THE EFFECT OF AN ELECTRONIC BENEFIT TRANSFER (EBT) SYSTEM ON FOOD EXPENDITURE OF FOOD STAMP RECIPIENTS: EVIDENCE FROM THE MARYLAND STATEWIDE IMPLEMENTATION

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ABSTRACT

Survey data before and after the statewide implementation of an Electronic Benefit Transfer system in Maryland is used to estimate the impact of this system on net food expenditure out of Food Stamp Program (FSP) benefits and income. A reduction in the net food expenditure from FSP benefits relative to income reduces the FSP's ability to target food expenditure.

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1. Introduction

An electronic benefits transfer (EBT) system is an alternative to paper food stamps that are currently used to issue and redeem Food Stamp Program (FSP) benefits. EBT is a point-of-sale terminal network system that uses plastic magnetic encoded cards much like ATM cards. The welfare reform bill, signed in August 1996, requires every state to distribute FSP benefits using an EBT system by 2002. As of March 1998, thirty-one states had operational food stamp EBT systems with thirteen operating statewide EBT systems.

Over the past twenty years, USDA has undertaken several demonstration projects to establish the feasibility of EBT technology and to evaluate its effect on recipients, food retailers, and financial institutions. Previous demonstration projects of the EBT technological have found that existing FSP recipients prefer EBT over paper food stamps. However, in spite of the extensive evaluations, there is little evidence available to suggest if the implementation of EBT will affect the behavior of actual or potential recipients (GAO, 1994).

Conceptually, EBT can affect behavior by altering the stigma associated with FSP participation. This change in FSP stigma has the potential to affect behavior in two ways. (1) A reduction in FSP stigma will lower the (psychic) cost of participating in this program, and, thus, increase the number of participating households even though the criteria used to determine eligibility are unaffected.[1] Since approximately 30-40 percent of households eligible for the FSP do not participate, the implementation of EBT has the potential to increase FSP participation. (2)

[1] Other factors such as improve security and convenience could also make participation in an EBT system more attractive and led to increased participation.

A reduction in FSP stigma increases the substitutability of food bought with food stamps and with income. This change will reduce the marginal propensity to spend on food out of food stamps by FSP participants, and, can potentially reduce the political support of the FSP as a low-income assistance program that targets food expenditure.

In this paper, evidence of the impact of EBT on food expenditure is evaluated. Data on the food expenditure by FSP recipients before and after the statewide implementation of EBT in Maryland in 1992-93 are used to estimate a food expenditure equation in each regime. A comparison of these results indicate that the implementation of EBT in Maryland reduced the marginal propensity to spend on food out of food stamp benefits by approximately 10 percent. Bootstrap confidence intervals indicate that this difference is significant at the 1% level.

2. The Impact of EBT on the Relationship Between Food Expenditures, Food Stamp Benefits, and Income

A unique feature of paper food stamps is that a given amount of benefits provided in this form increases net food expenditure by more than an equal amount of income. Empirically, this relationship have been noted by several different authors using a variety of data covering different time periods (Fraker, 1990). Estimates of the marginal propensity to spend out of food stamp benefits have ranged from between two to ten time the estimated marginal propensity to spend out of income.

The traditional utility maximizing model used to specify the food expenditure equation of food stamp recipients is due to Southworth (1945). This specification, however, is unable to rationalize the empirical difference between food stamp and income for recipients who spend

some income on food in addition to their food stamp benefits. For these inframarginal recipients, who are the vast majority of FSP participants, the Southworth formulation implies that the marginal propensities to spend on food out of income or food stamps should be the same.

A recent paper by Levedahl (1995) provides a utility maximizing specification of the food expenditure equation for food stamp recipients in which the marginal propensities of the inframarginal recipient are not necessarily equal. This generalization was achieved by assuming that food bought with food stamps and with income are less than perfect substitutes. In this specification, food expenditure by the food stamp recipient who spend all their food stamps on food was derived as,

(1) $E = pD(p,p_o,Y,S_o) + (1 - g_2/g_1)S_o$,

where E is total food expenditure; p,p_o are the price of food and other goods; Y is the total cash income; S_o is the dollar value of food stamp benefits; the function D(.) denotes the total demand for food bought with income; and g_2, g_1 are, respectively, equilibrium values of the Lagrangian multipliers associated with the food stamp and the income constraints.

Since, in equilibrium, a Lagrangian multiplier is equal to the marginal utility of the constraint, the ratio g_2/g_1 can be interpreted as the recipient=s evaluation of food stamp benefits relative to those of income. This interpretation implies that S_o worth of food stamps will substitute for income $(g_2/g_1)S_o$ spent on food. If food bought with income and food stamp are fungible then $g_2 = g_1$ and each dollar of food stamps benefits substitutes for a dollar of food bought with income. The fungible case is illustrated in the Southworth model. In that model inframarginal recipients “cash-out” their food stamps, and the only effect of food stamps on food is from an increased demand for food bought with income through the scale effect.

Even though most recipients can cash-out their food stamps, they choose not to. Instead, recipients use a dollars worth of food stamps to substitute for something less than a dollars worth of food bought with income. Estimates based on data collected after the elimination of the purchase requirement in 1979, indicate that an additional dollar of food stamps benefits substituting for approximately 75 to 80 cents of food bought with income.

In this paper, two possible hypotheses concerning the impact of EBT on the marginal propensity to spend on food out of food stamp benefits are tested. The first version is based on the above discussion and predicts that EBT will cause the marginal propensity to spend out of food stamp benefits to fall. The second version predicts that EBT will cause this marginal propensity to increase. Both versions predict that the marginal propensity out of income will fall.

Version 1: If the implementation of EBT reduces FSP stigma, as is commonly assumed, food bought with food stamps and income will become closer substitutes. This will increase g_2/g_1 and food stamps will substitute for a greater amount of food bought with income thereby reducing the marginal propensity to spend on food out of food stamp benefits.

A heuristic way of characterizing the effect of EBT on food expenditures in this case is to think of the current paper system and a cash benefits system as two endpoints. At one end, the current paper system results in greater food expenditure from food stamp benefits than from an equal amount of cash. At the other end, food stamps benefits and cash would be indistinguishable and generate the same food expenditure. By making food stamp benefits more cash like, EBT makes the propensity to spend on food out of food stamp benefits more like the propensity to spend out of income.

Version 2: An alternative view of EBT holds that this system will increase food purchases from

food stamp benefits (for example, GAO, p.43). Currently, up to 99 cents in change can legally be obtained by food stamp recipients on a given shopping occasion. EBT provides for an exact deduction of benefits from a recipient's account, eliminates the need for cash change, and thus eliminates the possibility that recipients will use the change for non-food purchases. By preventing this diversion of food stamp benefits for cash change, this alternative hypothesis implies that EBT will increase the marginal propensity to spend on food out of food stamp benefits, and decrease the marginal propensity to spend on food out of income.

3. Description of the Pre and Post Implementation Surveys

The data used in this paper were collected as part of the Expanded EBT Demonstration in Maryland (1994) conducted by Abt Associates under contract from USDA. Maryland was the first state to implement a statewide EBT system and this demonstration project was conducted to investigate features that might not be evident in earlier pilot demonstration projects.

Two surveys were conducted as part of this demonstration. A pre-implementation recipient survey, which addressed paper-system experience, was conducted between March and September 1992; the post-implementation survey, one year later, between June and September 1993. EBT was implemented in most jurisdictions in Maryland between June 1992 and April 1993. Food stamp recipients who had receiving benefits under the appropriate system for the two months prior to sample selection were eligible for the surveys. Recipients in both surveys were drawn using a two-stage cluster sampling design.

Respondents were asked to recall their food expenditure, income and food stamp benefits, etc. from the previous month. This procedure does not provide the levels of precision obtained from a detailed diary enumeration of household food use. However, there is no ex-ante reason to

expect that the levels and types of measurement error will change between the two surveys.

In total, pre and post implementation surveys consisted of 1,100 and 1,055 food stamp recipients (households), respectively. Missing values reduced the usable samples to 1,016 and 959 households. In addition, 7 household in the pre implementation survey and 5 households in the post implementation survey were deleted because their food expenditure exceeded twice their total income (cash income plus food stamp benefits).[2]

Results from the surveys indicated that average food expenditure fell from $211.13 to $194.37; food expenditure per household member fell from $92.00 to $84.66; and the household food share fell from 0.404 to 0.368 with the implementation of EBT. These differences were all statistically significant at the 1% level. In addition, the average monthly number of shopping trips by recipients to food store increased after the implementation of EBT from 3.8 to 4.6, a difference that was again significant at the 1% level.

These results suggest that the implementation of EBT in Maryland affected the food expenditure behavior by FSP recipients. In the next section, food expenditure equations are estimated separately for both pre and post samples in order to evaluate whether EBT might have changed the structural relationship between food stamp benefits, income and food expenditures.

4. Estimates of the Food Expenditure Equation for Food Stamp Recipients Before and After the Implementation of EBT

Estimates of the food expenditure equation of food stamp recipients were obtained using

[2] The food share for each of these households was at least seven standard deviations greater than the mean food share of the included households.

the functional form introduced by Senauer and Young (1986). This specification is written as,

(2) $\ln(\text{food expenditure}) = a_0 + a_1 \ln(\text{total income}) + a_2 (\text{food stamp benefits/total income}) + \varepsilon$.

Total income consist of cash income plus food stamp benefits. The a's are coefficients to be estimated. The coefficient a_0 is assumed to be a function of demographic variables, and reflects the influence of, for example, unit size and composition, etc., as well as the effect of (constant) prices. ε is an error term. The specification of this error term is discussed below.

Senauer and Young used this specification to demonstrate that the composition of total income affects food expenditure, i.e., $a_2 \neq 0$. Levedahl showed that this specification is the only functional form commonly used to estimate the food expenditure equation of food stamp recipients that exhibits 2nd order flexibility. The marginal propensities to spend out of food stamps and income given by this specification, are, respectively,

(3) $MPSS = w(a_1 + a_2 \alpha_y)$, and

(4) $MPSY = w(a_1 - a_2 \alpha_s)$

where w is the food expenditure share, and $\alpha_s + \alpha_y = 1$ are food stamp and cash income shares, all out of total income.

Marginal propensities were calculated for each recipient ((3) and (4)) using the appropriate LS estimates of a_1 and a_2 conditional on the recipient's food expenditure share and the share of food stamps to total income. The average marginal propensities for recipients in the pre and post implementation surveys are reported in column 1 of table 1. The results indicate that the average marginal propensity to spend out of food stamp benefits by recipients fell about 6 cents and the marginal propensity out of income fell about 1 cents after the implementation of EBT.

A t-test is traditionally used to test whether the difference between two sample means is statistical significant. Application of this test to evaluate the significance of the difference between the average marginal propensities before and after the implementation of EBT is complicated by the fact that the marginal propensities of each food stamp recipient is a function of the estimated LS coefficients. This means that the observations used to calculate the sample averages are not independent. This lack of independence invalidates the t-test for determining whether the mean marginal propensities are equal before and after the implementation of EBT.

In this paper, the statistical difference between the marginal propensities are evaluated using bootstrap procedures as an alternative to a t-test. However before presenting the results of the bootstrap analysis, results of some specification tests of the food expenditure equation (2) are presented. These tests were conducted in order to evaluate whether LS was likely to provide consistent estimates of the parameters a_1 and a_2.

4.1 Specification Tests of the Food Expenditure Equation

It is common for models based on cross-sectional data to exhibit heteroskedasticity in the error term ε. And, in fact, the LS estimates indicated evidence that the food expenditure equation of food stamp recipients for both the pre and post implementation surveys, are subject to heteroskedastic errors. Based on White's (1980b) direct test of heteroskedastic, the null hypothesis of homoskedastic errors was rejected at conventional levels for both the pre and post equations, see table 2. The evidence for heteroskedastic, however, is much strong in the pre-implementation survey,

For the purpose of comparing the pre and post marginal propensities, the existence of heteroskedastic, per say, is not a particular problem since confidence intervals for these

differences are numerically calculated in this paper using bootstrap methods. In particular, it is not necessary when bootstrapping to explicitly model the structure of heteroskedastic, as require in the traditional parametric approach, to get a consistent estimate of the covariance structure. Instead, a consistent estimate of the limiting distribution of the desired statistic can be generated from resamples of the original surveys providing these samples are "good" representations of their populations.

However, it is well known that other types of misspecification associated with a lack of independence between regressors and the errors, such as, for example, omitted variables, measurement errors, simultaneity, etc,, can be responsible for the rejection of the null hypothesis in tests of heteroskedasticity. These other causes of model misspecification would present a more serious problem. In particular, LS estimates of a_1 and a_2, used to calculate the marginal propensities in (2) would be inconsistent with this type of misspecification and any inference based on these estimates would be flawed.

In the case the investigator is unsure about the correctness of the model specification, White (1980b, p.824) suggests performing a specification test (White, 1980a) to augment the direct heteroskedastic test. This specification test is sensitive to model misspecification but not heteroskedastic. Accepting the null hypothesis of no model misspecification would indicate, therefore, that the result of the direct heteroskedastic test may be (reasonably) attributed to the existence of heteroskedastic errors. Thursby (1982) also suggests a similar strategy for discriminating between heteroskedastic and misspecification.

In this paper, White's specification test was undertaken using the variable addition method suggested by Breusch and Godfrey (1986, p.51-53) with the reciprocal of the squared fitted

values of ln(food expenditure) under the null hypothesis as weights. The results of this test indicates no specification error in either the pre or post estimates at conventional significance levels, however, the evidence is not as strong for the post-implementation survey, see table 2.

White notes that since his direct heteroskedastic and specification tests are dependent, the formal size of the sequential procedure is difficult to determine. Alternatively, the misspecification test can be performed using the RESET test. This test is also insensitive to heteroskedastic (Ramsey and Gilbert, 1972), and can be performed at the desired level, at least asymptotically. Calculation of RESET(4) again indicated no misspecification for either pre or post estimates at conventional levels, see table 2.[3]

Based on the specification tests reported in table 2, the analysis will continue based on the assumption that LS provides consistent estimates of a_1 and a_2.

4.2 Bootstrap Confidence Intervals

Table 1 lists various measures obtained from the bootstrap estimates of the sampling distribution of the average marginal propensities. These measures were calculated from histograms obtained by bootstrapping the recipients in the pre and post surveys. Draws were taken by resampling entire cases of data with each bootstrap sample conforming with the sample size in the original survey. For each bootstrap sample, the food expenditure equation was estimated using LS and average marginal propensities were calculated for the original sample of recipients using the new coefficient estimates of a_1 and a_2. These calculations provided 1000

[3] Thursby and Schmidt (1977) found this order of RESET performed well in a comparative study.

bootstrap estimates of the marginal propensities in each of the pre and post implementation regimes.

The statistical significance of the observed difference in the average marginal propensities in the two regimes was tested as follows. In the order of the bootstrap draws (1 to 1000) the difference between the corresponding pre and post average marginal propensities was calculated. The resulting empirical distribution function given by the 1000 differences was then used to approximate the confidence intervals around the true difference in the average marginal propensities. This calculation was done for pre and post differences in both MPSS and MPSY.

Estimates of the 99 percent confidence interval of the difference in the mean marginal propensities in the pre and post survey are given in the sixth and seventh row of the last column of table 1. For both income and food stamps, these confidence intervals lie completely above zero. These results provide strong evidence that the MPSS and MPSY are smaller after the implementation of EBT.

Presumably, more efficient estimates of a_1 and a_2 would give smaller bootstrap confidence intervals for a given size. This would, however, require modeling the underlying heteroskasdicity. Results in table 1 indicate, however, that the differences in the marginal propensities are large enough that this extra step is unnecessary.

5. Conclusion

When the current welfare reform legislation was first introduced in Congress as the Personal Responsibility Act (1994) one of its objectives was to dismantle the existing FSP and provide food assistance benefits as block grants to the states. At the time, this was generally interpreted to mean that the states would convert this program to one that paid cash benefits. In

the final legislation signed into law, however, the FSP was preserved in its existing form as a federal entitlement, admittedly with major modifications.

The success of maintaining the FSP as a federal entitlement can, to a large extent, be attributed to this program's ability to target food expenditure. Empirical evidence has measured food expenditure by recipients to be greater when benefits are provided in the form of food stamps then when provided as cash.

In this paper, evidence has been presented that the implementation of EBT in Maryland weakened the link between food expenditure and food stamp benefits. However, even after the implementation of EBT the difference between the impact of food stamps and income on food expenditure continued to be large.

Unfortunately, the Expanded EBT Demonstration did not collect information on either food intake or food prices paid by FSP recipients so that it is impossible to identify the source of the lower food expenditure. One possibility is that EBT, by lowering the stigma associated with food stamps, increased the number of food stores FSP recipients used. After EBT, recipients may be more willing to shop in food stores in suburban area that have lower prices than the typical urban store.

It remains to determine whether additional experience in an EBT regime will have a further impact on food expenditure in Maryland. Also it would be useful to determine if the impact of EBT on food expenditure measured in this paper is specific to Maryland or a general feature of EBT systems that are implemented statewide in other states.

Table 1: Sample Mean Marginal Propensity to Spend Out of Food Stamps (MPSS) and Mean Marginal Propensity to Spend Out of Income (MPSY) and Their Difference for Recipients in the Pre and Post-Implementation Surveys and Bootstrap Quintiles of the Estimated Limiting Distributions Using LS Estimates of the Food Expenditure Equation

		Bootstrap Estimates					
	Sample Mean	Mean	Median	SE	IQR	95% CI	99% CI
Pre							
MPSS	0.521	0.523	0.522	0.049	0.489/0.555	0.433/0.623	0.410/0.656
MPSY	0.010	0.010	0.010	0.014	0.000/0.020	-0.018/0.037	-0.031/0.047
Post							
MPSS	0.461	0.462	0.460	0.058	0.423/0.497	0.359/0.586	0.321/0.624
MPSY	-0.003	-0.004	-0.003	0.015	-0.015/0.007	-0.033/0.026	-0.045/0.033
ΔMPSS (pre - post)	0.060	0.061	0.062		0.058/0.066	0.038/0.074	0.030/0.083
ΔMPSY (pre - post)	0.013	0.014	0.013		0.013/0.014	0.011/0.016	0.011/0.017

IQR: Inter-quartile range
CI: Confidence interval
SE: standard error of bootstrap means

Table 2: Misspecification Test Results for the Food Expenditure Equation Based on Pre and Post Implementation Survey Data (observed level of significance in parentheses)

Test	Pre	Post
White's Direct Heteroskedastic, $\chi^2(p)$[a]	156.50 (<.001)	49.04 (.07)
White's Misspecification Test, $F(k+1,n-2k-2)$[b]	0.91 (.57)	1.41 (.11)
RESET(4), $F(3,n-k)$[c]	1.57 (.20)	1.99 (.11)

a. p=36, this version includes the second moments of the exogenous variables excluding the intercept and dummy variables, p=k'(k'+1)/2 .
b. k is the number of regressors under the null excluding the intercept, here k=19.
c. k is the number of regressors in the unrestricted case, here k=23.

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