head is not statistically different between treatment and control municipalities, suggesting that it is an exogenous shock, while illness of children and spouse are correlated with the program and so might be endogenous.

Data show that the exposure of households to crop loss and unemployment of household head is very high: over 10% of households had at least one crop loss and over 5% had at least one member unemployed for more than 3 months during the year previous to the interview. Around 11% of the households reported having the household head ill for more than two weeks at least once over the year prior to the survey. Death of any household member, being a victim of violence, and weather shocks are less frequent but can be very harmful to poor families because they result not only in loss of income but also in increased household expenditures.

Table 1. Frequency of Idiosyncratic Shocks

	Crop loss	**Unemployment, HH head**	**Death, HH member**	**Weather**	**Violence**
Baseline					
Control	11.39%	5.20%	1.81%	1.55%	1.16%
Treatment	9.58%	5.14%	2.01%	0.95%	1.02%
T-test (p value)	0.483	0.777	0.709	0.615	0.808
1st wave					
Control	12.66%	5.47%	1.81%	1.06%	0.95%
Treatment	13.50%	4.93%	2.54%	1.25%	1.48%
T-test (p value)	0.545	0.323	0.085	0.913	0.136
2nd wave					
Control	12.25%	5.87%	2.09%	5.95%	1.50%
Treatment	13.67%	5.61%	2.39%	5.57%	1.89%
T-test (p value)	0.563	0.193	0.598	0.469	0.536

Continue…

	Illness	Illness, HH head	Illness, partner	Illness, children
Baseline				
Control	9.37%	12.40%	9.56%	8.67%
Treatment	11.65%	13.96%	11.43%	7.95%
T-test (p value)	0.136	0.636	0.582	0.636
1nd wave				
Control	10.16%	12.66%	9.05%	7.61%
Treatment	9.97%	11.28%	8.18%	6.51%
T-test (p value)	0.024	0.645	0.067	0.045
2nd wave				
Control	9.61%	10.11%	7.32%	3.92%
Treatment	10.00%	10.60%	7.08%	3.33%
T-test (p value)	0.223	0.574	0.293	0.569

Notes: T-test of difference in household means computed clustering at the municipality level.

In order to capture the covariate nature of weather shocks, we use the proportion of households within a municipality reporting to have suffered this shock (de Janvry et al., 2006). Community violence is obtained from other sources and measures the number of terrorist attacks that municipalities had during the year before the interview.[8] Mean statistics and differences among treatment and control municipalities are presented in Table 2 As we can observe, there are not pre-treatment and post-treatment statistical differences in the occurrence of these covariate shocks between treatment and control municipalities.

Table 2. Frequency of Covariate Shocks

	Survey	Treatment	Control	T-test (p value)
Weather	Baseline	0.82	0.80	0.9725
	1st wave	0.96	1.06	0.8631
	2nd wave	1.35	1.74	0.1639
Violence	Baseline	0.82	0.87	0.8744
	1st wave	0.75	1.25	0.2075
	2nd wave	0.89	1.61	0.3476

Notes: Numbers indicates the average proportion of households on each municipality that have suffered weather and violence shocks. T-test of difference in means among communities in the sample.

[8] These data have been collected by Interconexion Electrica SA (ISA) since 1998. ISA is the biggest power line operator in Colombia, which has been the target of recurrent terrorist attacks.

Consumption

The evaluation survey of FA contains detailed information on food and nonfood expenditures in all three rounds: baseline, first wave, and second wave. In food expenditures, there is information on the amount of money spent by households in buying fruits and vegetables, cereals and grains, meats and animal products, and other food products, like soft drinks, alcoholic beverages, coffee, tea, etc. In the nonfood expenditures category, there is information on the money spent on clothing, health products and services, house maintenance products, school and educational goods, transportation, utilities, and other nonfood expenditures, like cigarettes, social events, and toys. Expenditures on durables, such as furniture, and luxury items are excluded from the calculation of nonfood expenditures.

Depending on the commodity, good, or service, the survey asked the head of household about the expenditures made during the week, month, semester, or year prior to the date of the survey. In order to construct the measures of household consumption used in this paper, we converted all expenditures into a household's monthly expenditures and then added them up across the corresponding categories: total consumption, food consumption, and nonfood consumption. We also deflated the measures using the National Consumer Price Index of Colombia and turned them into adult-equivalent[9] pesos at constant 2002 prices. Self-consumption was not included in the consumption measures due to lack of detailed information.

Table 3 shows that households spend around COP$62,500 per adult equivalent per month on total consumption, and that 70% of these expenditures are on food. There are no

[9] Household members older than 12 years old are counted as 1 person; household members younger than 12 years are counted as 0.5 person.

pretreatment differences in consumption between treatment and control households. Attanasio et al. (2005) have shown the effectiveness of the FA program to increase food consumption in both rural and urban areas. They estimate a 15% increase in average consumption levels one year after the baseline survey. They also find that shares in food and nonfood consumption are not affected by the program but that it has created redistributive effects in favor of children through expenditure on children's clothing and on education. The program has not significantly affected consumption of adult goods, such as alcohol and tobacco or adults' clothing.

Table 3. Consumption at Baseline

	Total	**Food**	**Nonfood**
Treatment	62565.66	41875.94	20689.72
Control	61197	42568.1	19651.37
T-test	0.2493	0.3863	0.1906

Notes: Consumption measures are per adult equivalent deflated to 2002 price level in Colombian pesos. T-test of difference in means computed clustering at the municipality level.

Control Variables

Table 4 provides the means and standard deviations of the main variables used in the analysis for the sample of households in the treatment and control municipalities for all three surveys. All of the variables used in all of the regressions are at the household level. Monthly household income is constructed by adding reported labor income, self-employment, pensions, interest, rents, and government transfers, including FA potential transfer.[10] Income transfers and remittances received from neighbors, friends, and relatives are excluded from total income, as these sources of income are likely to reflect ex-post adjustments to shocks. *Income* is expressed in adult equivalent measures and deflated to 2002 prices. *Agriculture* indicates the household head was occupied in agricultural

[10] Potential FA transfer was estimated for all beneficiary households according the number of beneficiary children in the household.

activities. *Members economically active* indicates the number of persons in the household older than 12 who were working or looking for job at the moment of the survey. *Education variables* indicates the last level of education by the head and partner of the household.[11] *Urban* is a dummy variable that takes a value of one for households located in urban areas and zero, otherwise. *Household composition variables* represents the proportion of household members by age.

Table 4. Summary Statistics of Main Variables for all Survey Rounds

	Treatment		**Control**	
Variable	Mean	Std. dev.	Mean	Std. dev.
Income	59742	47636	53954	57921
Labor Income	28390	41619	29128	50064
HH head age	45.182	12.540	46.727	12.676
Wife age	39.889	9.959	40.997	10.177
HH head education	2.885	1.430	2.974	1.495
Spouse education	3.083	1.198	3.159	1.290
Female HH head[a]	0.216	0.412	0.182	0.386
Own house[a]	0.271	0.444	0.245	0.430
Urban[a]	0.461	0.499	0.547	0.498
Agriculture[a]	0.107	0.161	0.096	0.150
Number of HH members 0–6	0.875	1.003	0.695	0.927
Number of HH members 7–12	1.391	1.026	1.428	1.005
Number of HH members 13–17	1.293	0.898	1.238	0.905
Number of HH members	4.669	1.784	4.789	1.784
Members economically active	1.885	1.187	2.024	1.223

Notes: Averages based on three rounds. Income measures are per adult equivalent deflated to 2002 price level in Colombian pesos.[a] Mean values of dummy variables represent percentage of households that meet each of the conditions of the variables.

4. Full Risk Sharing and the Permanent Income Hypothesis

The most relevant risk coping strategies theorized in the literature are the full risk-sharing hypothesis and the permanent income hypothesis (PIH). The full risk-sharing hypothesis implies that, once aggregate shocks are accounted for, the growth rate of consumption would be independent of any idiosyncratic shock affecting the income available to the household (Bardhan & Udry, 1999). That is, the only risk that any

[11] Education categories are: 1, none; 2, incomplete elementary; 3, complete elementary; 4, incomplete secondary; 5, complete secondary; 6, college; 7, graduate.

household faces is the risk faced by the municipality as a whole. The alternative mechanism to coping with income shocks is the permanent income hypothesis, which states that a household with no opportunity for cross-sectional risk pooling, but with unlimited access to a credit market and separable preferences of consumption and labor, makes savings or lending decisions so that the effects of shocks are spread out between current and future consumption (Bardham & Udry, 1999). According to the hypothesis, individuals tend to smooth consumption when facing transitory income fluctuations. In practice, these hypotheses are not very relevant to most of the rural households in developing countries, given the inexistence of complete credit markets.

Although both hypotheses have been repeatedly rejected in studies using micro-data, empirical evidence has shown that consumption reacts too little to income shocks to be consistent with the theory. Townsend (1994) and Ravallion and Chaudhuri (1997) test the hypothesis in the ICRISAT Indian villages and reject it, although they find a substantial amount of risk sharing. Deaton (1992) and Grimard (1997) test the hypothesis of perfect risk sharing within villages and ethnic groups in Côte d'Ivoire and find little evidence of any risk pooling at the municipality level and somewhat stronger evidence within ethnic groups. Udry (1994) also rejects the hypothesis for northern Nigerian villages. Skoufias (2003) examined the extent to which Russian households were able to protect their consumption from fluctuations in their income using longitudinal data from 1994 to 2000. The study found that consumption was only partially protected from idiosyncratic shocks to income, with food consumption's being better protected than nonfood consumption expenditures.

Evidence from developed countries has also rejected the hypothesis of full risk insurance (Mace, 1991; Cochrane, 1991). Cochrane (1991), using data on household food consumption from the Panel Study of Income Dynamics (PSID) for the period 1980–1983, regressed changes in consumption onto different measures of idiosyncratic shocks. His results rejected the full insurance hypothesis for some but not all of the different shocks. Similarly, Mace (1991) tested consumption insurance with panel data from the U.S. Consumer Expenditure Survey (CEX). She could not reject the full insurance hypothesis when evaluating changes in consumption against changes in income, but she did reject full insurance when using growth rates. Finally, using household panel data from Bangladesh, Ethiopia, Mali, Mexico, and Russia, Skoufias and Quisumbing (2003) examined the extent to which households are able through formal and/or informal arrangements to insure their consumption from specific economic shocks and fluctuations in their real income. The study showed that adjustments in nonfood consumption appeared to act as a mechanism for partially insuring ex-post the consumption of food from the effects of income changes.

These findings raise the question of how households achieve some level of consumption smoothing given their limited access to financial markets. It seems that poor households engage in self-insurance strategies and mechanisms to secure their level of consumption once they face negative shocks. The most common self-insurance mechanisms for uninsured households are taking loans from the informal financial sector (Udry, 1994), selling assets (Deaton, 1992; Rosenzweig & Wolpin, 1993), increasing household labor supply (Kochar, 1998), or sending children to work in order to supplement income (Jacoby & Skoufias, 1997). Townsend (1994) showed that even extremely poor villages in rural India may have self-insurance strategies that allow them to

come close to an optimal allocation of risk bearing. While these actions enable households to spread the effects of income shocks over time, they might have adverse consequences in the long run in terms of poverty and future vulnerability of households.[12]

According to Baez (2006), the work to date on the extent of consumption smoothing in rural areas allows us to draw three important conclusions. First, most if not all of the empirical work has mainly rejected the full risk-sharing model. Second, and regardless of that rejection, a large amount of consumption smoothing is taking place. Rural households are not purely consuming what they earn, although the poorest have less scope to do so. And third, considering some market failures that obstruct formal insurance in rural villages, informal mechanisms seem to play a significant role in protecting their consumption.

As these conclusions have been widely accepted, recent literature has gone beyond the complete market model and has proposed and encouraged "the construction and testing of market models with partial insurance" (cited in Blundell et al., 2008; Deaton & Paxson, 1992). Also, literature has centered on alternative informal instruments to bear risk, estimating the extent of consumption insurance over and above self-insurance, including the role of public interventions. In this paper we address both issues. First, we investigate how well-known public interventions in developing countries—CCTs—can play a significant role in reducing consumption vulnerability of poor households. Second, we estimate the degree of consumption insurance under the full risk-sharing model and under a partial insurance model recently proposed by Blundell et al. (2008).

[12] For example, there is evidence that the use of children as part of the household labor pool compromises human capital and productivity of those children, raising the risk of poverty for the next generation. Also, if assets that are used to buffer consumption from income fluctuations are themselves used in the production process, then there can be important effects on future income from even temporary shocks to current income.

Public interventions can play a significant role in strengthening or displacing the informal insurance mechanisms already in place. The following examples illustrate some of the effects of public intervention on consumption insurance. In South Africa, Jensen (2002) compares the difference in the level of remittances received by pensioned and non-pensioned workers, after the increase in pension levels, relative to the difference before the increase. Findings based on the crowding-out effect differ across both groups. In Mexico, public cash transfer programs have not displaced informal mechanisms within the scheme of risk-sharing mechanisms (Skoufias, 2003); the evidence, however, is not clear for Northern Thai villages, where the effects of public intervention vary across distinct private transfers and informal mechanisms (Townsend, 1995). Finally, in the case of Mexico, García-Verdú (2002) analyzes a model of informal insurance and also finds that there is no crowding-out effect between cash transfers and informal safety nets.

To date, no structural model has been estimated to address the issue of partial insurance directly. Blundell et al. (2008) address the issue of whether partial consumption insurance is available to agents and estimate the degree of insurance over and above self-insurance through savings. They do so by contrasting shifts in the distribution of income growth with shifts in the distribution of consumption growth and then analyze how these two measures correlate over time. We follow this methodology to estimate the parameters of partial insurance for transitory and permanent shocks. Section 6 presents the model proposed by Blundell et al. (2008), which is used in this paper for the estimation of partial insurance parameters.

5. Empirical Evidence of Consumption Insurance under the Full Risk-sharing Model

In this section we consider the model of Pareto efficient risk pooling within a community to estimate the extent of risk sharing in poor households in Colombia and to test the effect of FA as an instrument for consumption smoothing. One way of testing the hypothesis of complete risk sharing within a community is to examine whether the growth rate of household consumption is independent of the growth rate in household income after controlling for aggregate shocks.

We employ the following reduced form specification commonly encountered in the literature (e.g., Cochrane, 1991; Mace, 1991; Townsend, 1994; Ravallion & Chaudhuri, 1997) to test the null hypothesis of complete risk sharing within a municipality:[13]

$$C_{ivt} = \alpha_0 + \alpha S_{ivt} + \beta X_{ivt} + \delta_i + \gamma_v + \mu_t + \tau_{vt} + \varepsilon_{ivt} \qquad (1)$$

where C_{ivt} refers to adult equivalent consumption per capita of household *i* in municipality *v* at time *t*; S_{ivt} represents idiosyncratic shocks; X_{ivt} is a set of socioeconomic and demographic characteristics of the household that takes into account the composition of the household by age, sex, and education level of household head; and $\delta_i, \gamma_v, \mu_t, \tau_{vt}$ and ε_{ivt} represent household, municipality, time, municipality-time fixed-effects, and the idiosyncratic error term, respectively.

Theory predicts that, under complete risk sharing, $\alpha = 0$, and provides an estimate of the extent to which idiosyncratic income shocks play a significant role in explaining the household-specific consumption changes. For the purposes of the empirical analysis, the

[13] Similar specifications are defined in terms of consumption and income growth and include a set of binary variables *D* identifying each community separately by survey round (round and community interaction terms) in order to control for covariate shocks.

insurance group is defined to be the full set of households within a municipality.[14] Since our sample is representative of poor households in small towns in Colombia, and credit and insurance markets don't function at all in these towns,[15] the identification of the insurance group is adequate. In addition, we should expect that insurance arrangements are easier to organize and enforce in small and poor communities.

Consumption Insurance of FA

To test the effect of FA on consumption smoothing of beneficiary households, equation (1) is modified by including the FA_{ht}, which is a binary variable equal to 1 for households in treatment municipalities and 0 for households in control municipalities for each year. In this equation, the coefficient α_2 is the difference in the vulnerability to risk between beneficiary and control households in the program. A negative estimate of α_2 implies that FA has decreased vulnerability to risk in the treatment communities. An insignificant estimate of α_2 suggests that there are no significant differences in the level of consumption insurance between control and treatment households. The coefficient α_3 reflects the effect of the program on consumption.

$$C_{ivt} = \alpha_0 + \alpha_1 S_{ivt} + \alpha_2 FA_{ht} * S_{it} + \alpha_3 FA_{ht} + \beta X_{ivt} + \delta_i + \gamma_v + \mu_t + \tau_{vt} + \varepsilon_{ivt} \qquad (2)$$

We consider different definitions of consumption and different types of idiosyncratic shocks to estimate fixed effects regressions. As dependent variables we use food consumption, nonfood consumption, and total consumption. The idiosyncratic shocks considered are: (i) death of a household member, (ii) illness of a household member, (iii)

[14] On average, there are 50 households in each municipality.
[15] Less than 5% of the households have credit or a savings account.

crop loss or job loss, (iv) unemployment of household head, (v) weather shock, and (vi) violence. The household surveys asked each household whether it has suffered any of these shocks during the year prior to the date of the interview. Hence, each household was allowed to declare whether it was affected by a shock or not.

Fixed effects estimates of equation (2) presented in Table 5 include only one type of shock at a time in the regression. As discussed above, these estimates are obtained under the assumption that an insurance group consists of all households in a municipality and include municipality-year fixed effects. All regressions control for household composition by age, sex, and the following household characteristics: age and dummies for level of education of the household head, female household head, number of household members active in the labor market, dummy if the house is owned as a measure of assets, dummy for households working in agriculture as a proxy of vulnerability to shocks, and dummy for households located in urban regions as well as in different economics regions in the country.

Table 5. Impact of Idiosyncratic Shocks on Consumption

	Food consumption	Nonfood consumption	Total consumption
Crop loss	-0.078***	-0.031	-0.065**
	(0.02)	(0.03)	(0.02)
***Treatment**	0.058*	0.173*	0.086*
	(0.02)	(0.06)	(0.04)
Unemployment	-0.257***	-0.285***	-0.286***
	(0.04)	(0.04)	(0.04)
***Treatment**	0.077	0.005	0.063
	(0.07)	(0.10)	(0.07)
Death	0.000	0.296***	0.144**
	(0.05)	(0.04)	(0.05)
***Treatment**	-0.186*	-0.232**	-0.198**
	(0.08)	(0.09)	(0.07)
Weather	0.011	0.106	0.035
	(0.06)	(0.06)	(0.05)
***Treatment**	-0.170*	0.018	-0.040
	(0.08)	(0.08)	(0.07)
Violence	0.034	0.255***	0.163***
	(0.05)	(0.04)	(0.04)
***Treatment**	0.066	-0.344**	-0.158*
	(0.09)	(0.12)	(0.07)
Illness	0.026	0.187***	0.146***
	(0.02)	(0.01)	(0.02)
***Treatment**	-0.017	-0.008	0.013
	(0.03)	(0.06)	(0.04)
Illness, HH **head**	-0.010	-0.117**	0.028
	(0.02)	(0.04)	(0.02)
***Treatment**	-0.001	0.099	0.015
	(0.03)	(0.06)	(0.04)
Illness, non–wage earners	0.035	0.159***	0.059*
	(0.03)	(0.04)	(0.03)
***Treatment**	0.000	0.059	0.035
	(0.03)	(0.06)	(0.04)
Illness, children	-0.036	0.197***	0.047
	(0.02)	(0.04)	(0.03)
***Treatment**	0.095*	0.061	0.067
	(0.04)	(0.07)	(0.05)
Any shock	-0.046**	0.135***	-0.145***
	(0.02)	(0.03)	(0.02)
***Treatment**	0.031*	0.121**	0.078**
	(0.01)	(0.04)	(0.03)

Notes: The measure of consumption is its adult equivalent value in units of 2002 pesos. Robust standard errors, clustered at the municipality level, are in parentheses. Additional repressors included but not reported. Municipality -year effects included. Each individual coefficient is statistically significant at the *10%, **5%, or ***1% level.

Considering shocks one at a time, it is evident that the null hypothesis of perfect risk sharing is rejected for crop loss and unemployment when food consumption is the right hand side variable. Crop loss will reduce per capita food consumption by 8% and total consumption by 6%, while unemployment will reduce food consumption by 25% and nonfood consumption by 28%.[16] Weather shocks have no effect on consumption.

Shocks from death or illness of a household member increase nonfood and total consumption, as does being victim of violence, so there is no evidence of consumption smoothing for these shocks. On the contrary, consumption increases with respect to households that have no shocks. The increase in nonfood consumption is explained by the fact that these shocks usually increase health expenditures[17] or other components of nonfood expenditures. Neither of these shocks affects food consumption.

A positive estimate of the illness shock can be explained if the sick member is not an income provider for the household. That is, if health shocks hit household members that contribute income to the household, we should expect a decline in consumption due to the loss of labor income and to an increase in health expenditures, so the final effect in consumption will be ambiguous. But if illness shocks hit an income dependent of the household, consumption will definitely increase. Therefore, we identified which members of the household had illness shocks. We found that health shocks of the household head decrease nonfood consumption, while health shocks of household members not in the labor market increase nonfood consumption. Therefore, the effect of health shocks in

[16] The high coefficients of job loss could be a consequence of the potential endogeneity of this variable in the consumption equation. It could be expected that unemployment is correlated with unobservable characteristics of the household to explain consumption.
[17] Nonfood consumption is the sum of health, clothing, and miscellaneous expenditures.

consumption in our sample is a function of the role in the labor market of the household member who is receiving the illness shock.

The role of FA as an instrument for consumption insurance is also evaluated. Being a beneficiary of the FA program would protect the household's food consumption when it experiences a crop loss but not unemployment of the household head. It is interesting to see that treatment households are no better insured against unemployment than control households as the estimated coefficient is not statistically different from zero.

Negative estimations of violence and death shocks for treatment households indicate that, while control households increase consumption after these shocks, treatment households are better able to buffer them. One explanation is that treatment households might have available less costly ex-ante self-insurance strategies than control households. For example, it is possible that the FA cash transfer works as an income-smoothing mechanism for treatment households. A second explanation is that treatment households could be less exposed to health and violence shocks.

In the previous section we showed that shocks were not correlated with treatment before the program was implemented. However, we could expect that treatment households are less exposed to health shocks, including illness and death, since the preventive care component of the program may have an impact on reducing the illness risk of both adults and children. We tested the second hypothesis (refer to Table 1 for results) and found that illness shocks have decreased during the first and second waves, with respect to the baseline, and that there is no statistical difference between treatment and control groups, except for illness of a non–wage earner, which is lower for treatment

households than control households during the first survey. That difference disappears during the second survey. Therefore, the second hypothesis is not very probable.

We also tested the first hypothesis. Results are presented in Table 11 in the next section. We find that there are no statically significant differences between ex-post risk coping strategies used by treatment and control households, with the exception of relative and friend transfers. So it should be the case that treatment households are better able than control households to use income-smoothing strategies or ex-ante consumption-smoothing strategies.

Finally, we observe that, in general, having a negative shock will reduce food consumption but increase nonfood consumption and that the FA program works as an insurance to smooth food consumption but not to reduce increased nonfood expenditures. Total consumption has a very similar behavior as food consumption, which is explained by the fact that the share of food consumption is approximately 70% of total consumption.

Covariate Shocks

In order to capture the covariate nature of weather and violence shocks, we use the proportion of households within a municipality reporting to have suffered each shock as environmental and violence shock variables. Also, we use an alternative measure for violence: the number of terrorist attacks that municipalities have had during the year before the interview.

To examine the degree of consumption smoothing of individual households with respect to covariate risk, we remove the municipality-year fixed effects from the estimation to calculate the following equation:

$$C_{ivt} = \alpha_0 + \alpha_1^C S_{ivt} + \alpha_2^C FA_{vt} * S_{it} + \beta X_{ivt} + \delta_i + \gamma_v + \mu_t + \varepsilon_{ivt} \qquad (2)$$

The model of full risk sharing predicts that local risk-sharing arrangements permit households to efficiently pool the idiosyncratic variation within communities, but they can do little to help households deal with covariate risk. On the other hand, the PIH predicts that perfect credit markets permit households to smooth consumption, even when they are under covariate risk, if and only if these shocks are transitory. Therefore, we should expect $\alpha_1^C = 1$, under a Pareto efficient model, or an estimate of $0 < \alpha_1^C < 0$ if households are able to smooth at least some part of community shocks by formal or informal insurance mechanisms.

As before, we consider the following dependent variables: food consumption, nonfood consumption, and total consumption. The covariate shocks considered are: (i) violence and (ii) weather shocks. For estimation, we use fixed effects regression with robust standard errors clustering at a municipality level. All regressions control for the same exogenous variables included in equation (2). Results are presented in Table 6. As we observe, violence does not affect consumption. This is reasonable if we assume that most of the terrorist attacks are targeted at institutions such as banks, police stations, government offices, or to the army and not to civilians. Weather shocks seem to have a very small effect on consumption, decreasing nonfood consumption by 1% in control communities and by only 0.1% in treatment communities. Results are opposite to economic predictions, under which we should expect a significant effect from covariate shocks on consumption, with estimations close to one. However, these results can be explained by the fact that they are

not permanent but transitory shocks. In fact, Colombia had no severe long-term weather shocks during 2002–2005.

Table 6. Impact of Covariate Shocks on Consumption

	Food consumption	**Nonfood consumption**	**Total consumption**
Violence	-0.010	-0.009	-0.011
	(0.01)	(0.01)	(0.01)
***Treatment**	0.009	0.005	0.001
	(0.01)	(0.02)	(0.01)
Weather shocks	0.001	-0.013***	-0.006***
	(0.00)	(0.00)	(0.00)
***Treatment**	0.005*	0.009*	0.007**
	(0.00)	(0.00)	(0.00)

Notes: The measure of consumption is its adult equivalent value, in units of 2002 pesos. Robust standard errors, clustered at the municipality level, are in parentheses. Additional repressors included but not reported. Each individual coefficient is statistically significant at the *10%, **5%, or ***1% level.

Consumption Smoothing Against Idiosyncratic Income Change

Most of the empirical studies (Skoufias, 2003; Townsend, 1994; Ravallion & Chaudhuri, 1997) have tested the hypothesis of full risk sharing using changes on household income as a measure of shocks. Using income growth instead of negative shocks dummy variables has the advantage that income has the same time frame as consumption. In the section above, the reference period of consumption (the month before the survey) is very different from the period of shocks (year prior to the survey).

We estimate equation (3) using fixed effects of regression. In this specification we use consumption growth per adult equivalent in constant values as a dependent variable and income growth per adult equivalent in constant values as independent variables. Since declared income might be endogenous in our specifications, we use income moments as instrumental variables to control for endogeneity. Municipality-time fixed effects are replaced by a set of binary variables D identifying each community separately by survey round (round and community interaction terms). Including the community/round

interaction dummies have the purpose of controlling for aggregate shocks insured at the community level.

$$\Delta C_{ivt} = \alpha_0 + \alpha_1 \Delta Y_{ivt} + \alpha_2 FA_{vt} * \Delta Y_{it} + \beta X_{ivt} + \sum_{tv} \delta_{tv} D_{tv} + \varepsilon_{ivt} \quad (3)$$

Results from this specification will reveal the average degree of consumption insurance in the community to any change in the household's income. As before, under full risk sharing we expect $\alpha_1 = 0$, but if α_1 is positive and significant, it provides an estimate of the partial correlation between income and consumption growth in control municipalities. If FA helps beneficiary households to cope with income shocks, we should expect a significantly negative estimate of α_2, and the sum $\alpha_1 + \alpha_2$ will provide an estimate of the partial correlation between income and consumption growth in the treatment municipalities. The measure of consumption insurance adopted under this specification can be interpreted as a partial insurance parameter, where lower estimated values of α suggest a high degree of consumption insurance and thus a lower vulnerability of consumption to income shocks (Amin et al., 2003).

Table 7 reports estimations of equation (3) for total consumption and for food and nonfood consumption separately. The estimates presented in column (1) show that a 10% drop in real income is accompanied by a 1.8% drop in household total consumption, a slightly lower (1.7%) decrease in food consumption, and a higher (2%) drop in nonfood consumption. The relatively higher income coefficients for nonfood than for food consumption suggest that the consumption of food may be better insured than the consumption of nonfood.

The same regression was estimated using percentage change in labor income as an explanatory variable. We should expect a higher degree of consumption insurance with respect to changes in labor income than with respect to changes in total income since labor income is already insured.[18] In fact, we observe in Table 7 that consumption insurance is higher for labor income than for total income. The estimates for food consumption indicate that a 10% decrease in labor income will reduce total consumption by 0.9%, with no differences between food and nonfood consumption.

Therefore, if households perceive CCT as permanent income, we should expect a higher degree of consumption insurance for beneficiary households. However, the insignificant coefficients of the interaction of income changes with the dummy variable identifying beneficiary households of FA suggest that there are no significant differences in the level of consumption insurance between control and treatment households. One possible explanation is that households don't perceive the program as permanent income, although we consider that this is not very probable since the Colombian government has not defined a time frame for the program's operation. Another explanation is that there could be pre-treatment differences in the level of insurance among treatment and control households.[19] As this reason is more likely, we address it using matching methods. Description of the methodology and results are presented in a later section.

[18] Labor contracts are income-smoothing mechanisms that might reduce risk and the effects of negative income shocks.

[19] Particularly if consumption was less insured in the treatment municipalities relative to control municipalities prior to the implementation of the FA program.

Table 7. Impact of Idiosyncratic Income Changes in Household Consumption

	Food consumption	**Nonfood consumption**	**Total consumption**
	b/se	*b/se*	*b/se*
Δ(Ln total income)	0.172***	0.201***	0.188***
	(0.02)	(0.02)	(0.01)
***Treatment**	-0.016	-0.042	-0.027
	(0.02)	(0.03)	(0.02)
Δ(Ln labor income)	0.097***	0.090***	0.095***
	(0.01)	(0.02)	(0.01)
***Treatment**	-0.016	0.019	0.000
	(0.02)	(0.02)	(0.02)

Notes: The measure of consumption is its adult equivalent value in units of 2002 pesos. Robust standard errors, clustered at the municipality level, are in parentheses. Additional repressors included but not reported. Each individual coefficient is statistically significant at the *10%, **5%, or ***1% level.

Risk Pooling at the Community Level

Finally, we investigate whether risk sharing is in fact taking place among households within the same insurance community by eliminating the municipality-year fixed effects from equation (3) and including the average income growth of each municipality as a right hand side variable, as suggested by Deaton (1997) and Ravallion and Chaudhuri (1997).

$$\Delta C_{ivt} = \alpha_0 + \alpha_1 \Delta Y_{ivt} + \alpha_2 FA_{vt} \Delta Y_{it} + \gamma_1 \Delta \overline{Y_{vt}} + \gamma_2 FA * \Delta \overline{Y_{vt}} + \beta X_{ivt} + \varepsilon_{ivt} \qquad (4)$$

Under this model, the growth rate in household consumption is determined by the growth rate in household income as well as the growth rate in average community income. According to the hypothesis of full risk sharing, $\gamma_1 = 1$, so individual consumption is not protected from aggregate income shocks. Under imperfect risk sharing, evidence that the growth rate in average community income has a significant role in the growth rate of household consumption is consistent with the hypothesis that some risk sharing is taking place within the communities. We test also if the degree of insurance provided by the community is affected by the presence of the FA program. A positive coefficient would be

interpreted as the program's increasing risk pooling in the community; the opposite would be concluded for a negative coefficient.

Table 8. Impact of Average Community Income Changes in Household Consumption

	Food consumption	**Nonfood consumption**	**Total consumption**
	b/se	*b/se*	*b/se*
Δ(Average Ln income, municipality)	0.630*	0.386	0.353
	(0.27)	(0.59)	(0.36)
***Treatment**	-0.608	-0.929	-0.254
	(0.69)	(1.12)	(0.76)
Δ(Average Ln labor income, municipality)	-0.004	-0.878	-0.381
	(0.47)	(0.65)	(0.48)
***Treatment**	0.380	-0.202	0.448
	(0.88)	(1.44)	(0.89)

Notes: The measure of consumption and income is its adult equivalent value in units of 2002 pesos. Robust standard errors, clustered at the municipality level, are in parentheses. Additional repressors included but not reported. Each individual coefficient is statistically significant at the *10%, **5%, or ***1% level.

The estimated coefficients of the growth rate in average community income, the parameters γ_1 y γ_2, are reported in Table 8. The estimates provide evidence in favor of community risk sharing in food consumption but not in nonfood or total consumption. Also, no significant differences are found regarding the effect of mean community growth rate between treatment and control households. As changes in average community income reflect covariate income shocks, results show that households are less insured to covariate income shocks than to idiosyncratic income shocks, 37% and 80%, respectively.

Nonetheless, these results are opposed to our findings above when using measures of weather and violence shocks. As we said before, it is possible that our measures of community shocks are not the best or that they reflect community transitory shocks instead of permanent shocks. In order to check our results, we estimate the partial insurance model proposed by Blundell et al. (2006) and calculate the partial insurance parameters for permanent and transitory shocks using the same data. Results are very

similar to our regressions above. Details of the methodology and results are presented in Section 6.

Impact of FA on Consumption Insurance Using Matching Methods

In order to correct any pretreatment differences remaining from the quasi-experimental design used to select the sample of treatment and control municipalities, we use a difference in difference matching estimator[20] (also called conditional matching) as a method of preprocessing our data. Matching involves pairing treatment and comparison units that are similar in terms of their observable characteristics, and a DID estimator compares the conditional before/after outcomes of participants with those of nonparticipants, allowing for unobservable but temporally invariant differences in outcomes between participants and nonparticipants. Thus, the DID matching estimator extends the conventional DID estimator by defining outcomes conditional on the propensity score and using nonparametric matching methods to construct the differences. DID matching is superior to DID as it does not impose linear functional form restrictions in estimating the conditional expectation of the outcome variable and does reweight the observations according to the weighting function of the matching estimator (Smith & Todd, 2005).

In this section, we find unbiased estimates of the effects of the program in consumption insurance as a result of household income shocks and community average income shocks. We first preprocess our dataset with matching non-parametric methods[21] and then apply parametric techniques to increase efficiency. This procedure makes

[20] DID matching was first suggested by Heckman et al. (1998a). It extends the conventional DID estimator by defining outcomes conditional on the propensity score and using semiparametric methods to construct the differences.

[21] For matching, we use non-parametric kernel propensity score matching.

parametric models produce more accurate and considerably less model-dependent causal inferences (Ho et al., 2007). Also, we restrict the analysis to individuals in the common support—i.e., the region over which treated individuals have a counterpart in the group of controls—in order to minimize any bias due to extrapolation within the parametric specification.

Results in Table 9 show that, controlling for pretreatment differences, FA partially insures food consumption but not nonfood consumption. Unbiased estimates of the impact of the program on consumption insurance improve our previous estimates and are robust with estimations using dummy variables for idiosyncratic shocks.

Table 9. DID Matching Estimations: Impact of Household and Average Community Income Changes in Household Consumption Controlling for Pretreatment Effects

	Food consumption	**Nonfood consumption**	**Total consumption**
	b/se	*b/se*	*b/se*
Δ(Ln total income)	0.221***	0.257***	0.234***
	(0.02)	(0.02)	(0.01)
***Treatment**	-0.139***	-0.008	-0.154
	(0.03)	(0.03)	(0.05)
Δ(Average Ln income, municipality)	0.560**	0.386	0.353
	(0.27)	(0.59)	(0.36)
***Treatment**	0.039	-0.008	0.015
	(0.03)	(0.03)	(0.02)

Notes: The measure of consumption and income is its adult equivalent value in units of 2002 pesos. Robust standard errors, clustered at the municipality level, are in parentheses. Additional repressors included but not reported. Each individual coefficient is statistically significant at the *10%, **5%, or ***1% level.

Using DID matching gave us an advantage over the small number of studies that have tried to identify the impact of cash transfer programs on consumption insurance. As Skoufias (2003) remarks, "the absence of any reliable consumption data in treatment and control villages before the implementation of *Progresa* prevent one from applying the difference-in-differences estimator for the evaluation of the impact of PROGRESA on consumption insurance" (pp.638).

6. Partial Insurance Model

Based on Blundell, Pistaferri, and Preston (2008), we estimate the degree of partial insurance for transitory and permanent shocks for different households' characteristics: (i) household head education level, (ii) urban and rural households, (iii) single parent and biparental households, and (iv) FA beneficiary and control households. In this model, partial insurance is defined as smoothing mechanisms—other than personal savings and borrowings—to smooth consumption changes when incomes are shifted by permanent or transitory shocks. These mechanisms could help us understand the lower volatility of consumption in relation to the volatility of income and introduce a method to measure the impact of different-smoothing tools (Casado, 2009). This model is better than the full insurance model in the sense that it examines the roles of asymmetric information, moral hazard, and heterogeneity and shows how the complete markets model must be amended to include some forms of imperfect insurance.

This analysis of partial insurance requires the study of income and consumption process and its relationship to transitory and permanent income shocks. In this model, the relationship between income shocks and consumption depends on the degree of persistence of income, and we expect to uncover less insurance for more persistent shocks. Blundell and Preston (1998) derive the conditions under which the growth of variance and covariance of income and consumption can be used to separately identify the growth in variance of permanent and transitory income shocks. Blundell, Pistaferri, and Preston (2008) describe the transmission of income inequality into consumption inequality and derive the transitory and permanent partial insurance parameters.

It is supposed that income has the following equation:

$$\log Y_{i,t} = Z'_{i,t}\varphi_t + P_{i,t} + v_{i,t}$$

where Y is real income and Z a set of control variables (such as education of the household head and number of household members, among others). $P_{i,t}$ is the permanent income component, and $v_{i,t}$ stands for transitory income.

Assuming a random walk for $P_{i,t}$ ($P_{i,t} = P_{i,t-1} + \zeta_{i,t}$) and a martingale process MA(q) for $v_{i,t}$ ($v_{i,t} = \sum_{j=0}^{q} \theta_j \varepsilon_{i,t-j}$), the difference of the unpredicted income can be written as:

$$\Delta y_{i,t} = \zeta_{i,t} + \Delta v_{i,t} \quad \text{where} \quad \Delta\, y_{i,t} = \Delta LnY_{i,t} - \Delta Z'_{i,t}\varphi_t$$

The Euler equation with CRRA preferences and complete credit markets is:

$$C_{i,t-1}^{\beta-1} = \frac{1 + r_{t-1}}{1 + \delta} e^{\Delta Z'_{i,t}\varphi_t} E_{t-1} C_{i,t}^{\beta-1}$$

Computing the mapping from the income shocks $\zeta_{i,t}$ and $\varepsilon_{i,t}$ to the optimal consumption growth following estimations by Blundell et al. (2008), and assuming that personal saving is the only mechanism available to smooth consumption, we obtain the consumption growth equation:

$$\Delta c_{i,t} = \phi_{i,t}\zeta_{i,t} + \psi_{i,t}\varepsilon_{i,t} + \xi_{i,t}$$

where ϕ is the loading factor of permanent shocks and ψ of transitory shocks and where ξ represents innovations in consumption independent of those from income. The moments required to compute the partial insurance parameters were estimated using diagonally weighted minimum distance (DWMD).

Following Meghir and Pistaferri (2004, cited in Blundell et al., 2008) we identify the parameters of interest ψ and ϕ for transitory and permanent shocks in income. Following

this approach, ψ and ϕ can be understood as the instrumental variable estimation of Δc_t on Δy_t using $(\Delta y_{t-1} + \Delta y_t + \Delta y_{t+1})$ and $E(\Delta c_t \Delta y_{t+1})$ as instruments, respectively.

$$\psi = \frac{E(\Delta c_t \Delta y_{t+1})}{E(\Delta y_t \Delta y_{t+1})} \quad \text{and} \quad \phi = \frac{E(\Delta c_t(\Delta y_{t-1} + \Delta y_t + \Delta y_{t+1})}{E(\Delta y_t(\Delta y_{t-1} + \Delta y_t + \Delta y_{t+1})}$$

Where transitory insurance parameter ψ is computed measuring the relation between income and lagged consumption, it must be correlated through the transitory component $E(\Delta c_t \Delta y_{t+1}) = \sigma_\varepsilon^2$. Similarly, we compute the covariance between current consumption and current income growth $E(\Delta c_t \Delta y_t)$, removing the contribution of the transitory component to compute the permanent income shock effect $E(\Delta c_t(\Delta y_{t-1} + \Delta y_t + \Delta y_{t+1}) = \sigma_\zeta^2$. Finally, the variance of the component σ_ξ^2 is computed like the variance of consumption growth, removing the contribution of permanent and transitory income shocks.

In order to instrument our income variable, we use retrospective data on income captured in the baseline survey for the years 1999, 2000, and 2001. We also infer income for 2004 from an income equation controlling for household and individual characteristics.

In the above representation, the case of full insurance would be $\phi = \psi = 0$, where neither transitory nor permanent shocks in income would affect consumption. The case of no insurance would be $\phi = \psi = 1$. Parameter estimations between zero and one identify the degree of transmission of income shocks into consumption. If coefficients are closer to zero, the degree of insurance will be higher. These partial insurance parameters include self-insurance (precautionary saving) and other insurance devices, but we cannot identify each insurance component by itself.

7. Empirical Evidence of Consumption Insurance under a Partial Insurance Model

In this section we compare results from the full risk-sharing model with estimations from the partial insurance model proposed by Blundell et al. (2008). Using panel data on income and consumption, we are able to estimate the degree of partial insurance for transitory and permanent shocks for different household characteristics: (i) household head education level, (ii) urban and rural households, (iii) single parent households, and (iv) FA beneficiary households. Results show the advantage of allowing partial insurance, since households in the sample seem to be less insured than predicted by the complete market hypothesis but more insured than predicted by the permanent income hypothesis.

The FA dataset doesn't show evidence of a MA(q) process for transitory shocks, so we assume they are uncorrelated ($v_{i,t} = \varepsilon_{i,t}$). Diagonally weighted minimum distance (DWMD) was used to estimate parameters because it allows for heteroskedasticity, unlike equally weighted minimum distance (EWMD). Also, we assume that insurance parameters are constant over time.

Table 10. Partial Insurance Parameters

		Food consumption		**Nonfood consumption**	
Criteria	Groups	Permanent shocks (Φ)	Transitory shocks (Ψ)	Permanent shocks (Φ)	Transitory shocks (Ψ)
Complete sample		0.42	0.18	0.50	0.17
Program FA	Control group	0.44	0.14	0.51	0.17
	Treatment group	0.37	0.16	0.51	0.16
Education of household head	without high school	0.42	0.17	0.49	0.17
	with high school	0.26	0.14	.	0.22
Number of parents	Two	0.41	0.17	0.52	0.18
	One	0.41	0.14	0.42	0.15
Location	Rural	0.43	0.15	.	0.21
	Urban	0.41	0.20	0.48	0.13

Notes: The measure of consumption and income is its adult equivalent value, in units of 2002 pesos.

Estimations of transitory and permanent partial insurance parameters for different groups are presented in Table 10. Parameters are estimated for the whole sample and for

treatment and control households of the FA program. Other subgroups are also considered in order to identify households with better mechanisms for consumption smoothing. We estimated partial insurance parameters for education of the household head (with or without high school), number of parents in the household, and household location in urban or rural municipality.

For the full sample, a 10% permanent income shock induces a 4.2% permanent change in food consumption and a 5% change in nonfood consumption. Simultaneously, a 10% transitory income shock induces significant 1.8% transitory and permanent changes in consumption. We find higher degrees of insurance to transitory shocks than to permanent shocks for all different groups. Food consumption seems to insure better from permanent shocks than nonfood consumption. The insurance coefficient of the transitory shocks is not statistically different between food and nonfood consumption, which indicates that total consumption is not fully insured against transitory shocks but that the degree of insurance is high.

The insurance against permanent shocks for the treatment group is higher than for the control group for food consumption but not for nonfood consumption. That is, as in our previous results, we observe that the program protects food consumption but not nonfood consumption of beneficiary households. More interesting are the results for educated household heads. The insurance capacity to permanent shocks of educated household heads (with high school) is almost 74%, while the insurance capacity of uneducated household heads (without high school) is 58%. Insurance to transitory shocks is also higher for educated households, but the difference with uneducated households is not statistically significant. Finally, we have computed the insurance for urban-rural, bi-

parental, and single-parent households, not finding relevant differences in comparison with the whole sample. In conclusion, we observe that the partial insurance for permanent and transitory shocks provides a better understanding of the degree of insurance than the full insurance model.

8. Risk Coping Strategies and the Role of FA

Results have shown that households in rural Colombia are able to partially spread the effects of income shocks over time and that this is partially due to risk-sharing arrangements across households at the community level at any one point in time. However, we also observed that covariance between nonfood consumption and income is still pretty low and that risk pooling has been effective in smoothing only food consumption but not other consumption. Therefore, households may be adopting a variety of self-insurance strategies to spread the effects of income shocks over time. For example, they may use their savings (Paxson, 1992); take out loans from the informal financial sector (Udry, 1994); sell assets (Deaton, 1992; Rosenzweig & Wolpin, 1993); adjust their labor supply (Kochar, 1998) including sending their children to work instead of school in order to supplement income (Jacoby & Skoufias, 1997); or rely on transfers and remittances from friends and neighbors (Rosenzweig, 1988; Besley, 1995; Morduch, 1999).

In this section we examine whether the incidence of different shocks is associated with increased likelihood of using the following coping instruments: (i) increasing expenditures, (ii) using savings, (iii) incurring debts, (iv) receiving transfers from friends or relatives (v), selling assets, or (vi) increasing the labor supply of household members.

Households were asked at baseline and in the first survey how they responded to these shocks. Households could select more than one instrument.

Although answers to these questions could differ from their behavioral responses, they give a glimpse of how households cope with income shocks and how FA alters these responses. We estimate the following probit model separately for each of the six coping instruments mentioned above:

$$Prob(Y_{it} = 1) = \alpha + \beta S_{it} + FA(\alpha_1 + \beta_1 S_{it}) + \emptyset X_{it} \qquad (4)$$

where Y equals one when the household declares it used each specific instrument to cope with shocks and where S is a vector of dummy variables denoting the incidence of any of the following shocks: (i) death of a household member, (ii) illness of a household member, (iii) crop loss, (iv) natural disaster, or (v) violence. X is a vector of household and municipality characteristics, such as the age and sex of household head and spouse, whether the household is headed by a female, the education level of the household head and spouse, binary variables for owning the house where they live, if the household works on cropping or harvesting, and age composition of the household. Municipality variables include a dummy variable for household beneficiaries of FA, for the regions of the country, for urban areas, and for the survey round. Finally, the coefficients of interest are β and β_1, where β denotes whether the incidence of a shock increases the likelihood that the dependent variable Y equals 1 and the extent to which the incidence of the same shock entails a stronger or opposing reaction in the households benefited by FA ($\beta + \beta_1$).

Table 11 presents the marginal effects of the different shock variables on the probability of adopting a specific response. Results show that, controlling for household

characteristics and for any income shocks, beneficiary households seem to rely more on savings and less on transfers to smooth consumption. Crop loss is handled by reducing expenditures and receiving transfers from friends and relatives. However, it is notable that treatment households seem to reduce the likelihood of using transfers from friends and relatives as a risk coping instrument when they are hit by these shocks and increase the likelihood of using assets as a risk coping instrument.

Weather and death shocks are more likely to result in a household's receiving help from relatives, while illness shocks force households to incur new loans, probably in the informal sector at very high interest rates. However, the program has no differential effect on these self-insurance arrangements.

Table 11. Risk Coping Strategies for Idiosyncratic Shocks

	Reduce expenditures	**Use savings**	**Sell assets**	**Internal transfers**	**Credit**	**Increase labor supply**
	b/se	b/se	b/se	b/se	b/se	b/se
Treatment	-0.194	0.131*	-0.055	-0.250**	-0.030	-0.010
	(0.11)	(0.04)	(0.09)	(0.09)	(0.09)	(0.09)
Death	-0.150	0.235*	0.107	0.231*	0.026	-0.328*
	(0.12)	(0.10)	(0.11)	(0.11)	(0.13)	(0.15)
Death *trtmt	0.000	-0.043	-0.192	0.166	0.115	0.348
	(0.17)	(0.17)	(0.16)	(0.16)	(0.20)	(0.21)
Illness	-0.043	0.138	-0.012	0.128	0.304***	-0.126
	(0.09)	(0.09)	(0.07)	(0.07)	(0.05)	(0.09)
Ilness *trtmt	0.043	0.005	-0.059	0.150	0.004	0.083
	(0.12)	(0.12)	(0.10)	(0.09)	(0.08)	(0.11)
Crop loss	0.429***	-0.060	-0.138*	0.265***	0.009	0.100
	(0.08)	(0.06)	(0.06)	(0.06)	(0.05)	(0.07)
Crop loss *trtmt	-0.018	0.084	0.144*	-0.189*	0.045	0.091
	(0.13)	(0.09)	(0.05)	(0.09)	(0.09)	(0.10)
Weather	-0.055	0.046	-0.085	0.365*	-0.124	0.125
	(0.18)	(0.14)	(0.13)	(0.18)	(0.17)	(0.16)
Weather *trtmt	-0.051	-0.709*	0.105	-0.133	-0.325	-0.239
	(0.23)	(0.30)	(0.19)	(0.23)	(0.22)	(0.23)
Violence	-0.252*	-0.142	0.120	-0.056	-0.422*	-0.011
	(0.12)	(0.17)	(0.15)	(0.12)	(0.17)	(0.14)
Violence *trtmt	0.278	0.282	-0.113	0.048	0.110	-0.048
	(0.17)	(0.22)	(0.27)	(0.19)	(0.22)	(0.17)
N	5528	5522	5518	5516	5525	5519

Notes: The measure of consumption is its adult equivalent value in units of 2002 pesos. Robust standard errors, clustered at the municipality level, are in parentheses. Additional repressors included but not reported. Each individual coefficient is statistically significant at the *10%, **5%, or ***1% level.

Results from this section suggest that the FA program might be crowding out some self-insurance instruments such as internal transfers, while reinforcing the use of savings. Attanasio and Rios-Rull (1999) have shown that, in a model of risk sharing under limited commitment, the introduction of a government insurance scheme can crowd out preexisting informal risk-sharing arrangements, resulting in a decrease in welfare for the beneficiaries. Therefore, further research should explore how different coping instruments have in fact been displaced or reinforced by FA.

Although results reveal that the program affects the role of transfers as a risk coping instrument for treatment households, we observe statistical differences neither over time nor between treatment and control samples on transfers to and from households, in kind, or in cash. Average transfers before and after the program are presented in Table 12. As stated above, evidence here is not validated with household behavior.

Table 12. Transfers in Money Received by Households

	Treatment	**Control**	**T-test (p-value)**
Baseline	347957.3	341160	0.1157
1st wave	368110.4	355374.4	0.4467
2nd wave	361998.8	355946.9	0.8422

Notes: The measures of transfers are per household in units of 2002 pesos. T-test of difference in means computed clustering at the municipality level.

9. Conclusion

Under our several specifications above, we reject the hypothesis of complete consumption insurance, although we observe a high level of consumption smoothing among poor households in small villages in Colombia. Results show that (i) the growth rate of consumption is related to the growth rate of income, but certainly less so than what one would expect under the alternative hypothesis of a complete lack of risk-sharing tools,

suggesting that insurance is incomplete; (ii) food consumption is better insured than nonfood consumption; (iii) risk-pooling mechanisms at the community level insure food consumption but not nonfood consumption; (iv) transitory covariate shocks are not correlated with changes in consumption; and (v) household consumption growth is much more respondent to changes in aggregate municipality consumption than to changes in household income. Overall results are consistent with the partial insurance parameters proposed by Blundell et al. (2008) and are robust to different specifications.

This study has also analyzed the impact of a CCT program on the ability of households to smooth consumption when faced with negative shocks. Results suggest that CCT programs are effective as risk-management instruments, especially if they are perceived as permanent. Overall, beneficiary households of FA appear to have lower absolute changes in consumption than control households when subject to idiosyncratic shocks, and there is no effect of the program on risk pooling within communities. Results show that beneficiary households of the program are able to protect food consumption from shocks such as crop loss and also to safeguard nonfood consumption when faced with the death of a household member or victimization by violence. The program has not been effective in insuring unemployment and illness shocks. In sum, Familias en Acción, despite not being a consumption insurance program, helps treated families to smooth consumption.

Widely known theories of risk coping strategies in the literature, like the Pareto full risk sharing hypothesis and the permanent income hypothesis, are clearly rejected by the data, giving support to partial insurance models. Estimation of the partial insurance parameters for transitory and permanent shocks reinforces some of our previous findings.

On average, households are able to self-insure consumption against transitory shocks by approximately 83% and against permanent shocks by about 45%. FA works as insurance for permanent shocks for food consumption but not for nonfood consumption. Insurance for permanent and transitory shocks is statistically significantly higher for educated households than for uneducated households. In conclusion, we observe that the partial insurance model for permanent and transitory shocks provides a better understanding of the degree of insurance than the full insurance model.

Results raise questions about the precise mechanism by which poor households in Colombia cope with risk. That is, households do not rely exclusively on risk-sharing arrangements; instead, they appear to complement informal risk-sharing strategies with self-insurance strategies. Thus, the next step in this research project is to test how costly self-insurance strategies have been displaced by the program. More precisely, we will investigate whether the conditional aspect of the program prevents parents from using their children as risk coping instruments in response to shocks.

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