Journal of Development Economics 107 (2014) 144–156

Contents lists available at ScienceDirect

Journal of Development Economics

journal homepage: www.elsevier.com/locate/devec

Cash, food, or vouchers? Evidence from a randomized experiment in northern Ecuador

Melissa Hidrobo [a,*], John Hoddinott [a], Amber Peterman [b], Amy Margolies [a], Vanessa Moreira [c]

[a] Poverty Health and Nutrition Division, International Food Policy Research Institute, 2033KSt, NW, Washington, DC20006, USA
[b] Department of Public Policy, University of North Carolina, Chapel Hill, NC27599, USA
[c] The World Bank, Washington, DC20006, USA

ARTICLE INFO

Article history:
Received 9 January 2013
Received in revised form 17 November 2013
Accepted 29 November 2013

JEL classification:
D04
I38
O12

Keywords:
Food assistance
Cash and in-kind transfers
Food security

ABSTRACT

The debate over whether to provide food-assistance and the form that this assistance should take has a long history in economics. Despite the ongoing debate, little rigorous evidence exists that compares food-assistance in the form of cash versus in-kind. This paper uses a randomized evaluation to assess the impacts and cost-effectiveness of cash, food vouchers, and food transfers. We find that all three modalities significantly improve the quantity and quality of food consumed. However, differences emerge in the types of food consumed with food transfers leading to significantly larger increases in calories consumed and vouchers leading to significantly larger increases in dietary-diversity.

1. Introduction

Certain design issues are common to all social transfer interventions: who should receive benefits; how much should be given and with what frequency; how long should benefits be provided; what form of assistance should be provided; what conditions should be attached; whether the intervention is incentive compatible with the behaviors or outcomes that are the objective of the program; and the cost-effectiveness of different design options. Analysis of these issues has a long history within economics. They appear in Senior's (1834) report on the operation of the Poor Laws in nineteenth century England, in the functioning of the Famine Codes in late nineteenth century and early twentieth century India (Drèze, 1990), in discussions surrounding welfare reform in the United States in the 1990s (Blank, 2002), and in contemporary debates regarding the design and implementation of social protection programs in developing countries (Grosh et al., 2008). The form of assistance – cash, near-cash transfers such as vouchers, or in-kind – has been especially contested.

Assistance in the form of cash is justified primarily on the grounds that it generates the largest welfare gains because it allows beneficiaries to use the transfers as they see fit. As Glaeser (2012) notes, "I am grateful for the freedom I enjoy when spending my earnings; surely, aid recipients also like autonomy. They can choose the spending that best fits their needs if they are given unrestricted income." Under the second theorem of welfare economics, given certain assumptions, lump-sum cash transfers are efficient in that they move the economy from one pareto optimum to another without introducing welfare-destroying distortions (Blackorby and Donaldson, 1988; Currie and Gahvari, 2008). Moreover, it is argued that less stigma is attached to cash transfers, which, compared with in-kind or near-cash transfers such as vouchers or food stamps, are less visible to non-beneficiaries (Grosh et al., 2008). After the necessary administrative structures are in place, cash transfers are also perceived to be less costly to administer. Jacoby (1997) argues that in-kind transfers are associated with a large deadweight loss due to substantially lower benefits relative to the cost of providing it.

Two arguments are made to justify near-cash transfers such as food stamps and in-kind transfers. The first relates to targeting. Where it is not possible or very costly to identify beneficiaries, in-kind transfers are advantageous because only those truly in need will take-up these in-kind benefits, and consequently, in-kind transfers may be less distortionary than cash transfers (Blackorby and Donaldson, 1988; Currie and Gahvari, 2008; Drèze, 1990). Bruce and Waldman (1991)

* Corresponding author. Tel.: +1 202 862 4612.
E-mail addresses: m.hidrobo@cgiar.org (M. Hidrobo), j.hoddinott@cgiar.org (J. Hoddinott), amberpeterman@gmail.com (A. Peterman), a.margolies@cgiar.org (A. Margolies), vmoreiradasilva@worldbank.org (V. Moreira).

0304-3878
http://dx.doi.org/10.1016/j.jdeveco.2013.11.009

extend this argument, showing that in the presence of a Samaritan's Dilemma, in-kind transfers are more efficient than cash transfers even under conditions of perfect information. The second argument for in-kind transfers is essentially paternalistic. Policy makers and program implementers seek to change a particular behavior or the consumption of a particular good (Currie and Gahvari, 2008). Underpinning this motive is an assumption that in-kind transfers do not crowd out private spending on the good being provided.

Other arguments in favor of one form of transfer over another are circumstance dependent (Coate, 1989). For example, although cash transfers are preferable when prices are declining, beneficiaries are protected from price increases when they receive in-kind transfers. The provision of cash transfers can also adversely affect non-beneficiaries living in the same locality when food markets are not integrated because the injection of cash may cause food prices to rise (Basu, 1996; Gentilini, 2007).

In the United States over the past 40 years in-kind programs have been growing faster than cash programs (Glaeser, 2012). Rather than debating which type of assistance is *most* effective, the debate usually centers on the effectiveness of a specific program such as the Supplemental Nutrition Assistance Program (SNAP, formerly known as the Food Stamp Program). Only a handful of studies in the United States compare different policy options for food assistance. One such study compares food stamps to equivalent cash transfers and finds that food stamp beneficiaries spend a greater fraction of their transfers on food, a result commonly referred to as the cash-out puzzle (Fraker et al., 1995). However, using variation in the roll-out of the food stamp program across counties, Hoynes and Schanzenbach (2009) find that the marginal propensity to consume food out of the food stamp is similar to the marginal propensity of cash. Another recent study compares the less restricted SNAP program to the more restricted Women, Infants, and Children (WIC) program and finds that WIC leads to greater nutritional impacts, especially among children (Yen, 2010).

In developing country contexts, the merits of cash transfers rather than near-cash or in-kind transfers, particularly food, have produced a debate that Devereux (2006) describes as polarized and acrimonious. There are concerns regarding the cost-effectiveness of alternative transfer modalities, a belief that in-kind transfers have especially pernicious disincentive effects and the impression that in-kind recipients often sell a portion of their transfers at prices below their market value, thereby reducing their value. This debate, however, has been hobbled by a lack of rigorous evidence. Numerous studies exist on the impact of cash transfers (for review see Fiszbein et al. (2009)) and food transfers (for review see Barrett and Maxwell (2005) and Margolies and Hoddinott (2012)), but comparisons of impact are often confounded by differences in program design, the magnitude of the transfer, and the frequency of the transfer.

In randomized studies of programs in Sri Lanka and Mexico impacts of cash and food transfers are compared and although food is inframarginal in both programs, in Sri Lanka food leads to smaller impacts on total food expenditures, while in Mexico food and cash lead to similar impacts (Cunha, 2012; Sharma, 2006; Skoufias et al., 2008). Differences in the design of cash and food transfers within and across countries however could explain results. In Sri Lanka cash transfers were provided bi-weekly over a three month period whereas food was provided twice, and in southern Mexico the food transfer was worth 33% more than the cash transfer at local market prices. In a randomized study in the Democratic Republic of Congo, cash and coupons are compared and found to have similar impact on total food expenditures (Aker, 2013). However, similar to the studies in Mexico and Sri Lanka, differences across cash and coupons (or food in the case of Mexico and Sri Lanka) emerge with respect to consumption of certain food items.

To our knowledge, this is the first study that directly compares three different types of food assistance side by side, and thus contributes to the existing literature. It uses a randomized design to compare the impact and cost-effectiveness of cash, food vouchers, and food transfers on the quantity and quality of food consumed. To reduce the probability that impact estimates are confounded by differences in program design, careful attention was paid to ensure that all aspects of the transfer program – transfer levels, transfer frequency, and conditions and nutrition messages attached to program participation –were as similar as possible across modalities. Moreover, the program was fielded in several urban and peri-urban localities in Ecuador with well-functioning food markets. Together with the fact that the intervention was small relative to the size of the local economy, means that results are not confounded by differences in price trajectories faced by beneficiaries receiving different transfer modalities.[1]

We find that all three treatment arms significantly improve the quantity and quality of food consumed as measured by the value of per capita food consumption, per capita caloric intake, and dietary diversity measures. However, across treatment arms differences emerge in the types of food consumed with food transfers leading to a significantly larger increase in calories consumed, and vouchers leading to a significantly larger improvement in dietary diversity. Combining impact estimates with costing data, we find that in this setting – urban with well-functioning food markets –given the significantly higher costs of implementing food transfers, food is always the *least* cost-effective modality for improving any outcome measure, and vouchers are usually the most cost-effective.

The rest of this paper is structured as follows: Section 2 introduces the program and study design; Section 3 presents the data and descriptive analysis; Section 4 discusses the empirical methods used to evaluate the different transfer modalities; Section 5 presents the impact results; Section 6 conducts robustness checks and extended analysis; Section 7 presents the costing and cost-effectiveness analysis; Section 8 discusses beneficiaries preferences and costs; and Section 9 concludes.

2. Program design

2.1. Intervention

Responding to a request from the government of Ecuador in April 2011, the World Food Programme (WFP) expanded its assistance to address the food security and nutrition needs of Colombian refugees and to support their integration into Ecuadorian communities. The new program was designed as a prospective randomized control trial and consisted of six monthly transfers of cash, food vouchers, or food to Colombian refugees and poor Ecuadorian households. The objectives of the program were three-fold: 1) to improve food consumption by facilitating access to more nutritious foods, 2) to increase the role of women in household decision-making related to food consumption, and 3) to reduce tensions between Colombian refugees and host Ecuadorian populations.

The program was implemented in seven urban centers in the provinces of Carchi and Sucumbíos. Both Carchi and Sucumbíos are northern border provinces that receive high influxes of Colombian refugees and cross-border traffic. However, Carchi is located in the northern highlands and Sucumbíos is located in the Amazonian lowlands, and therefore, each has distinct cultural, socio-economic and geographic features. *Barrios* (or neighborhoods)[2] within these urban centers were chosen for the intervention by WFP in consultation with the United Nations High Commissioner for Refugees (UNHCR) as areas that had large numbers of Colombian refugees and relatively high levels of poverty. Each household in the selected *barrios* was visited, mapped, and administered a one-page questionnaire that consisted of basic demographic and

[1] In 2010 the population of the two urban cantons where the study took place –Lago Agrio and Tulcan – was 91,744 and 86,498 respectively. The total number of beneficiaries across the two cantons was 3642. Thus, approximately 2% of the population experienced a 10% increase in income, which we conjecture had little impact on prices.

[2] *Barrios* are existing administrative units within the urban centers with oversight over social services and other administrative functions.

socioeconomic questions. These questions were used to develop a proxy means test to define program eligibility. However, based on point scores by nationality, the decision was made to automatically enroll all Colombian and mixed-nationality households. In addition, all households who reported receiving the government's social safety net transfer program, the *Bono de Desarrollo Humano*(BDH) were automatically excluded from eligibility. Households residing in the selected *barrios* with low socioeconomic status as measured by the proxy means test that met the criteria described above were eligible to participate in the program.

During enrollment and sensitization, the program was described as a poverty and food security transfer targeted toward women, and therefore, the majority of the entitlement cardholders were expected to be women. However, based on household demographics (for example, if there was no adult woman available), men could also be entitlement holders and participate in all program activities. Overall, approximately 79% of cardholders in Carchi and 73% of cardholders in Sucumbíos were women (WFP-Ecuador, 2011).

Participating households received benefits from May 2011 to October 2011.[3] The value of the monthly transfer was standardized across all treatment arms at US$40 per month per household. The transfer size for all modalities was set to be roughly comparable to the national cash transfer scheme, the BDH, which at the time of program design, was US$35 per month per household. For the cash treatment arm, the $40 was transferred monthly onto pre-programmed ATM cards. Cash transfer households were able to retrieve the cash at any time after it had been transferred onto the card; however, it had to be taken out in bundles of $10. The food vouchers were also valued at $40 and given in denominations of $20, redeemable for a list of nutritionally-approved foods at central supermarkets in each urban center. The list of approved foods consisted of cereals, tubers, fruits, vegetables, legumes, meats, fish, milk products, and eggs. The food vouchers could be used over a series of two visits per month and had to be redeemed within 30 days of initial receipt of the voucher. The vouchers were serialized and printed centrally, and were non-transferable. The food transfer was valued according to regional market prices at $40 and included rice (24 kg), vegetable oil (4 l), lentils (8 kg), and canned sardines (8 cans of 0.425 kg). Although $40 was less than the majority of household's total monthly food consumption at baseline, the quantity of food received for each item was higher than what the median household in our sample consumed at baseline, which suggests that for many households the items from the food transfer will be extra-marginal.[4]

Nutrition sensitization was a key component of the program, aimed at influencing behavior change and increasing knowledge of recipient households, especially in regard to dietary diversity. To ensure a consistent approach to knowledge transfer, a curriculum was developed by WFP to be covered during each monthly training session. Topics included (1) program sensitization and information, (2) family nutrition, (3) food and nutrition for pregnant and lactating women, (4) nutrition for children ages 0–12 months, and (5) nutrition for children ages 12–24 months. All participants regardless of transfer modality participated in this training, and transfers were conditional on attendance. In addition to monthly meetings, posters and flyers on nutrition were developed and posted at distribution sites, including supermarkets, banks, food warehouses, and community centers, to further expose participants across all three modalities to messaging. Flyers covered topics such as recommended food groups, daily nutritional requirements, proper sanitation, and food preparation processes. An example of a WFP poster is included in the Appendix (Fig. A.1). Emphasis throughout the messaging and trainings was placed on foods that prevent iron, vitamin A, calcium, and iodine deficiencies, and on the importance of eating a wide range of food groups in order to maximize the absorbency of different micronutrients.

Particular attention was given to ensure that beneficiaries' experiences with the program would be similar across modalities, and descriptive results indicate that this goal was achieved. In particular, across all modalities beneficiaries reported extremely high rates of satisfaction with both the program and program transparency, believed that the program was fair, and reported that program employees treated them with respect. On average, 99% of beneficiaries reported receiving their transfers in totality and 97% reported that they received all information needed to understand how the program worked. Across the three modalities, a minimum of 88% of beneficiaries stated that they received their scheduled payments on time and that they knew how many transfers they would receive. Knowledge gained from the nutrition sensitization sessions, as measured by a set of questions at baseline and follow-up, was also similar across modalities.[5]

Beneficiaries were also asked about how they used their most recent transfer. Voucher households reported using 98.8% on food consumption, compared to 83% for cash households and 63.2% for food households. Cash households reported that the remainder was spent on nonfood expenditures (6.3%), shared with others outside the household (2.4%), and saved for later use (8.3%). Food households reported that the remainder was saved for later use (29.4%) and shared with others outside the household (6.8%). Less than 1% of voucher and food beneficiaries reported selling their food or voucher.

2.2. Study design

The program evaluation was based on random assignment. Randomization was conducted in two stages: first, *barrios* were randomized to either the treatment group or the control group; second, all treatment clusters (geographical units within *barrios*) were randomized to cash, food voucher, or food transfer. Because the geographic area in each urban center was relatively small, this measure was taken to avoid having a cluster assigned to the control group within the same *barrio* as a cluster assigned to the treatment group and consequently causing discontent among potential beneficiaries. Due to the distinct socioeconomic and geographic characteristics of Sucumbíos and Carchi, the randomization of cluster centers was stratified at the province level. The number of clusters per *barrio* varied from one to six, with an average of approximately two per *barrio*. The *barrios* and clusters were randomized into the four treatment arms using percentages of 20/20 for the control and food arms, and 30/30 for the cash and food voucher arms.[6] In total 80 *barrios* and 145 clusters were randomized into the four intervention arms —control, cash, vouchers and food.

3. Data

The baseline survey was conducted in March–April 2011 before the first transfers were distributed. The follow-up survey was conducted approximately seven months later (October–November 2011) after the last of the six transfer distributions. The baseline sample for the evaluation consists of 2357 households of whom 2122 were re-surveyed at

[3] First distribution occurred at the end of April/early May, and last distribution in early October 2011.

[4] At baseline the median household consumed 21.5 kg of cereals, .13 kg of fish and seafood, and 1.97 kg of pulses and legumes.

[5] Out of 8 items intended to measure nutrition knowledge (for example, food sources of vitamin A or iron) only 1 showed significantly different impacts across modalities.

[6] One unexpected complication in the study design was the change in beneficiary criteria implemented during the baseline survey data collection. In the process of surveying households, it was concluded that the targeting for the transfers was too broad, resulting in the inclusion of households who were relatively well off. This led to a re-targeting process where households who were relatively well off were dropped from the program. Since there were not enough households in existing *barrios* to replace those that had been excluded and still reach program enrollment targets, the decision was made to expand coverage to additional *barrios* on the outer circle of urban areas. These areas were subsequently re-randomized into treatment arms according to the approximate percentage lost.

follow-up. Of these households, 2087 have complete food consumption data at baseline and follow-up.

Household-level baseline and follow-up questionnaires include detailed information on household food and non-food expenditures, in addition to information on demographics, assets, nutrition knowledge, transfers in and out of household, education, labor, health, discrimination, and decision-making. The follow-up questionnaire also includes a section on a household's experience with the transfers. Using information from the food and non-food expenditure modules we create measures of household food and non-food consumption, dietary diversity, and caloric intake.

3.1. Outcome indicators

Household food consumption aggregates are constructed from the value of food eaten in the home and the value of food eaten outside the home in the last seven days. Food eaten in the home is composed of 40[7] different food items consumed from not only from food purchased in the marketplace but also food produced at home, food received as gifts or remittances from other households or institutions, and food received as payments for in-kind services. Median prices from food purchased are used to calculate the total value of food consumed from home production or received as gifts or in-kind payments. Weekly household values of food consumed are converted to monthly values, which are then converted to household per capita values by dividing by the number of household members. Although we use per capita values, our results are robust to using adult equivalent values.[8]

Caloric intake is constructed from the amount of food consumed in the home (from purchases, own stock, or in kind payments). Specifically, the amount of food consumed for each item is multiplied by the energy value for that item to obtain the kilocalories consumed. Energy values are taken from the Nutrition Database for Standard Reference (USDA, 2010) and from the *Tabla de Composicion de Alimentos de Centroamerica* (Manchu and Mendez, 2007). Total weekly household caloric values are then converted to daily amounts and divided by household size to obtain caloric intake per person per day. In some specifications, we also use adult equivalent values of caloric intake.

Food consumption and caloric intake play important roles in meeting food security needs. However, households do not solely value quantity — a more varied diet is also important. Increased dietary diversity is associated with a number of improved outcomes in areas such as birth weight, child anthropometrics, hemoglobin concentrations, hypertension, cardiovascular disease, and cancer (Hoddinott and Yohannes, 2002). We construct three separate measures for dietary quality: the Dietary Diversity Index (DDI), Household Dietary Diversity Score (HDDS), and the Food Consumption Score (FCS). The most straightforward of these measures, the Dietary Diversity Index, sums the number of distinct food items consumed by the household in the previous seven days. The household questionnaire covers 40 such food items, and thus the DDI ranges from 1 to 40. Hoddinott and Yohannes (2002) show that the DDI correlates well with both household dietary quantity and quality, and therefore, it provides a useful summary point of comparison within the measured sample. The HDDS captures a similar element of food access, although it differs from DDI in that frequency is measured across standardized food groups, instead of individual food items. The score is calculated by summing the number of food groups consumed in the previous seven days from the following 12 groups (Kennedy et al., 2011): cereals, roots/tubers, vegetables, fruits, meat/poultry/offal, eggs, fish/seafood, pulses/legumes/nuts, milk/milk products, oils/fats, sugar/honey, miscellaneous. Lastly, WFP measures food insecurity using a proxy indicator called the food consumption score (FCS). The FCS is calculated by summing the number of days that the household consumed the corresponding food group (staples, pulses, vegetables, fruit, meat and fish, milk and dairy, sugar and honey, oils and fats), multiplying the number of days by the food group's weighted frequencies, and summing across categories to obtain a single proxy indicator. Households are then categorized as having poor to borderline consumption if their FCS score is less than or equal to 35 (WFP, 2008). The FCS has been found to correlate well with caloric availability at the household level (Wiesmann et al., 2009) and thus reflects the quality of the diet in terms of energy and diversity.

Non-food consumption is calculated from the value of items purchased or acquired in the last month or three months for the following 17 items: personal care, home and kitchenware, communication (telephone and internet), electricity and gas, transportation, water, housing (rent and repairs), entertainment, beauty services, clothes and shoes for adult males, clothes and shoes for adult females, clothes and shoes for children, furniture and electronics, jewelry, toys, education, and tobacco.[9] All values are converted to monthly per capita values. Total consumption is constructed from a household's non-food and food consumption.

3.2. Attrition and balance

The attrition rate of households from baseline to follow-up is 10%. If attrition is correlated with treatment assignment, this could potentially bias our impact estimates. The first row in Table 1 shows no significant difference in attrition rates across intervention arms. Even across arms with similar attrition rates, differential attrition could threaten the internal validity of the study. In particular, if households that leave the treatment arms are poorer than households that leave the control arm, then our treatment estimates will be biased because any change in outcomes will be due to both treatment *and* differential attrition. In order to examine if differential attrition threatens the internal validity of the study, we compare baseline characteristics of households that leave the study across each intervention arm. Table B.1 in the appendix reveals that across 126 difference in means test for those who attrited, only 3 are significant at the 5% level. Those who left the food and cash arm are significantly younger than those who left the control arm; and those who left the food arm are less likely than the voucher arm to have a dirt floor. However, baseline analysis across treatment and control arms for households that remained in the study (Table 1) reveals that differences in age and dirt floor are not significant; therefore, the bias due to the differential attrition of these variables is likely to be very small. Even so, as a robustness check, we bound our estimates following Lee (2009).

To ensure that randomization was successful, we compare baseline characteristics across treatment and control households (Table 1). We conduct the analysis on the 2087 households that are in the baseline and follow-up surveys and have complete data on food consumption. We compare each treatment arm separately to the control arm and each treatment arm to the other treatment arms.

Table 1 reveals that household heads in the control group have a mean age of approximately 42 years, 32% have secondary schooling or higher, 28% are married, 37% are Colombian, and slightly more than one quarter are females. The average household size and total monthly consumption per capita for the control arm is 4.12 and $111 respectively. Although these households are poor, their daily per capita caloric intake is high, at 2021 kcal (or 2565 for adult equivalent caloric intake). Using the average total monthly consumption across all arms of $404.34, the transfer of $40 is approximately 10% of a household's

[7] The food consumption module included tobacco products; however, we include tobacco in the non-food consumption aggregate and not the food consumption aggregate.

[8] Adult equivalent values are calculated using the following formula: $AE = (A + \propto K)^{\theta}$ where $\propto = .5$ and $\theta = .9$ (Deaton and Zaidi, 2002).

[9] We do not include health expenditures because the health module was only applied to households who reported a member being sick in the last four weeks. Consequently, 27% of households at follow-up have missing health expenditures. As recommended by Deaton and Zaidi (2002), we also exclude taxes and ceremonies because they happen infrequently and often do not represent normal consumption patterns.

Table 1
Baseline mean characteristics by intervention arms.

		Means				P-value of difference					
	N	Control	Food	Cash	Voucher	Food -Control	Cash -Control	Voucher -Control	Food -Cash	Food -Voucher	Cash -Voucher
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Attrition Rates	2357	0.11	0.08	0.09	0.11	0.11	0.34	0.80	0.43	0.18	0.49
Household head characteristics											
Female	2087	0.26	0.25	0.28	0.29	0.96	0.49	0.37	0.48	0.37	0.87
Colombian	2087	0.37	0.28	0.24	0.26	0.22	0.05	0.08	0.57	0.76	0.71
Married	2087	0.28	0.30	0.28	0.27	0.59	0.89	0.65	0.50	0.33	0.74
Age (years)	2087	41.71	41.13	41.42	42.21	0.57	0.80	0.68	0.80	0.36	0.55
Has secondary education or higher	2087	0.32	0.35	0.35	0.38	0.49	0.54	0.21	0.92	0.63	0.54
Household characteristics											
Number of children 0-5 years	2087	0.59	0.66	0.59	0.62	0.25	0.95	0.58	0.28	0.56	0.62
Number of children 6-15 years	2087	1.02	0.90	0.89	0.83	0.21	0.12	0.01	0.91	0.44	0.45
Household size	2087	4.12	3.91	3.82	3.75	0.17	0.03	0.01	0.57	0.33	0.64
Floor type: dirt	2087	0.06	0.04	0.03	0.04	0.51	0.24	0.57	0.61	0.91	0.50
Owns television	2087	0.81	0.82	0.79	0.82	0.93	0.46	0.77	0.39	0.83	0.24
Owns computer	2087	0.27	0.32	0.29	0.29	0.28	0.56	0.54	0.54	0.53	1.00
Owns mobile phone	2087	0.85	0.80	0.82	0.84	0.11	0.25	0.63	0.61	0.25	0.50
Owns Car/truck/motorcycle	2087	0.24	0.22	0.24	0.24	0.47	0.81	0.99	0.58	0.43	0.77
Owns land	2087	0.13	0.12	0.12	0.13	0.78	0.74	0.80	0.95	0.65	0.57
Outcome variables											
Dietary diversity index	2087	17.02	17.44	17.41	17.28	0.53	0.51	0.64	0.95	0.77	0.77
Household dietary diversity score	2087	9.11	9.22	9.23	9.19	0.57	0.49	0.61	0.95	0.87	0.78
Food consumption score	2087	59.05	60.93	60.00	59.75	0.35	0.57	0.66	0.63	0.52	0.86
Total per capita consumption (monthly)	2087	111.03	110.46	111.02	114.35	0.93	1.00	0.59	0.94	0.55	0.58
Non-food per capita consumption (monthly)	2087	65.65	63.50	62.60	65.11	0.68	0.55	0.91	0.86	0.74	0.59
Food per capita consumption (monthly)	2087	45.38	46.96	48.42	49.23	0.63	0.26	0.15	0.64	0.47	0.75
Caloric intake per capita (daily)	2087	2021.38	1803.24	1922.36	1813.00	0.26	0.60	0.25	0.25	0.92	0.17
P-value from joint F-test			0.87	0.63	0.68						

Columns 2-5 report baseline means by intervention arm for household in the study analysis. Columns 6-11 report p-values from tests on the equality of means for each variable. Standard errors are clustered at the cluster level. F-tests of joint significance: test of joint significance in regression of respective treatment dummies on 20 baseline variables.

pre-transfer consumption. Across 132 (22 × 6) difference-in-means tests between the treatment and control groups, only four are statistically different at the 5% level, which reveals that randomization was, for the most part, effective at balancing baseline characteristics. While with 132 tests, the probability that we will reject a true null hypothesis for at least one outcome is nearly 100% (Duflo et al., 2007), as a robustness we rerun all our specifications controlling for these baseline covariates.

3.3. Graphical analysis

Fig. 1 shows the densities at baseline and follow-up of two outcome indicators: 1) the log value of per capita food consumption, and 2) the FCS. At baseline there are no large differences between the pooled treatment and control arms for either indicator. However, at follow-up the density for the pooled treatment group has shifted more to the right causing a larger difference between the treatment and control groups. Our estimation strategy explained in more detail below captures these differences of the treatment group compared to the control group.

4. Methods

Our estimation strategy relies on the randomized design of the transfer program. Random assignment of clusters assures that, on average, households will have similar baseline characteristics across treatment and control arms, as demonstrated in the previous section. Such a design eliminates systematic differences between beneficiaries and non-beneficiaries and minimizes the risk of bias in the impact estimates due to "selection effects". Moreover, we take advantage of the baseline survey and estimate the treatment effect using Analysis of Covariance (ANCOVA) which controls for the lagged outcome variable. Given the high variability and low autocorrelation of our food consumption data, ANCOVA estimates are preferred over difference-in-difference estimates (McKenzie, 2012). The ANCOVA model that we estimate is the following:

$$Y_{hj1} = \propto + \beta_f food_j + \beta_c cash_j + \beta_v voucher_j + \gamma Y_{hj0} + \delta P_{hj} + \mu_j + \varepsilon_{hj}$$

where Y_{hj1} is the outcome of interest for household h from cluster j at follow-up and Y_{hj0} is the outcome of interest at baseline. $food_j$, $cash_j$, and $voucher_j$ are indicators that equal one if cluster j is in the corresponding treatment arm. β_f, β_c, and β_v represent the intent-to-treat estimators, or the effect of being assigned to the specific treatment arm. P_{hj} is an indicator for the level of stratification or province and equals one if a household resides in Sucumbíos at baseline.[10] μ_j and ε_{hj} are iid errors across clusters and across households within clusters. To test whether the intent to treat estimators are statistically different across treatment arms, we conduct Wald tests of equality and report the p-values. In all regressions we cluster the standard errors at the level of randomization that is the cluster.

Given the relative success of random assignment, the inclusion of baseline controls is not necessary to obtain unbiased estimates of β. Thus in our main estimates we do not control for other baseline covariates. However, as robustness we present the same results with

[10] Stratification occurred in the two provinces of Sucumbíos and Carchi.

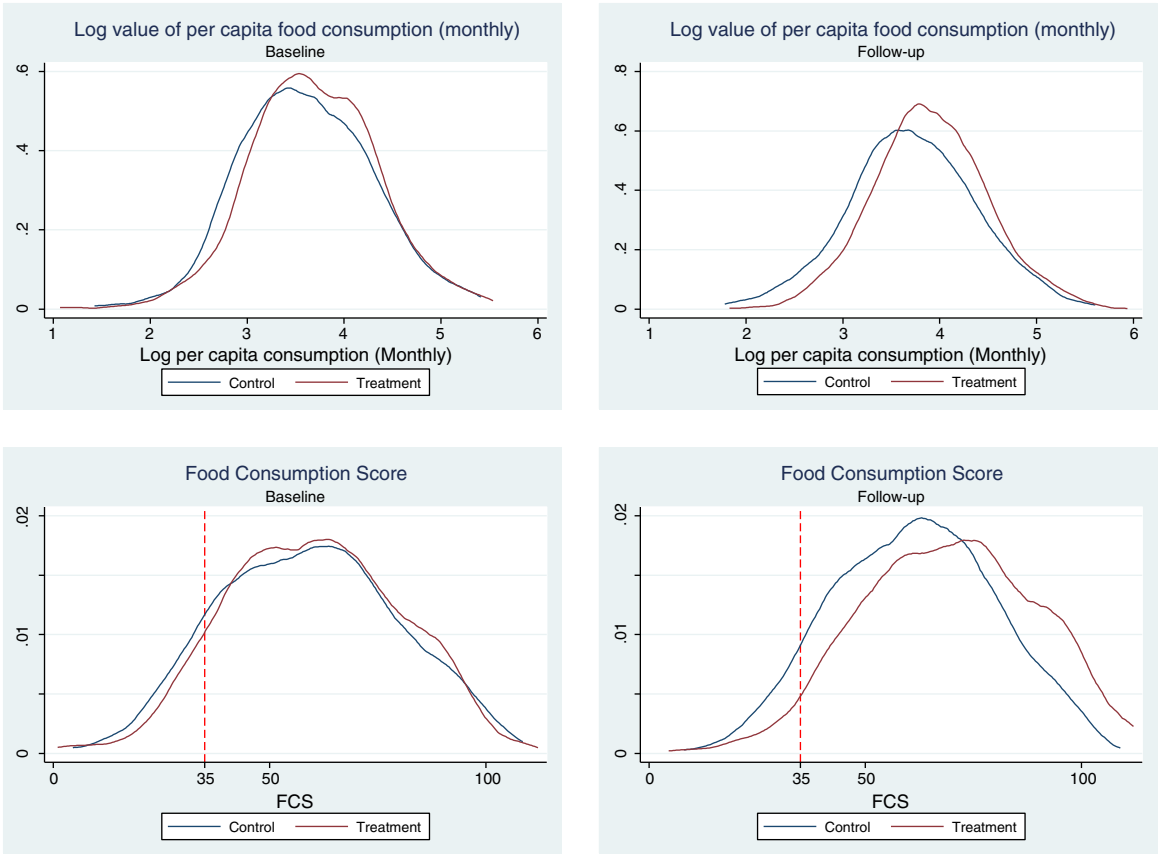

Fig. 1. Kernel density plots of food security outcomes, by treatment and control group at baseline and follow-up.

extended covariates in the appendix. The extended baseline control variables include: an indicator for whether household head is female, an indicator for whether household head is Colombian, an indicator for whether household head has at least some secondary education, household head's age, number of children 0–5 years old, number of children 6–15 years old, and household wealth quintiles (five indicators for each quintile). The household wealth quintiles are constructed from a wealth index that is created using the first principal from a principal components analysis (PCA). Variables used to construct the index are housing infrastructure indicators (e.g., type of floor, roof, toilet, light, fuel, and water source) and 11 asset indicators (e.g., refrigerator, mobile phone, TV, car, and computer).

5. Results

5.1. Food and non-food consumption

We begin our analysis by comparing the impact of treatment on the value of food, non-food, and total consumption (Table 2). The outcomes of interest are in monthly per capita terms. The first three columns of Table 2 reveal the impact in levels, and the last three reveal the impact in percent changes or log values.

All three treatment arms significantly improve a household's food consumption and total consumption. Being in the program significantly increases the value of a household's per capita food consumption by $5.47-$9.22 depending on the treatment arm (column 1). The size of the impact is not significantly different across arms, which implies that the amount of the transfer being used on food consumption is the same across transfer modalities. Similar to results on food consumption, all three arms significantly increase the value of non-food and total per capita consumption by $6.78-$9.22 and $12.66-$18.50 respectively, and the size of the impact is not significantly different across arms (columns 2 and 3).

Given that consumption data is highly skewed, our preferred estimates are the log estimates from columns 4-6. These estimates reaffirm the previous results and reveal that all three arms significantly increase the value of food and total consumption, and food and vouchers significantly increase the value of non-food consumption. The difference in the size of the impact across treatment arms is never significant, which reveals that the three transfers lead to similar spending patterns on food and non-food items. The increase in per capita food consumption ranges from 14% for the cash group to 20% for the food group, or an increase of $6.66-$9.51.[11] The increase in total per capita consumption ranges from 11% for the cash group to 17% for the food group, or an increase of $12.30-$19.01.

5.2. Caloric intake and dietary diversity

Although the impact on the value of food consumption is similar across treatment arms, the types of food being bought may differ, and in particular food consumption patterns may differ with respect to energy value and dietary diversity. Table 3 reveals that all three treatment arms significantly improve both households' caloric intake and dietary diversity, however, differences across treatment arms begin to emerge. For example, food leads to a 21% increase in caloric intake while cash

[11] It is worth noting that the average number of days since beneficiary's last transfer is approximately 16 days. Although transfers are expected to last a month, there could be differences across arms in how quickly transfers are consumed. We explore this further in Section 6.

Table 2
Impact of treatment arms on food and non-food consumption.

	LEVELS			LOGS		
	Food consumption (per capita)	Non-food consumption (per capita)	Total consumption (per capita)	Food consumption (per capita)	Non-food consumption (per capita)	Total consumption (per capita)
Food treatment	9.22	9.22	18.50	0.20	0.15	0.17
	(2.79)***	(3.30)***	(5.02)***	(0.04)***	(0.07)**	(0.05)***
Cash treatment	5.47	6.81	12.66	0.14	0.07	0.11
	(2.56)**	(3.93)*	(5.09)**	(0.04)***	(0.06)	(0.04)***
Voucher treatment	6.38	6.78	13.45	0.15	0.13	0.13
	(2.58)**	(2.82)**	(4.38)***	(0.04)***	(0.06)**	(0.04)***
R^2	0.21	0.17	0.22	0.26	0.25	0.25
N	2087	2087	2087	2087	2087	2087
Baseline Mean	47.54	64.29	111.83	.	.	.
P-value: Food = Voucher	0.31	0.46	0.33	0.23	0.75	0.40
P-value: Cash = Voucher	0.73	0.99	0.88	0.80	0.35	0.63
P-value: Food = Cash	0.17	0.57	0.30	0.14	0.27	0.21

Standard errors in parenthesis clustered at the cluster level. * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.
All estimations control for baseline outcome variable and province.

leads to a 12% increase and this difference in the size of the impact is significant at the 5% level.

While caloric intake plays an important role in meeting households' food security needs, a more varied diet is important for improving health outcomes. In contrast to the results on caloric intake, food leads to significantly smaller impacts than vouchers on dietary diversity as measured by the DDI and FCS. Cash also leads to significantly smaller impacts than vouchers on the FCS. While the impact of cash and food on the FCS is 6.57 and 6.96 points respectively (or an 11 and 12% increase), the impact of vouchers is 9.56 (or a 16% increase). The last column in Table 3 estimates the impact of transfers on the percentage of households with poor to borderline food consumption as measured by the FCS. Even though all three modalities significantly increase the FCS, only vouchers and food significantly decrease the percentage of households with poor to borderline food consumption scores, and the size of the decrease is significantly larger for the food arm when compared with the cash arm.

5.3. Impact by food groups

In order to see what food items are driving the differences in caloric intake and dietary diversity across arms, we disaggregate caloric intake and the frequency of consumption by the 12 food groups that make up the HDDS (Table 4). The top panel of Table 4 reports impacts on food frequency – or number of days in the last week that a household consumed the specific food group. The bottom panel, reports impacts on daily per capita caloric intake for each food group. The last 4 columns of Table 4, consists of the food groups included in the food transfer. Consistent with the composition of the food transfer, there are large and significant increases in the number of days households in the food group consumed cereals, fish and seafood, and pulses and legumes. Significant increases are also found in the number of days the food group consumed roots and tubers, fruits, meat and poultry, and milk and diary, which implies that these items are not substitutes for those in the food basket. Cash also leads to significant increases in 7 food groups: roots and tubers, vegetables, meat and poultry, eggs, milk and dairy, fish and seafood, and pulses and legumes. On the other hand, vouchers lead to the largest number of significant increases in 9 out of the 12 food groups. When compared to food transfers, vouchers lead to significantly larger increases in the frequency of consumption of vegetables, eggs, and milk and dairy. When compared to cash transfers, vouchers lead to significantly larger increases in the frequency of consumption of fish and seafood, and pulses and legumes.

Results on caloric intake follow a similar pattern. In particular food leads to significant increases in the caloric intake of the items that make up the food transfer in addition to increases in roots and tubers, vegetables, fruits, meat and poultry, and milk and dairy. Cash follows a similar pattern as food, except that the increase in caloric intake from food is significantly larger for fish and seafood, and pulses and legumes. When compared to vouchers, food also leads to significantly larger increases in calories from fish and seafood and from pulses and legumes. These significantly larger increases in items that make up the food

Table 3
Impact of treatment arms on food security outcomes.

	Log caloric intake (per capita)	HDDS	DDI	FCS	Poor food consumption
Food treatment	0.21	0.61	2.36	6.96	-0.05
	(0.04)***	(0.12)***	(0.44)***	(1.22)***	(0.02)***
Cash treatment	0.12	0.47	2.64	6.57	-0.02
	(0.04)***	(0.11)***	(0.42)***	(1.29)***	(0.02)
Voucher treatment	0.18	0.60	3.13	9.56	-0.04
	(0.04)***	(0.12)***	(0.45)***	(1.39)***	(0.02)***
R^2	0.17	0.16	0.27	0.16	0.08
N	2087	2087	2087	2087	2087
Baseline Mean	1895.43	9.18	17.27	59.86	0.11
P-value: Food = Voucher	0.40	0.86	0.07	0.07	0.73
P-value: Cash = Voucher	0.15	0.16	0.22	0.05	0.13
P-value: Food = Cash	0.03	0.12	0.48	0.77	0.09

Standard errors in parenthesis clustered at the cluster level. * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$. Baseline mean of log caloric intake reported in levels.
All estimations control for baseline outcome variable and province.

Table 4
Impact of treatment arms on food frequency and caloric intake by food groups.

									In-kind food items			
	Roots & Tubers	Vegetables	Fruits	Meat & poultry	Eggs	Milk & dairy	Sugar & honey	Other	Cereals	Fish & seafood	Pulses, legumes & nuts	Oils & fats
Panel A.	Outcome variable: Number of days in the last week household consumed…											
Food treatment	0.30	0.15	0.31	0.27	0.04	0.38	0.06	-0.19	0.36	0.77	1.22	0.04
	(0.16)*	(0.11)	(0.16)*	(0.09)***	(0.15)	(0.17)**	(0.08)	(0.19)	(0.10)***	(0.13)***	(0.15)***	(0.11)
Cash treatment	0.33	0.33	0.13	0.39	0.25	0.70	-0.04	0.05	0.07	0.25	0.58	-0.07
	(0.17)**	(0.10)***	(0.15)	(0.11)***	(0.15)*	(0.17)***	(0.09)	(0.19)	(0.10)	(0.09)***	(0.12)***	(0.11)
Voucher treatment	0.48	0.40	0.28	0.35	0.47	0.98	-0.04	0.02	0.21	0.48	0.79	-0.10
	(0.17)***	(0.10)***	(0.14)**	(0.11)***	(0.14)***	(0.19)***	(0.09)	(0.19)	(0.10)**	(0.09)***	(0.12)***	(0.11)
N	2087	2087	2087	2087	2087	2087	2087	2087	2087	2087	2087	2087
Baseline Mean	5.15	6.07	4.50	1.91	3.65	2.92	6.45	4.41	6.22	0.85	1.53	0.40
P-value: Food = Voucher	0.35	0.02	0.88	0.41	0.01	0.00	0.17	0.30	0.09	0.03	0.01	0.16
P-value: Cash = Voucher	0.43	0.44	0.34	0.75	0.19	0.16	0.98	0.87	0.13	0.01	0.09	0.73
P-value: Food = Cash	0.87	0.11	0.32	0.25	0.23	0.07	0.18	0.21	0.00	0.00	0.00	0.28
Panel B.	Outcome variable: Log per capita caloric intake (daily) …											
Food treatment	0.24	0.20	0.24	0.37	0.09	0.51	0.05	0.13	0.22	1.29	0.90	0.16
	(0.12)**	(0.07)***	(0.11)**	(0.11)***	(0.09)	(0.16)***	(0.06)	(0.10)	(0.05)***	(0.17)***	(0.15)***	(0.10)
Cash treatment	0.19	0.24	0.16	0.46	0.06	0.68	0.05	0.06	0.16	0.49	0.44	0.06
	(0.10)*	(0.07)***	(0.10)	(0.12)***	(0.08)	(0.13)***	(0.06)	(0.10)	(0.06)***	(0.14)***	(0.13)***	(0.09)
Voucher treatment	0.16	0.24	0.21	0.42	0.19	0.89	0.09	0.04	0.17	0.57	0.63	0.07
	(0.10)	(0.07)***	(0.10)**	(0.11)***	(0.09)**	(0.15)***	(0.06)	(0.10)	(0.06)***	(0.12)***	(0.13)***	(0.09)
N	2087	2087	2087	2087	2087	2087	2087	2087	2087	2087	2087	2087
Baseline Mean	146.31	29.53	198.52	142.76	37.33	102.50	317.73	24.21	818.46	22.20	49.16	6.72
P-value: Food = Voucher	0.46	0.53	0.72	0.66	0.30	0.01	0.47	0.35	0.32	0.00	0.04	0.32
P-value: Cash = Voucher	0.75	0.95	0.56	0.75	0.15	0.10	0.52	0.83	0.74	0.41	0.11	0.94
P-value: Food = Cash	0.63	0.50	0.39	0.45	0.81	0.22	0.94	0.45	0.15	0.00	0.00	0.31

Standard errors in parenthesis clustered at the cluster level. * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$. Baseline means of log per capita caloric intake reported in levels.
All estimations control for baseline outcome variable and province.

transfer –fish and seafood, pulses and legumes – suggest that these items were extramarginal.

6. Extensions and robustness checks

6.1. Heterogeneity by energy deficient households

One concern for policymakers is that transfers, and especially the food modality, are increasing the energy consumption of a population that is not deficient in energy at baseline. A similar study in Mexico found that cash and food not only led to increases in energy consumption, but also increases in women's weight with the greatest impact occurring in already obese women (Leroy et al., 2010, 2013). To investigate whether larger increases in calories occur for those who are not energy deficient at baseline, we create interaction terms of each treatment arm with an indicator that equals one if a household consumes more than 2100 adult equivalent kcals a day.[12] Thus the coefficients on the treatment arms represent the impact for households not consuming more than 2100 kcals a day and the interaction terms represent the differential effect with respect to consuming more than 2100 kcals. Given that we are using an adult equivalent cutoff, we estimate the impact on adult equivalent outcomes instead of per capita outcomes. The first column in Table 5 reveals the average impact of the treatment arms on adult equivalent caloric intake, and the second column reveals the heterogeneous impacts with respect to being above the cutoff. Similar to the per capita outcomes in Table 3, the average treatment effects on caloric intake across all arms are large and significant. The treatment effect of food is significantly larger for households not consuming more than 2100 adult equivalent kcals a day than for households consuming more than 2100 adult equivalent kcals a day. For households not consuming 2100 kcals, the impact across arms is significantly larger for food than cash and vouchers. Although the differential effect is significant for the food arm, the impact on caloric intake for households receiving more than 2100 kcals a day is still large (15% increase) and significant. In contrast to the food arm, the differential effect is not significant for the cash or voucher arms.

Table 5
Heterogeneous impact on caloric intake.

	Log caloric intake (per adult equiv.)	Log caloric intake (per adult equiv.)
Food treatment	0.22	0.28
	(0.04)***	(0.05)***
Cash treatment	0.12	0.12
	(0.03)***	(0.05)**
Voucher treatment	0.17	0.19
	(0.04)***	(0.05)***
Food X High caloric intake (kcals > 2100)		-0.13
		(0.06)**
Cash X High caloric intake (kcals > 2100)		0.01
		(0.06)
Voucher X High caloric intake (kcals > 2100)		-0.05
		(0.06)
High caloric intake (kcals > 2100)		0.11
		(0.05)**
Constant	5.44	5.75
	(0.23)***	(0.33)***
N	2087	2087
P-value: Food = Voucher	0.22	0.09
P-value: Cash = Voucher	0.15	0.09
P-value: Food = Cash	0.01	0.00

Standard errors in parenthesis clustered at the cluster level. * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.
All estimations control for baseline outcome variable and province.

[12] 2,100 is the recommended kilocalories per day for woman 18-30 years with moderate activity. 2150 is the recommended kilocalories per day for woman 30-60 years with moderate activity (Smith and Subandoro, 2007). Our results are robust to either cutoff.

6.2. Robustness

Although treatment was not significantly associated with attrition from baseline to follow-up (Table 1) and those who attrited across control and treatment arms are similar on observable characteristics (Appendix Table B.1), attrition may be correlated with unobserved heterogeneity in the outcome variables. To address issues of non-random sample selection, we bound our treatment estimates following Lee (2009). The idea behind Lee bounds is to construct worst case scenarios by assuming those households who select into the sample because of treatment (marginal households) are at the very top or very bottom of the outcome distribution. Thus trimming the upper and lower tails of the outcome distribution by the proportion of marginal households yields bounds on the treatment effects. In other words, we trim the outcome distribution of each treatment arm by the difference in the proportion of non-missing observations between the treatment and control arm, over the proportion of non-missing observations of the treatment arm. Appendix Tables B.2 and B.3 reveal tight bounds on the treatment estimates, which is not surprising given that the difference in non-missing observations between the treatment and control arms is quite small. Moreover, Tables B.2 and B.3 reveal that even the lower bound estimates, show large and significant impacts across all treatment arms on the quantity and quality of food consumed.

We also address issues of outliers, typical in consumption data, and the few imbalances across baseline characteristics, by checking whether our results are robust to adding control variables and to winsorizing the tails – or converting the bottom 1% of observations to the 1% value and the top 1% of observations to the 99% value (Appendix Tables B.4 and B.5). We do not estimate winsorized values for the HDDS outcome because it does not contain large tails (it ranges from 1-12 with a large number of observations at both 1 and 12). Results reveal that adding covariates and winsorizing slightly changes the coefficients on treatment, however, general conclusions remain the same. In particular, all treatment arms improve the quantity and quality of food consumed, however, food leads to larger increases in calories and vouchers lead to larger increases in dietary diversity.

6.3. Cash conundrum

Appendix Table B. 4 reveals that differences between cash and food on the value of food consumption have become slightly more pronounced. The consistently smaller impact of cash on the value of consumption, leads to questioning why this occurs. One potential explanation is that there could be differences across transfers in how quickly or slowly transfers are consumed, and if cash is consumed more quickly and thus not captured in the 7 day food consumption recall, then we may be underestimating the impact of cash. We take advantage of the variation in the timing of when the survey was conducted to investigate whether length of time since the last transfer led to differential impacts on food security and whether this varied by treatment arm. For logistical reasons, the survey was first administered in Sucumbíos and then Carchi, consequently 98% of beneficiaries in Sucumbíos were surveyed 3-17 days after their last transfer and 99% of beneficiaries in Carchi were surveyed 18-30 days after their last transfer. As a result, we divide our sample by province and create different indicators across provinces for length of time since transfer. In Sucumbíos, we create an indicator that equals one if time since last transfer is greater than a week (70% of beneficiaries in Sucumbíos were surveyed more than one week after the transfer) and for Carchi we create an indicator that equals one if time since last transfer is greater than 3 weeks (75% of beneficiaries in Carchi were surveyed more than 3 week after the transfer). With the exception of food transfers in Carchi, results indicate that there are no differential impacts with respect to the timing since the last transfer (Appendix Table B.6). This is not surprising given that all three transfer modalities were expected to last a month and 98.5% of households were surveyed within a month of being treated.

Another possible explanation is that cash households self-report saving a significant amount of their transfer. While we did not collect detailed data on savings, the few questions we have on bank accounts and savings, shows no evidence of increased savings in the cash arm or any other arm (results available upon request). Cash and food households also self-report sharing their transfers, and again we find little evidence in our data that households are sharing transfers with others outside the household (results available upon request). Instead of making transfers to others outside the household, cash could be crowding out other forms of transfers into the household. In Mexico and South Africa, public transfer programs have been found to crowd out private transfers (Albarran and Attanasio, 2003; Jensen, 2004) which is consistent with models of altruism and perfect and imperfect risk sharing. We do find evidence for this hypothesis, and in particular, cash households are significantly less likely than control households to take out a loan or borrow money from family or institutions (Appendix Table B.7). The same is not true for food and voucher households. The decrease in the amount of money coming into cash households from loans is 28% or $52 over a 6 month period. This translates to a monthly per capita value of approximately $2.20, which may account for some of the smaller impact of cash on consumption. Voucher households also experience crowding out and in particular they experience a significant decrease in the probability and value of food transfers in the form of gifts and informal sharing from friends and family outside the household. However, the decrease in value is very small and translates to a per capita monthly value of $0.11.

7. Costing

We collected detailed information on the costs of implementing the three modalities using an ABC-I (Activity-based Costing – Ingredients) method. The ABC-I method combines activity-based accounting methods with the "ingredients" method whereby program costs are obtained from inputs, input quantities, and input unit costs (Edejer et al., 2003; Fiedler et al., 2008). An advantage of the detailed information on costs obtained from WFP's accounting ledgers and interviews is that costs that are common across modalities can be separated from those that are modality specific. For example, the cost of obtaining data needed to implement the proxy means test is a common cost – it is independent of the type of transfer a household received. In contrast, the cost of manufacturing debit cards used by cash beneficiaries is specific to the cash transfer modality. A second strength of these cost data is that we can calculate the staff costs associated with this intervention. Again, some staff costs, such as those associated with project launch, are common across all modalities. Likewise, other staff costs are modality specific, such as time spent identifying supermarkets willing to accept vouchers.

We are interested in the modality-specific costs of implementing these transfers. Modality specific costs are those costs unique to

Table 6
Modality specific cost of improving outcomes by 15%.

	Food	Cash	Voucher
Value of food consumption	$8.60	$3.20	$3.27
Caloric intake	$8.19	$3.74	$2.73
HDDS	$24.56	$8.97	$7.01
DDI	$12.28	$2.99	$2.73
FCS	$14.33	$4.08	$3.07

Modality specific costs per transfer are used to calculate the cost of increasing each outcome by 15%.

Table 7
Transfer preference, by treatment status.

	Means			P-value of difference		
	Food	Cash	Voucher	Food -Cash	Food -Voucher	Cash -Voucher
If given the choice, beneficiary would prefer to receive						
All of the transfer in its current modality	0.55	0.77	0.56	0.00	0.91	0.00
None of the transfer in its current modality	0.28	0.09	0.31	0.00	0.45	0.00
N	341	425	441			

Sample consists of households who participated in the program. First three columns report baseline means by intervention arm, last three columns report p-values from tests on the equality of means for each variable. Standard errors are clustered at the cluster level.

each program type, excluding common costs of program implementation (planning costs, targeting, sensitization, nutrition training and others) and the $40 cost of the actual transfer. Expressing these costs in per-transfer terms, the cost to provide a food transfer is $11.46; a cash transfer, $2.99; and a voucher, $3.27 (Appendix Table B.8).

Breakdown of these modality-specific costs reveals information on the amount of variable and fixed costs, and human resource versus physical resource costs (Appendix Table B.8). The cost of physical materials associated with vouchers, such as printing, is trivial. However, significant staff costs are associated with supermarket selection and negotiation of contracts, and voucher reconciliation and payment. These staff costs account for nearly 90% of the cost of implementing the voucher component of the intervention. The principal cost associated with the cash transfer is the production of debit cards. The food transfer is significantly more expensive due to the cost of transport to distribution sites and the rental of storage facilities. Repackaging bulk items for distribution is also costly, accounting for approximately 30% of the cost of food distribution. Moreover, the costs of food will not tend to decrease with economies of scale because much of the modality specific costs are physical resource costs such as transport and re-packaging.

In order to compare the cost-effectiveness across modalities, we conduct a simulation whereby beneficiaries' outcomes increase by 15%. Specifically, we calculate the cost to achieve this goal using food, cash and vouchers, conditional on the transfer size and abstracting from costs common to all modalities. Given the different metrics by which our outcomes are measured, we conduct simulations for each outcome. For example, Table 3 indicates that cash transfers increase the FCS by 6.57 points; an 11% increase. Therefore, the modality specific cost of increasing FCS by 15% using cash transfers is (15%/11%) *x* $2.99 which equals $4.08. Table 6 shows the results of these calculations for each modality for the following five outcomes: the value of per capita food consumption, per capita caloric intake, HDDS, DDI and FCS. Across all outcomes, food is always the most costly means of improving these outcomes by 15%. Second, vouchers are usually the least costly means of improving these outcomes by 15%, with the exception of one outcome, increasing the value of food consumption, where vouchers and cash have very similar costs.

This cost-effectiveness analysis assumes that the cost to WFP of procuring foods is equal to their market value. Using data provided by WFP on procurement costs, we are able to assess this assumption. The canned fish, rice, lentils and oil provided to beneficiaries were largely procured locally, although an additional portion of the vegetable oil and lentils were obtained through international procurement. External shipping and human resource related pipeline costs are included for those commodities procured internationally, while in-country transport is included for locally procured commodities. Using these data, we find that it cost WFP $46.76 to procure a $40 ration. When the modality-specific costs of each program type are combined with the cost of transfers inclusive of food procurement cost, we find that it is considerably less expensive to provide cash ($42.99 per transfer) or vouchers ($43.27 per transfer) than food ($58.22 per transfer). While the cost to WFP of procuring food may vary according to a host of factors, we find that in this case food is more expensive to procure and to deliver to program beneficiaries.

8. Beneficiaries' preferences and costs

Other factors to take into account when assessing whether cash or in-kind transfers should be provided relates to beneficiaries' costs (time and money) associated with receiving payments and beneficiaries' preferences. Beneficiaries are asked how they would like to receive transfers in the future. Table 7 shows that 55% of food beneficiaries prefer to receive transfers entirely in food, 77% of cash beneficiaries prefer to receive transfers entirely in cash and 56% of voucher beneficiaries prefer to receive transfers entirely as vouchers. While these numbers suggest widespread satisfaction with these transfer modalities, they may be subject to bias toward the modality that beneficiaries receive. More interesting are the proportions of those who having received one form of transfer do not wish to receive the same form in the future if faced with other options. Only 9% of cash beneficiaries do not wish to receive further transfers in the form of cash. In contrast, 28% of food beneficiaries do not wish to receive further transfers in the form of food and 31% of voucher beneficiaries do not wish to receive further transfers in vouchers.[13] This is consistent with arguments in favor of cash over other transfer modalities in that beneficiaries appear to appreciate the autonomy that comes with cash.

In terms of costs to beneficiaries, cash and voucher recipients spend an average of $1.46 and $1.65 per month respectively on transportation and other out-of-pocket expenses to retrieve transfers. Food recipients spend slightly more, $2.12, as many had to use taxis to carry home the heavy loads of food given at the distribution points. In terms of opportunity costs from time spent traveling to the distribution point and waiting to receive their transfers, cash recipients spend 45 min traveling and waiting while food and voucher beneficiaries spend on average 93 and 92 min, respectively. Consistent with beneficiaries' preferences, overall cash recipients incur the least costs in terms of time and money.

9. Conclusion

The debate over the merits of food assistance and the form this assistance should take has a long history in economics. Despite this enduring debate, little rigorous evidence exists that compares food assistance in the form of cash versus in-kind. This paper uses a randomized

[13] One main complaint from voucher recipients was that the supermarkets had higher prices. While we do find slightly higher prices on some items such as fruits or meats and chicken, for other items such as cereals, pulses, and tubers, there are virtually no differences. There is also a possible quality difference, especially for fresh items, however, it is also possible that these differences are due to perceptions of beneficiaries or reflections of the types of goods they purchase in the supermarket.

evaluation to assess the impacts and cost-effectiveness of cash, food vouchers, and food transfers. We find that all three treatment arms significantly improve the quantity and quality of food consumed as measured by the value of per capita food consumption, per capita caloric intake, and dietary diversity measures - HDDS, DDI and FCS. Across treatment arms we find no differences in the amount of the transfer that is used on food and non-food consumption. However, we do find significant differences in the types of food consumed. In particular, food leads to a significantly higher increase in calories and vouchers lead to significantly larger improvements in dietary diversity.

When we decompose food consumption into food groups, underlying patterns explaining these differences emerge. The larger increase in calories from the food arm is mainly due to significantly larger increases in consumption of fish and seafood, and pulses and legumes. The larger increase in dietary diversity from the voucher arm is mainly due to significantly larger increases than the food arm in the number of days households consume vegetables, eggs, and milk and dairy and significantly larger increases than the cash arm in the number of days households consume fish and seafood and pulses and legumes. These differences in impacts across transfer modalities indicate that transfers of equivalent value and frequency are used differently on food. While food transfers increase food consumption, the increase is concentrated mainly on the food items that make up the food transfer. Vouchers also increase food consumption but are used on more varied food items such as vegetables, eggs, and milk and dairy. The difference in food consumption between cash and vouchers is a little more subtle, and most likely due to the limits placed on vouchers towards nutritious food. Differences in prices and types of food available at the supermarkets versus central markets may be another reason for the differences in food consumption between cash and voucher recipients. For example, the price of sardines and tuna is cheaper ($4.04 versus $4.21) in supermarkets than central markets and this could explain the significantly higher increase in frequency of consumption of fish and seafood in the voucher arm.

Theory predicts that transfers of equal value that are infra-marginal should have similar impacts on food consumption. Consistent with theoretical predictions, we find that the transfer of $40/month which is inframarginal with respect to the mean value of food consumption had the same impact across arms on the value of food consumption. This result is similar to Hoynes and Schanzenbach's (2009) findings with the Food Stamp program in the United States, and to Cunha (2012) findings with the PAL program in Mexico. Similar to Cunha's findings, we also find that the specific items that make up the food transfer are extramarginal in that they lead to significantly larger increases in consumption of these items than cash. An important policy question is whether these increases in consumption of certain items from in-kind transfers are justified. In Ecuador's case, are larger increases in consumption of cereals, pulses and legumes, and fish and sardines justified over larger increases in consumption of milk and dairy in the cash group or milk and dairy, eggs, and vegetables in the voucher group? Preliminary indicators on dietary diversity suggest that they are not; however, a more in-depth analysis of health indicators is needed and left for future work.

It is important to emphasize that all three intervention arms received identical nutrition education and were exposed to the same messaging components as part of the transfer program. Although we are not able to parse out the contribution of this education component on overall impact, there is suggestive evidence that at least part of the increase in food security is due to behavior change induced by nutrition knowledge. In particular, we observe larger shares of household's food consumption dedicated to dairy; pulses, legumes and nuts; animal meat and eggs; and fruits and vegetables; and smaller shares dedicated to starches and tubers, and oils and fats. The contribution of the nutrition trainings on food security has implications for external validity and program design for implementers with similar objectives. Although nutrition messaging and trainings are a common feature of many transfer programs, they are often grouped into a multi-component program conditionality, and are rarely isolated in impact evaluations as an experimental component in themselves (Fiszbein et al., 2009). The general lack of rigorous research on the role of education and training within transfer programs points to the need for further studies specifically designed to provide evidence.

Especially for policy makers, an important component of our analysis is related to costs and the cost-effectiveness of implementing the different transfer modalities. We find that the modality specific cost is $11.46 to provide a food transfer, $2.99 to provide a cash transfer and $3.27 to provide a voucher. Given these costs and impacts, food is the *least* cost-effective means of improving food consumption and dietary diversity outcomes. However, the direct comparison of cash versus vouchers is not as straightforward and ultimately depends on the specific objectives of policy makers. If the objective is to increase the value of food consumption, then there is not a difference between cash or food vouchers. However, if the objective is to increase dietary diversity or caloric intake, then vouchers are more cost-effective than cash.

Although we find that the food voucher is the most cost effective modality across most indicators, this conclusion may not apply to other settings. In particular, our findings are specific to urban populations with well-functioning markets and supermarkets. Our findings may not hold in areas where supermarkets do not have the capacity to receive more clients, or where they do not have a consistent supply of various food items. Moreover, the food energy consumption of the targeted population is relatively high and not as vulnerable to price or weather shocks. Thus, the way in which beneficiaries spend the transfer may be different from that of populations with low food energy consumption or populations whose food energy consumption is more vulnerable to weather shocks such as rural farmers. For these populations, increasing and smoothing their food consumption may be more of a priority than improving the diversity of their diet.

In the context considered here, choosing the “winner” among the different modalities depends on the objectives of the policy makers. If the objective of these transfers is simply to improve welfare, cash is preferable. Cash is the modality that beneficiaries are most satisfied with, and it is the cheapest means of making transfers. Given the budget available to WFP for this project, shifting from food to cash could have increased the number of beneficiaries by 12%. If the objective is to increase calories or dietary diversity, vouchers are the most cost-effective means of doing so, followed by cash. Although the voucher modality is the most cost-effective means of increasing caloric availability and dietary quality, it is the modality *least* preferred by beneficiaries. Thus policy makers are faced with the tradeoff of improving overall welfare or improving specific outcomes. The former gives aid recipients autonomy while the latter restricts their choices in order to achieve specific objectives.

Acknowledgements

We are grateful to the *Centro de Estudios de Población y Desarrollo Social* (CEPAR) for assistance in data collection and management, in particular to Rommel Andrade, Eduardo Arguello, Luis Revelo and Gabriela Vallejo, to Caroline Guiriec for assistance in grant administration, and WFP (Rome and Quito) for excellent collaboration and program implementation, in particular to Lynn Brown, Deborah Hines, and the entire WFP-Ecuador staff. We would like to thank Harold Alderman and seminar participants at the International Food Policy Research Institute, Cornell University, University of California, Riverside, and Washington Area Development Economics Symposium for helpful comments. We gratefully acknowledge funding from the Government of Spain received through the World Food Programme and funding provided by the CGIAR's Policy, Institutions and Markets research program to IFPRI.

Appendix A. Example of poster on nutrition messaging

Fig. A.1. WFP Poster.

Appendix B. Supplementary Tables

Supplementary tables to this article can be found online at http://dx.doi.org/10.1016/j.jdeveco.2013.11.009.

References

Aker, J., 2013. Cash or Coupons? Testing the Impacts of Cash versus Vouchers in the Democratic Republic of Congo. Center for Global Development Working Paper(320).

Albarran, P., Attanasio, O.P., 2003. Limited commitment and crowding out of private transfers: evidence from a randomised experiment*. Econ. J. 113 (486), C77–C85.

Barrett, C.B., Maxwell, D., 2005. Food aid after fifty years: recasting its role. Routledge, New York.

Basu, K., 1996. Relief programs: when it may be better to give food instead of cash. World Dev. 24 (1), 91–96.

Blackorby, C., Donaldson, D., 1988. Cash versus kind, self-selection, and efficient transfers. Am. Econ. Rev. 78 (4), 691–700.

Blank, R.M., 2002. Evaluating Welfare Reform in the United States. J. Econ. Lit. 40 (4), 1105–1166.

Bruce, N., Waldman, M., 1991. Transfers in kind: Why they can be efficient and nonpaternalistic. Am. Econ. Rev. 81 (5), 1345–1351.

Coate, S., 1989. Cash versus direct food relief. J. Dev. Econ. 30 (2), 199–224.

Cunha, J.M., 2012. Testing Paternalism: Cash vs. In-kind Transfers in Rural Mexico. Am. Econ. J. Appl. Econ. (forthcoming).

Currie, J., Gahvari, F., 2008. Transfers in Cash and In-Kind: Theory Meets the Data. J. Econ. Lit. 46 (2), 333–383.

Deaton, A., Zaidi, S., 2002. Guidelines for constructing consumption aggregates for welfare analysis. World Bank, Washington, DC.

Devereux, S., 2006. Cash transfers and social protection. Paper presented at the Regional Workshop on "Cash transfer activities in southern Africa" (Johannesburg, South Africa) http://sarpn.org/documents/d0002199/Cash_Transfer_Devereux_Oct2006.pdf.

Drèze, J., 1990. Famine prevention in India. In: Dreze, J., Sen, A., Hussain, A. (Eds.), The Political Economy of Hunger, vol. II. Clarendon Press, Oxford, pp. 13–122.

Duflo, E., Glennerster, R., Kremer, M., 2007. Using randomization in development economics research: A toolkit. Handb. Dev. Econ. 4, 3895–3962.

Edejer, T., Baltussen, R., Adam, T., Hutubessy, R., Acharya, A., Evans, D., Murray, C. (Eds.), 2003. Making choices in health: WHO guide to cost-effectiveness analysis. World Health Organization, Geneva.

Fiedler, J.L., Villalobos, C.A., De Mattos, A.C., 2008. An activity-based cost analysis of the Honduras Community-Based, Integrated Child Care (AIN-C) programme. Health Policy Plan. 23 (6), 408–427.

Fiszbein, A., Schady, N., Ferreira, F.H.G., Grosh, M., Kelleher, N., Olinto, P., Skoufias, E., 2009. Conditional Cash Transfers: Reducing Present and Future Poverty. Washington D.C., The World Bank.

Fraker, T.M., Martini, A.P., Ohls, J.C., 1995. The effect of food stamp cashout on food expenditures: An assessment of the findings from four demonstrations. J. Hum. Resour. 30 (4), 633–649.

Gentilini, U., 2007. Cash and food transfers: A primer *Occasional Paper* (Vol. 18). World Food Programme, Rome.

Glaeser, E., 2012. Cash Is Better Than Food Stamps in Helping Poor, *Bloomberg*. (Retrieved from) http://www.bloomberg.com/news/2012-02-28/cash-better-than-food-stamps-in-helping-poor-commentary-by-edward-glaeser.html.

Grosh, M., Del Ninno, C., Tesliuc, E., Ouerghi, A., 2008. For protection and promotion: the design and implementation of effective safety nets. World Bank Publications, Washington, DC.

Hoddinott, J., Yohannes, Y., 2002. Dietary diversity as a food security indicator *Food Consumption and Nutrition Division Discussion Paper* (Vol. 136). International Food Policy Research Institute, Washington, DC.

Hoynes, H.W., Schanzenbach, D.W., 2009. Consumption responses to in-kind transfers: Evidence from the introduction of the food stamp program. Am. Econ. J. Appl. Econ. 109–139.

Jacoby, H.G., 1997. Self-selection and the redistributive impact of in-kind transfers: An econometric analysis. J. Hum. Resour. 233–249.

Jensen, R.T., 2004. Do private transfers 'displace'the benefits of public transfers? Evidence from South Africa. J. Public Econ. 88 (1), 89–112.

Kennedy, G., Ballard, Terri, Dop, M., 2011. Guidelines for Measuring Household and Individual Dietary Diversity. Food and Agriculture Organization, Rome.

Lee, D.S., 2009. Training, wages, and sample selection: Estimating sharp bounds on treatment effects. Rev. Econ. Stud. 76 (3), 1071–1102.

Leroy, J.L., Gadsden, P., Rodríguez-Ramírez, S., de Cossío, T.G., 2010. Cash and in-kind transfers in poor rural communities in Mexico increase household fruit, vegetable, and micronutrient consumption but also lead to excess energy consumption. J. Nutr. 140 (3), 612–617.

Leroy, J.L., Gadsden, P., de Cossío, T.G., Gertler, P., 2013. Cash and in-kind transfers lead to excess weight gain in a population of women with a high prevalence of overweight in rural Mexico. J. Nutr. 143 (3), 378–383.

Manchu, M., Mendez, H., 2007. Tabla de Composicion de Alimentos de Centroamerica. (Segunda ed.) Guatemala: Instituto de Nutricion de Centro America y Panama (INCAP), Organizacion Panamericana de la Salud (OPS).

Margolies, A., Hoddinott, J., 2012. Mapping the Impacts of Food Aid: Current Knowledge and Future Directions. UNU-WIDER, Working Paper No. 2012/34.

McKenzie, D., 2012. Beyond baseline and follow-up: the case for more T in experiments. J. Dev. Econ. 99 (2), 210–221.
Senior, N.W., 1834. Poor Law Commissioners' Report of 1834. Copy of the Report made in 1834 by the Commissioners for Inquiring into the Administration and Practical Operation of the Poor Laws. Presented to both Houses of Parliament by Command of His Majesty. Printed for H.M. Stationery Off. by Darling and Son, London (1905 Retrieved from http://oll.libertyfund.org/title/1461/74122).
Sharma, M., 2006. An assessment of the effects of the cash transfer pilot project on household consumption patterns in tsunami-affected areas of Sri Lanka. IFPRI, Washington, DC.
Skoufias, E., Unar, M., González-Cossío, T., 2008. The impacts of cash and in-kind transfers on consumption and labor supply: Experimental evidence from rural Mexico. The impacts of cash and in-kind transfers on consumption and labor supply: Experimental evidence from rural Mexico. *World Bank Policy Research Working Paper Series* (Vol.).
Smith, L.C., Subandoro, A. (Eds.), 2007. Measuring Food Security Using Household Expenditure Surveys. Food Security in Practice technical guide series. International Food Policy Research Institute, Washington, DC.
USDA, 2010. National Nutrient Database for Standard Reference (Release, 23 ed. USDA-Agricultural Resource Service, Beltsville, MD.
WFP, 2008. Food consumption analysis: Calculation and use of the food consumption score in food security analysis. World Food Programme, Rome.
WFP-Ecuador, 2011. Report on the Cash and Voucher project: Quarterly Report of Monitoring, May-July 2011. World Food Programme, Quito.
Wiesmann, D., Bassett, L., Benson, T., Hoddinott, J., 2009. Validation of the World Food Programme's food consumption score and alternative indicators of household food security *IFPRI Discussion Paper* (Vol. 00870). International Food Policy Research Institute, Washington, DC.
Yen, S.T., 2010. The effects of SNAP and WIC programs on nutrient intakes of children. Food Policy 35 (6), 576–583.