

REPERCUSSIONS OF FERTILIZER SUBSIDY PROGRAMS ON PRIVATE SECTOR  
INPUT RETAILERS:

EVIDENCE FROM MALAWI AND PROPOSAL FOR FURTHER RESEARCH

By

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## ABSTRACT

### REPERCUSSIONS OF FERTILIZER SUBSIDY PROGRAMS ON PRIVATE SECTOR INPUT RETAILERS:

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This paper looks at the experiences of agricultural input retailers in Malawi as a result of the Agricultural Input Subsidy Program. In particular, it focuses on the impact of excluding private sector retailers from participation in the subsidy program. Using a difference-in-difference approach to modeling fertilizer sales, it attempts to evaluate how retailers who were allowed to participate for part of the duration of the program but were then excluded experienced this policy change in comparison to retailers who were not allowed to participate at any point in the program. Furthermore, by looking at survey attrition over a two-year period, this paper looks at the evidence for and against the case that the subsidy program is driving private sector retailers out of business entirely. Due to known problems with the data and the results of testing done in the process of this research, this paper goes on to discuss the ideal methods that could produce the data needed to more accurately and comprehensively address the questions discussed in the first parts of the paper.

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## ACRONYMS

AD Agrodealer

ADMARC Agricultural Development and Marketing Corporation

AISP Agricultural Input Subsidy Program

SFFRFM Smallholder Farmers' Fertilizer Revolving Fund of Malawi

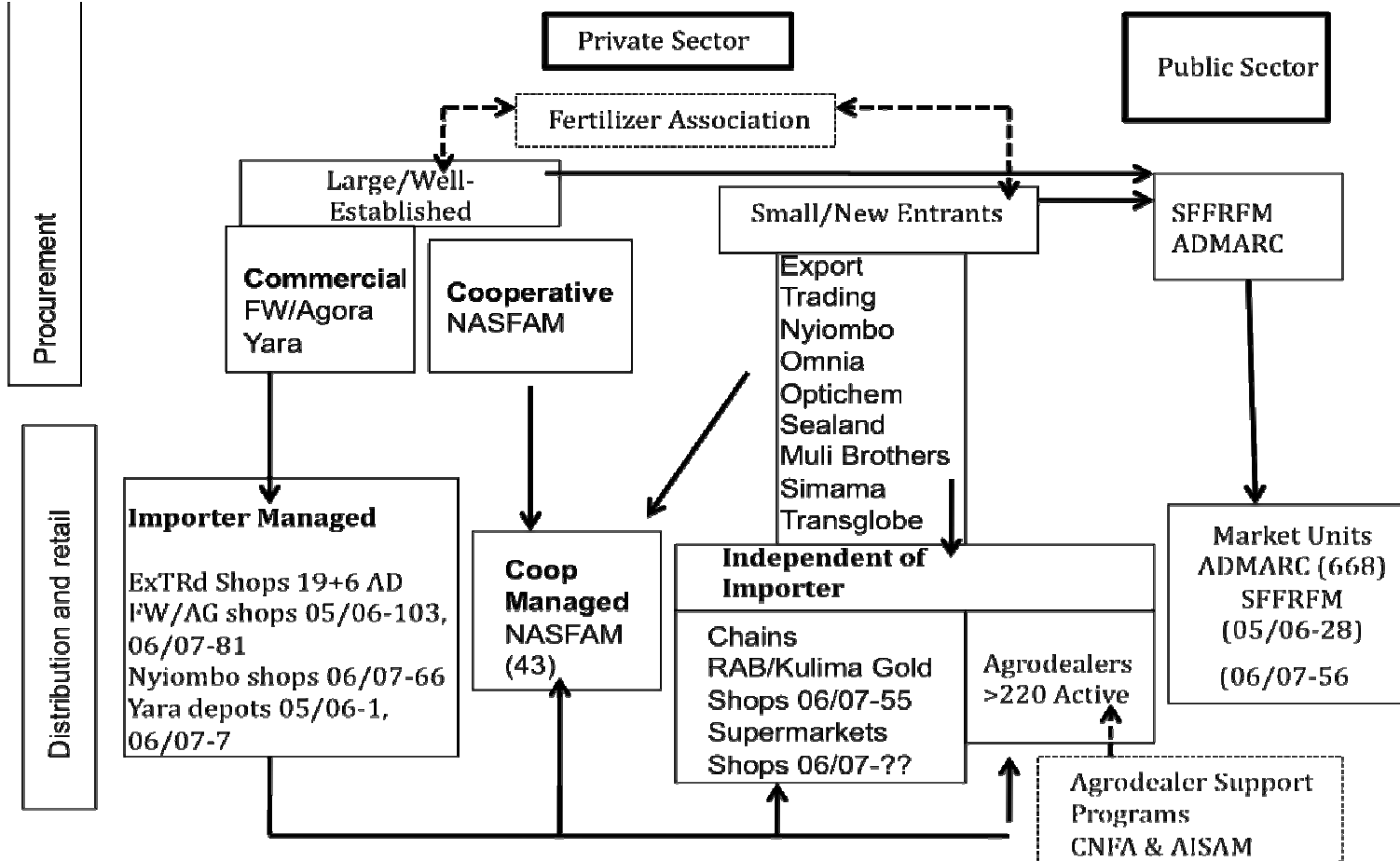
## 1. Introduction

Beginning in 2005/06, Malawi's government began a series of changes in their agricultural input subsidy policies. In 2005/06, the government implemented a new subsidy program to replace and improve upon their previous policies. In subsequent years they significantly changed how the new subsidy program was implemented. These changes, which affected subsidies for seed and fertilizer, had a significant effect on the viability of private sector input supply. This paper looks first at the structure and composition of Malawi's agricultural input industry, then at the policy changes that were enacted and finally at the effects on the private sector input retailers.

### 1.1 Malawi's Agricultural Input Industry

Malawi's agricultural input industry has four general categories of retailers: government retailers, major distributors, cooperatives, and independent agrodealers. These are illustrated in figure 1, which shows the general structure of the industry and the relationships within the industry.

Figure 1: Structure of the Malawi Fertilizer Industry



Source: Kelly, Boughton and Lenski 2010



The first category is in the public sector, which consists of ADMARC and SFFRFM outlets. SFFRFM imports fertilizers and also does some distribution; however, ADMARC is the major distributor of fertilizers for the government, selling supplies that are imported by SFFRFM as well as products imported for the government by private sector importers. In the early 1990's ADMARC was the only seller of fertilizer to smallholders, however the private sector entered the market during the 1990's with market liberalization and a removal of fertilizer subsidy programs. In 2005/06 ADMARC and SFFRFM were responsible for 45% of fertilizer sales (Dorward et al, 2008). The extent of government participation is highly variable, but these outlets are important for farmers who live in areas that do not have a sufficient private presence.

The second category is the major distributors (e.g., Rab, Farmers' World, Agora). Most of the distributors are also major importers. All distributors have a network of retail outlets that not only sell fertilizers but also conduct other commercial functions such as buying crops from farmers or selling food products, farm equipment, seeds, and crop chemicals. However, as of 2008/09, RAB has withdrawn from selling fertilizer as a result of uncertainty about government policy (Kelly, Boughton and Lenski 2010.)

A third category is the independent agrodealers. These are independently owned small outlets that usually sell some combination of agricultural inputs (improved seeds, fertilizers, and crop chemicals) and other products such as agricultural equipment, groceries, hardware, clothing and housewares (Kelly, Boughton and Lenski 2010). They typically have smaller stocks and less variety than the major distributor outlets. Many of the agrodealers concentrate on seeds and crop chemicals because the capital required is lower than for fertilizer and the margins tend to be higher. Among

those who do sell fertilizers, they often differentiate themselves from the distributors by selling in smaller quantities than the 50 kg bags sold by the distributors.

Two organizations provide support to the independent agrodealers, CNFA and AISAM. These organizations provide support at the retail level including training programs that improve dealers' ability to provide advice to customers on the appropriate use of inputs, to manage finances, and to access market information. CNFA also facilitates AD access to supplier credit by offering the suppliers a 50-75% guarantee on any credit extended to ADs in the CNFA network. Thus far, only a small percent of CNFA agrodealers have met the eligibility criteria for getting the credit. Several of the early recipients, however, have "graduated" and now receive credit directly from the suppliers without the CNFA guarantee.

A fourth category is the network of cooperatives. These are part of the NASFAM network, and commercially supply inputs to members. These cooperatives benefited from donor support, which provided substantial funding for training and other types of assistance through 2006/07. Although a major source of input supply for their members in the past, including having been authorized to distribute subsidized fertilizers in 2006/07 and 2007/08, NASFAM, due to an increasingly difficult financial situation, withdrawn from fertilizer sales almost entirely before the 2008/09 decision to limit distribution of subsidized fertilizers to government outlets.

## 1.2 Motivations and implementation of AISP

During 2002/03 and 2003/04, when Malawi was using a Targeted Inputs Program, only 40% of smallholders bought commercial fertilizer, indicating that more than half of smallholder households could not afford commercial fertilizer. This would

result in lower maize productivity and contribute to food insecurity problems (Kelly et al. 2008). Therefore, in 2005/06 the government began the AISP program. The objectives were to increase smallholder productivity as well as increase food and cash crop production in order to reduce vulnerability to food insecurity.

In its first year, 1.3 million farmers received a total of 130,000 tons of fertilizer (World Bank, n.d.). By the 2007/2008 season, 1.7 million farmers received 170,000 tons of fertilizer. The program uses vouchers, which are distributed to farmers and are redeemable for fertilizer at a discounted price at retail stores. The price farmers pay with the vouchers is about one-fifth of the market price for fertilizer (IFPRI, 2009). In 2008/09, this program cost 80 percent of the budget of Malawi's Ministry of Agriculture and Food Security, and 15% of the national budget.

The four types of retailers in Malawi's agricultural input sector have had distinct experiences through the course of AISP. In 2005/06, only government structures were allowed to participate in the voucher program. However, in 2006/07 and 2007/08, vouchers were redeemable at both government retailers and at government authorized private sector distributors; independent agrodealers were excluded from direct participation, but a few managed to arrange with the distributors to redeem vouchers on their behalf. In 2006/07 and 2007/08, the private sector sold around 25% of the subsidized fertilizer. However, in 2008/09 the inclusion of the private sector was discontinued, and since that time the vouchers are only redeemable at government retail stores. According to the government, this was necessary to prevent fraud and improper use of the vouchers. This claim is not supported by evidence which showed that fraudulent vouchers were less prevalent, in proportion to the number of vouchers

accepted, among the private sector than at ADMARC/SFFRFM shops (Logistic Unit, 2009).

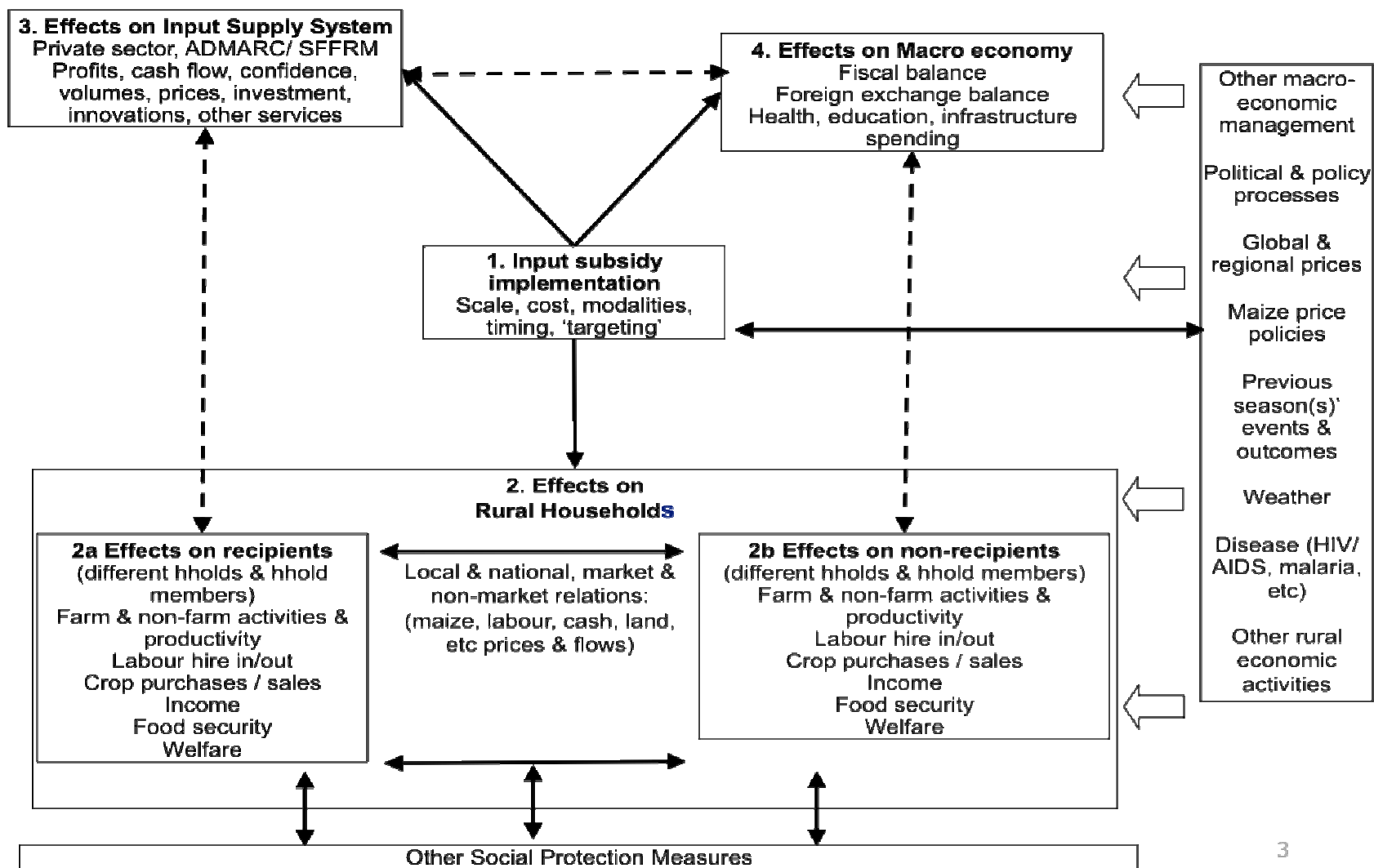
The effect of this exclusion on fertilizer sales and on the viability of the private sector fertilizer retailers has not yet been fully determined. Understanding the effect of the fertilizer subsidy program on private sector retailers is important for several reasons. First, other countries in Africa are developing or considering programs that are similar. Therefore, a deeper understanding of the effects of this program may provide lessons for others. Second, the subsidy program is quite expensive for Malawi, creating questions about the sustainability of the program. If the subsidy program cannot be sustained long term, then maintaining a strong private sector would be important. However, some (especially government retailers) argue that the public sector is better suited to providing agricultural inputs compared to the private sector, which was part of the justification of private sector exclusion in Malawi's program in 2008/09. Understanding the effect of policy changes within the general subsidy program is also important. Kelly, Boughton and Lenski (2010) reported, "In 2007, [private sector] input suppliers were unanimous in stating that the most important thing the government could do to assist the development of a viable input supply network was to ensure policy stability." Two large-scale input supply assessments that included the perspectives of the retail sector have been done, one in 2006/07 (reported in Dorward et al. 2008) and one in 2008/09 (Kelly, Boughton, Lenski, 2010).

### 1.3 Motivation, implementation and results of 2006/07 study

The first of these input supply assessments was done in 2006/07 as part of a full-scale assessment of the subsidy program conducted for Malawi's Ministry of Agriculture

and Food Security (see Dorward et al. 2008). The goal of this evaluation was to “assess the impact and implementation of the AISP in order to provide lessons for future interventions in growth and social protection” (Dorward et al, 2008). The overall study was broad in nature, looking at a wide range of actors and factors hypothesized to have an effect on the subsidy program implementation and impacts. Figure 2 is a diagram of the conceptual framework used for the overall study.

Figure 2: Conceptual Framework of the 2006/07 Input Supply Assessment



Source: School of Oriental & African Studies, Wadonda Consults, and Michigan State University, 2008.

The part of the initial study of most relevance to the current paper is that dealing with the input supply system (top left corner of Figure 2). The general objectives of the input supply component were to examine the performance of the program, describe its impacts on different types of actors (ADMARC/SFFRFM, private sector importers, private sector distribution chains, cooperatives, independent agro dealers), and solicit recommendations for improvements. The indicators of interest were sales volume trends, displacement of commercial sales, and changes in costs of doing business, confidence in the sector, investment, and numbers of competitors.

Information about the input supply sector came primarily from formal interviews with the major importers and distributors (both public and private sector), a survey of input retailers in 6 purposively selected districts, secondary data on fertilizer imports provided by government services, and retail outlet sales data provided by importer/distributors for selected outlets in the 6 districts covered by the retail survey. Quantitative data on input access and use collected at the household level through a nation-wide survey of 2,491 farm households was used to supplement the input sector study (particularly the analysis of displacement). Information collected through focus group discussions carried out with farmers and community leaders in the same 6 districts as the retailer survey were also used to supplement the input sector analysis. The data of most interest to the present study is that collected by the retailer survey. The sampling frame for the 2006/07 retailer survey was created by combining complete lists of AISAM dealers participating in the seed subsidy program or who expressed interest in the fertilizer voucher program, a complete list of individuals who had been trained to be agrodealers by CNFA, lists of distributor retail outlets provided by the

home office of each distributor, and a list of ADMARC/SFFRFM outlets provided by the logistics unit. One problem with the sampling frame was the lack of a complete census of agrodealers, which meant that any who were not members of CNFA or AISAM were not included in the initial sampling frame.

Retailers who were interviewed were selected randomly from each category (distributors, government, independent agrodealers). Agrodealers were intentionally over-sampled relative to others because of their heterogeneity compared to distributors and government outlets.

There were several constraints affecting the survey of retail shops, and what analysis it could be used for. The first was that because of costs and logistics, the retailer survey was done in only six districts, meaning that the results could not be considered nationally representative. Two districts were selected in each region, one district that had relatively dense input supply, and one that had less dense coverage. Consequently, the results of the retailer survey are not nationally representative but reflect the situation in each of the selected districts. A second constraint was the fluidity of the independent agrodealer part of the retail sector within those districts. Some of the shops from the CNFA and AISAM lists could not be found or were not selling inputs, and a number of independent AD shops not on the list were identified and used as substitutes.<sup>1</sup>

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<sup>1</sup> CNFA listed as members all individuals who had received CNFA training to become agrodealers, whether they had actually started selling inputs or not. Many individuals were encouraged to participate in the training by the expectation that they would receive credit and other financial support to start a business; when this was not forthcoming, those trainees without their own financial resources did not start selling inputs or sold seeds and agricultural chemicals only, which are less capital intensive than fertilizers.



In addition to the sampling issue, there were data challenges. During the questionnaire testing it became apparent that collecting accurate quantitative data on sales and profits was difficult, with very few of the independent agrodealers able to provide reliable information over time and most of the distributors reporting that only their home offices were able to provide sales data. To address these problems, the home offices of the distributors (including ADMARC/SFFRFM) were contacted and agreed to provide the sales data for the selected outlets. The quantitative questions about sales and profits were retained for the independent agrodealers, but a number of more qualitative questions about perceptions of trends in sales and profits were added to supplement the weak quantitative data.

One component of the 2007 analysis was an estimate of fertilizer displacement, using both national sales data and household survey data. There are two relevant types of displacement in the case of the fertilizer subsidy. The first is on the consumer side of the subsidy. In this case displacement can be defined as the percent decrease in purchases of un-subsidized fertilizer per unit of subsidized fertilizer purchased. The second type is on the retailer side. In this case displacement can be defined as the percent decrease in sales of un-subsidized fertilizer per unit of subsidized fertilizer sold. In both cases these are aggregate measures, not individual consumer or retailer measures.

The results of the 2007 study consumer side displacement analysis show displacement between 30 and 40%. Displacement is higher among the less poor farmers. The evidence of displacement suggests that the program is not being as cost effective as it could be, with each sack of subsidized fertilizer the government is offering

bringing about less than a full sack of additional fertilizer use. The study also discussed the retailer side displacement. A regression of private sector sales from 1997/98 to 2004/05 on parastatal sales showed a negative relationship, with parastatal sales in 2005/06 leading to a 32% reduction in private sector fertilizer sales, and a 26% reduction in 2006/07.

However, there were some issues affecting the ability to use national sales data to look at the retail side, making the estimate less ideal. One of these weaknesses was because looking only at a simple regression of sales ignores the effects of other relevant variables that affect unsubsidized sales, but there was not sufficient data to include variables such as fertilizer and crop prices, income, and density of sale outlets and there were limited degrees of freedom as well.

The study used the retailer survey to look at suppliers' views about the strengths and weaknesses of the program, as well as their general opinions about the concept of the program. Despite implementation problems, most retailers supported continuation of the program; only 10% of retailers surveyed wanted to end the program or return to an earlier subsidy policy. Retailers who supported the program cited many reasons for continuing the program including that it assisted the poor and the small farmers, that it reduced hunger and increased yields, and that it increased business.

#### 1.4 Motivation, implementation and results of 2009 study

In 2009, a follow up study to the 2007 input supply study was conducted, and results reported in Kelly, Boughton and Lenski (2010). The goal of this study was to evaluate how the AISP, and in particular the changes to the program in 2007/08 and 2008/09, affected the structure and performance of the agricultural input sector, with an

emphasis on the program’s effect on commercial input supply. This analysis primarily relied on descriptive statistics. The sources of data used were reports from the Logistics Unit, interviews with key informants, a retailer survey, focus groups with farmers and interviews with community leaders.

As in 2006/07, there were several constraints on implementation of the retailer survey. First, the intent was to re-interview each of the retailers interviewed in 2006/07. However, only 65% of those retailers were located and re-interviewed. In the process of adding new retailers to the sample, a few problems occurred. First, the lack of an updated sampling frame meant that the replacement process was inconsistent. Replacement retailers were selected by each survey team using a combination of information from other retailers and community leaders to identify candidates for the survey. Second, there were significant changes in geographic distribution of the retailers surveyed and in composition of the retail sample. These changes are shown in table 1.

Table 1: Composition of Retailer Sample by District and Type of Retailer

Region	District	Distributors 2007 vs. 09	ADMARC/ SFFRFM 2007 vs. 09	Coops 2007 vs. 09	Independent agrodealers 2007 vs. 09
North	Mzimba	10 - 21	5 - 6	4 - 2	31 - 10
	Rumphi	2 - 6	24 - 20	6 - 2	8 - 6
Center	Kasungu	14 - 16	8 - 6	4 - 2	24 - 14
	Lilongwe	10 - 11	6 - 5	7 - 3	27 - 22
South	Blantyre	5 - 5	15 - 16	0 - 1	22 - 23
	Machinga	6 - 7	13 - 12	0 - 0	19 - 14
TOTAL	Number	47 - 66	71 - 65	21 - 10	131 - 89
	Percent	17 - 29	26 - 28	8 - 4	49 - 39

Source: Kelly, Boughton and Lenski (2010)

One important issue to note is that these changes in composition are not necessarily an accurate reflection of changes in population of retailers, especially in terms of the number of distributors which were substituted for independent agrodealers when there were not enough agrodealers to survey. This is primarily a result of a lack of a census of input retailers, and therefore a lack of a sampling frame.

A second constraint on implementation was the time spent training the interviewers. The shorter training period relative to the prior survey meant that interviewers were sometimes confused about the process of conducting the survey and did not get adequate training with respect to sample replacement procedures.

Despite these limitations, the 2009 study found several interesting results. The first set of these results looked at changes in composition of the agricultural input sector. Among these was an analysis of the change in number of competitors that input retailers were facing. Retailers were asked to report the number of competitors within their marketing area, which was defined as the average distance customers traveled. The results show a 15% increase in number of competitors from 2005/06 to 2008/09 for independent agrodealers and a 3% increase for distributors over the same time period. For ADMARC/SFFRFM, there was a 7% increase in number of competitors from 2005/06 to 2007/08, followed by a decrease in competition to below 2005/06 numbers in 2008/09, following the exclusion of the private sector from the fertilizer subsidy program.

### 1.5 Additional Research

Considerable work has been done on evaluating input subsidy programs, both in Malawi and in other countries in Africa. Much of this work has focused on how to maximize the effectiveness of such programs, especially in terms of increasing fertilizer

usage, but there has also been substantial research on how subsidy programs do and should relate to commercial market development. This section will summarize some of the most relevant and recent research that has been done.

Substantial research has been done on “smart” subsidies. The principles for this are outlined by Minde and Ndlovu (2007) “as those involving (S)pecific targeting to farmers who would not otherwise use purchased inputs...(M)easurable impacts, (A)chievable goals, a (R)esults orientation, and a (T)imely duration of implementation” (Minde et al, 2008). These principles are further outlined in Morris et al. (2007), and Minde et al. (2008) discussed the applications of the principles of smart subsidies to Malawi, Zambia and Kenya in assessing those countries subsidy programs. Dorward et al. (2008) discussed the implementation and design of Malawi’s program in context of this approach.

Xu, Burke, Jayne & Govereh (2009) studied the effects of a subsidy program in Zambia. Using rural household data, they measured the “crowding in” and “crowding out” of the commercial fertilizer sector as a result of Zambia’s government programs. They conclude that the effect depends on local characteristics such as the existing level of private sector activity and average wealth. However, Zambia’s program continues to use private distributors as a channel for distributing subsidized fertilizer, so the recent experience of the private sector in Malawi is substantially different.

Rickert-Gilbert and Jayne (2009) looked at how the fertilizer subsidy program in Malawi affected demand for commercial fertilizer. Using panel household survey data, they estimated demand for commercial fertilizer. They found that while the

implementation of the subsidy did result in an increase in total fertilizer use, there was some displacement of commercial fertilizer sales.

## 1.6 Objective

While the 2006/07 and 2008/09 input market assessments in Malawi provided valuable insights into the experience of agricultural input retailers with the AISP, the objectives of the study do not include a formal econometric analysis of the sector. Although the data collected is not ideally suited for this type of analysis, econometric results could provide useful insights that cannot be achieved through the use of descriptive statistics. One ideal measure would be to calculate a formal measurement of displacement based on retail data as a counterpart to the calculations made from the household data. In this case displacement would be defined as the decrease in commercial fertilizer sales as a result of subsidized fertilizer sales. However, there is not sufficient aggregate data on a national level to estimate this. Instead, using the sales and price data provided in the 2008/09 survey, this study will attempt to supplement the results from the existing 2008/09 assessment with an econometric model for fertilizer sales in the private sector. Additionally, since the experiences of independent agrodealers have differed significantly from those of distributors, this study will use data available on survey attrition to assess experiences of agrodealers over a three-year portion of the subsidy program.

## 2. Ideal analysis and model development

### 2.1 The difference-in-difference approach and the total sales model

In order to understand the short-term effects of the exclusion of the private sector from the fertilizer subsidy program, one approach is to model total fertilizer sales. Since independent agrodealers and distributors had different experiences, with agrodealers being excluded since the beginning of the program and distributors being newly excluded in 2008/09, this allows the use of a difference-in-difference approach to model the effect of the policy. This method can be applied to repeated cross-section data or to panel data. Since the data available for the proposed regression analysis is quasi-panel, this section will only consider that case.

A generalized two period version of the difference-in-difference model using panel data is:

$$(1) y_{it} = \beta_0 + \delta_0 d_{2t} + \delta_1 \text{policy}_{it} + a_i + \mu_{it}$$

In this model,  $d_{2t}$  is a dummy variable equal to 0 in the first time period and 1 in the second time period,  $\text{policy}_{it}$  is a variable equal to one if case  $i$  is affected by the policy in period  $t$  and zero otherwise, and  $a_i$  are observable fixed effects. Using a first difference yields

$$(2) (y_{i2} - y_{i1}) = \beta_0 + \delta_1 (\text{policy}_{i2} - \text{policy}_{i1}) + (\mu_{i2} - \mu_{i1})$$

This simplifies to

$$(3) \Delta y_i = \beta_0 + \Delta(\text{policy}_i) + \Delta(\mu_{it})$$

Using fixed effects or variable effects modeling approach for equation 1, this model can be used to assess a policy impact over a two year period.

This approach can be applied to the desired model for total sales, where  $y_{it}$ 's are fertilizer sales. In this case, since the policy change of interest is the exclusion of distributors from receiving fertilizer coupons,  $policy_{it}$  can be represented using an interaction term between a dummy variable for distributor and a dummy variable for the year. However, to accurately model sales, other time varying factors need to be included in the model (including but not limited to prices), so the model for total sales should be adjusted to

$$(4) Sales_{it} = \beta_0 + \delta_0 d_{2t} + \delta_1 policy_{it} + \beta_x(c_{it}) + a_i + \mu_{it}$$

Where  $c_{it}$  is a vector of other time varying factors such as prices.

## 2.2 Desired variables and sample

To estimate fertilizer sales, there are several desired variables to give the most accurate model. First, total fertilizer sales need to be provided for at least two years, but more years are highly desirable to give as detailed and "long-term" data as possible.

The other important variables to consider are the  $c_{it}$ 's. The most basic of these is the sale price of fertilizer for each retailer for each year of the panel or quasi-panel. Ideally this would be weighted for the varying prices for the different types of fertilizer sold (urea, DAP, 23.31.0 S4, CAN, and compound D). This would require detailed sales data on how much they sold of each type of fertilizer in addition to the total fertilizer sales. It would also ideally be weighted for differentiated prices in the rainy season and the dimba and dry seasons. Finally, since some retailers sold both 50kg bags and smaller quantities of fertilizer that were priced per kg, including the differentiated prices for those would be ideal.



Other desirable variables in the  $c_{it}$  vector include variables for expected rainfall and expected maize prices, preferably calculated at the district level. There are several ways of calculating these expectations. For rainfall using a long-term average is best. There are several potential models for price expectations. Variables representing fixed characteristics of each retailer such as business structure and geographic location are also necessary. Finally, data on fertilizer coupon distribution is desirable to give an estimate of the approximate effect on retailer sales from the actual distribution process of the coupons.

The other consideration in the estimation process is the ideal sample to be used. Maximizing sample size, conditional on maximizing accuracy of the data provided by each retailer included in the sample, is the most important consideration here. Therefore, the ideal sample would include all private sector retailers who sold fertilizer in at least one year of the panel. If using true panel data a balanced panel would also be desirable. Another consideration is to make sure to exclude any retailers whose answers are likely to be suspect, including retailers who provided contradictory data or who were not qualified to answer the questions.

### 3. Data Availability and Limitations

#### 3.1 Attrition between 2007 and 2009

Between 2006/07 and 2008/09, there were significant levels of attrition among participants. The extent of this problem is shown in table 2.

Table 2: Attrition Among Survey Participants, 2006/07 to 2008/09

	Distributors	Cooperatives	Independent agrodealers	Government Structures
N surveyed in 2006/07	48	21	132	70
N re-surveyed in 2008/09	40	10	79	61
% attrition	16.7	52.3	40.2	12.9

While the causes of attrition cannot fully be known, within the private sector it might be explained by the potential crowding out of the private sector as a result of the fertilizer subsidy program. If that were the case, the data might be biased towards showing less of a drop off in sales, as only the businesses that were hurt the least would be included in the sample. This is more likely to be an issue among agrodealers, since they have been excluded since the beginning of the program, whereas distributors would have only been excluded for one year, meaning that they are more likely to have survived despite any possible crowding out effects. This interpretation is supported by the relative numbers of retailers that could not be located in 2008/2009, and by the relative numbers of new retailers interviewed in 2008/09. The high levels of attrition meant that even if there were no other issues, using a balanced panel between the two years of the survey would have had a much smaller sample size than either survey alone.

### 3.2 Missing Data Points

In the 2008/09 survey, many interviewees did not answer all of the questions they were asked. Areas of particular concern for this analysis include data on fertilizer prices and on the quantity of fertilizer sales. Table 3 demonstrates how extensively missing data points decreased the useable sample size.

Table 3: Missing Sales Data

	Distributors	Cooperatives	Independent Agrodealers	Government Structures
N interviewed	66	10	89	65
N providing sales data for 2007/08	43	7	50	39
N providing sales data for 2008/09	52	6	54	56

For the case of the desired price data, there were several non-ideal types of missing data. As described in section 2, ideal price data would be weighted for the different types of fertilizer and account for differentiated prices between 50kg bags and smaller quantities of fertilizer purchased. However, weighting the price data was not feasible since the sales data was not differentiated between types of fertilizer. Therefore, in terms of including prices for both 50kg bags and smaller quantities of fertilizer purchased, only 7 of the private sector retailers interviewed in 2008/09 provided data on what their price was for fertilizer sold by kg for urea (the most common fertilizer purchased) in 2008/09 and only 11 provided this same data for their 2007/08 operations. A final problem with the price data was that there were some missing values for prices among retailers who provided sufficient sales data. Instead of

excluding all these cases, this problem was resolved by generating an approximation using the median price within the district where the retailer was located.

### 3.3 Inconsistencies and unreliability of data

Quasi-panel data on sales were collected in both the 2007 and 2009 surveys. In 2009, data was collected retroactively for several years, including the 2006/07 season. However, in the process of determining the years to include in the quasi-panel analysis, a comparison of the reported sales in 2006/07 from the 2007 survey and the reported 2006/07 sales collected in the 2009 survey revealed that there was no clear relationship between these answers. A simple correlation test found no correlation between the two sets of answers.

A visual representation of this problem is presented in figures 3a and 3b. Figure 3a shows all of the available data points, whereas figure 3b omits the outliers and shows the smaller sales points, which are not otherwise visible.



Reliability of the sales data for 2006/07 provided in 2008/09 is suspect for two reasons. First, in 2008/09 the survey team had very limited field time and often interviewed sales clerks instead of waiting to speak with owners or managers. Second, sales records for previous years were not often kept on site, so even managers would not be expected to have as accurate recall of sales as they would have in the actual year of the survey. Therefore, presumably the results from the 2007 survey are more accurate, however price data was not available from that survey. Since the reliability of the data for 2006/07 in the 2009 survey is very questionable, the analysis will only look at the quasi-panel data set of sales in 2007/08 and 2008/09, both of which were collected in the 2009 survey.

#### 3.4 Other factors involved

In examining the data, it is also important to keep in mind that in addition to the fertilizer subsidy program, other events in Malawi also affected fertilizer sales and the experiences of agricultural input retailers. One of these issues deals with the cooperatives; between 2006/07 and 2008/09, the cooperatives lost some of their funding from USAID and other donors. This greatly reduced their viability, and explains why so many cooperatives were not re-interviewed, completely separate from any possible effects from the fertilizer coupon program. Another issue that affected retailers was that AISAM network did not work in the Center and North regions in 2008/09, negatively impacting the agrodealers in those regions. Both of these events are likely to have had significant effects on the cooperatives and agrodealers respectively, but would not show up explicitly in analysis and may give a misleading impression about the effect

of other events such as the fertilizer subsidy. It is important to keep this in mind during the subsequent analysis and examination of the results.

## 4. Analysis Conducted

### 4.1 Testing for Biases in the Data

As discussed in section 3, the quality of the data may have suffered as a result of high levels of attrition and high numbers of missing values. To assess the extent of these problems, probit functions were used to examine two separate issues.

The first is an assessment of whether there were systemic biases impacting attrition from the survey between 2006/07 and 2008/09. Because the final sample is a quasi-panel sample rather than a true panel drawing on the first survey, this potential bias is not directly related to the formal regression analysis. However, since the sampling for the 2008/09 survey was based on the 2006/07 sample, it is worth considering separately from the issue of modeling the sales data. This issue will be referred to as survey attrition bias.

The second issue is an assessment of whether the missing values from the quasi-panel desired sample created any systemic biases in the data used for the sales model. Unlike the question of survey attrition, this is directly relevant to the formal regression analysis and must be considered carefully. This issue will be referred to as missing value bias.

#### *Survey Attrition*

To test for survey attrition bias, a probit function was used. The identified possible sources of bias were business type (agrodealer, cooperative, distributor and government), region (north, central and south), participation in the seed coupon program (in 2006/07), and selling agricultural chemicals. The first two are very basic business characteristics, which might be likely to influence attrition. The last is included



based on the hypothesis that businesses that participated in a subsidy program that they were not then excluded from might have had more stability in their businesses despite changes in the fertilizer subsidy program. Because of different levels of participation in the seed program between independent agrodealers and distributors (85% of distributors participated in 2006/07 while less than 30% of agrodealers participated) these effects are separated out into two interaction variables, seed subsidy participation by agrodealers and seed subsidy participation by distributors.

Therefore, the model for assessing survey attrition bias is:

(5) Survey attrition=f(distributer, agrodealer, cooperative, north, central, seedparticipation\*agrodealer, seedparticipation\*distributor, soldchemicals).

The results from this model are shown in table 4.

Table 4: Survey Attrition Bias Test Results

	Df/DX	Z	P> z
Distributer***	-0.562	-15.81	0.000
Agrodealer*	0.18	1.71	0.088
Cooperative***	0.353	2.89	0.004
North***	0.337	4.21	0.000
Central***	0.250	3.31	0.001
Agrodealer seed participation	0.110	0.77	0.441
Distributer seed participation	0.95	.	.
Sold Chemicals	-0.127	-1.17	0.242

\* Statistically significant at the 10% level

\*\*\*Statistically significant at the 1% level

These results point to multiple sources of attrition bias. First, both independent agrodealers and cooperatives were significantly more likely to fail to be re-interviewed

than government retail outlets, whereas distributors were more likely to be re-interviewed than government retail outlets. For the cooperatives, this can be attributed to a reduction of funding by USAID and other donors that forced them to reduce the magnitude of their input supply program. For agrodealers, the significant levels of attrition may have some of the most direct implications on how those retailers were affected by the 2008/09 private sector exclusion and will be explored in more detail later. Including the interaction term for seed participation and including the sold chemicals variable resulted in agrodealer only being statistically significant at the 10% level, whereas when they are excluded the agrodealer dummy is statistically significant at the 5% level. This suggests that participation in the seed program and selling agricultural chemicals may have influenced agrodealers' abilities to stay in business, even though they were not statistically significant. Another source of bias was regional; retailers in the North and Central regions were much more likely to fail to be re-interviewed than retailers in the South. This can largely be attributed to the fact that the AISAM network did not work in the North and Central regions in 2008/09. By itself, participating in the seed coupon program was not at all statistically significant, even accounting for the differences between agrodealers and distributors, and neither was selling chemicals.

### *Missing Values*

Since all government retailers and cooperatives were excluded from the analysis, the desired sample would be a quasi-panel sample including all of the agrodealers and distributors who were interviewed in 2008/09 and sold fertilizer in at least one year, regardless of whether they were interviewed in 2006/07. The degree to which this

sample differs from the actually available sample has already been discussed in section 3.

A modified version of the survey attrition probit model will provide an assessment of the extent to which there are any systemic biases from missing values. Because all government retailers and cooperatives were excluded, those variables cannot be included in the second model because they would be perfect predictors. Additionally, there is no reason to include participation in the seed program, since this model is assessing willingness and ability to provide answers, not health of the business. To try to assess any relationship that existed with the 2006/07 survey, a new variable was included, "original case" which is a dummy variable equal to one if the retailer was interviewed in 2006/07 and zero if it was a new retailer selected in 2008/09. Because agrodealers and distributors had very different experiences, "original case" is in the model as an interaction term, evaluated separately for distributors and agrodealers. Therefore, the model for assessing missing value bias is

(6) missing values=f(agrodealer, north, south, originalcase\*agro, originalcase\*distributor)

The results from this model are shown in table 5.

Table 5: Missing Value Bias Test Results

	dF/dx	Z	P> z
Distributor	-0.038	-0.2	0.841
North	-0.116	-1.12	-0.264
South*	0.163	1.67	0.096
Agrodealer Original case	-0.182	-1.16	0.246
Distributor original case	-0.166	-1.19	0.234

\* statistically significant at the 10% level

These results show that there is no strong evidence of any statistically significant missing value bias. South is significant at the 10% level, with retailers in the south being less likely to give enough data to be included in the sample. Original Case is not significant for either agrodealers or distributors, suggesting that there is not a strong linkage between the two types of potential bias. However, since no variables were significant at the 5% level, the overall implications of this test indicate that there does not need to be correction for missing value bias in the main regression models.

#### 4.2 Preliminary Evidence from the Data

Before conducting the formal econometric analysis, looking at descriptive statistics provides a baseline for assessing the available data. This was done by looking at retailers' perceptions of the effects of the subsidy exclusion policy. In 2008/09 retailers were asked how they expected their profits from input retail to change over time, and why. To maximize sample size, this portion of the analysis will include all retailers interviewed in 2008/09 who sold fertilizer. These results are shown in table 6.

Table 6: This year do you expect the percent of your sales revenue coming from your agricultural input business to be higher or lower than in 2007/08?

	Distributor		Government		Cooperative		Agrodealer	
	Num.	%	Num.	%	Num.	%	Num.	%
Higher	27	44	44	79	4	50	38	50
Lower	32	53	6	11	5	50	26	34
Same	1	3	6	11	0	0	12	15

source: Kelly, Boughton and Lenski 2010

Among agrodealers, the majority of those expecting an increase cited increased demand for inputs as the reason; other reasons cited were good rains, the subsidy program, and other business factors. Agrodealers expecting a decrease primarily attributed the decrease to the subsidy program. Distributors cited these same factors as well. Unsurprisingly, government structures anticipated increases primarily due to the subsidy program, but also cited increased demand for inputs. Only a few government structures anticipated a decrease in sales, but those who did attributed it to the subsidy program, too much competition, and lower supplies and stock.

These results suggest that distributors and independent agrodealers may have had mixed effects from the subsidy program, and even those who were negatively impacted by it may have had this effect partially compensated for by increased demand for agricultural inputs. This is important to keep in mind as the econometric results are examined.

#### 4.3 Total sales model

Based on the derivation of the model outlined in section 2, the estimation form for the total sales model is

$$(7) TS_{it} = \beta_0 + \delta_0 0809_t + \beta_1 \text{distributer}_i + \beta_2 \text{distributer}_i 0809_t + \beta_3 \text{Pmz}^*_{it} + \beta_4 \text{Pfert}_{it} + \beta_5 \text{North}_i + \beta_6 \text{Center} + \beta_6 \text{rainfall}^*_{it} + e_{it}$$

To evaluate the specifications for this model, both a fixed effects regression and a random effects GLS regression were run, and then tested for random effects using a Breusch and Pagan test had  $\chi^2 = 57.75$ , and the Hausman Test had a  $\chi^2 = 8.05$ . Both of these tests indicate that a random effects model would be appropriate. However, since fixed effects is better at dealing with biases that cannot be directly corrected for, results for both are reported in tables 7 and 8.

Table 7: Random Effects Results

	Robust Coefficient	Z	
Rain ex	565.8	0.91	
Maize Price ex	2851.9	1.2	
North	-5795.7	-0.59	
Central	-9799.5	-1.13	
D0809	-65459.7	-1.26	
*Distributer	18789.64	1.89	
D0809*Distributer	-365.8	-0.06	
Voucher Distribution	.074	1.59	
FertPrices	4.15	1.13	
R <sup>2</sup> within			.0569
R <sup>2</sup> between			.1289
R <sup>2</sup> Overall			.1234

\*significant at the 10% level

Using fixed effects, the model would simplify to

$$(8) TS_{it} = \theta_0 + \delta_0 D_{0809t} + \theta_1 \text{distributer}_{it} D_{0809t} + \theta_2 P_{mz}^*_{it} + \theta_3 P_{fert}_{it} + \theta_4 \text{rainfall}^*_{it} + v_{it}$$

Table 8: Fixed Effects Results

	Robust Coefficient	Z	
Rain ex	-1537.8	-1.29	
Maize Price ex	-1465.3	-1.23	
D0809	113117.8	1.24	
D0809*Distributor	-325.8	-0.05	
Voucher Distribution	.213	1.57	
FertPrices	-28.4	-1.24	
R <sup>2</sup> within			.1238
R <sup>2</sup> between			.0615
R <sup>2</sup> Overall			.0519

Neither model has very high R<sup>2</sup> values. Additionally, in both regressions combined, only one variable is statistically significant at the 10% level: the coefficient on distributor in the random effects model. This is not a particularly enlightening response, as all that it tells us is that distributors sold more fertilizer than agrodealers, which is completely unsurprising. In neither model are relevant prices statistically significant, which is very surprising. These results hold up with various modifications to variable specification and slight changes in the model.

These results do not show any statistically significant negative impact from the 2008/09 exclusion on total sales of fertilizer for either agrodealers or distributors. These

results are somewhat surprising given retailers' highly negative perspectives of the impact of the policy, however as discussed in section 4.2, increased demand for agricultural inputs may have at least partially compensated for any negative effects of the changes in subsidy implementation. They also indicate that commercial sales are still occurring, sometimes in substantial amounts for distributors. While studies of demand for fertilizer have found virtually no demand for commercial fertilizer among small-holder farmers after the subsidy program was implemented (Rickert-Gilbert, etc), it is possible that distributors are still selling commercial fertilizer to large-holder farmers, especially for tobacco in 2008/09, compensating for the loss of subsidized sales. Since there was very little survey attrition by distributors, survey attrition cannot be fully responsible for these results.

The lack of statistically significant results, especially for prices, and the low  $R^2$  values for a fairly standard model suggest that there may be problems within the data, and may also reflect the inaccurate ways that some of the data points, especially fertilizer prices, needed to be calculated as a result of insufficient data. The sample size is also relatively small, creating additional econometric problems.

To investigate these results further, the previously described missing value bias test was modified to include retailers' answers to questions about the effect of the policy change on their business. They were asked whether the policy caused them to have lower customer traffic, lower profits, lower revenues, and lower sales. When these variables were added in to the test for selection bias for both distributors and agrodealers (either looking at only one or a variable representing whether any of the four were true) the effect was statistically significant (at the 5% level) and negative;



retailers who perceived negative impacts on their business were more likely to provide all the necessary data than those who did not. These results are shown in table 9.

Table 9: Expanded Missing Value Bias Test

	dF/dx	Z	p> z
Distributor	0.03	0.14	0.889
North	-0.099	-0.92	0.358
South	0.145	1.45	0.147
Agrodealer Original case	0.217	-1.34	0.182
Distributor original case	0.083	0.55	0.58
Agrodealer Negative experience **	-0.267	-2.15	0.031
Distributor Negative experience **	-0.314	-2.35	0.019

\*\* statistically significant at the 5% level

While this bias cannot be directly corrected for in the regression, the implications of this revised test are important. The results mean that if there is any bias in these results, it is towards a worse experience by the retailers. Therefore, the total sales model does not provide statistically significant evidence of decreased sales by distributors after being excluded from the subsidy program. Again, the discussion surrounding sales expectations may at least partially explain this lack of statistically significant results. However, the results are contradictory to previous research and somewhat surprising, so further investigation would be desirable.

#### 4.4 Additional evidence on the independent agrodealer sectors

Unlike distributors, agrodealers were never allowed to participate in the fertilizer subsidy program, so the 2008/09 shift in policy was less relevant to them, except to make any competitors who were distributors less competitive, and any competitors who were government outlets even more competitive. Therefore, to understand how the exclusion from the subsidy program has affected independent agrodealers, another framework for evaluating the effects must be found. In addition to the importance of understanding the effects on this part of the agricultural input sector, this could provide some insights into how an extension of the exclusion of distributors would affect them. As discussed earlier, agrodealers were highly significantly less likely to be re-interviewed. Although reports on what happened to the agrodealers who were not re-interviewed is incomplete, at least a large part of this problem was agrodealers who were no longer in business, rather than retailers who refused to be re-interviewed. Therefore, understanding the attrition of agrodealers may be a way to gain some information about the effects of the fertilizer subsidy program on the agrodealers, if there is sufficient evidence linking attrition among agrodealers and the fertilizer subsidy program. This section will attempt to informally “test” the hypothesis that the high level of attrition among agrodealers is a result of their exclusion from the fertilizer subsidy program.

Since the subsidy program, and the agrodealers' exclusion from it, started in 2005/06, it would be ideal to be able to look at changes in the agrodealer sector starting the year before. However, the first survey was conducted in 2006/07, and while it asked questions about several prior years going back to 2004/05, many retailers were not able

to provide that information, often because they had not been in business for that long. Therefore, while understanding attrition from 2006/07 to 2008/09 is not the ideal way of assessing agrodealers experience it maximizes the data available and at least gives a partial picture of agrodealers' experiences.

While the data cannot actually tell us the causes of attrition, understanding the characteristics of the shops that were re-interviewed compared to those that were not can point to some possibilities. Additionally, if those characteristics can be related directly or indirectly to the fertilizer subsidy program, the preliminary evidence for and against the hypothesis that the significant agrodealer survey attrition was a result of the agrodealers' exclusion from participating in the fertilizer subsidy.

*Hypothesis 1: The Exclusion Was Responsible for High Levels of Attrition*

There are multiple ways that the fertilizer subsidy could have impacted agrodealers. The first is direct impact: agrodealers who sold fertilizer would see a reduction in fertilizer sales, potentially driving them out of business. If in 2006/07 the agrodealers who were not re-interviewed said that fertilizer sales were more important to their business than the agrodealers who were re-interviewed, this would provide some evidence for that claim. However, when analyzing the data from the 2006/07 survey there is no evidence to support this; the difference in importance of fertilizer sales is not statistically significantly different between the two categories of agrodealers. Additionally, 64% of the agrodealers who were not re-surveyed did not even stock fertilizer in 2006/07, whereas 50% of those agrodealers who were re-surveyed carried fertilizer. This suggests that the agrodealers who were selling fertilizer and closed between 2006/07 and 2008/09 did not close because of further drops in fertilizer sales, but since we do not have data on their sales before the program was implemented, the

overall effect of the program cannot be determined based on fertilizer sales data alone. Using a very small sample size, the experiences between 2005/06 and 2006/07 in sales among agrodealers provide some evidence that the agrodealers who closed were not in the middle of a large period of decline in fertilizer sales, 35.3% of agrodealers who were not re-surveyed in 2008/09 said that they experienced a large increase in fertilizer sales between 2005/06 and 2006/07 and another 17.6% reported a moderate decline. However, these results are only drawn from a sample size of 16, making them unreliable for reaching valid conclusions.

One important issue in discussing the possibility of a direct negative impact is that agrodealers may have had a buffer against those impacts. Agrodealers often sold more fertilizer in quantities less than the 50kg bags that were used for the subsidy program. Providing the smaller quantities gave the agrodealers an advantage over other outlets that only sold 50kg bags, drawing business from farmers who wished to purchase less fertilizer. In 2006/07, retailers were asked whether sales of less than 10kg, 11-49 kg, or 50kg bags were most important to their business. The results for all retailers providing that data are shown in table 10.

Table 10: Importance of Sales of Small, Intermediate and Large Fertilizer Bags

Business Structure		Small Fertilizer Packs (less than 10kg)	Intermediate (11-49 kg)	50 kg bags of fertilizer
Distributor	N	4	0	41
	%	8.9	0	91.1
Government Structure	N	1	0	67
	%	1.5	0	98.5
Cooperatives	N	1	0	19
	%	5	0	95
Agrodealer	N	47	4	29
	%	58.8	5	36.3
Total	N	53	4	156
	%	24.9	1.9	73.2

Source: 2006/07 retailer survey

While these results do not give detailed information on who actually sold fertilizer in quantities less than 50kg bags, they do show that independent agrodealers were the only retailer type that were more likely to depend on smaller quantities of fertilizer than the 50kg bags. 63.8% of independent agrodealers had most of their fertilizer sales be in quantities less than 50kg bags.

A second way that the fertilizer subsidy could have affected agrodealers is indirectly: potential customers who would have gone to agrodealers to buy fertilizer without the subsidy went elsewhere both for fertilizer purchases and while buying fertilizer also bought other goods that they would have bought at the agrodealer. In this situation, the importance of fertilizer sales is not directly related. Instead, support might be found for this theory in questions about whether customers who bought fertilizer also bought other goods. Unfortunately, this information is unavailable. Since participation in the seed coupon program might at least partially compensate for that effect (because customers might still come to get seeds even if they weren't getting fertilizer), any

difference in participation between categories of agrodealers would be relevant.

However, as in the original attrition bias testing this variable doesn't show any statistically significant differences, so it does not provide evidence either way.

#### *Hypothesis Two: Other Factors Caused the High Levels of Attrition*

If the subsidy program cannot be proved to be responsible for agrodealer attrition there needs to be another plausible explanation for the high levels of attrition among agrodealers as compared to distributors and government outlets. One compelling possibility is that independent agrodealers are less stable, and enter and exit the market with much higher frequency than other types of input retailers. While there is no long-term data on entry and exit of agrodealers, in 2006/07 data was collected on how long various retailers had been open, and how long they had been selling agricultural inputs. For distributors, the median length of operation was 6.5 years, and the median length of input sales was 5 years. For all agrodealers the median length of operation was 5 years, and length of input sales was 3 years. For those agrodealers who were not re-interviewed, length of operation was 4 years and length of input sales was 2 years. While this data is not conclusive, it does indicate that the agrodealers were on average open for less long, and selling inputs for a shorter period of time, which might suggest that they are less stable. However, entry into input sales within that time period may be partially linked to programs implemented to train agrodealers in selling fertilizer, making length of input sales a less accurate indicator. This issue does not impact the length of operation. Another partial explanation is that the agrodealers in the North and Central regions who were not re-interviewed were hurt by the fact that AISAM withdrew from those regions in 2008/09, cutting off a significant source of retail level support.

## 5. Desired data and data collection methods

As discussed in section three, the data collected in the 2009 survey was not ideal for conducting the econometric analysis that this paper discussed. This is primarily a result of two factors, the first being that the objectives of both the 2007 and 2009 studies did not include the ability to conduct these types of analysis, and the second being the constraints preventing the ability to implement the surveys in ideal ways. While recognizing these very real constraints, which have already been discussed, this section will explore the ideal methods for generating the data that would allow for a more accurate and comprehensive econometric evaluation of the program.

### 5.1 Sampling Methods

The first set of ideal changes would be to sampling methods. Ideally, districts would be chosen randomly. However, a modification of this may be more desirable since some districts have few agricultural input retailers and little data could even be collected from these districts. Therefore, a list of districts with a certain amount of agricultural input activity could be generated and the districts chosen randomly from that list.

To have completely random selection of retailers within each selected region, a complete sampling frame, including all agrodealers, distributor outlets, cooperatives, and government outlets would need to be developed. In practice, the costs of doing this are extremely high, but it would be necessary to conduct the desired econometric analysis. Getting the data on distributors and government structures should not be prohibitively difficult; the biggest issue would be getting a complete list of agrodealers. In some years, AISAM and CNFA have updated lists of their members, which would be

a good starting point. However, their lists do include retailers who do not sell fertilizer, and agrodealers who are not members of either organization would not be included on those lists, which may generate biases in the data. If the community surveys continue, these could be used to try to supplement the list of agrodealers. For a more complete list a very expensive agrodealer census would be necessary. Within the sampling frame, it may also be desirable to not have complete randomization. For the 2006/07 sampling agrodealers were over-sampled because they are a more heterogeneous group than distributors, and this practice may be desirable to continue, although exact numbers should be carefully selected.

In future years, there are a couple of options for how to deal with sampling replacement cases. One approach would be to randomly replace each unavailable retailer with a new retailer of the same structure. However, this would not reflect changes in composition of the retail sector. Therefore, another option would be to instead compute the relevant proportions of the sector made up by different types of retailers, and choose the samples to reflect changes in composition. In either case, the important part is to make sure that this procedure is conducted identically in all cases, rather than having teams decide for themselves. Doing this would require having a full-time researcher working in the field. Additionally, the ability to do either of these would be constrained by the ability to create a complete sampling frame in both the first year and in all future years. Updating the sampling frame every year is important because of the frequency of entry and exit of agrodealers, and because of changes in composition of the market.



## 5.2 Training

One fairly easy change to implement would be having a longer training period for interviewers. Training was done effectively in 2006/07, so modeling it after that training would be sufficient. Better training would help interviewers fully understand the questions in the survey, which would lead to them being more aware of who is supposed to answer which questions and how to decide whether the person being interviewed is reliable.

Team leaders also need additional training in how to provide useful summaries of their experiences during the data collection period. An important piece of this is training on how to deal with shops that are closed, both during the first year of sampling and then in future years of follow-up surveys. During the first year, this training would mostly consist of how to replace a randomly selected retailer. During future years, this would have two parts. The first would be training in the desired method for replacing the previously interviewed shop, minimizing sampling bias. The second would be training team leaders on how to record information about the unavailable retailers, and how to find out maximum information on why that shop was not re-interviewed. In 2008/09 one team leader provided information about each shop that was not re-interviewed, but since everyone didn't record that information, those answers cannot be generalized over the whole sample. The ability to implement either of these methods would be faced with a time constraint; however this would be the ideal implementation. A more detailed understanding of the causes of attrition would be highly desirable to generate accurate econometric results, and as discussed in section four it may also

provide an additional way to look at the effect of the fertilizer subsidy. However, in analyzing the latter, care must be taken because there are other factors affecting agrodealers, including the generally unstable nature of most agrodealers, which could cause attrition and are completely unrelated to the subsidy program. Additional data may be able to help distinguish between causes of attrition.

In addition to improved training methods, budgeting more time in the field for interviewers would also be helpful. One problem in 2008/09 was that many of the interviews were with sales clerks instead of owners/managers, which contributed to inaccuracies in the data given. With more time, interviewers could return on another day to speak with an owner who was not there during the first attempt.

### 5.3 Survey Instrument

For the most part, a similar survey instrument to the ones used in 2006/07 and 2008/09 could be used as the baseline for this revised study. Although this could be combined with questions about the seed coupon program, this section will only discuss questions about the fertilizer coupon program.

To ameliorate the basic modeling process for sales, the survey needs to consist at minimum of questions about fertilizer sales history, divided into subsidized and unsubsidized fertilizer. For distributors and government structures the ideal way of collecting this would be to get the data from headquarters, where records are usually most accurate. Asking managers is problematic because they generally do not keep historical records on site, and because they often have not been at a particular location long enough to have an understanding of how that location's sales have changed over time. It would be useful to have fertilizer sales data divided into different types of

fertilizer as well, but the experience in 2008/09 showed that even retailers who can provide total sales are much less likely to be able to provide that level of detail in the data. Price data also need to be gathered, in equal categories as for sales data, so that any sales data can be directly matched with its price data. Because of quantity discounts there may be some challenges getting comprehensive data on this, but whatever data can actually be gathered should be, since the sales analysis would be impossible to conduct without it.

Other data that would be useful would be more subjective questions for the retailer. As in 2008/09, questions about how the retailer perceived changes between years would be a useful way of evaluating how opinion reflected the data provided. Also, any new policy changes should be asked about to assess in detail retailers perceptions about current subsidy policy. The 2008/09 instrument also included questions on implementation problems of the subsidy, such as long lines, falsified coupons, incorrect coupons, corruption, and bribery, which should be retained in the revised questionnaire.

The 2008/09 questionnaire also asked some questions about business structure and the importance of various items they stocked. These questions are important and for agrodealers especially it might be useful for this section to be expanded.

Questions on seed subsidy and sales could also be used in the survey to avoid duplication of surveying efforts, but it is important to make sure that a sufficient sample of the retailers actually sells fertilizer or has sold fertilizer in the past.

In terms of creating an effective panel, the instruments and methods need to be consistent over years. One problematic aspect of the panel using two surveys was that

the method for collecting sales data was inconsistent. In 2006/07, agrodealers were asked to report fertilizer sales at the time of the interview, and for distributor outlets the sales data was collected from distributor headquarters. In 2008/09 however, all private sector retailers were asked to provide sales data at the time of collection. As discussed earlier, in terms of historical sales data, there was no correlation between sales reported in 2006/07 and 2008/09 for the same years. This problem may in part be due to the altered methods of sales data collection.

. Policy-specific questions can be added, subtracted, or modified between years if there have been specific policy changes that make those questions irrelevant or inappropriate. However, consistency in wording of questions about policies would be desirable to be able to compare results from different policies in as accurate a way as possible. Additional questions can also be added, based on questions raised by past research or other sources, but subtracting questions, even if they don't seem useful at the time, should be minimized because their value may become apparent at a future time, and having as many data points as possible will be important.

#### 5.4 Implementation

One important part of implementing the study is figuring out methods to minimize attrition. In 2008/09, at least some portion of the attrition was due to retailers being unwilling to be re-surveyed, due in part to anger over government policies, and in part reluctance to answer questions because they were unclear on who was conducting the survey and who it was for, which was intended to be made clear. While retailers cannot be forced to participate, there may be ways of maintaining a positive relationship with retailers and effectively communicating the benefits of participation. Another way of

minimizing attrition is to avoid surveying at times that seasonal retailers are unavailable for surveying. Surveying at regular intervals, and avoiding surveying at time periods when seasonal shops would be closed can achieve this. In practice, doing this may be costly but minimizing attrition is a worthwhile goal and even small steps in this direction could improve the results of the study. The survey instrument could be modified to include exactly what periods of the year the shop is open, so that interviewers can prioritize going to those shops during periods when they would actually be available. This method is not perfect, as this is variable for some shops, depending on rains and supplies, but it would still be an improvement.

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