FARM HOUSEHOLDS CONSUMPTION HETEROGENEITY AND RURAL BUSINESS DYNAMICS

Madhav Regmi and Allen M. Featherstone*

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*Regmi: Graduate Student, Department of Agricultural Economics, Kansas State University, mregmi@ksu.edu. Featherstone: Professor and Department Head, Department of Agricultural Economics, Kansas State University, afeather@k-state.edu.

Abstract

In this paper, we use recent demand estimation models for the KFMA dataset to identify the determinants of farm household expenditure patterns and its implications to the main street business. Comparing endogeneity adjusted and unadjusted QUAIDS model estimates, we establish that not accounting for endogeneity leads to the inconsistent demand estimates. Our results show that success of a business operating in farming communities depends on the farm characteristics of that location. We also find that some business benefits by offering the lowest possible cost for their items, while other by increasing the income level of purchasing households through efficient farm production measures.

Key Words: Farm Household Expenditure, Business, Endogeneity, QUAIDS

INTRODUCTION

Farm household expenditure fluctuation in the U.S. mainly depends on the variation of farm income. Though nonfarm income helps to reduce farm household income instability, using the data from six decades (1933-1999), (Mishra and Sandretto, 2002) illustrates that there still exists the wide income variation in the farm households. Farm income variability arises due to the fluctuations in the farm yield and market prices Jones et al. (2010). Along with U.S. farm policy, the change in the policies of the major US agricultural commodities importing countries (EU, China and Russia) also contribute to the US farm income variability Mishra and Sandretto (2002). Jones et al. (2010) states that farm households in the low end of the income distribution likely to have lower farm income and high end of the distribution likely to have higher farm income. They also find that 5 to 8% of the U.S. farm households have the negative household income each year, which is very large in comparison to the 0.1% of all US household.

To better understand the implications of farm income fluctuation on household expenditure and its spillover effects on main street business, for the first time, Carriker et al. (1993) performs a research using Kansas farm household dataset. They analyze twelve years (1976-87) of Kansas Farm Management Association (KFMA) dataset for a representative sample of 184 farms. Their paper makes a significant contribution in explaining how the change in farm household expenditure pattern impacts the business serving the farming communities. Despite of the several theoretical and empirical advancements in demand estimation, after Carriker et al. (1993) study, there is no improvement in the literature that links farm household expenditure pattern and the main street business, to the best of our knowledge. While periodic investigation of this important research question is necessary in the changing economic scenarios, the lack of progress in this field of knowledge is surprising.

The fact that the technological innovations along with the modification in farm policies affect the farm income and thereby the farm household expenditure. Hence, it is crucial to look at the contribution of these changes on main street business. Empirical estimates that provide the extent of effect on rural business from farm income fluctuation can help the main street business for their labor, capital, output and price decisions accordingly. Meanwhile, we can also use these estimates to infer the possible spillover effect of farm policy changes on the business that are active in the farming regions. Therefore, we are reassessing the issue identified by Carriker et al. (1993) using the recent and appropriate demand estimation models, for a sufficiently large number of farm households in the changing socio-economic scenarios. In addition, our approach also identifies the implications of farm household characteristics on the choice of business in a particular locality. Note that this part of literature is not discussed in Carriker et al. (1993). Along with the above mentioned theoretical contribution, we also extensively investigate the robustness and compare the outcomes from different econometric models to provide some econometric contribution in demand estimation.

REVIEW OF LITERATURE

Household expenditure analysis has been a priority research for economists, even during the sufficient and quality data deficiency period. Barnum and Squire (1979) use cross-section dataset from Malaysian households to show that farm production affects the household consumption through expenditure elasticities. Some studies during the eighties within US examine the farm and nonfarm household expenditure focusing on a particular good or a specific group. Blanciforti and Green (1983) evaluates the aggregate commodity expenditure for annual U.S. time series dataset (1948-1978) on 11-aggregate commodity classifications. They identify that Almost Ideal Demand System (AIDS) which includes persistence in consumption behavior patterns and allows autocorrelation is a more viable demand system to study consumer behavior. Using US Bureau of Labor Statistics (BLS) household expenditure cross-section survey (1972-73) for 14 different expenditure categories, Chavas and Citzler (1988) provide an analysis of household characteristics affecting the consumption behavior. They find that family size has cost economies and revenue diseconomies for the household.

As we discussed in the introduction, there is lack of published paper relating household expenditure fluctuation and business sector after Carriker et al. (1993). However, there are several literature that emphasize the relationship of farm household income and expenditure with agribusiness supporting industries. Specifically, the interaction of the farm households with the upstream and downstream agribusiness within the same or nearby communities. Lawrence et al. (1997) analyze a sample data from 1,000 Iowa pork producer to derive the implications of hog industry to the agribusiness in the rural communities. They use logit analysis to understand the producer's decision to bypass nearest available choice of production inputs. Results demonstrate that producers of all size are willing to travel some distance to purchase inputs; but, the larger producers are more likely to avoid the input markets in the nearby community. Later, Lambert et al. (2009) use 2004 Agricultural Resource Management Survey (ARMS) data to understand the farm household's expenditure pattern within and outside the local communities. Multinomial logit for purchasing patterns of farm households show that farms located in the urban areas are more likely to buy households items from the local community but travel a considerable distance to purchase farm business items. They observe the exact opposite pattern for the farms located in the rural areas. Thus, Lambert et al. (2009) argue that farm input industry and the food processing industry can be influenced by the farm policy. Roberts et al. (2013) extend similar study in the Europe for two different agricultural economy. Using different types of probit models, they conclude that the agricultural transactions associated with the farm households depends on the locality of the farms and nature of communities. Highly developed agricultural sector (North East, Scotland, UK) purchase the agricultural inputs from spatially concentrated agricultural markets far from the local community. Whereas, the underdeveloped agricultural sector (Podlaskie, Poland) make the agricultural transactions from the spatially dispersed agricultural markets that are located nearby by the farms. Most of the research that focuses in explaining the effect of farm household expenditure on the farm input suppliers or other food processing industry have used the different type of choice models (probit or logit) in their analysis. In contrast, we use unique econometric procedures for demand estimation to explain the relationship of farm household consumption patterns and the rural business (not only the agribusiness) using the recent KFMA dataset. We also perform the robustness check of two econometric demand estimation models and establish the model selection recommendation based on our findings.

This paper is organized as follows. In the next section, it provides details of the data and variables that are used in the demand estimation. Then, it illustrates the demand system estimation procedures. Later, it discusses the major results based on the estimated coefficient estimates and elasticities. Finally, the paper concludes by summarizing the major findings and implications of the study.

DATA

We use Kansas Farm Management Association (KFMA) household expenditure dataset from 1993 to 2015 in this study. To avoid the inconsistent estimation from farms with missing and irrelevant information, we perform some data cleaning before obtaining the final study sample. KFMA survey module assume that households having more than $1700 annual food expenditure are likely to provide the complete household expenditure dataset; thus, we drop the farms having annual food expenditure less than $1700. In addition, farm households having negative expenses in any of the items, zero expenses in clothing and utilities, operator's age not more than 20, wrongly assigned association number are excluded from the analysis. Along with these, we drop one farm household having the number of family dependents as 72. At the end, farm households not having continuous data for the five of the twenty three years are also dropped. This, then, reduces to our final analysis sample to 836 farms (9,179 data points).

As our research extend the investigation of Carriker et al. (1993), we generate the consumption and price variables using the same approach. Thus, there are nine different consumption items in this study; clothing, education, food, nonfarm utilities, furniture and household equipment, household operations, medical care, nonfarm auto expense and other. Here, "other" category represents the total expenses in recreation, gifts and charitable contributions. Moreover, we obtain seasonally unadjusted U.S. city average price indices for eight of the nine consumption categories for the period of 1993-2015 from the U.S. Department of Labor Statistics[1]. As the price indices for the aggregate "other" category; gifts, charitable contributions and recreation are not directly available, we use stone's price index

[1] BLS

to calculate its price series. Following Deaton and Muellbauer (1980), we substitute average annual expenditure shares for item i in year t ($\overline{w}_{it}$) and eight price series for item i in year t (p_{it}) in the Stone's general price index to get the missing price series (P_t^*) of the "other" consumption category. Therefore, the Stone's general price index P_t^* in year t is defined as;

$$\log P_t^* \equiv \sum_{i=1}^{n} \overline{w}_{it} \log(p_{it}) \tag{1}$$

Also, four demographic characteristics are used in this study. Namely, the type of farm business (1=farm is organized as cooperation or as partnership, 0 = otherwise), total family living expenses situation (1=total family expenses[2] is greater than net farm income, 0= otherwise), age of the farm operators (years) and the number of family dependents[3]. The descriptive statistics of these variables are presented in the Table 1.

All the expenditures and net income values in the Table 1 are deflated by the general CPI into 2015 dollars. We also use the real values of these variables in the demand estimation. Table 1 implies that average annual real expenditure in 2015 dollars is highest for the aggregate category of recreation, gifts and charitable contribution ($10548.830) and lowest for the furniture ($1222.514). Average annual real net farm income in 2015 dollars for the sample dataset is $82802.170. Additionally, the average age of operator in the sample is 52.19 years, 39.9% of sample household expenses has exceeded net farm income, 2.4% of sample farm households are organized as cooperation and partnership and the average number of family dependents in the sample is 3.24. Finally, the demand systems are estimated using these nine budget shares, nine price indices and four farm household characteristics.

[2] This "total family expenses" information is used only to obtain this dummy variable. And, it includes variable expenses in above mentioned nine consumption items as well as other fixed investment such as insurance, interest etc. However, "total household expenditure" which will be frequently used in later section only indicates the total expenses in the above considered nine consumption categories.

[3] Based on the survey module, for partnership and corporations farms, it represents the family dependents for the "primary" operator.

MODEL

Almost Ideal Demand System (AIDS) of Deaton and Muellbauer (1980) has been a commonly used model for demand analysis. However, we use Quadratic Almost Ideal Demand System (QUAIDS). It is a demand system specification develop by Blundell et al. (1993) and Banks et al. (1997). The basic hypothesis behind applying the QUAIDS model is that it can provide an improvement in the demand elasticities as compared to the AIDS model. Unlike the popular AIDS model which require expenditure share Engel curves are linear in the logarithm of total expenditure (Deaton and Muellbauer, 1980), QUAIDS includes a quadratic expression of expenditure variable that fits the empirical data well. Because, it allows the same consumption category to be luxury for a given level of income and necessities at higher income level (Banks et al., 1997). We also find that the Engel curves associated with all the consumption groups endorses the use of QUAIDS model over the AIDS model (Figure 1).

Following (Khanal et al., 2015), we conduct Likelihood Ratio (LR) test for the restricted model (AIDS model) and unrestricted model (QUAIDS model) for more justification. For this purpose, we estimate the AIDS model and the endogeneity uncorrected QUAIDS model. Although endogeneity corrected QUAIDS model is not used in the LR test, we also interpret the estimates that are obtained using this model. The rationale behind estimating the endogeneity corrected QUAIDS model is presented in the next section. We use the log likelihood of endogeneity uncorrected QUAIDS model to obtain the test statistics of LR test because it avoids the invalidity of the inference, as oppose to the endogeneity corrected model (Wooldridge, 2010).

We find log likelihood of AIDS (restricted model) model as 99478.287 and endogeneity uncorrected QUAIDS (unrestricted model) model as 99736.212. Therefore, the LR statistics which has chi-square distribution asymptotically becomes:

$$LR = 2\ [\text{Log likelihood of QUAIDS} - \text{ Log likelihood of AIDS }] \tag{2}$$

Here, the LR statistics is 515.85 which is greater than 11.07 (chi-square statistics with 5 degrees of freedom at 5% level of statistical significance). Hence, we reject the null hypothesis at 5% level of statistical significance and conclude that QUAIDS model is prefer over the AIDS model for the demand system estimation.

Demand systems are estimated using the household level living expenditure for each consumption categories. Given the total consumption expenditure, consumer can decide how much to spend across nine different groups (clothing, education, food, nonfarm utilities, furniture and household equipment, household operations, medical care, non-farm automobile maintenance and other). We assume the weak separability among these consumption categories. Thus, the demand of each category is estimated given the total expenditure on that group. Banks et al. (1997) demonstrate an indirect utility function for this system as follows:

$$\ln V = \left[\frac{ln\ m - ln a(p)}{b(p)} + \lambda(p)\right]^{-1} \tag{3}$$

Where,

$$ln\ a\,(p) = \alpha_0 + \sum_{i=1}^{n} \alpha_i \ln p_{\ i} \ + \frac{1}{2}\ \sum_{i=1}^{n}\sum_{j=1}^{n} \gamma_{ij} \ln p_{\ i}\ \ \ln p_{\ n} \tag{4}$$

$$b\,(p) = \ \prod_{i=1}^{n} {p_i}^{\beta_i} \tag{5}$$

Given the vector λ is statistically equal to zero, the set of goods in consideration has the linear Engel's curve and the QUAIDS model reduced to the AIDS model. QUAIDS model allows the curvature of Engel curve, which is basically the budget shares in the QUAIDS, obtain by using Roy's Identity to the above indirect utility as follows:

$$w_i = \alpha_i \ \ + \sum_{j=1}^{n} \gamma_{ij} ln\ p_j + \ \beta_i \ln\left(\frac{m}{a(p)}\right) \ + \ \frac{\lambda_i}{b(p)}\left[\ln\left(\frac{m}{a(p)}\right)\ \right]^2 \tag{6}$$

Where, w_i refers to the budget share of consumption category i in the study area. Hence there are a total of nine budget share equations (clothing, education, food, nonfarm utilities, furniture and household equipment, household operations, medical care, non-farm automobile maintenance and other). Additionally, m is the nominal consumption expenditure and P_j price index of consumption category j. Similarly,α_0, α_i , γ_{ij} , β_i and λ_i are the parameters to be estimated.

Since the QUAIDS model preserves flexibility and consistency in aggregation of consumers as like in AIDS model, the restrictions on the parameters of the budget share equations are:

i). Adding-up:

$$\sum_{i=1}^{n} \alpha_i = 1; \sum_{i=1}^{n} \beta_i = 0; \sum_{i=1}^{n} \lambda_i = 0 \tag{7}$$

ii). Homogeneity:

$$\sum_{j=1}^{n} \gamma_{ij} = 0 \tag{8}$$

iii). Symmetry:

$$\gamma_{ij} = \gamma_{ji} \tag{9}$$

Since we are interested in identifying effect of farm household characteristics along with the income and price effects, the expenditure and price elasticities are obtained following the Poi et al. (2002) and Poi et al. (2012) study. Poi et al. (2002) extend the quadratic AIDS model by incorporating the demographics in the Ray (1983) expenditure scaling technique. In the Ray's method household expenditure function has following form:

$$e = \ m_0 \ (p, z, u) * \ e^{R(p,u)} \tag{10}$$

Where, $m_0 \ (p, z, u)$ scales the expenditure function to incorporate demographic and household characteristics that can be further expressed as:

$$m_0 \ = \overline{m_0}\,(z) * \emptyset \ (p, z, u) \tag{11}$$

Here, $\overline{m_0}\,(z)$ measures the increase in a household's expenditures as a function of z, not controlling for any changes in consumption patterns. Whereas, $\emptyset \ (p, z, u)$ controls for changes in relative prices and the actual goods consumed. Poi (2012) parametrizes $\overline{m_0}\,(z)$ as follows:

$$\overline{m_0}\,(z) = \ 1 + \rho^{'} \ z \tag{12}$$

Where ρ is a vector of parameter to be estimated. Furthermore, Poi (2012) parameterizes $\emptyset \ (p, z, u)$ as follows:

$$ln \ \emptyset \ \ (p, z, u) = \frac{\prod_{i=1}^{k} p_j{}^{\beta_j} \ \ (\prod_{j=1}^{k} p_j^{\eta_j^{'} \ \ z} - 1)}{\frac{1}{u} - \sum_{j=1}^{k} \lambda_i \ ln \ p_j} \tag{13}$$

In the above equation η_j represents the jthcolumn of the $s \ \times k$ parameter matrix η. Now, the expenditure share equation has the following form:

$$w_i = \alpha_i \ \ + \sum_{j=1}^{n} \alpha_{ij} \ ln \ p_j + \ (\beta_i + \eta_j^{'} \ \ z) \ln\left(\frac{m}{\overline{m_0}\,(z) \ \ a(p)}\right) \ + \ \frac{\lambda_i}{b\,(p) \ \ c(p, z)} \left[\ln\left(\frac{m}{\overline{m_0}\,(z) \ \ a(p)}\right)\ \right]^2 \tag{14}$$

Where, $c(p,z) = \prod_{j=1}^{k} p_j^{\eta_j^{'} z}$ The adding up constraints needs:

$$\sum_{j=1}^{k} \eta_{rj} = 0 \tag{15}$$

for $r = 1,\ 2,\ 3, \ldots.., s$.

In this case also, given the vector λ_i is statistically equal to zero then the QUAIDS model reduced to the AIDS model. We derive the elasticities for this model as describe in the poi (2012). Thus, the uncompensated price elasticity (ϵ_{ij}) of good i with respect to good j is:

$$\epsilon_{ij} = -\delta_{ij} + \frac{1}{w_i}\left(\gamma_{ij} - + \left[\beta_i + \eta_j^{'} z + \frac{2\lambda_i}{b(p)\ c(p,z)} \ln\left(\frac{m}{\overline{m_0}(z)\ a(p)}\right)\right] \right.$$
$$\left. * \left(\alpha_j + \sum_j^n \gamma_{ij} \ln p_j\right) - \frac{\left(\beta_i + \eta_j^{'} z\right) \lambda_i}{b(p)\ c(p,z)} \left[\ln\left(\frac{m}{\overline{m_0}(z)\ a(p)}\right)\right]^2 \right.$$

In the above equation, $\delta_{ij} = 0$ for $i = j$ and $\delta_{ij} = 1$ for $\neq j$. Now, the expenditure elasticity for good i is given by:

$$\mu_i = 1 + \frac{1}{w_i}\left[\beta_i + \eta_j^{'} z + \frac{2\lambda_i}{b(p)\ c(p,z)} \ln\left(\frac{m}{\overline{m_0}(z)\ a(p)}\right)\right] \tag{16}$$

Now, the compensated price elasticities $({\epsilon_{ij}}^C)$ are derive from the Slustky equation as:

$${\epsilon_{ij}}^C = \epsilon_{ij} + \mu_i w_j \tag{17}$$

EXPENDITURE ENDOGENEITY

We suspect that total consumption expenditure might be moving together with the error terms of the demand equations. It is because the total expenditure can be determined jointly with the expenditure shares of the individual group share equations. Inconsistent parameter estimates can result if the demand system is estimated ignoring such potential endogeneity issue; because, it significantly impacts the demand elasticity estimates Dhar et al. (2003). Though Dhar et al. (2003) also mention the potential price endogeneity, it shouldn't be an issue in our case because we are using the US city average price indices as the prices variables that are exogenously obtained from the BLS dataset. Therefore, our major concern is the potential expenditure endogeneity. Dhar et al. (2003) also confirm the findings of LaFrance (1993) that severe effect on the applied welfare analysis can occur if there is no control for expenditure endogeneity. In order to address the expenditure endogeneity issue in this QUAIDS demand system, we follow the augmented regression approach, as described in the Banks et al. (1997).

In this first step, we estimate a reduced form OLS regression using the suspected endogenous variable (logarithm of total expenditure) as dependent variable. We regress the total expenditure on net farm income and the square of net farm income as the instrument, together with a set of all the prices in logarithm form and other exogenous socio-economic variables (Table2). Net farm income is a valid instrument in this scenario because it is sufficiently correlated with the total expenditure but not with the error term in the demand model. We predict the residuals from the first stage-regression then add it as an additional explanatory variable to estimate the endogeneity adjusted QUAIDS model. Since the coefficient estimates of the residual variables are significant (7 out of 9) at 10% level of statistical significance, we fail to reject the potential expenditure endogeneity issue. Hence, we estimate and interpret the endogeneity adjusted QUAIDS model in this study. Also, we estimate the endogeneity unadjusted QUAIDS model for the purpose of comparison.

RESULTS

Determinants of Household Consumption

Summary of both the endogeneity adjusted and unadjusted QUAIDS parameter estimates for all the nine different consumption items demand functions is presented in the Table 3.

In this section, we outline the results and discussion based on the parameter estimates of endogeneity adjusted QUAIDS; the fifth column of Table 3. Out of nine consumption categories, we obtain that eight expenditure and seven expenditure square terms are statistically significant. This leads to the conclusion that there exists nonlinear distribution of household level consumption expenditure. We find that 21 price effects out of 45 are significantly different at 10% level of statistical significance. It implies that quantity responses significantly to movements in relative group prices.

Households having old household head is likely to consume more of clothing, food, nonfarm utilities, household operations, medical care and nonfarm auto maintenance; but, less of education, furniture, recreation, gifts and charitable contributions. Farm households with higher living expenses over the net farm income are likely to consume more of medical care, recreation, gifts and charitable contributions; but, less of education, food, non-farm utilities, household operations and nonfarm auto maintenance. Cooperation or partnership type farms are likely to consume more of furniture, medical care, recreation, gifts and charitable contributions; but, less of clothing and food. Households with higher number of dependents are likely to consume more of nonfarm utilities, furniture, household operations; but, less of clothing, education, food, medical care and non-farm auto maintenance.

Price and Expenditure Elasticities

Expenditure elasticities, compensated price elasticities and uncompensated prices elasticities of the endogeneity unadjusted and adjusted QUAIDS estimation are presented in the 4 and 5 respectively. For the better analysis of farm household consumption pattern and rural business dynamics, we compare the estimates of both QUAIDS models. Positive and statistically significant expenditure elasticities of endogeneity unadjusted QUAIDS model indicate that all the items in consideration are normal goods. Thus, 1% increase in the total expenditure leads to a 1.05%, 1.39%, 0.58%, 0.48%, 1.30%, 1.32%, 0.87%, 0.86% and 1.45% increase in the expenditure of clothing, education, food, non-farm utilities, household furniture, household operations, medical, nonfarm auto maintenance, and other items (recreation, gifts and charitable contributions). Similarly, endogeneity adjusted QUAIDS model expenditure elasticities suggest that all nine items are normal good at 10% level of statistical significance. Hence, 1% increase in the total expenditure implies to a 0.87%, 0.33%, 0.72%, 0.75%, 1.74%, 1.06%, 0.90%, 0.47% and 1.64% increase in the expenditure of clothing, education, food, non-farm utilities, household furniture, household operations, medical, nonfarm auto maintenance and other items.

Both QUAIDS models suggest that household furniture, household operations, recreation, gifts and charitable contributions as a luxury goods. However, expenditure elasticity results are largely differed between these two models for clothing and education. We obtain education and clothing as luxury goods in endogeneity uncorrected models, which is somewhat consistent with Carriker et al. (1993) who find education as luxury and clothing as the borderline luxury good. Note that they also use the endogeneity unadjusted demand model for the estimation. In the flip side, the endogeneity corrected model illustrates that both education and clothing are necessary goods.

Compensated and uncompensated own price elasticities in endogeneity adjusted and the unadjusted models show that all the own price elasticities are negative. In both model scenarios, compensated own price elasticities are slightly lower in absolute value than the uncompensated own price elasticities; however, there is no difference in the sign and the significance at 10% level of statistical significance. Based on endogeneity unadjusted QUAIDS model estimates, 1% increase in the prices of clothing, education, nonfarm utilities, furniture, household operations, nonfarm auto maintenance and other categories causes respective decrease in demand by 1.91%, 6.68%, 1.91%,3.81%,4.08%, 4.49% and 1.81%. Similarly, endogeneity adjusted QUAIDS model indicates that 1% increase in the prices of clothing, education, nonfarm utilities, furniture, household operations, nonfarm auto maintenance and other categories causes respective decrease in demand by 1.82%, 4.03%, 0.65%, 1.98%, 3.14%, 3.57%, 1.19%, 4.21% and 1.73%. Though the endogeneity corrected compensated own price elasticities associated with only these seven consumption categories are significant, the absolute value of these estimates for all these categories are lower than the endogeneity unadjusted model.

In endogeneity unadjusted QUAIDS model, compensated cross price elasticities implies that clothing and food, clothing and medical care, clothing and other category, education and non-farm utilities, education and furniture, education and non-farm auto maintenance, food and non-farm utilities, food and other category, nonfarm utilities and furniture, furniture and household operations, household operations and non-farm auto maintenance, household operations and other category are substitutes at the 10% level of statistical significance. Moreover, the same model identifies clothing and education, clothing and household operations, food and furniture, nonfarm utilities and medical care, furniture and medical care as complements at the 10% level of statistical significance.

Accordingly, endogeneity corrected QUAIDS model finds that clothing and food, clothing and other category, education and non-farm utilities, education and furniture, education and nonfarm auto maintenance, food and nonfarm utilities, food and other category, nonfarm utilities and furniture, nonfarm utilities and other category, household operations and other category, medical care and other category are the substitutes at the 10% level of statistical significance. Whereas, clothing and education, clothing and household operation, education and other category, food and household operations, nonfarm utilities and medical care, furniture and medical care are the complements at the 10% level of statistical significance.

IMPLICATIONS

The take away from the coefficient estimates of endogeneity corrected QUAIDS model is that rural business can make the investment or production decisions based on the farm characteristics of that particular location. For example, education business is likely to be impacted negatively in a place with low net farm income than total family expenses, old farm operator and higher number of family dependents. Similarly, food business is less likely to thrive in the location with farm households with less net farm income than living expenses, business type with no cooperation or partnership and higher number of family dependents. In the same way, we can breakdown the results for the business related to the remaining seven items.

We compared the elasticities estimates of endogeneity uncorrected and endogeneity corrected models. While endogeneity unadjusted model categorizes clothing and education as the luxury goods, endogeneity corrected model identifies these two items as the normal goods.

Accordingly, endogeneity uncorrected model find that medical care is substitute for clothing; which is very difficult to explain in the study region. However, the endogeneity adjusted model find no evidence of substitution between medical care and clothing. Results from both expenditure and price elasticity estimates confirm the findings of Dhar et al. (2003) that not controlling for the expenditure endogeneity results inconsistent parameter estimates and significantly impacts the demand elasticities.

Fluctuation in farm household expenditure are largely contributed by the change in farm income because off-farm income are relatively stable. As luxury consumption items are most likely to be affected by the fluctuation in the household expenditure, instability in farm income can have significant impact on the business related to the luxury items. This leads to the result of endogeneity unadjusted model that rural business on clothing, education, household furniture, household operations, recreation, gifts and charitable contributions are most likely to be affected negatively when farm income reduces. Except for clothing, Carriker et al. (1993) also obtain the same conclusions. Whereas, the endogeneity corrected QUAIDS model suggest that variability in the farm income most likely to affect the rural business on household furniture, household operations, recreation, gifts and charitable contributions.

Additionally, endogeneity corrected model find that non-farm auto maintenance cost has the highest response in the farm household expenditure on non-farm auto maintenance. It may be interesting to note that expenditure elasticity of endogeneity corrected model fail to establish evidence on the large impact of household expenditure variability on education. However, compensated own price elasticity derive from the same model indicate that change in cost of education has the second highest response in farm household education expenditure.

CONCLUSIONS

We have used 1993-2015 Kansas Farm Management Association (KFMA) dataset for 836 farm households to understand the role of household consumption patterns on the main street business. Analysis of expenditure pattern of nine different household consumption items have identified the associated socio-economic determinates, expenditure elasticities and price elasticities. Results of endogeneity adjusted and unadjusted QUAIDS model are also compared to make some empirical contribution.

In a nutshell, we have confirmed that endogeneity uncorrected model leads to the inconsistent demand estimates. The major contribution of the paper is theoretical, for those business that are located in the farming regions and majority of their consumers from farming background. We have obtained that success of those business could be location specific as it also depends on farm characteristics of that particular region. Most importantly, we have found that business involved in the education and non-farm auto maintenance are likely to be benefited more if they switch to some alternative or manage the available resources to offer the most possible lower cost to these items. Whereas, local business involved in household furniture, household operations, recreations, gifts and charitable contributions, are most likely to be benefited by the efficient farm level production measures and effective farm bills.

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Table 1: Descriptive Statistics

Variable	Description	Mean	Std. Dev.
Clothing expenses	Annual expenditure on clothing ($)	1815.858	2188.743
Education expenses	Annual expenditure on education ($)	2304.347	5283.923
Food expenses	Annual expenditure on food ($)	8489.777	4911.434
Utilities expenses	Annual expenditure on nonfarm utilities ($)	3090.364	3052.322
Furniture expenses	Annual expenditure on furniture and household equipment ($)	1222.514	2286.995
Household operation expenses	Annual expenditure on household operations ($)	5494.252	8470.405
Medical care expenses	Annual expenditure on medical care ($)	5945.66	5358.961
Auto expenses	Annual expenditure on non-farm auto maintenance ($)	2950.658	6783.736
Other expenses	Expenditure on other items ($)	10548.83	13244.17
Net farm income	Net farm income ($)	82802.17	168958.1
Clothing price	Price index of clothing	126.127	5.411
Education price	Price index of education	145.043	49.033
Food price	Price index of food	187.1	31.581
Utilities price	Price index of utilities	168.539	40.116
Furniture price	Price index of furniture	127.303	6.049
Household operation price	Price index of household operations	125.735	2.327
Medical care price	Price index of medical care	308.314	73.583
Age	Age of the operator (years)	52.191	12.3
Living	Dummy variable (1=total family living expenses greater than net farm income, 0=otherwise)	0.399	0.49
Business	Business type (1= farm was organized as cooperation or as partnership, 0=otherwise)	0.024	0.153
Dependents	Number of family dependents	3.241	1.63

Note: Net income and all the expenditure variables are calculated by deflating nominal values by CPI into the 2015 dollars

Table 2: Parameter estimates for reduced form expenditure (log x)

Variables	Coefficients	Std .Err.
Constant	4.097	3.846
Net Farm Income	0.000**	0
Net Farm Income Square	0.000**	0
Clothing Price Index (in log)	0.873**	0.376
Education Price Index (in log)	2.542**	1.19
Food Price Index (in log)	1.153	0.926
Utility Price Index (in log)	0.092	0.166
Furniture Price Index (in log)	-1.881**	0.767
Operation Price Index (in log)	3.202**	1.368
Auto Price Index (in log)	-1.61	1.28
Other Price Index (in log)	-2.669**	1.027
Medical Price Index (in log)	-0.135	0.209
Age	0.002**	0
Living	0.144**	0.011
Business Type	0.115**	0.03
Family Dependents	0.084**	0.003

Note: Asterisks ** represent significance at the 10% level.

Table 3: Parameter estimates for QUAIDS with and without endogeneity-adjustment

		Endogeneity Unadjusted		Endogeneity Adjusted	
Variables	Equation	Coef.	Std. Err.	Coef.	Std. Err.
Constant	$\alpha 1$	-0.078**	0.04	-0.094**	0.045
	$\alpha 2$	-0.254**	0.118	-0.457**	0.129
	$\alpha 3$	0.329**	0.102	0.270**	0.109
	$\alpha 4$	0.244**	0.035	0.303**	0.047
	$\alpha 5$	0.192**	0.068	0.160**	0.071
	$\alpha 6$	0.358**	0.129	0.666**	0.145
	$\alpha 7$	0.278**	0.139	0.233	0.152
	$\alpha 8$	-0.049	0.094	-0.131	0.101
	$\alpha 9$	-0.02	0.057	0.050	0.074
Expenditure	$\beta 1$	-0.032**	0.006	-0.033**	0.009
	$\beta 2$	-0.035**	0.014	-0.075**	0.02
	$\beta 3$	0.104**	0.015	0.047**	0.021
	$\beta 4$	0.094**	0.009	0.077**	0.013
	$\beta 5$	-0.019**	0.008	-0.034**	0.011
	$\beta 6$	0.081**	0.019	0.193**	0.028
	$\beta 7$	-0.080**	0.019	-0.028	0.026
	$\beta 8$	-0.071**	0.013	-0.041**	0.017
	$\beta 9$	-0.042**	0.020	-0.108**	0.024
Prices	11	-0.039**	0.016	-0.034**	0.016
	$\gamma 21$	-0.099**	0.032	-0.067**	0.032
	$\gamma 31$	0.084**	0.038	0.092**	0.038
	$\gamma 41$	-0.020**	0.009	-0.019**	0.009
	$\gamma 51$	0.021	0.020	0.014	0.020
	$\gamma 61$	-0.102**	0.039	-0.097**	0.04
	$\gamma 71$	0.081**	0.038	0.044	0.038

γ81	0.034	0.03	0.028	0.030
γ91	0.040**	0.012	0.040**	0.013
γ22	-0.266**	0.101	-0.121	0.102
γ32	-0.016	0.084	-0.015	0.084
γ42	0.043**	0.019	0.041**	0.020
γ52	0.150**	0.06	0.109**	0.060
γ62	-0.119	0.112	-0.082	0.114
γ72	0.169	0.114	0.019	0.114
γ82	0.161**	0.08	0.162**	0.080
γ92	-0.023	0.023	-0.046**	0.027
γ33	0.12	0.137	0.050	0.137
γ43	0.093**	0.026	0.062**	0.026
γ53	-0.130**	0.056	-0.133**	0.057
γ63	0.074	0.109	0.084	0.110
γ73	-0.089	0.107	-0.046	0.108
γ83	-0.141	0.090	-0.108	0.090
γ93	0.005	0.032	0.015	0.034
γ44	-0.053**	0.014	-0.065**	0.015
γ54	0.039**	0.013	0.030**	0.014
γ64	0.030	0.028	0.068**	0.030
γ74	-0.107**	0.029	-0.100**	0.030
γ84	0.010	0.022	0.021	0.022
γ94	-0.035**	0.013	-0.039**	0.016
γ55	-0.079	0.052	-0.056	0.052
γ65	0.166**	0.089	0.112	0.089
γ75	-0.196**	0.066	-0.143**	0.067
γ85	0.031	0.061	0.041	0.061
γ95	0.000	0.016	0.026	0.017
γ66	-0.348**	0.177	-0.178	0.180
γ76	0.137	0.125	0.043	0.126

	γ86	0.090	0.111	0.068	0.112
	γ96	0.072**	0.038	-0.018	0.047
	γ77	-0.236	0.164	-0.046	0.166
	γ87	0.079	0.099	0.061	0.099
	γ97	0.163**	0.034	0.169**	0.037
	γ88	-0.249**	0.11	-0.231**	0.11
	γ98	-0.015	0.026	-0.041	0.028
	γ99	-0.208**	0.021	-0.105**	0.033
Expenditure Square	λ1	-0.003**	0.001	-0.002**	0.001
	λ2	-0.007**	0.001	-0.004**	0.002
	λ3	0.020**	0.002	0.010**	0.002
	λ4	0.015**	0.001	0.009**	0.001
	λ5	-0.003**	0.001	-0.005**	0.001
	λ6	0.006**	0.002	0.018**	0.003
	λ7	-0.008**	0.002	-0.003	0.003
	λ8	-0.006**	0.001	0.000	0.002
	λ9	-0.015**	0.002	-0.024**	0.004
Operator Age	age1	0.000**	0.000	0.000**	0.000
	age2	-0.000**	0.000	0.000**	0.000
	age3	0.000**	0.000	0.000**	0.000
	age4	0.000**	0.000	0.000**	0.000
	age5	0.000	0.000	-0.000**	0.000
	age6	0.000**	0.000	0.000**	0.000
	age7	-0.000**	0.000	-0.000**	0.000
	age8	0.000**	0.000	0.000**	0.000
	age9	-0.000**	0.000	-0.001**	0.000

Living Expense (Dummy)	living1	0.000	0.000	0.000	0.000
	living2	0.000	0.000	-0.001**	0.000
	living3	-0.002**	0.001	-0.001**	0.000
	living4	-0.001**	0.000	-0.000**	0.000
	living5	0.000	0.000	0.000	0.000
	living6	-0.001	0.001	-0.001**	0.000
	living7	0.003**	0.001	0.002**	0.000
	living8	-0.001**	0.000	-0.001**	0.000
	living9	0.002**	0.001	0.002**	0.001
Business Type	Business1	-0.005**	0.001	-0.005**	0.000
	Business2	0.002	0.001	0.000	0.001
	Business3	-0.008**	0.002	-0.007**	0.001
	Business4	0.000	0.001	0.000	0.001
	Business5	0.001	0.001	0.001**	0.001
	Business6	0.001	0.002	0.002	0.001
	Business7	0.003	0.002	0.002**	0.001
	Business8	0.003**	0.001	0.001	0.001
	Business9	0.003**	0.002	0.005**	0.002
Dependent	Dependent1	-0.001**	0.000	-0.001**	0.000
	Dependent2	-0.003**	0.000	-0.003**	0.000
	Dependent3	-0.002**	0.000	-0.001**	0.000
	Dependent4	0.001**	0.000	0.001**	0.000
	Dependent5	0.000**	0.000	0.000**	0.000
	Dependent6	0.001**	0.000	0.001**	0.000
	Dependent7	-0.001**	0.000	-0.000**	0.000
	Dependent8	-0.000**	0.000	-0.001**	0.000
	Dependent9	0.005**	0.000	0.004**	0.000

Residuals	vhat1			-0.001**	0.000
	vhat2			-0.007**	0.001
	vhat3			0.007**	0.001
	vhat4			0.004**	0.001
	vhat5			0.001**	0.000
	vhat6			-0.005**	0.001
	vhat7			0.001	0.001
	vhat8			-0.003**	0.001
	vhat9			0.001	0.001
Cutoff	ρ_{age}	0.019**	0.005	0.151**	0.067
	ρ_{liv}	-0.105**	0.058	-0.536**	0.256
	ρ_{bus}	0.176	0.108	-0.113	0.342
	ρ_{dep}	-0.074**	0.010	-0.275**	0.111
	ρ_{vhat}			1.608**	0.578

CLH=Cloth, EDU= Education, FOD=Food, UTL= Utility,FUR=Furniture, OPT= Operation, MED=Medical, OTH=Other.Asterisks ** represent significance at the 10% level.

Table 4: Expenditure and Price Elasticities from QUAIDS Model without Endogeneity Adjustment

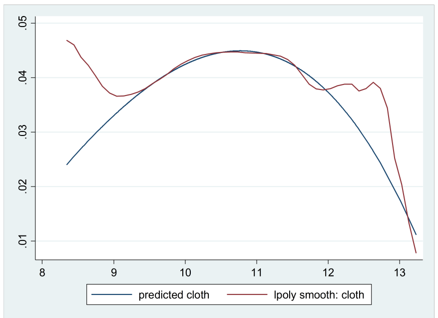
		Price Elasticity																	
		Compensated									Uncompensated								
Items	Exp. Elasticity	CLH	EDU	FOD	UTL	FUR	OPT	MED	ATO	OTH	CLH	EDU	FOD	UTL	FUR	OPT	MED	ATO	OTH
CLH	1.05**	-1.91**	-2.34**	2.37**	-0.2	0.48	-2.07**	1.87**	0.75	1.07**	-1.96**	-2.39**	2.13**	-0.29	0.45	-2.20**	1.71	0.67	0.83**
	(0.02)	(0.38)	(0.74)	(0.87)	(0.21)	(0.46)	(0.90)	(0.87)	(0.69)	(0.27)	(0.38)	(0.74)	(0.87)	(0.21)	(0.46)	(0.90)	(0.87)	(0.69)	(0.27)
EDU	1.39**	-2.13**	-6.68**	0.24	1.29**	3.13**	-2.19	3.48	3.32**	-0.46	-2.19**	-6.75**	-0.07	1.17**	3.09**	-2.35	3.27	3.22**	-0.78
	(0.04)	(0.67)	(2.14)	(1.76)	(0.40)	(1.27)	(2.36)	(2.38)	(1.69)	(0.49)	(0.67)	(2.14)	(1.76)	(0.40)	(1.27)	(2.36)	(2.38)	(1.69)	(0.49)
FOD	0.58**	0.45**	0.05	-0.46	0.33**	-0.52**	0.37	-0.15	-0.49	0.41**	0.43**	0.02	-0.59	0.29**	-0.54**	0.3	-0.23	-0.53	0.28**
	(0.01)	(0.17)	(0.37)	(0.61)	(0.11)	(0.25)	(0.49)	(0.48)	(0.40)	(0.14)	(0.17)	(0.37)	(0.61)	(0.11)	(0.25)	(0.49)	(0.48)	(0.40)	(0.14)
UTL	0.48**	-0.1	0.73**	0.89**	-1.91**	0.55**	0.23	-0.84**	0.37	0.09	-0.12	0.70**	0.79**	-1.95**	0.53**	0.17	-0.91**	0.34	-0.02
	(0.01)	(0.11)	(0.22)	(0.30)	(0.15)	(0.15)	(0.32)	(0.34)	(0.25)	(0.15)	(0.11)	(0.22)	(0.30)	(0.15)	(0.15)	(0.32)	(0.34)	(0.25)	(0.15)
FUR	1.30**	0.73**	5.25**	-4.14**	1.63**	-3.81**	6.08**	-6.90**	1.07	0.1	0.67	5.18**	-4.44**	1.52**	-3.84**	5.93**	-7.10**	0.98	-0.2
	(0.04)	(0.70)	(2.12)	(1.99)	(0.46)	(1.82)	(3.12)	(2.34)	(2.14)	(0.56)	(0.70)	(2.12)	(1.99)	(0.46)	(1.82)	(3.12)	(2.34)	(2.14)	(0.56)
OPT	1.32**	-0.76**	-0.88	0.71	0.16	1.46	-4.08**	1.54	0.98**	0.85**	-0.82**	-0.95	0.41	0.05	1.43**	-4.23**	1.34	0.88	0.55**
	(0.02)	(0.33)	(0.95)	(0.93)	(0.23)	(0.75)	(1.50)	(1.06)	(0.95)	(0.32)	(0.33)	(0.95)	(0.93)	(0.23)	(0.75)	(1.50)	(1.06)	(0.95)	(0.32)
MED	0.87**	0.53	1.08	-0.22	-0.46	-1.28	1.19	-2.57	0.48	1.26	0.49**	1.04	-0.41	-0.54**	-1.31**	1.09	-2.71**	0.42	1.06**
	(0.02)	(0.25)	(0.74)	(0.70)	(0.19)	(0.44)	(0.82)	(1.08)	(0.65)	(0.22)	(0.25)	(0.74)	(0.70)	(0.19)	(0.44)	(0.82)	(1.08)	(0.65)	(0.22)
ATO	0.86**	0.44	2.16	-1.51	0.43	0.42	1.58	1	-4.49**	-0.04	0.41	2.12**	-1.7	0.36	0.39	1.48	0.87	-4.56**	-0.23
	(0.02)	(0.41)	(1.10)	(1.23)	(0.29)	(0.83)	(1.53)	(1.36)	(1.51)	(0.35)	(0.41)	(1.10)	(1.23)	(0.29)	(0.83)	(1.53)	(1.36)	(1.51)	(0.35)
OTH	1.45**	0.20**	-0.1	0.40**	0.03	0.01	0.44**	0.83**	-0.01	-1.81**	0.14**	-0.17	0.08	-0.09	-0.03	0.27	0.61**	-0.12	-2.14**
	(0.01)	(0.05)	(0.10)	(0.14)	(0.05)	(0.07)	(0.17)	(0.15)	(0.11)	(0.09)	(0.05)	(0.10)	(0.14)	(0.05)	(0.07)	(0.17)	(0.15)	(0.11)	(0.09)

Standard errors are shown in parantheses. Asterisks ** represents significance at the 10% level.

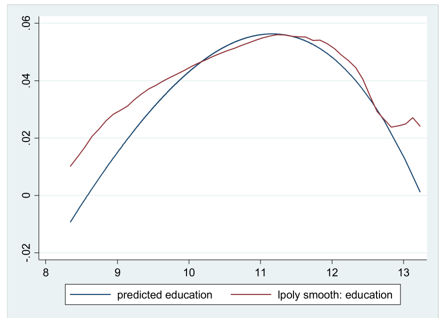
Table 5: Expenditure and Price Elasticities from QUAIDS Model with Endogeneity Adjustment

		Price Elasticity																	
		Compensated									Uncompensated								
Items	Exp. Elasticity	CLH	EDU	FOD	UTL	FUR	OPT	MED	ATO	OTH	CLH	EDU	FOD	UTL	FUR	OPT	MED	ATO	OTH
CLH	0.87**	-1.82**	-1.72**	2.44**	-0.19	0.29	-1.66**	1.06	0.64	0.95**	-1.86**	-1.76**	2.25**	-0.26	0.27	-1.76**	0.93	0.57	0.75**
	(0.07)	(0.38)	(0.74)	(0.87)	(0.21)	(0.46)	(0.91)	(0.87)	(0.69)	(0.28)	(0.38)	(0.74)	(0.87)	(0.21)	(0.46)	(0.91)	(0.87)	(0.69)	(0.27)
EDU	0.33**	-1.56**	-4.03**	0.07	1.38**	2.19**	-0.46	0.28	3.21**	-1.10**	-1.57**	-4.04**	0	1.35**	2.19**	-0.5	0.23	3.19**	-1.18**
	(0.13)	(0.68)	(2.15)	(1.76)	(0.40)	(1.27)	(2.37)	(2.40)	(1.69)	(0.50)	(0.68)	(2.15)	(1.76)	(0.40)	(1.27)	(2.37)	(2.40)	(1.69)	(0.49)
FOD	0.72**	0.47**	0.02	-0.65	0.28**	-0.52**	0.34	-0.03	-0.42	0.51**	0.44**	-0.02	-0.81**	0.22**	-0.54**	0.26	-0.15	-0.47	0.35**
	(0.03)	(0.17)	(0.37)	(0.61)	(0.11)	(0.25)	(0.49)	(0.48)	(0.40)	(0.14)	(0.17)	(0.37)	(0.61)	(0.11)	(0.25)	(0.49)	(0.48)	(0.40)	(0.14)
UTL	0.75**	-0.09	0.78**	0.75**	-1.98**	0.51**	0.27	-0.90**	0.4	0.27**	-0.13	0.74**	0.58**	-2.04**	0.49**	0.18	-1.02**	0.35	0.09
	(0.05)	(0.11)	(0.23)	(0.30)	(0.15)	(0.16)	(0.32)	(0.34)	(0.26)	(0.15)	(0.11)	(0.23)	(0.30)	(0.15)	(0.16)	(0.32)	(0.34)	(0.26)	(0.15)
FUR	1.74**	0.44	3.67**	-4.13**	1.53**	-3.14**	4.85	-5.03**	1.47	0.34	0.37	3.59	-4.52**	1.38**	-3.19**	4.65	-5.29**	1.34	-0.06
	(0.13)	(0.71)	(2.12)	(1.99)	(0.46)	(1.82)	(3.13)	(2.35)	(2.14)	(0.57)	(0.71)	(2.13)	(1.99)	(0.46)	(1.82)	(3.13)	(2.35)	(2.14)	(0.56)
OPT	1.06**	-0.61**	-0.18	0.65	0.19	1.17	-3.57**	0.77	0.84	0.73**	-0.65**	-0.23	0.41	0.1	1.14	-3.69**	0.61	0.77	0.49
	(0.07)	(0.33)	(0.96)	(0.93)	(0.23)	(0.75)	(1.50)	(1.06)	(0.95)	(0.32)	(0.33)	(0.96)	(0.93)	(0.23)	(0.75)	(1.50)	(1.06)	(0.95)	(0.32)
MED	0.90**	0.3	0.09	-0.05	-0.50**	-0.93**	0.59	-1.19	0.43	1.27**	0.26	0.05	-0.25	-0.57**	-0.96**	0.49	-1.33	0.36	1.07**
	(0.06)	(0.25)	(0.75)	(0.70)	(0.19)	(0.44)	(0.82)	(1.09)	(0.65)	(0.22)	(0.25)	(0.75)	(0.70)	(0.19)	(0.44)	(0.82)	(1.09)	(0.65)	(0.22)
ATO	0.47**	0.38	2.10**	-1.29	0.46	0.57	1.36	0.89	-4.21**	-0.26	0.36	2.07**	-1.4	0.42	0.56	1.31	0.82	-4.24**	-0.37
	(0.08)	(0.41)	(1.10)	(1.24)	(0.30)	(0.83)	(1.53)	(1.36)	(1.51)	(0.36)	(0.41)	(1.10)	(1.24)	(0.30)	(0.83)	(1.53)	(1.36)	(1.51)	(0.35)
OTH	1.64**	0.18**	-0.23**	0.50**	0.10**	0.04	0.38**	0.85**	-0.08	-1.73**	0.11**	-0.31**	0.14	-0.04	-0.01	0.19	0.60**	-0.20**	-2.11**
	(0.04)	(0.05)	(0.10)	(0.14)	(0.06)	(0.07)	(0.17)	(0.15)	(0.11)	(0.10)	(0.05)	(0.10)	(0.14)	(0.06)	(0.07)	(0.17)	(0.15)	(0.11)	(0.09)

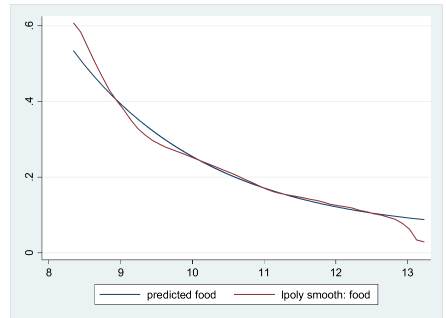
Standard errors are shown in parantheses. Asterisks ** represents significance at the 10% level.



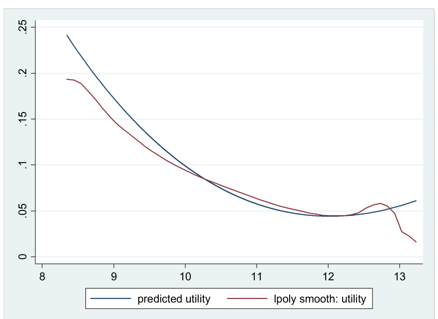
(a) Clothing



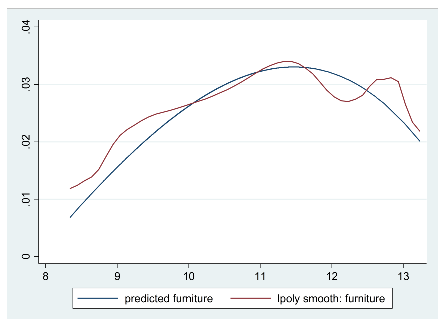
(b) Education



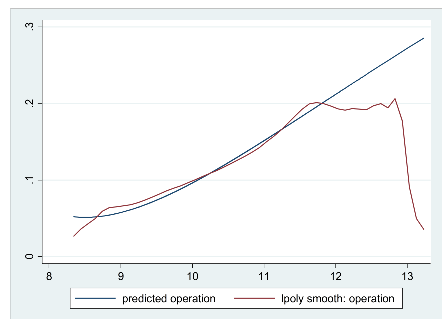
(c) Food



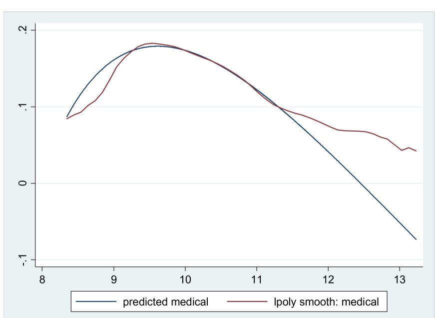
(d) Utilities



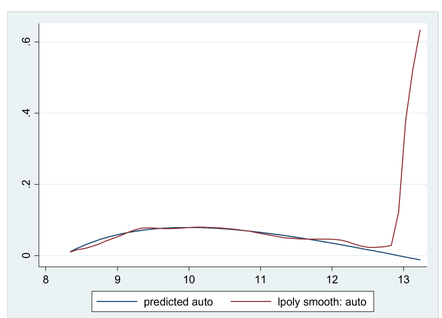
(e) Furniture



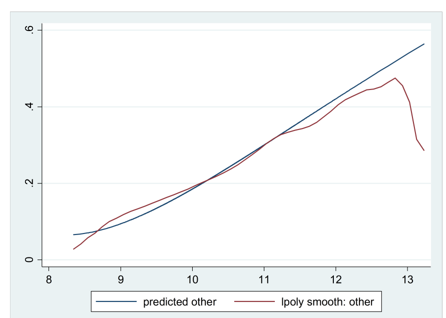
(f) Household Operations



(g) Medical Care



(h) Automobile Maintenance



(i) Other

Figure 1: Non-parametric Engel curves for Nine Different Consumption Categories