Much ado about nothing? The effect of the rice price increase between 2005-10 on the households in rural Bangladesh

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Abstract

This paper studies the impact of the rice price increase between 2005 and 2010 on the calorie intake of rural households in Bangladesh. To identify the effect of the shock, we employ a difference-in-differences framework and compare the net rice buyers with the self-sufficient households, as the latter does not suffer from any income effect while the former suffers from a negative income effect. In combination with a similar analysis on seller households, our findings indicate that the surge in the domestic rice price has no effect on the calorie intake of rural households. A similar pattern of calorie intake was also observed for more disaggregated non-rice food items including the high priced items like fish and meat. Along with previous studies on household food consumption, our investigation indicates that the low-income households may cope such situations through intra-group rather than inter-group substitution of low priced food items. This study reveals that nutritional consideration, which is more important than welfare or poverty in the context of developing countries, does not require any special government action to handle such situations.

JEL-Classification: D12, I32, O13, O53, Q12.

Keywords: Rice Price Increase; Difference-in-difference Estimation; Nutrition; Bangladesh.

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1. Introduction

Higher food price forces households to reduce both the quantity and the quality of their food consumption (e.g. Brinkman, de Pee, Sanogo, Subran, and Bloem, 2010; Alem and Söderbom, 2012; Kumar and Quisumbing, 2013; D'Souza and Jolliffe, 2012, 2014; Hasan, 2016a,c). For instance, the most vulnerable households in Afghanistan sacrificed the quality of diet to maintain their calorie intake at the time of a high food price shock in 2007-08 (D'Souza and Jolliffe, 2014). The same event also forced a large proportion of low-income households in Bangladesh to reduce their consumption of non-rice food and/or non-food items to maintain or even increase their consumption level of rice (Raihan, 2009; Sulaiman, Parveen, and Das, 2009). Hasan (2016c) specifically compared the net rice buyer households in rural Bangladesh with those that are self-sufficient in rice and found that the increase in domestic rice prices between 2005 and 2010 reduced the non-rice food consumption of the former by 7% but did not affect their rice consumption. A similar analysis indicated that, although the rice consumption of net rice seller households remained similar, non-rice food consumption of such household increased by 9%.

Low food consumption, induced by price shocks, affect the welfare and poverty status of low-income households who are the net buyer of food items (Ivanic and Martin, 2008; Ferreira, Fruttero, Leite, and Lucchetti, 2013; Attanasio, Di Maro, Lechene, and Phillips, 2013; Balagtas, Bhandari, Cabrera, Mohanty, and Hossain, 2014; Hasan, 2016b). However, a more important consideration of the effect of low food consumption is through the channel of nutrition, which may hamper the long-run cognitive development of children or lower the productivity of the grown ups (Sulaiman, Parveen, and Das, 2009; World Bank, 2012). For example, Torlesse, Kiess, and Bloem (2003) observed that the proportion of underweight children is positively associated with the rice expenditure in Bangladesh, as lower expenditure on rice allowed households to spend more on nonrice food items and thereby increasing their diet quantity and quality. Wile some articles like D'Souza and Jolliffe (2012, 2014) focus on the calorie intake and food diversity of different expenditure groups, no known study focuses on the potentially most affected group - the net rice buyer households. Furthermore, such studies typically employ indices while investigating the effect of higher food prices on the diversity in food consumption, which can be very subjective and less informative.

Against this background, this paper studies the effect of the rice price increase between 2005

and 2010 on the calorie intake and (items and) types of food consumption of net rice buyer and net rice seller households in rural Bangladesh.[1] We use the 2005 and 2010 waves of a nationally representative household survey in Bangladesh to exploit the natural experiment setting of the rice price increase and employ a difference-in-difference (DD) framework. We use autarkic households as the control group and buyer (also repeated on seller) households as the treatment group in our models. To avoid the aggregation problem, instead of modeling for the physical quantity, we model for the calorie intake from important expenditure groups. Our results indicates no significant effect of the higher rice price on the calorie intake and diet diversity of net rice buyer and seller households. This paper contributes to the literature that investigates the impact of higher food prices by indicating the shift in the consumption pattern of rural households in Bangladesh which allows them to avoid any negative consequence on nutrition.

The remainder of this article is organized as follows. Section 2 briefly describes the data. Section 3 presents the methodology employed in our investigation together with the empirical strategy and identifying assumptions. Results from our analysis are presented at Section 4. Section 5 concludes.

2. Data

We employ data from the 2005 and 2010 waves of the Bangladesh Household Income and Expenditure Survey (HIES). The HIES is a repeated cross-section survey and is conducted in every 5 years to generate nationally representative socioeconomic information at the household level. Households in the survey is selected with a two-stage stratified random sampling. Sample restriction in our investigation is similar to Hasan (2016c) which provides us a random sample of 5,355 and 7,495 rural households in 2005 and 2010, respectively.

Analysis with the physical quantity of a food can indicate the effect on its consumption. However, the aggregation problem arising from the availability of different types of food and their units of measurement complicates the analysis with physical quantity. For example, rice is consumed in different forms including puffed rice, beaten rice and plain rice. Furthermore, availability of different qualities of food allow households to shift to a cheaper variety within the category, e.g., from

[1]The domestic price increase during 2005-2010 for typical non-rice food and non-food items were relatively low compared to the rice price increase (Bangladesh Bureau of Statistics, 2011; Ministry of Finance, 2012; Hasan, 2016c).

fine to coarse quality rice. As a result, we use the total calorie intake and calorie intake from each category (e.g., rice, lentil and protein) as the dependent variables in our models. This trick allows our dependent variables to avoid the complexity arising from the uneven price increase for different food items between the two survey periods. We also conducted the analysis with the number of food items consumed, number of food category consumed and the consumption of rice in Kg.[2]

The magnitude of the effect of an increase in rice price relies on the definition of buyer, autarkic, and seller households. To do so, we use the normal daily consumption of rice and the average rice yield depending on whether the size of owned agricultural land allow them to harvest a quantity that fulfills their normal daily consumption of rice.[3] Based on the definition for each household type, Table 1 indicates an over time increase in the calorie intake and number of non-rice food items consumed. However, we generally observe a reduction in the consumption of rice and consequently a lower calorie intake from the category.

[Table 1]

Summary statistics of a set of relevant demographic and socioeconomic variables indicates a reduction in household size over time (Table 2). We observe a higher school year among the spouses of male household heads and an increase in household income and consumption. For both periods, the more a household associated with agriculture, the higher their income and consumption.

[Table 2]

3. Methodology

The rice price increase between 2005 and 2010 was an exogenous event.[4] This allows us to investigate household's food consumption pattern using a difference-in-difference (DD) framework as follows:

$$Y_{it} = \alpha + \beta Y_{2010} + \gamma Buyer_i + \delta Buyer_i * Y_{2010} + \psi X_i + u_i, \quad (1)$$

[2]HIES provides item wise food consumption data. We count the number of food items consumed during the survey. The number of types of food category is obtained by aggregation of similar food items. Rice consumption quantity (in Kg.) was directly available in the data.

[3]For detail, see Hasan (2016c).

[4]The mean rice price in July 2005 and July 2010, around which the survey data were collected, which was Tk.15.57 and Tk.27.85, respectively. This was due to the higher international food price during 2007-08 and the movement of exchange rate during 2010. For detail about the exogeneity of the event, see Hasan (2016c).

where Y_{it} denotes the total calorie intake per capita per day of household i at period t = {2005, 2010}, Y_{2010} is a dummy for the price increase, $Buyer_i$ indicates if household i is a net rice buyer (reference group is autarkic households), the vector X_i includes dummies for educational categories of household head/spouse, income per capita, season of data collection and agricultural asset value and u_i is the error term. The DD estimator δ measures the effect of a higher rice price on the calorie intake of buyer households.

A joint determination of income and calorie intake can make the former endogenous in our models. This is, however, unlikely for our case with large proportions of low-income households. We assume a two-stage budgetary framework, in which households decide income first and then conditional on income, decide spending on (and consequently the calorie intake from) each types of food. Furthermore, with no evidence for any significant change in food consumption pattern between 2005 and 2010 in rural Bangladesh, we assume that the same underlying trend in the dependent variable for both the treatment and the control group continues. As a result, the OLS estimate of δ in our analysis identifies the local average treatment effect (LATE), i.e., the average treatment effect of the higher rice price on the consumption of net rice buyers.

4. Results and discussion

The OLS estimates of model (1) parameters are presented in column 1 of Table 3. They indicate no overtime change in the calorie intake of rural households. On the other hand, buyer households have a significantly lower intake of calorie compared to the autarkic households, which can be due to the fact that a large proportion of agricultural households are daily laborer who receives part of their wage in kind in the form of meals during work. However, buyers did not significantly reduce their calorie intake after the increase in the price of rice. Among other variables, age and sex of household head positively affect the calorie intake of a household, indicating that the elder and female headed households are better in managing food consumption. Interestingly, while the education of household head positively affect the dependent variable, education of the spouse (of household head) does the opposite. A possible explanation for such results is that educated mothers are more careful about obesity or too busy to prepare food for the household members. Finally, agricultural asset value also significantly effect the calorie intake of households indicating that they

need to feed more hired labor as they own more agricultural asset to work with.

[Table 3]

In column 2 of Table 3, we repeated the analysis with the number of food items consumed as the dependent variable. We obtained similar results except an overtime significant increase in the number of food items consumed. Interestingly, female head now negatively affect the dependent variable while education of the spouse does the opposite. Results with the types of food consumed in Column 3 and rice consumption in Kg. in Column 4 also indicate a similar story. Column 5 and 6 indicate that while households reduce their consumption of rice with time and education, at the same time they increase the consumption of nonrice food items. All of the model results fail to indicate that the consumption of the buyer households were affected by the higher rice price. Repeating the analysis for seller households also tells a similar story (Table 4). Modeling separately for calorie intake from grain, non-rice grain, pulses, protein, fruits and other items also indicate a similar consumption pattern for all types of households. This is particularly important as it indicates no reduction in the diet diversity of the buyer or the seller households. As expected, household income plays a significant role in most of our models.

[Table 4]

Our results are robust to a number of modifications in our model. For example, the requirement of the size of owned land employed to define buyer, autarkic and seller households can be claimed to be arbitrary. Therefore, we repeat the analysis with gradually increasing the requirements. The plot of the estimates in Figure 1 demonstrates that our results are largely robust to the choice of cutoffs. There are concerns about the artificially high significance of the DD estimate, as the DD standard errors severely understate the standard deviation, particularly when the errors are serially correlated (Bertrand, Duflo, and Mullainathan, 2004). To confirm that the concern is not valid in our case, we randomly assign the treatment status to our sample households and then simulate the actual level of significance. Results from such tests in Table 5 indicate that the significance level of the DD estimates corresponds with the standard normal distribution.

[Figure 1]

[**Table 5**]

The findings of our analysis provide evidence for category wise consumption smoothing. This is particularly interesting as Hasan (2016c) observed a reduction of the value of consumption of non-rice food for buyer and the opposite for the seller. Non-rice food items experienced a relatively lower price increase than that of rice and therefore it possible that the use of identical deflator for both the categories for adjustment of inflation in the analysis underestimates the consumption of the former. Nevertheless, it is likely that buyers (sellers), who are negatively (positively) affected by higher rice price, shift to cheaper (costly) varieties within each category. Our data indicate that buyer households reduce their consumption quantity (kg) of medium quality rice but increase that of low-quality rice while autarkic households do the opposite. Seller households, on the other hand, increase their consumption of rice that is high in quality while reduce that of the low quality. Unfortunately, lack of the quality information of our data does not allow us to validate our guess for non-rice food items but it is reasonable to assume a similar pattern for them.

This analysis, by examining the intake of calorie from each items, provides a better understanding by overcoming both the problem of aggregation of different food items as well as the uneven increase in prices for different food categories. Our findings about consumption smoothing are similar to but more general than Raihan (2009). However, the findings are opposite to that of Torlesse et al. (2003); Sulaiman et al. (2009) and West and Mehra (2010) who find that the price increase results in a less diversified food basket than before. In particular, in times of a food price shock, we do not find any evidence that low-income households shift from high priced food category like protein to cheaper food items like pulse and vegetables.

This study may have important implications on Bangladesh and other low-income countries. Our investigations indicate that, while a food price increase can make individuals unhappy it may not have much effect on the intake of the food items and thus the nutritional status of households. Thus, in the face of a food price shock, a more general income support program can protect the households from any nutritional consequences. However, a sustainable long-term solution for higher rice prices and a more realistic medium- to long-run solution would require increasing the investment in rice research and development and raising the farm productivity.

5. Conclusion

We investigate the impact of the higher rice price between 2005-2010 in Bangladesh on the food consumption of net rice buyer and net rice seller households. We also investigate the impact of the same event on the food diversity of such households by comparing the number of food items/types consumed between the two survey period. Using the natural experiment setting of the increase in rice price and employing the household data of 2005 and 2010 in a DD framework, we find no significant change in the food consumption pattern of net rice buyer and net rice seller households when we compared them with the households that are self sufficient in rice. Our analysis indicates that the government in the developing countries, which aim to protect the low-income households from food price shocks, would not worry too much about the nutritional consequence of higher food price shock as long as they provide income support to the low-income households.

Tables and Figures

Table 1: Summary statistics of dependent variables by household type (weighted)

	2005			2010		
	Buyer	Autarkic	Seller	Buyer	Autarkic	Seller
Kcal. per capita per day						
Mean	2,198	2,505	2,860	2,289	2,572	2,987
SD	619	765	1,165	727	753	1,166
Min	190	486	992	304	861	498
Max	8,504	7,244	15,947	12,882	7,495	12,412
Items consumed						
Mean	33	37	38	39	42	43
SD	9	9	8	10	9	9
Min	8	16	16	11	15	13
Max	63	66	69	83	82	77
Types of item consumed						
Mean	22	24	25	23	26	27
SD	7	7	7	8	8	8
Min	5	7	9	4	8	8
Max	47	48	53	63	62	58
Rice consumption per capita (kg)						
Mean	14	15	17	13	14	16
SD	4	5	7	5	4	6
Min	1	3	3	1	3	3
Max	46	46	77	76	44	64
Kcal. from rice per capita per day						
Mean	1,585	1,735	1,892	1,503	1,620	1,789
SD	481	544	764	513	495	718
Min	93	340	288	82	371	288
Max	5,190	5,190	8,712	8,650	4,943	7,291
Kcal. from nonrice per capita per day						
Mean	613	770	968	785	952	1,197
SD	327	412	560	430	487	657
Min	73	146	253	92	151	127
Max	5,549	3,627	7,235	6,282	5,476	6,135
N	3,972	893	461	5,790	1,113	562

TABLE 2: Summary statistics of independent variables by household type (weighted)

	2005			2010		
	Buyer	Autarkic	Seller	Buyer	Autarkic	Seller
Demographics						
Family size	4.85	5.13	4.75	4.56	4.59	4.18
	(2.02)	(2.24)	(2.43)	(1.88)	(1.93)	(1.99)
Adult member	2.50	2.89	3.03	2.48	2.78	2.81
	(1.10)	(1.36)	(1.61)	(1.08)	(1.29)	(1.27)
Child member	2.35	2.24	1.73	2.08	1.81	1.37
	(1.51)	(1.52)	(1.40)	(1.41)	(1.36)	(1.30)
Age of household head	44.39	49.10	51.51	44.98	49.75	53.28
	(13.36)	(13.97)	(14.79)	(13.99)	(14.36)	(15.26)
Female head	0.11	0.10	0.10	0.16	0.15	0.12
	(0.31)	(0.30)	(0.30)	(0.36)	(0.36)	(0.33)
Education						
Household head with no education	0.68	0.47	0.31	0.65	0.45	0.38
	(0.47)	(0.50)	(0.46)	(0.48)	(0.50)	(0.49)
Household head with primary education	0.15	0.16	0.15	0.15	0.16	0.14
	(0.36)	(0.37)	(0.36)	(0.36)	(0.37)	(0.35)
Household head with secondary education	0.15	0.28	0.37	0.16	0.27	0.31
	(0.36)	(0.45)	(0.48)	(0.37)	(0.45)	(0.46)
Household head with higher sec. education	0.02	0.08	0.16	0.02	0.09	0.14
	(0.14)	(0.27)	(0.36)	(0.16)	(0.29)	(0.35)
Spouse with no education	0.72	0.59	0.44	0.65	0.51	0.49
	(0.45)	(0.49)	(0.50)	(0.48)	(0.50)	(0.50)
Spouse with primary education	0.14	0.16	0.21	0.16	0.18	0.15
	(0.35)	(0.37)	(0.41)	(0.37)	(0.39)	(0.35)
Spouse with secondary education	0.13	0.22	0.32	0.18	0.27	0.30
	(0.34)	(0.42)	(0.47)	(0.38)	(0.45)	(0.46)
Spouse with higher secondary education	0.01	0.02	0.04	0.01	0.03	0.06
	(0.09)	(0.13)	(0.20)	(0.08)	(0.17)	(0.24)
Finances						
Income per capita (Tk.)	974	1,470	2,571	2,052	3,554	4,575
	(886)	(2,379)	(9,404)	(3,169)	(11,167)	(10,159)
Consumption per capita (Tk.)	972	1,303	1,841	1,970	2,581	3,648
	(764)	(874)	(1,809)	(1,376)	(1,356)	(2,497)
Landholding						
Owned cultivable land per capita (acre)	0.03	0.31	1.04	0.03	0.31	1.11
	(0.05)	(0.11)	(0.88)	(0.05)	(0.11)	(0.95)
Other						
Lean Season	0.18	0.16	0.14	0.16	0.17	0.15
	(0.38)	(0.36)	(0.35)	(0.37)	(0.38)	(0.36)
Agricultural asset value per capita (Tk.)	195	1,265	2,206	604	2,250	6,070
	(1,078)	(6,304)	(5,421)	(7,974)	(11,556)	(17,839)
N	3,972	893	461	5,790	1,113	562

Source: Hasan (2016c).
Note: Standard deviations in parentheses.

TABLE 3: Effect of the 2005-2010 rice price increase on Buyer households

	Calorie intake	Items consumed	Types of food consumed	Rice consumption in kg	Calorie from rice	Calorie from nonrice
Year 2010	45.66	4.85***	1.73***	-0.97***	-109.83***	165.17***
	(43.99)	(0.55)	(0.45)	(0.23)	(25.81)	(25.86)
Buyer	-249.46***	-2.59***	-1.63***	-1.22***	-138.61***	-103.65***
	(31.84)	(0.39)	(0.30)	(0.18)	(20.42)	(17.47)
DD estimate	41.92	0.37	-0.12	0.39*	43.97*	-9.25
	(40.10)	(0.46)	(0.37)	(0.22)	(25.49)	(22.53)
Income per capita	0.02*	0.00*	0.00**			0.01**
(2010 Price)	(0.01)	(0.00)	(0.00)			(0.01)
Age of household	6.83***	0.04***		0.04***	4.51***	2.13***
head	(0.54)	(0.01)		(0.00)	(0.39)	(0.31)
Female head	82.40***	-3.03***	-2.10***			114.58***
	(24.82)	(0.30)	(0.24)			(15.25)
Household head has	43.10**	1.96***	1.32***			54.84***
primary education	(17.78)	(0.24)	(0.19)			(10.55)
Household head has		2.01***	1.75***	-0.23*	-26.52*	68.23***
secondary education		(0.29)	(0.21)	(0.12)	(13.64)	(11.78)
Household head has	78.86*	2.74***	2.76***	-0.44**	-50.05**	166.01***
higher secondary education	(40.46)	(0.53)	(0.45)	(0.22)	(24.58)	(27.48)
Household head has		3.61***	3.70***	-1.54***	-174.74***	141.95***
graduate degree		(1.11)	(0.98)	(0.53)	(59.72)	(48.91)
Household head has						
other education						
Spouse with primary		1.36***	1.16***	-0.55***	-62.21***	27.29***
education		(0.24)	(0.19)	(0.10)	(11.85)	(10.51)
Spouse with		2.16***	1.90***	-0.95***	-107.29***	80.49***
secondary education		(0.26)	(0.20)	(0.12)	(14.16)	(12.96)
Spouse with higher		2.93***	3.38***	-1.68***	-190.92***	134.10***
secondary education		(0.82)	(0.64)	(0.37)	(42.02)	(35.22)
Spouse with graduate	-376.27**	5.67**		-4.80***	-544.22***	
degree	(147.55)	(2.82)		(0.84)	(95.53)	
Spouse with other	-149.72***		1.79*	-1.35**	-153.62**	
education	(41.73)		(1.03)	(0.54)	(61.40)	
Lean Season						
Agricultural asset	0.00***	0.00*	0.00**	0.00***	0.00***	0.00***
value per capita (2010 price)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	2126.60***	33.88***	21.34***	13.79***	1563.84***	597.74***
	(47.01)	(0.64)	(0.43)	(0.27)	(30.29)	(27.45)
Adjusted R^2	0.099	0.314	0.277	0.131	0.131	0.239
F	.	39.87	.	.	.	31.15
N	11,768	11,768	11,768	11,768	11,768	11,768

Notes: 1. Standard errors in parentheses. * p <0.10, ** p <0.05, *** p <0.01.
2. Models include district fixed effects and employ clustered robust standard errors.

TABLE 4: Effect of the 2005-2010 rice price increase on Seller households

	Calorie intake	Items consumed	Types of food consumed	Rice consumption in kg	Calorie from rice	Calorie from nonrice
Year 2010	74.62*	5.12***	2.05***	-0.91***	-103.32***	177.10***
	(42.24)	(0.52)	(0.46)	(0.23)	(25.84)	(24.89)
Seller	336.33***	1.55***	1.03**	1.42***	161.61***	169.54***
	(64.80)	(0.49)	(0.42)	(0.35)	(39.40)	(32.25)
DD estimate	58.63	-0.94	-0.53	0.03	3.85	54.51
	(90.98)	(0.73)	(0.60)	(0.47)	(53.76)	(50.71)
Income per capita	0.01*					0.00**
(2010 Price)	(0.00)					(0.00)
Age of household	5.40***	0.04***	0.02**	0.02***	2.35***	3.49***
head	(1.21)	(0.01)	(0.01)	(0.01)	(0.80)	(0.66)
Female head		-2.48***	-1.77***			138.13***
		(0.48)	(0.43)			(34.25)
Household head has		1.62***	1.12***			61.29**
primary education		(0.42)	(0.37)			(30.54)
Household head has		2.14***	1.84***			60.05***
secondary education		(0.40)	(0.34)			(20.76)
Household head has		2.95***	2.84***			144.11***
higher secondary education		(0.57)	(0.50)			(35.39)
Household head has	-289.96***	2.37**	1.98**	-1.89***	-214.39***	
graduate degree	(101.23)	(1.17)	(0.99)	(0.61)	(69.37)	
Household head has						
other education						
Spouse with primary	-94.06**	1.46***	1.50***	-1.16***	-132.01***	
education	(42.89)	(0.40)	(0.37)	(0.24)	(26.84)	
Spouse with	-113.95***	1.84***	1.82***	-1.78***	-201.88***	43.77*
secondary education	(42.59)	(0.38)	(0.34)	(0.23)	(26.65)	(24.09)
Spouse with higher	-173.32**		1.88**	-2.76***	-313.40***	
secondary education	(80.27)		(0.82)	(0.44)	(49.72)	
Spouse with graduate	-622.88*			-4.56*	-516.80*	
degree	(371.98)			(2.72)	(308.90)	
Spouse with other		1.94***		-4.38***	-496.34***	410.40***
education		(0.70)		(0.33)	(37.52)	(62.99)
Lean Season				-0.63**	-71.75**	
				(0.30)	(34.04)	
Agricultural asset	0.01***	0.00***	0.00***	0.00***	0.00***	0.00***
value per capita (2010 price)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	2328.70***	35.61***	21.33***	15.17***	1720.86***	684.06***
	(77.13)	(0.83)	(0.68)	(0.41)	(46.82)	(50.50)
Adjusted R^2	0.116	0.282	0.219	0.122	0.122	0.220
F	9.69	.	15.19	.	.	.
N	3,029	3,029	3,029	3,029	3,029	3,029

Notes: 1. Standard errors in parentheses. * p <0.10, ** p <0.05, *** p <0.01.
2. Models include district fixed effects and employ clustered robust standard errors.

TABLE 5: Implied significance level of the DD estimates

	Calorie intake	Items consumed	Types of food consumed	Rice consumption in kg	Calorie from rice	Calorie from nonrice
Buyer						
Significance level	0.05	0.06	0.05	0.04	0.05	0.06
Observations	1,000	1,000	1,000	1,000	1,000	1,000
Seller						
Significance level	0.06	0.04	0.05	0.05	0.04	0.05
Observations	1,000	1,000	1,000	1,000	1,000	1,000

Notes: 1. For simulation, we employed the analysis sample with 1000 repetitions.
2. Models include district fixed effects and employ clustered robust standard errors.

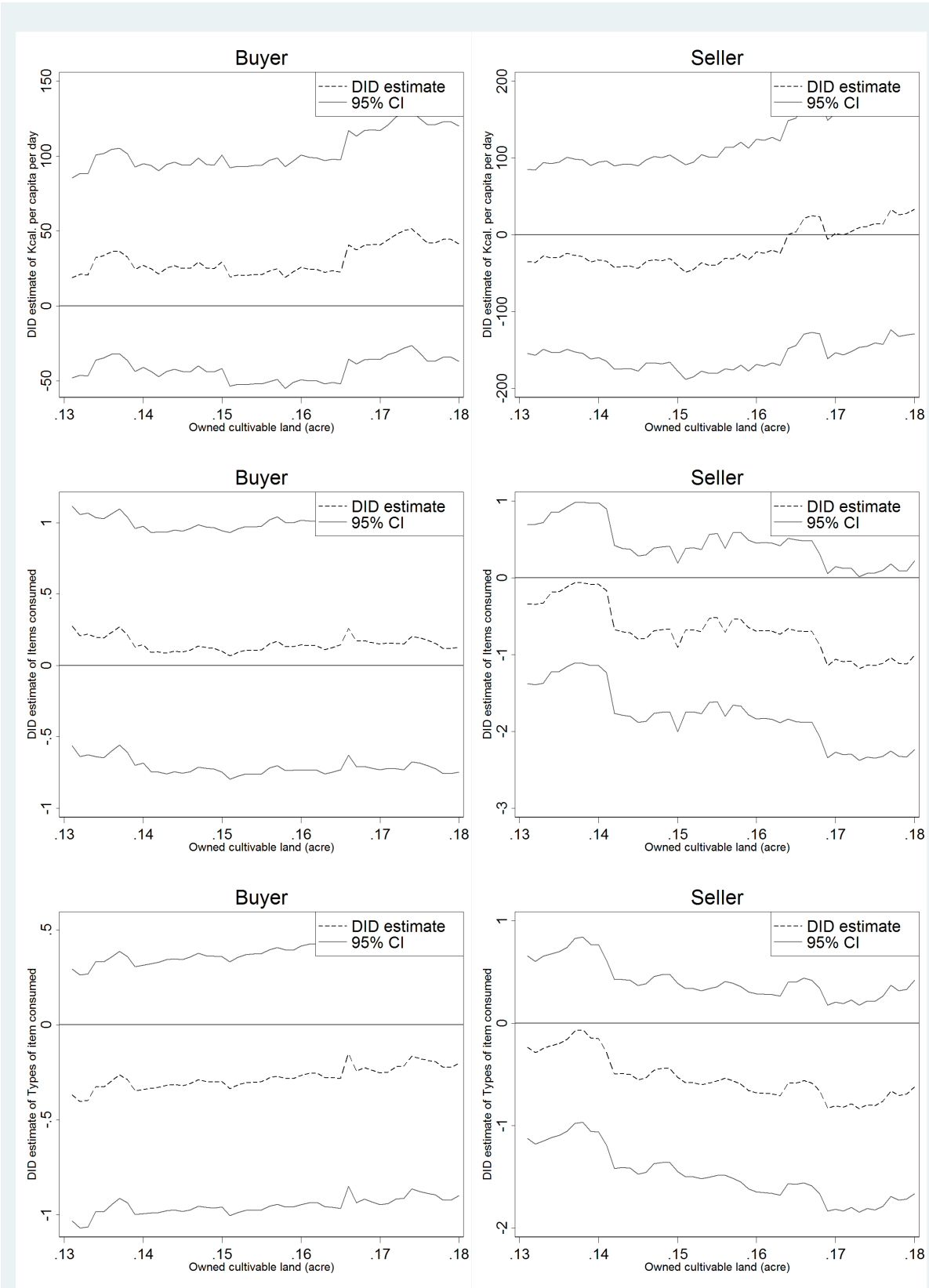

FIGURE 1: Distribution of DD estimate

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Appendix A Appendix Tables

Table A.1: Effect of the 2005-2010 rice price increase on Buyer households

	Kcal. per capita per day from					
	grain	non-rice grain	pulses	protein	fruits	other item
Year 2010	-20.37	85.63***	4.34	9.00*	21.46***	35.06***
	(28.47)	(10.66)	(2.87)	(5.43)	(7.22)	(8.73)
Buyer	-152.77***	-17.68***	-4.99***	-30.20***	-16.27***	-32.61***
	(22.03)	(6.82)	(1.83)	(3.97)	(4.35)	(5.86)
DD estimate	38.55	-3.49	-1.26	0.65	-6.34	5.53
	(27.62)	(10.00)	(2.47)	(5.17)	(5.63)	(7.47)
Income per capita		0.00**	0.00*	0.00**	0.00**	0.00**
(2010 Price)		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Age of household	4.85***	0.30**	0.25***	0.43***	0.35***	0.62***
head	(0.41)	(0.12)	(0.04)	(0.07)	(0.07)	(0.10)
Female head			6.03***	11.74***	29.29***	48.55***
			(1.57)	(3.43)	(3.30)	(5.07)
Household head has		13.03**		14.93***	6.19**	18.06***
primary education		(5.49)		(2.18)	(2.49)	(3.47)
Household head has		15.39***	2.23*	15.36***	5.58**	24.43***
secondary education		(4.81)	(1.15)	(2.56)	(2.49)	(4.06)
Household head has		29.82***	7.74***	44.43***	27.59***	43.46***
higher secondary education		(11.00)	(2.54)	(6.83)	(7.13)	(8.09)
Household head has	-148.34**			37.98***		66.16***
graduate degree	(60.76)			(10.41)		(15.97)
Household head has			-15.62***			
other education			(4.56)			
Spouse with primary	-49.19***	11.43**		7.22***		12.02***
education	(12.27)	(4.80)		(2.40)		(3.83)
Spouse with	-89.46***	19.78***	3.12**	22.60***	6.55**	34.04***
secondary education	(13.76)	(5.63)	(1.28)	(2.81)	(2.61)	(4.49)
Spouse with higher	-160.28***	29.28**		44.18***		70.42***
secondary education	(42.13)	(13.80)		(8.41)		(12.48)
Spouse with graduate	-456.92***	104.40*	-16.33*	113.99***		
degree	(106.35)	(56.58)	(8.68)	(35.47)		
Spouse with other	-187.64***			73.83***		
education	(62.24)			(11.46)		
Lean Season	-34.28*		10.13***		-23.97***	
	(18.43)		(2.68)		(4.25)	
Agricultural asset	0.00***			0.00**	0.00**	0.00***
value per capita (2010 price)	(0.00)			(0.00)	(0.00)	(0.00)
Constant	1638.78***	142.90***	32.01***	73.94***	154.20***	154.19***
	(32.82)	(15.06)	(3.13)	(5.81)	(7.49)	(9.48)
Adjusted R^2	0.111	0.203	0.243	0.191	0.191	0.224
F	.	10.81	16.45	.	17.91	30.09
N	11,768	11,768	11,768	11,768	11,768	11,768

Notes: 1. Standard errors in parentheses. * p <0.10, ** p <0.05, *** p <0.01.
2. Models include district fixed effects and employ clustered robust standard errors.

TABLE A.2: Effect of the 2005-2010 rice price increase on Seller households

	Kcal. per capita per day from					
	grain	non-rice grain	pulses	protein	fruits	other item
Year 2010	-16.52	90.56***	5.37*	12.84**	26.33***	35.46***
	(28.05)	(10.86)	(2.94)	(5.38)	(7.04)	(8.70)
Seller	188.81***	17.19*	12.47***	51.53***	26.68***	48.18***
	(42.92)	(10.09)	(3.63)	(7.92)	(7.18)	(12.17)
DD estimate	8.87	6.37	0.96	1.23	20.62	17.33
	(59.84)	(16.48)	(5.06)	(11.22)	(13.19)	(16.41)
Income per capita		0.00**	0.00**	0.00**		0.00**
(2010 Price)		(0.00)	(0.00)	(0.00)		(0.00)
Age of household	2.70***	0.79***	0.29***	0.68***	0.32**	1.09***
head	(0.87)	(0.26)	(0.07)	(0.15)	(0.16)	(0.22)
Female head			7.90**	20.63**	36.58***	70.59***
			(3.68)	(8.99)	(7.13)	(13.05)
Household head has	58.19*			21.81***		25.42**
primary education	(35.26)			(7.19)		(11.58)
Household head has				19.83***		27.58***
secondary education				(4.83)		(7.32)
Household head has				40.74***	22.72**	57.16***
higher secondary education				(8.60)	(9.57)	(12.24)
Household head has	-199.15***				-46.15***	48.02**
graduate degree	(73.10)				(11.36)	(20.32)
Household head has				-36.37**		
other education				(16.99)		
Spouse with primary	-102.94***	31.09***			-16.25***	
education	(30.82)	(10.15)			(4.83)	
Spouse with	-160.22***	39.45***		12.37**		
secondary education	(30.05)	(9.41)		(6.09)		
Spouse with higher	-254.40***	67.93***			-24.29**	29.04*
secondary education	(53.82)	(19.72)			(12.32)	(16.90)
Spouse with graduate	-522.69*					-114.94***
degree	(306.07)					(27.72)
Spouse with other		546.95***		19.62*	-78.66***	99.55***
education		(53.76)		(11.20)	(21.63)	(15.40)
Lean Season	-62.48*				-44.52***	
	(35.60)				(6.52)	
Agricultural asset	0.00***		0.00**	0.00***	0.00***	0.00***
value per capita (2010 price)	(0.00)		(0.00)	(0.00)	(0.00)	(0.00)
Constant	1810.96***	131.75***	29.26***	79.51***	197.67***	163.70***
	(55.01)	(20.97)	(4.18)	(9.74)	(10.74)	(16.11)
Adjusted R^2	0.119	0.254	0.195	0.174	0.186	0.177
F	9.72	.	16.27	.	.	.
N	3,029	3,029	3,029	3,029	3,029	3,029

Notes: 1. Standard errors in parentheses. * p <0.10, ** p <0.05, *** p <0.01.
2. Models include district fixed effects and employ clustered robust standard errors.