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Is mental accounting of farm produce associated with more consumption of own-produced food?

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ABSTRACT

This study examines whether mental accounting theory is applicable to consumption of own-produced food of smallholder farm households. We are motivated by the farm household's procedure of allocating own-produced food, and some evidence of inflexible use of own-produced food reserve. Using hypothetical scenarios of food reserve and consumption, we find that smallholder farm households show evidence of having a mental budget for own-produced food for self-consumption, tracking their consumption against the budget, and compensating for earlier over- or underconsumption. A substantial number of people used the reserve of their own produced food, exceeding their consumption needs, as their mental budget to guide their consumption, leading to an outcome of overconsumption of own produce. Furthermore, we explored factors of mental accounting and proposed policy implications of the study.

1. Introduction

Smallholder farm households, despite being food producers, are the most malnourished group particularly suffering from micronutrient deficiencies due to low dietary diversity in many developing countries (IFPRI, 2016; FAO, 2014; Pinstrup-Andersen, 2007). Unlike pure consumers who can only consume food from purchasing, many smallholder farm households consume considerable amounts of food from their own produce (Fanzo, Hunter, Borelli, & Mattei, 2013; Sibhatu & Qaim, 2018). However, limited research has dealt with the questions of how smallholder farm households allocate the quantities of their produce to sell and to consume, and how their consumption of own produce would be influenced by the allocation. We aim to apply some insights from mental accounting theory to explain the consumption of own-produced food of farm households due to observed deviations from the standard economic prediction.

According to the standard economic model, the consumption of own produce is not influenced by the allocation itself because allocation can be flexible and happening frequently due to changes in market prices and transaction costs (Taylor & Adelman, 2003). However, evidence shows that the allocation is often made once in the harvest season, in which part of the own produce is pre-committed for own consumption, especially for grain (Park, 2006; Piggott, 2003). This “pre-committed quantity” is often larger than the quantity the household needs to consume within a harvest period and does not respond to price changes (Huang et al., 2018; Park, 2006; Piggott, 2003). However, the inflexible use of a “pre-committed quantity” may come at a cost. When the market is accessible, the increased cash income from selling part of the grain reservation can be used to purchase other food varieties and other commodities or services. Nevertheless, an outcome of excess consumption of own-produced grains and tubers was found as compared with the dietary recommendation (Huang et al., 2018). It seems that with excess grain reservation, households consume more than needed and overlook the opportunity cost of consuming the excess part of grain reserve. This excess consumption raises nutritional concerns, since grain-producing households, for example, could have sold the overconsumed part of grain for cash income and bought more varieties of food to achieve a more diversified diet.

Considering the process of allocating own-produced food, the inflexibility of using own-produced food reserve, and the overconsumption result all together, we assume that the allocation and consumption process of own-produced food is very similar as the financial budget setting and expenditure tracking behavior predicted by mental accounting theory, which therefore may offer an explanation of the observed overconsumption of own produce.

Mental accounting theory describes how people set mental budgets for specific categories of expenses and then consume with that budget in mind (Thaler, 1985, 1999, 2008), and it violates the standard

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economic principle of fungibility of money (Thaler, 1999). Mental accounting theory relies on the assumption of two processes: setting budgets for specific expense categories and tracking ongoing expenses against the set budgets. These processes predict that people's consumption is guided by the set budget. Hence mental accounting may cause economically irrational behavior. If people set budgets too low or too high, and without any flexible adjustments either to budget setting or consumption tracking, either underconsumption or overconsumption may happen (Heath & Soll, 1996).

We expect a substantial part of smallholder farm households to use their food reserve as a mental budget guiding their consumption behavior. In line with existing mental accounting research, we also expect that too high or too low consumption during some time subsequently will be compensated in order to keep within the food budget or to deplete the budget. To test our expectation, in the first part of our study, by using hypothetical scenarios, we set a food reserve condition (exceeding their consumption needs), create surplus and shortage situations with respect to the quantities of "food-needed-to-consume" in the middle of a harvest period, and observe the farmer's choice of food consumption in the next half of the period. In this way, we investigate whether people use "food-needed-to-consume" or "food reserve" as the mental budget, and whether people track their food consumption against the set budget and compensate. We further examine what socio-economic and demographic factors are associated with mental accounting of own-produced food in the second part of our study, and the effect of mental accounting on actual consumption of own produce in the third part of our study. We conducted a face-to-face household survey of 424 agricultural households in four poor rural counties of southwest China in August of 2018 to collect data needed for our study.

Given the limited research on the mental accounting of food consumption quantity (Krishnamurthy & Prokopec, 2010; Sussman, Alter, & Paley, 2016), our study may enrich the application of mental accounting theory to non-monetary resources and non-pure consumers, and bring new insights into understanding the allocation and consumption process of own-produced food of agricultural households, especially in developing countries where smallholder agriculture is prevalent.

We begin by reviewing literature on the allocation of own produce of agricultural households, the application of mental accounting theory to the food area, and factors of mental accounting. We then present methods and results of each of three study parts testing mental accounting hypotheses on consuming own-produced food, factors and effects of mental accounting, respectively. We conclude with a discussion of our findings.

2. Literature

2.1. Allocation of own-produced food

Smallholder farm households consume a considerable amount of own-produced food, especially in developing countries (Sibhatu & Qaim, 2018). However, the question of how agricultural households exactly determine the amount of food that is sold and the quantity that is kept for eating at home has not been studied sufficiently.

Agricultural Household Models (AHM) offer a framework to analyze the question of how agricultural households allocate own-produced food (Taylor & Adelman, 2003). In brief, in agricultural household models, market prices and transaction costs play important roles in the choice of households to be self-sufficient or not (Goetz, 1992; Key, Sadoulet, & Janvry, 2000). Agricultural households will thus make a rational calculation of market prices, transaction costs, and subjective valuation of their produce. If the subjective valuation of own-produced products is higher than the market price minus transaction costs, then it is better to keep the product for own consumption (Taylor & Adelman, 2003).

However, in low-income rural contexts where small-scale farming is prevalent, own-produced food, especially grain, is often used first to meet agricultural households' own consumption needs. Thus, households are frequently observed to first reserve a "pre-committed quantity" from produce for own consumption, then sell the rest for cash income (Park, 2006). The "pre-committed quantity," however, is usually more than what a household needs in a harvest period (Barrett & Dorosh, 1996; Park, 2006). This behavior mainly happens because, in addition to the consumption motive, there is also a precautionary motive, to avoid suffering from price and yield shocks in the next harvest period (Park, 2006). Storing a more-than-needed amount of grain serves as a consumption smoothing strategy for agricultural households.

The "pre-committed quantity" of food reserve, however, usually does not respond to price changes (Huang et al., 2018; Park, 2006; Piggott, 2003). It seems that even when market price is high, and the market is accessible, households may still be reluctant to sell part of the "pre-committed quantity" for cash income. Little is known about whether this inflexible use of food reserve influences household food consumption, and what the dietary outcome might be.

We expect that some part of the households will consider the reserve of their own produce as a mental budget for consumption, and this budget is guiding their consumption to some extent, thus turning part of the precautionary motive into a consumption motive.

2.2. Mental accounting theory

Mental accounting refers to people's psychological separation of resources and how people track the use of resources. Mental accounting was broadly defined by Thaler (1999, pp. 183) as "the set of cognitive operations used by individuals and households to organize, evaluate, and keep track of financial activities." Mental accounting has mainly been discussed in the domain of financial decision making (see Zhang & Sussman, 2018 for a review; Antonides & Ranyard, 2017). Grouping or labeling funds into different categories or accounts is the basic element of mental accounting. The accounts can be created either by origin of money (e.g. regular income, windfall money) (Milkman & Beshears, 2009; Thaler, 1999), or by intended use of the money (e.g. money for entertainment, food, and clothing) (Heath & Soll, 1996). Extensive evidence shows that categorizing or labeling funds will influence people's spending decisions, and people have different marginal propensity to spend across categories or accounts (Zhang & Sussman, 2018). For example, people are more likely to spend on luxury goods (e.g. a vacation, Henderson & Peterson, 1992) from windfall money than from regular income. Thus, mental accounting violates the standard economic principle of fungibility of money (Thaler, 1999).

Although mental accounting facilitates people's financial decisions, acts as a self-control device to avoid excess spending or consumption (Cheema & Soman, 2006), and helps people to reach certain goals, the inflexible characteristics of mental accounting come at a cost and may lead to suboptimal outcomes. In the process of mental accounting, different accounts and budgets are preset. However, consumption opportunities change over time, and the utility of consuming a unit of product or service may also change over time. The preset budgets may not meet the updated need for consumption. If people stick to tracking against the preset budget, and resist transfer across budgets, people may underconsume goods they desire and may overconsume goods that they desire less (Hastings & Shapiro, 2013; Heath & Soll, 1996). For example, if the budget for food is preset, and food prices decline, people may overlook the opportunity to transfer the surplus "food money" to other uses, leading to overconsumption of food (Just, Mancino, & Wansink, 2007). However, Cheema & Soman (2006) showed that mental accounting is not always entirely inflexible and sometimes malleable, through the process of (re-)constructing mental accounts and classifying ambiguous expenses.

Although mental accounting theory has been developed in the area

of financial decisions and has been applied mainly to monetary resources, is has also been applied to different types of decisions, including decisions about the use of time (Rajagopal & Rha, 2009; Soman, 2001), emotions (Levav & Mcgraw, 2009) and healthy diets (Krishnamurthy & Prokopec, 2010). So far, applications of mental accounting to other domains and to non-monetary resources remains largely unexplored (Zhang & Sussman, 2018).

Since we aim to explore the application of mental accounting to own-produced food of smallholder farm households, the next subsection will review the application of mental accounting to food consumption, both for food expenditure and food quantity.

2.3. Application of mental accounting to food consumption

A branch of studies has aimed at exploring the earmarking or labeling effect of money for specific use for food expenditure in incentivized cases. These studies have apparent policy implications since the policy makers would like to know, with the same monetary value of resources, which way to offer the resources would be more effective to achieve their goals: earmarking funds or cash? Several studies showed that households in the US had a higher marginal propensity to consume food when receiving food stamps and coupons than when receiving an equal amount of cash subsidies (Fox, Hamilton, & Lin, 2004; Fraker, Martini, & Ohls, 1995; Hastings & Shapiro, 2018). This is contradicting rational economic theory, which predicts that when the food budget is larger than the incentives, the same monetary value of cash and coupons would have the same effect. Similarly, in an incentivized case, but more for commercial interest, Abeler and Marklein (2008) found that wine-restaurant patrons spent 25% more on beverage when receiving an 8 euro voucher labeled for “beverages” than when receiving an 8 euro voucher labeled for “gourmet and beverages.” In a non-incentivized context, Villa, Barrett, & Just (2011) found that dietary diversity responses differed by different income sources for pastoral households in East Africa, even after accounting for alternative explanations of intrahousehold bargaining and market failures. These studies show that the type of budget (cash or in kind) influenced consumer spending, pointing to the non-fungibility of resources across different budgets predicted by mental accounting theory.

A few studies investigated people's mental accounting of food consumption quantity rather than food expenditure. They mainly studied whether people use mental accounting of food consumption to help control themselves to achieve a healthy diet. Krishnamurthy & Prokopec (2010) applied mental accounting theory to study consumption of food quantity and calorie intake. They showed that both a mental budget (the number of fun-sized candy bars the respondent think he/she should consume in a day) and an external reference point (the average number of fun-sized candy bars university students eat in a day) are needed to significantly reduce consumption of candy bars. They also showed the importance of unit-compatibility on the effect of mental budgeting on consumption control. To be specific, when the unit of the mental budget (e.g. calorie intake per day) was compatible with the description of consumption (number of calories for a particular dessert), the consumption of desserts was significantly lower than when it was incompatible. This study shows that both mental budgets and reference points may influence the amount of consumption.

2.4. Factors of mental accounting

Not everyone behaves as mental accounting theory predicts, neither as standard economic theory predicts. There are a few studies exploring the underlying social-economic and demographic factors of mental accounting (Abeler & Marklein, 2008; Antonides, De Groot, & Van Raaij, 2011; Muehlbacher & Kirchler, 2013). Cognitive abilities, wealth level, experience as indicated by age, and gender were found to be associated with mental accounting as follows.

Frederick (2005), Benjamin, Brown, & Shapiro (2013) showed that people with higher cognitive skills are prone to behave as standard economic theory predicts, while people with lower cognitive skills are more likely to act in accordance with theories of bounded rational behavior. Particularly, Abeler & Marklein (2008) found that subjects with lower mathematical skills were more likely to practice mental accounting. Antonides et al. (2011) found people with lower education level tended to do more mental accounting.

Antonides et al. (2011) found that less wealthy people with lower income, less savings, and more debts were more likely to practice mental accounting. They explained that people in less wealthy conditions have a stronger need to keep spending within the limits of each account. So they are more likely to use mental accounting as a self-control device. However, Muehlbacher & Kirchler (2013) found that mental accounting was positively related to income among entrepreneurs.

People with more experience in life (as indicated by age) or having experience with a specific economic behavior were assumed to do less mental accounting regarding this behavior. It is because with more experience, people have more time and opportunity to learn how to deal with issues without using mental accounting. However, Antonides et al. (2011) found age and being a financial manager of the household had no effects on mental accounting concerning household finance. In contrast, Muehlbacher & Kirchler (2013) found that age was the strongest predictor of mental accounting and older entrepreneurs did more mental accounting. However, they also found that experience of being self-employed had no effect on mental accounting practices.

Mental accounting is also assumed to differ by gender. Men were found to have a higher level of cognitive reflection (Frederick, 2005), and were expected to practice less mental accounting than women. Antonides et al. (2011) found evidence that men tended to use less mental accounting than women, controlling for the role of household financial manager. Summarizing, cognitive skills, wealth, experience and gender may influence the prevalence of mental accounting.

3. Part 1: Mental accounting of own-produced food

We aimed to test our expectations concerning mental accounting of own-produced food consumption. Particularly, we aimed to answer the questions of whether households use the “food-needed-to-consume[1]” or the “food reserve” as their mental budget, and whether the budget is guiding households’ consumption of own-produce. We asked for the amount of their “food-needed-to-consume” and created a food reserve condition exceeding their consumption needs in hypothetical conditions. Further, we constructed scenarios in which, allegedly, insufficient (or excess) levels of consumption had occurred in the first half of the consumption period as compared with half of the amount of food-needed-to-consume. By asking respondents about their consumption in the remaining consumption period, tracking consumption against the budget, and the type of budget being tracked could be inferred.

3.1. Subjects

We conducted a face-to-face household survey of 424 households in 76 villages of 4 poor counties[2] of Yunnan and Guizhou Provinces in southwest China in August of 2018. In each county, 19 villages were selected using the probability-proportional-to-size (PPS) method, and in each village 5–6 households were randomly selected. From those 424 households, 68 were rice producers and 143 were potato producers.

[1] “Food needed-to-consume” in this study means “the amount of food the household thinks they usually consume in a certain period of time.”

[2] From The National Plan for Poverty Reduction between 2011 and 2020, Chinese government has designated 592 national poor counties. The 4 sampled counties were selected from those 592 national poor counties based on their willingness to cooperate and high prevalence of small-scale farming.

Both rice and potatoes are harvested only once a year in the survey areas.

3.2. Scenario design

We used a scenario approach to study people's hypothetical decisions on consuming own-produced rice and potatoes. A 2 × 2 within-subjects design was applied. All subjects were asked questions under two scenarios: insufficient and excess consumption in the first half of the year, and for two products: rice and potatoes.

All 424 subjects, including both producers and non-producers, were asked three questions for each food product. Taking rice as an example, first, subjects were asked how many kilograms of rice the household needed to consume a year[3]. Then, subjects were told they had 120% of the reported amount needed as a reserve of their own rice produce for consumption right after the harvest. This way, we aimed at simulating the common behavior of farmers to reserve a bit more rice than needed due to consumption and precautionary motives. Then, two scenarios with different amounts of rice consumption in the first half year were constructed, one in which less than half (40%) of the amount needed was consumed, the other in which more than half (60%) of the amount needed was consumed, resembling situations of surplus and shortage in the second half year, respectively. Under these two scenarios, subjects were asked how much rice they would consume in the second half of the year. In order to exclude the explanation of observed over-consumption of own produce or opportunity cost neglect due to limited market access or high transaction cost, we added a clause to remind the household that their own produce could be easily sold for cash money. The exact wording of the three questions for rice was as follows.

> Question 1: How many kilograms of rice does your household need to consume each year?
> Answer 1:__X__kilograms.
> Question 2 (Scenario A): You just said your household needs to consume X kilograms of rice a year. Suppose that your household reserved 1.2X kilograms just after your harvest. Now, half a year has passed since the harvest, and you have consumed 0.4X kilograms of your own-produced rice, less than half of what you think your household needs to consume for a whole year. You have 0.8X kilograms left for the remaining half of the year, and you can easily sell your produce to the market. How many kilograms will you consume from your own-produced rice in the next half year?
> Answer 2:_____kilograms.
> Question 3 (Scenario B): Now, imagine half a year has passed since the harvest, and you have consumed 0.6X kilograms of your own-produced rice, more than half of what you think your household needs to consume for a whole year. You have 0.6X kilograms left for the remaining half of the year, and you can easily sell your produce to the market. How many kilograms will you consume from your own-produced rice in the next half year?
> Answer 3:_____kilograms.

After the three questions for rice were asked, the same questions were then asked for potatoes. The exact food amounts stated in the questions (e.g. 0.4X, 0.8X, 1.2X, etc.) were automatically calculated by the electronic questionnaire software, and shown on a tablet (rather than the 0.4X etc.), based on the rice demand (X) reported by the household in response to the first question. If the stated consumption in the second half year plus the consumption in the first half year in the scenario exceeded the pre-determined reserve (1.2X), an error warning appeared on the screen to remind the enumerator to check the answer again with the subject and if necessary, ask the question again. Well-trained enumerators asked the questions to the subjects and recorded their answers on the electronic questionnaire equipment.

3.3. Predictions and hypotheses

We were interested in several possible strategies for consumption according to either the standard economic theory or the mental accounting hypothesis, to be considered next. We expected that such strategies would be used by substantial parts of the respondents, leading to the different predictions to be considered next.

Prediction 1. Rational decisions.

If subjects made rational decisions, in line with standard economic consumer theory, stated consumption in the second half year would be 0.5X kilograms, half of what they thought they needed to consume in a whole year. The answer should not be influenced by the consumed amount in the first half of the year, meaning that they would not adjust their consumption to situations of surplus and shortage to compensate. Therefore, under this assumption, it was predicted that in both scenarios A and B, people would consume 0.5X kilograms in the second half year.

Prediction 2. Mental accounting using food needed as the total budget.

If subjects did mental accounting on consumption of own produce and took the food they thought they needed (X kilograms) as the total budget, they would track their consumption against this budget and compensate. Intuitively, they would consume more in the surplus situation and consume less in the shortage situation sticking to the total annual budget of X kilograms. Under this assumption, in Scenario A, subjects would answer 0.6X kilograms, and in Scenario B, people would answer 0.4X kilograms. We tested this prediction by testing whether the proportion of subjects who fit Prediction 2 was significantly different from zero.

Prediction 3. Mental accounting using food reserve as the total budget.

If subjects did mental accounting on consumption of own-produce and took the food reserve (1.2X kilograms) as the total budget, tracking consumption against this budget and compensating, they would answer 0.8X kilograms in Scenario A, and 0.6X kilograms in Scenario B. We tested this prediction by testing whether the proportion of subjects who fit Prediction 3 (answer 0.8X in Scenario A and 0.6X in Scenario B) was significantly different from zero.

Prediction 4. Adjustment effect.

Subjects may have adjusted their estimation of consumption needed in the second half year based on the information of 0.4X or 0.6X consumption in the first half year given in the scenarios. For example, in Scenario A, subjects may have thought the household needed to consume only 0.4X kilograms in the first half year. Therefore, in the second half year, the household also needed to consume only 0.4X kilograms. In this case, they would answer 0.4X kilograms in Scenario A, and 0.6X kilograms in Scenario B.

Table 1 summarizes the four predictions. Taking possible computation errors into consideration, we allowed for a range of 5% below and above the hypothesized answers as acceptable deviations from the predictions.

The main objective of this part of study was to show that the behavior of mental accounting for consumption of own-produced food existed. Predictions 2 and 3 both were based on the assumption that people did mental accounting of consumption of own-produced food, albeit with different mental budgets in mind.

3.4. Results

3.4.1. Answers by predictions and evidence of mental accounting

Table 2 reports the respondents' answers by each of the four predictions. The results are first summarized by rice and potatoes, then

[3] The Chinese wording actually means "How many kilograms of rice does your household usually consume a year?" The word "need" here does not mean the minimum amount to survive on.

Table 1
Summary of four predicted answers in Scenarios A and B.

Predictions	Mental budget	Answers in Scenario A		Answers in Scenario B	
		Predicted answer	Likely answer range	Predicted answer	Likely answer range
P1: Rational decisions	-	0.5X	[0.475X, 0.525X]	0.5X	[0.475X, 0.525X]
P2: Mental accounting (consumption need)	X	0.6X	[0.570X, 0.630X]	0.4X	[0.380X, 0.420X]
P3: Mental accounting (reservation)	1.2X	0.8X	[0.760X, 0.800X]	0.6X	[0.570X, 0.600X]
P4: Adjustment effect	-	0.4X	[0.380X, 0.420X]	0.6X	[0.570X, 0.600X]

Table 2
Summary of answers for hypothetical questions by four predictions.

Predictions	Mental budget	Rice		Potatoes		Overall (either for rice or for potatoes)	
P1: Rational decisions	-	33	7.78%	31	7.31%	50	11.79%
P2: Mental accounting (consumption need)	X	13	3.07%	18	4.25%	24	5.66%
P3: Mental accounting (reservation)	1.2X	98	23.11%	103	24.29%	125	29.48%
P4: Adjustment effect	-	62	14.62%	60	14.15%	78	18.40%
Mental Accounting (P2 + P3)		111	26.18%	121	28.54%	144	33.96%

incorporated in the "Overall" column, showing the number of subjects whose answers were consistent with each Prediction, for either rice or potatoes, in order to provide an overall picture.[4]

Table 2 shows that the largest proportion of subjects' answers were consistent with Prediction 3. Overall, 29.48% of the subjects' answers were consistent with Prediction 3, followed by 18.40% for Prediction 4, 11.79% for Prediction 1, and 5.66% for Prediction 2. The order of these percentages is the same in each column.

We counted 144 subject answers consistent with either Prediction 2 or 3 (33.96%), which was significantly different from zero (chi2(1) = 229.2898, p = .000), thus showing that a significant proportion of subjects showed some behavior of mental accounting for consumption of own-produced food.

3.4.2. Mental budget: food needed or food reserved

There were 125 (29.48%) subjects whose answers fit Prediction 3, which was significantly different from zero (chi2(1) = 195.0071, p = .000), showing that a significant proportion of people took the reserved amount of food as their mental consumption budget. We also noticed that the number of subjects using the reserved amount (1.2X) as their mental budget was significantly higher (chi2(1) = 89.6518, p = .000) than those using the amount of food needed (X) as their mental consumption budget. As a result, these subjects chose to consume more than what they needed, thus signaling overconsumption. This result is all the more striking since they have been informed explicitly that their produce could be easily sold on the market for cash income.

3.4.3. Mental accounting in surplus and shortage scenarios

Table 3 shows the results by scenario. According to standard economic consumer theory, the answers concerning consumption in the remaining half of the year should not be influenced by the scenario frame. However, in the shortage scenario (Scenario B), with less food remaining than planned, there were significantly more subjects showing behavior of mental accounting than in the surplus scenario (Scenario A). Specifically, as shown in the last row of Table 3, the proportion of subjects whose answers fit Prediction 2 or 3 in Scenario A was 33.49% for rice, and 34.20%, for potatoes, which was significantly smaller than those in Scenario B (rice: 45.75%, chi2(1) = 13.3704, p = .000; potatoes: 44.81%, chi2(1) = 10.0155, p = .002). This result revealed that people did more mental accounting in case of shortage or scarcity, which is in line with the finding that less wealthy respondents with more debts do more mental budgeting than the wealthy (Antonides et al., 2011).

3.4.4. Strict and partial mental accounting

Above, we have defined subjects who did mental accounting for consumption of own-produced food as those whose answers fit either Prediction 2 or Prediction 3 in both Scenarios A and B, which is a rather strict condition. Actually, people who showed food budget tracking behavior in one of the two scenarios could be considered as doing partial mental accounting, which can be seen as a relaxed version of mental accounting. Therefore, we define the former strict version as "strict mental accounting," and the latter relaxed version as "partial mental accounting," referring to subjects whose answers were in line with either Prediction 2 or 3, either in Scenario A or B, and did not show rational decision making (Prediction 1) or adjustment behavior (Prediction 4).

Table 4 shows the number and proportion of subjects showing strict and partial mental accounting. Overall, there were 33.96% of subjects showing strict mental accounting and 53.07% showing partial mental accounting (strict mental accounting included). This result indicates that more than half of the subjects showed mental accounting behavior at some level.

As a conclusion, this part of study shows evidence of mental accounting of consumption of own-produced food. While rational behavior consistent with standard economic theory also was shown, more than half (53.07%) of the subjects showed mental accounting behavior at some level. Heath & Soll (1996) used the percentage of subjects showing underconsumption of food expenditure within a week after a typical food purchase as an indicator of mental budgeting. They found the percentage to vary from 45% to 55%, which is very close to the percentage we found. Moreover, we found more respondents using "food reserve" than "food-needed-to-consume" as their mental budget, and tracking consumption against the budget, consequently indicating overconsumption of own-produced food. Lastly, we found the percentage showing mental accounting in the food shortage scenario to be higher than that in the food surplus scenario, indicating that people did more mental accounting when recourses were scarce.

4. Part 2: Factors of mental accounting of own-produced food

In Part 2, we aimed to study the possible factors associated with mental accounting of consumption of own-produced food. The previous literature regarding factors of mental accounting as summarized in

[4] It is possible that a respondent's answers fit in one Prediction for rice but in the other Prediction for potatoes. After excluding such cases, the percentage that fit each prediction did not change much, and the test results still hold.

Table 3
Summary of answers for hypothetical questions by scenario.

	Scenario A (Surplus)	Rice		Potatoes		Scenario B (Shortage)	Rice		Potatoes	
P1: Rational decisions (-)	[0.475X, 0.525X]	83	19.58%	72	16.98%	[0.475X, 0.525X]	63	14.86%	53	12.50%
P2: Mental accounting (X)	[0.570X, 0.630X]	42	9.91%	40	9.43%	[0.380X, 0.420X]	73	17.22%	71	16.75%
P3: Mental accounting (1.2X)	[0.760X, 0.800X]	100	23.58%	105	24.76%	[0.570X, 0.600X] (Adjustment effect excluded[a])	121	28.54%	119	28.07%
Mental Accounting (P2 + P3)		142	33.49%	145	34.20%		194	45.75%	190	44.81%

[a] As described in section 3.3., Adjustment effect is for subjects whose answers fit Prediction 4, they answered 0.4X in Scenario A and at the same time 0.6X in Scenario B. There are 62 subjects fit Prediction 4 for rice questions, and 60 for potato questions as shown in Table 2. For Prediction 3, the expected answer in Scenario B is also 0.6X, to avoid possible confusion, we hereby emphasize that the statistics here have excluded adjustment effect by excluding those 62 subjects whose answers fit Prediction 4 for rice, and 60 for potatoes.

Table 4
Number and proportion of subjects showing strict and partial mental accounting.

	Strict mental accounting		Partial mental accounting (strict mental accounting included)	
Rice	111	26.18%	206	48.58%
Potatoes	121	28.54%	203	47.88%
Overall	144	33.96%	225	53.07%

Section 2.4 showed that cognitive skills, wealth, experience and gender may influence the prevalence of mental accounting. We expected households who actually produced rice and potatoes, and who were wealthier, would be less likely to practice mental accounting. We also expected respondents who had more years of education, who were male, and who were decision maker regarding selling farm produce would be less likely to practice mental accounting.

4.1. Method

We used the same samples as in Part 1 of our study and we applied the method of Logit regression in which the binary dependent variable indicated whether or not the subject showed strict mental accounting based on the classification in Part 1 as shown in Table 4. The explanatory variables mentioned in the previous paragraph cover aspects at both household and respondent level.

At the household level, the experience-relevant variables included whether the household produced rice or potatoes, and whether the household engaged in agricultural production activities without producing rice or potatoes. The log of total household income was included as a wealth-relevant variable. The number of household members in the age brackets of 5 years or under, 6–14 years, 15–64 years, and 65 years or over were also included as control variables.

At the respondent level, experience-relevant variables included whether the respondent was the decision maker of selling farm produce, and whether the respondent's occupation was farmer. The years of education of the respondent, and whether the respondent received training in farm management (including producing and selling skills training) in the 12 months before the survey were included as cognitive ability-relevant variables. Also, age and gender of the respondent were included.

We conducted two regressions, using strict mental accounting for rice, and potatoes as dependent variables, respectively. Sample statistics of all variables are shown in Table 5.

Table 5
Sample statistics in Part 2.

Variable	#Obs	Mean	Std. Dev.
Mental accounting (Rice) (1 = yes 0 = no)	424	0.262	0.440
Mental accounting (Potatoes) (1 = yes 0 = no)	424	0.285	0.452
Household level			
Producer (Rice) (1 = yes 0 = no)	424	0.160	0.367
Engaged in agriculture but not rice producer (1 = yes 0 = no)	424	0.743	0.438
Producer (Potatoes) (1 = yes 0 = no)	424	0.337	0.473
Engaged in agriculture but not potato producer (1 = yes 0 = no)	424	0.566	0.496
Log of total income	424	10.530	1.104
Number of household members aged 0–5 years	424	0.309	0.564
Number of household members aged 6–14 years	424	0.432	0.728
Number of household members aged 15–64 years	424	2.203	1.176
Number of household members aged 65+ years	424	0.557	0.773
Respondent level			
Gender (1 = male 0 = female)	424	0.649	0.478
Age in years	424	52.330	12.659
Years of education	424	5.705	3.768
Training of farm management (1 = yes 0 = no)	424	0.219	0.414
Occupation as a farmer (1 = yes 0 = no)	424	0.613	0.488
Decision maker of selling farm produce (1 = yes 0 = no)	424	0.448	0.498

4.2. Results

Table 6 shows the regression results for mental accounting by rice and potato farmers. The likelihood ratio statistics show that the two models were both significant. Likewise, the predictive capability of the models, measured as the percentage of correct classification, was 74.76% and 73.35%, respectively.

The coefficient of actual producer of rice/potatoes was negative and statistically significant for rice (Coeff. = −1.014) and potatoes (Coeff. = −0.705), respectively. Odds ratios were 0.362 for rice, and 0.494 for potatoes. This result shows that actual producers were 50%–64% less likely to practice mental accounting than non-rice or non-potato producers. Households who did not produce rice or potatoes, but engaged in other agriculture were around 49% (Coeff. = −0.679 for rice; Coeff. = −0.636 for potatoes) less likely to practice mental accounting than households who were not engaged in agriculture at all. Apparently, the more relevant the real experience of households was, the less likely they were to practice mental accounting on their consumption of own produce.

Household structure was significantly associated with mental accounting of consumption of own produce. The number of household members below the age of 5 years had a significant positive effect on mental accounting for rice and potatoes. However, the number of household members in the age categories of 15–64 years, and 65 years or over both had negative effects. It appeared that with more adult members in the household, mental accounting of consumption of own produce diminished, possibly due to the effect of accumulated life experience. People with more life experience may have learned how to deal with own-produced food reserves. Also, the presence of more adult household members may have led to more rational decisions as a result of joint decision making. Households with children under 5 years old, usually having a relatively young household head, probably had less life experience, apparently leading to more mental accounting.

The male gender of the respondent had a positive effect on mental accounting, and was significant for potato farmers, meaning that men were more likely to practice mental accounting of consumption of own produce than women. The direction of the gender effect is consistent

Table 6
Logit regressions of mental accounting.

Variables	Rice		Potatoes	
	Coeff.	Odds Ratio	Coeff.	Odds Ratio
Producer (Rice)	-1.014**	0.362		
	(0.508)			
Engaged in agriculture but not rice producer	-0.679*	0.507		
	(0.378)			
Producer (Potatoes)			−0.705*	0.494
			(0.400)	
Engaged in agriculture but not potato producer			−0.636*	0.529
			(0.376)	
Log of total income	-0.092	0.912	0.002	1.002
	(0.125)		(0.114)	
Number of household members aged 0–5	0.636***	1.888	0.483**	1.621
	(0.214)		(0.212)	
Number of household members aged 6–14	−0.014	0.986	−0.027	0.974
	(0.174)		(0.166)	
Number of household members aged 15–64	−0.211*	0.810	−0.252**	0.777
	(0.128)		(0.125)	
Number of household members aged 65+	−0.190	0.827	−0.449**	0.639
	(0.183)		(0.197)	
Gender	0.399	1.490	0.489*	1.631
	(0.285)		(0.287)	
Age	0.008	1.008	0.008	1.008
	(0.012)		(0.011)	
Years of education	−0.023	0.977	−0.038	0.963
	(0.038)		(0.036)	
Training	−0.754**	0.470	−0.222	0.801
	(0.338)		(0.296)	
Occupation as farmer	0.513*	1.671	0.477*	1.611
	(0.283)		(0.268)	
Decision maker of selling farm produce	−0.028	0.972	−0.468*	0.626
	(0.244)		(0.242)	
Constant	0.170	1.185	−0.301	0.740
	(1.457)		(1.257)	
# Of observations	424		424	
LR chi2(14)	31.41		27.04	
Prob > chi2	0.0029		0.0123	
Log likelihood	−228.063		−240.017	
Pseudo R2	0.0644		0.0533	
Correctly classified	74.76%		73.35%	

Robust standard errors in parentheses, *** $p<.01$, ** $p<.05$, * $p<.10$

with the finding of Muehlbacher & Kirchler (2013) on mental accounting of self-employed taxpayers, although the effect of gender was not significant in their study. However, the result differed from Antonides et al. (2011), who showed that men did less mental accounting than women.

Training in farm management had a negative effect on mental accounting and was significant for rice farmers. The odds ratio was 0.470. The training in farm management included producing and selling skills training, which may have helped improve the cognitive abilities regarding how to deal with farm produce. This result is in line with the expectation that training improves the cognitive abilities of people, leading to less mental accounting. The effect of education on mental accounting was also negative, although not statistically significant.

The coefficients for occupation as a farmer were both positive and statistically significant in the regressions for mental accounting of rice and potato farmers. Odds ratios were 1.671 for rice, and 1.611 for potatoes. This result shows that farmers were more likely to practice mental accounting than non-farmers. This may partly due to the significant negative correlation between occupation as a farmer and years of education. Being a farmer was associated with having less years of education in our sample, which might have resulted in less cognitive ability, and thus a higher probability of practicing mental accounting. Interestingly, the role of decision making regarding selling farm produce showed a negative effect on mental accounting for both regressions and was statistically significant for potato farmers. This result implies that when respondents made selling decisions in real life, they were less likely to practice mental accounting of consuming own-produced food. When a respondent was a farmer and at the same time the decision maker regarding selling agricultural products, the effects on mental accounting were offset. We further checked the mean values of mental accounting for the 118 respondents who were farmer but not decision maker for selling own produce, and for the 48 respondents who were decision maker for selling but not farmer. The mean value of mental accounting of the former (0.424) was significantly larger than of the latter (0.208) ($chi2(1) = 7.2562, p = .007$). This finding was in line with the expectation that people with more selling experience would be aware of the opportunity cost of consuming own produce and would practice less mental accounting of consumption of own produce. Log of total income and age of respondent showed no significant effects on mental accounting.

To sum up, this part of the study revealed that households who actually produced rice or potatoes, households with more members aged over 15 years, and respondents who were trained and who were decision makers regarding selling farm produce, were less likely to practice mental accounting of consuming their own produce. Households with more members aged 5 years or under, respondents whose occupation was farmer, and male farmers were more likely to practice mental accounting of consuming own produce.

5. Part 3: Mental accounting and consumption of own produce in real life

In Part 3, we aimed to show evidence of mental accounting of consuming own produce in real life. We tested whether the households' consumption of rice or potatoes from own-produce and from market purchase was significantly influenced by the food reservation, for actual rice or potato producers.

5.1. Method

Of the 424 total sampled households, 68 produced rice, and 143 produced potatoes in real life. In addition to the quantity of rice and potato needed by the household in a year, for actual producers, we also gathered information on the reservation of produce, consumption from own produce, and consumption from market purchases, together with other market information such as market price of rice and potatoes, transportation cost for selling them, and distance to market.

In the scenarios of Part 1, we created a pre-condition that households' reservation was more than the quantity that they thought they needed to consume in a year. But in real life, the reservation could be either greater or smaller than household consumption needed. In each of the circumstances, mental accounting was supposed to show different influence on consumption of own produce.

When the food reservation was greater than needed, households' consumption of own produce may have been guided by the more-than-needed reservation. We first calculated the difference between food reservation and food needed. If the difference had a significant positive effect on the consumption of own produce, then this would instigate the budget tracking process of mental accounting.

When reservation was less than needed, households doing mental accounting and sticking to consume what they reserved, in the end might fail to meet their level of consumption needed and experience underconsumption. They could also, on the other hand, purchase food from the market to meet their consumption needs after depleting the food reserve. Therefore, in this circumstance, we aim to test whether

households purchase more from the market when the difference between food needed and food reserve is larger. If so, then mental accounting does not influence households much when reservation is less than needed because they compensate the depletion of food reserve by market purchases to meet their consumption needs.

We applied OLS regressions and estimated the effects of difference between reservation and consumption needs from own produce, and consumption from market purchase, respectively, separately for rice and potato farmers. The empirical models are given as follows:

$$Cprod_i = \alpha D_i{}^*(R_i - N_i) + \beta(1 - D_i)^*(R_i - N_i) + \gamma p_i + \delta t_i + \eta d_i + \theta in_i + \vartheta adeq_i + \varepsilon_i \quad (1)$$

$$Cmakt_i = \alpha' D_i{}^*(R_i - N_i) + \beta'(1 - D_i)^*(R_i - N_i) + \gamma' p_i + \delta' t_i + \eta' d_i + \theta' in_i + \vartheta' adeq_i + \varepsilon_i' \quad (2)$$

Where

$Cprod_i$ denotes the consumption amount of own-produced rice (or potatoes) of household i in the past 12 months of the survey time;
$Cmakt_i$ denotes the consumption amount of rice (or potatoes) purchased from the market of household i in the past 12 months of the survey time;
R_i denotes reservation amount of own-produced rice (or potatoes) of household i in the past 12 months of the survey time;
N_i denotes consumption need of rice (or potatoes) of household i in the past 12 months of the survey time;
D_i denotes whether the reservation (R_i) is greater than consumption need (N_i), if $R_i > N_i$, $D_i = 1$, if $R_i \leq N_i$, $D_i = 0$;
p_i denotes the market price of rice (or potatoes), of household i;
t_i and d_i denote the transportation cost to sell rice (or potatoes), and the distance to market for household i, considered as proxies of transaction cost, respectively;
in_i denotes the total income of household i;
$adeq_i$ denotes the number of equivalent adults of household i (OECD, 1982);
$\alpha, \beta, \gamma, \delta, \eta, \theta, \vartheta, \alpha', \beta', \gamma', \delta', \eta', \theta', \vartheta'$ are parameters to be estimated, ε_i and ε_i' are i.i.d. error terms.
$D_i{}^*(R_i - N_i)$ is a cross-term of the dummy variable D_i and the difference of amount of reservation and consumption needs of household i.

In regression (1) with consumption from own produce as the dependent variable, if the coefficient α is significantly positive, then we know that when reservation is larger than food needed, the budget tracking process of mental accounting occurred, and the more-than-needed reservation partly led to more consumption of own produce.

In regression (2) with consumption from market purchase as the dependent variable, if the coefficient β' is significantly positive, then we know that when reservation is less than food needed, the larger the gap between consumption of own produce and consumption need, the more households will purchase food from the market, and thus limiting the effect of mental accounting.

Descriptive statistics of the variables are shown in Table 7 for rice producers, and Table 8 for potato producers. Of the 68 rice producers, 43 had reserved more rice than the household needed; their mean rice consumption from own produce was 315.91 kg, and they made no market purchases (Table 7). Of the 143 potato producers, 93 had reserved more potatoes than needed; their potato consumption from own-produce was 236.50 kg, and that from market purchases was only 5.16 kg, which is much less than that of the 50 households whose reservation was less than needed (Table 8). The consumption from market purchases was substantial for both rice (115.52 kg) and potato farmers (55.74 kg) with less food reserve than needed (Tables 7 and 8, resp.).

5.2. Results

Table 9 presents the regression results for consumption from own produce and consumption from market purchases of actual rice and potato producers. The F-statistics show that the four models (two for rice producers, two for potato producers) were all significant.

In the regressions that take consumption of own produce as dependent variables (see columns (1) and (2) in Table 9), our interest variable—the interaction of the dummy variable (whether the reservation was larger than consumption needed) and the difference between reservation and food needed—had a significant positive effect on consumption of own produce for both rice producers ($\alpha = 0.142$, $p = .004$) and potato producers ($\alpha = 0.068$, $p = .000$). These significant positive coefficients indicate that a larger surplus of reservation over consumption needed was associated with more consumption from own produce, indicating the tracking process of mental accounting, in line with our expectation.

As for the influence on consumption from market purchases, we found that when the reservation was less than consumption needed, the coefficients were significant and positive for both rice producers ($\beta' = 0.349$, $p = .000$) and potato producers ($\beta' = 0.653$, $p = .000$). These results indicate that households purchase from the market to meet their consumption needs when they face reservation shortage or depletion. Therefore, in this case, mental accounting did not influence households much, and the underconsumption outcome is less likely to happen.

Transportation costs of selling rice had significant positive effects on consuming own-produced rice ($\delta = 1.066$, $p = .017$), which shows that higher transportation cost may make households choose to consume more of their own produce, rather than selling it. The number of adult equivalents in the household had significant positive effects on consuming own-produced rice and potatoes but not on consuming purchased rice and potatoes, indicating that households with more adult equivalents consumed more of their own produce, and they probably only purchases rice or potatoes when the own produce reserve was depleted.

In line with the evidence of mental accounting of consumption of own-produced food, shown in Part 1 by using hypothetical questions, this part of study on one hand shows that when reservation was greater than food needed, the larger the difference was, the more consumption from own produce occurred, indicating the tracking process of mental accounting in real life. On the other hand, this part of study showed that when food reservation was less than the food needed, and larger the gap was, the more households purchased from the market.

6. Conclusions and discussion

This study examined whether mental accounting theory is applicable to consumption of own-produced food of smallholder farm households. We find evidence that people use mental budgets of quantities of own-produced food for self-consumption, track consumption against the set budget, and compensate their consumption by consuming less (more) according to the quantity left in the budget (Part 1). This finding extends the application of mental accounting to a non-monetary resource, namely food. Different from the sparse literature on mental accounting of food, focused on the self-control aspect of mental accounting in order to avoid consuming too much indulgent unhealthy food, this study suggests that smallholder farm households, being both food producers and consumers, may overlook the opportunity cost of consuming own produce due to mental accounting. Furthermore, we found that households used food reserve more than the amount of food needed to consume as a mental budget, consequently leading to over-consumption of own-produced food (Part 1).

The first part of our study used hypothetical scenarios, which may be associated with hypothetical bias, since behavior in real life might be different. Further, the setting in Part 1 only considered the situation

Table 7
Descriptive statistics of variables for rice producers.

Rice	Total n = 68		R > N n = 43		R ≤ N n = 25	
	M	SD	M	SD	M	SD
Consumption from own produce	322.53	151.10	315.91	135.73	333.92	176.86
Consumption from market purchase	42.47	100.95	0.00	0.00	115.52	140.21
Reservation	574.53	373.13	718.60	381.88	326.72	179.77
Consumption need	379.56	188.07	319.77	124.93	482.40	232.38
D*(reservation − need)	252.21	329.51	398.84	336.65	0.00	0.00
(1 − D)*(need − reservation)	57.24	144.40	0.00	0.00	155.68	205.53
Price	4.72	0.65	4.71	0.69	4.73	0.59
Total income (1,000 Yuan)	51.87	36.11	47.00	32.22	60.26	41.32
Distance to market	6.97	6.24	7.62	6.78	5.85	5.13
Transportation cost for selling	9.87	36.91	8.60	34.41	12.04	41.52
Number of adult equivalents	3.00	1.23	2.78	1.14	3.39	1.31

when households' food reservation was larger than consumption needs. How people react when food reservation is less than consumption needs cannot be known from Part 1. To deal with these two issues, in the third part of the study we selected actual rice and potato producers with either greater or smaller food reserve than the amount of food needed, as in a natural field experiment. We then studied their consumption of own produce (for those having a larger food reserve), resp. consumption from market purchases (for those having a smaller food reserve). In Part 3 of the study we find indications of the budget tracking process of mental accounting in situations of excess food reserve as in Part 1. Also, we found that mental accounting seemed less obvious in situations where food reserve was lower than consumption needs. Instead, in these situations, households purchase more food from the market to compensate the shortage of the available food, consequently rendering underconsumption less likely. In brief, when the food reserve is greater than consumption needs, the excess reserve is to some extent guiding people's consumption; when the reserve is lower than consumption needs, consumption needs may serve as the mental budget, and people will compensate the shortage from market purchases when the food reserve is depleted.

We also extend the literature on factors of mental accounting. We found some experience-related and cognitive ability-related variables having a negative effect on mental accounting. For example, people who are actual rice or potato producers, and who are the decision maker regarding selling own produce and those who had received farm management training tended to do less mental accounting. This is in agreement with the findings of List (2003) that market experience eliminate market anomalies. Our evidence may support the idea that market experience may reduce another anomaly in decision making, namely mental accounting. However, the experience effect may be resource-specific, meaning that, if people have more experience in dealing with a specific resource, they will practice less mental accounting regarding this specific resource. We proposed this assumption of the experience effect on specific behavior, because we found that actual rice or potato producers were less likely to practice mental accounting on own-produced rice and potatoes than households who engaged in agriculture but did not produce rice or potatoes. The effect of specific resource may also help to explain why we found no significant income effect on mental accounting of consuming own produce in Part 3, but we found more mental accounting in the food shortage scenario in Part 1. The resource to which mental accounting was applied, is own-produced food in our study, which is more specific than income. In addition, since the experience effect may also be very behavior-specific, we proposed this assumption of the experience effect on specific behavior, because we found that people who are the decision maker regarding selling own produce practiced less mental accounting of consuming their own produce, but not people who were farmers (and not decision makers). Farmers usually engage in production activities, while decision makers regarding selling own produce have gained experience in dealing with the allocation and use of own produce. Decision makers may have become more sensitive to the opportunity cost of consuming the food reserve.

Some policy implications regarding nutrition improvement of smallholder farm households can be generated from this study. Nutrition education programs in rural areas usually focus on telling people what to eat and how to eat, without linking food consumption to their market selling decisions. In addition, information such as recommended food and nutrient intake per adult equivalent and for the whole household could be made more easily available as part of nutrition education programs. Making the reference level of consumption more explicit for the households may contribute to avoiding overconsumption due to inappropriately pre-committed food quantity budgets. Furthermore, our study suggests that offering information to make smallholder farm households aware of the opportunity cost of consuming own-produced food could be valuable, which could be included in the farm management training offered to farm households.

Table 8
Descriptive statistics of variables for potato producers.

Potatoes	Total n = 143		R > N n = 93		R ≤ N n = 50	
	M	SD	M	SD	M	SD
Consumption from own-produce	223.35	263.52	236.50	277.07	198.90	236.98
Consumption from market purchase	22.85	67.48	5.16	22.54	55.74	102.68
Reservation	911.99	1475.85	1260.11	1720.97	264.50	305.75
Consumption need	283.35	268.51	246.23	232.63	352.40	315.99
D*(reservation − need)	659.38	1412.27	1013.88	1647.77	0.00	0.00
(1 − D)*(need − reservation)	30.73	83.75	0.00	0.00	87.90	123.28
Price	1.89	0.93	1.80	0.86	2.06	1.03
Total income (1,000 Yuan)	61.26	88.66	68.84	105.92	47.16	37.45
Distance to market	6.36	5.53	6.36	5.75	6.34	5.15
Transportation cost for selling	15.10	94.79	22.58	116.92	1.20	8.49
Number of adult equivalents	2.86	1.19	2.82	1.20	2.93	1.19

Table 9
Regressions of consumption from own produce and consumption from market purchases.

Variables	Consumption from self-produce		Consumption from market purchase	
	Rice (1)	Potato (2)	Rice (3)	Potato (4)
D*(reservation − need) for rice	0.147***		−0.062*	
	(0.050)		(0.0337)	
(1 − D)*(need − reservation) for rice	0.346***		0.349***	
	(0.120)		(0.0815)	
D*(reservation − need) for potato		0.068***		−0.001
		(0.015)		(0.002)
(1 − D)*(need − reservation) for potato		0.022		0.653***
		(0.246)		(0.042)
Rice price	−5.538		1.303	
	(25.390)		(17.18)	
Potato price		−28.330		−4.296
		(22.610)		(3.818)
Transport cost for selling rice	1.066**		−0.198	
	(0.434)		(0.294)	
Transport cost for selling potatoes		−0.113		−0.017
		(0.217)		(0.037)
Distance to market	−0.601	−1.956	0.846	0.464
	(2.488)	(3.702)	(1.684)	(0.625)
Total income × 1,000	0.260	−0.262	−0.336	0.010
	(0.460)	(0.232)	(0.311)	(0.039)
Number of adult equivalents	39.160***	44.47**	7.121	−2.682
	(13.420)	(17.150)	(9.083)	(2.895)
Constant	154.300	134.600*	24.060	15.810
	(117.900)	(77.200)	(79.780)	(13.040)
Observations	68	143	68	143
Prob > F	0.000	0.000	0.000	0.000
R-squared	0.380	0.209	0.364	0.656

Standard errors in parentheses, *** p < 0.01, ** p < 0.05, * p < 0.1

Although we found some evidence of mental accounting in consuming own-produced food, we need to mention some limitations of our study. First, in Part 1, we created hypothetical scenarios that may not fully reflect reality. People's mental accounting of their own produce might be weak or even disappear when the market price is high enough and when transaction costs are low enough. That is, we are not clear about the boundaries of the behavior of mental accounting on own-produced food. Also, in our hypothetical questions, we created a condition of food reserve being 20% higher than the food needed to consume, and then we observed people tracking their consumption against the food reserve budget. However, we expect that, if the food reserve is high enough to exceed a certain level, people may not track against it anymore. Thus, the boundaries of the effect of mental accounting of consuming own-produced food remain a question. We leave this question for future research.

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References

Abeler, J., Marklein, F., 2008. Fungibility, labels, and consumption. In: IZA Discussion Papers, No. 3500. Institute for the Study of Labor, Bonn, pp. 1–42.
Antonides, G., De Groot, M., Van Raaij, F., 2011. Mental budgeting and the management of household finance. Journal of Economic Psychology 32 (4), 546–555.
Antonides, G., Ranyard, R., 2017. Mental accounting and economic behavior. In: Ranyard, R. (Ed.), Economic Psychology. John Wiley & Sons.
Barrett, C.B., Dorosh, P.A., 1996. Farmers' welfare and changing food prices: Nonparametric evidence from rice in Madagascar. American Journal of Agricultural Economics 78 (August), 656–669.
Benjamin, D.J., Brown, S.A., Shapiro, J.M., 2013. Who is 'behavioral'? Cognitive ability and anomalous preferences. Journal of the European Economic Association 11 (6), 1231–1255.
Cheema, A., Soman, D., 2006. Malleable mental accounting: The effect of flexibility on the justification of attractive spending and consumption decisions. Journal of Consumer Psychology 16 (1), 33–44.
Fanzo, J., Hunter, D., Borelli, T., Mattei, F. (Eds.), 2013. Diversifying food and diets: using agricultural biodiversity to improve nutrition and health. Routledge, New York, NY.
FAO, 2014. The state of food and agriculture: Innovation in family farming. Food and Agriculture Organization of United Nations, Rome Retrived from. http://www.fao.org/3/a-i4040e.pdf.
Fox, M.K., Hamilton, W., Lin, B., 2004. Effects of food assistance and nutrition programs on nutrition and health. In: United States Department of Agriculture, Economic Research Service, Food Assistance and Nutrition Research Report No. 19-4, Retrived from. https://www.ers.usda.gov/webdocs/publications/46575/30211_fanrr19-4a_002.pdf?v=41479.
Fraker, T.M., Martini, A.P., Ohls, J.C., 1995. The effect of food stamp cashout on food expenditures: an assessment of the findings from four demonstrations. The Journal of Human Resources 30 (4), 633–649.
Frederick, S., 2005. Cognitive reflection and decision making. Journal of Economic Perspectives 19 (4), 25–42.
Goetz, S.J., 1992. A selectivity model of household food marketing behavior in Sub-Saharan Africa. American Journal of Agricultural Economics 74 (2), 444.
Hastings, J.S., Shapiro, J.M., 2013. Fungibility and consumer choice: evidence from commodity price shocks. The Quarterly Journal of Economics 128 (4), 1449–1498.
Hastings, J., Shapiro, J.M., 2018. How are SNAP benefits spent? Evidence from a retail panel. American Economic Review 108 (12), 3493–3540.
Heath, C., Soll, J.B., 1996. Mental budgeting and consumer decisions. Journal of Consumer Research 23 (1), 40–52.
Henderson, P.W., Peterson, R.A., 1992. Mental accounting and categorization. Organizational Behavior and Human Decision Processes 51, 92–117.
Huang, J., Antonides, G., Kuhlgatz, C., Nie, F., 2018. Mental accounting, production scale, and consumption of self-produced food: Empirical evidence from rural China. In: Agricultural and Applied Economics Association Annual Meeting 2018 No. 273986, August 5-7. Washington, D.C..
IFPRI, 2016. Global nutrition report 2016: From promise to impact. International Food Policy Research Institute, Washington, DC Retrived from. http://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/130354/filename/130565.pdf.
Just, D.R., Mancino, L., Wansink, B., 2007. Could behavioral economics help improve diet quality for nutrition assistance program participants? In: United States Department of Agriculture, Economic Research Service, Economic Research Report No. ERR-43, Retrived from. https://www.ers.usda.gov/webdocs/publications/45822/11534_err43_1_.pdf?v=0.
Key, N., Sadoulet, E., Janvry, A.De, 2000. Transactions costs and agricultural household supply response. American Journal of Agricultural Economics 82 (2), 245–259.
Krishnamurthy, P., Prokopec, S., 2010. Resisting that triple-chocolate cake: mental budgets and self-control. Journal of Consumer Research 37 (1), 68–79.
Levav, J., Mcgraw, A.P., 2009. Emotional accounting: how feelings about money influence consumer choice. Journal of Marketing Research XLVI (February), 66–80.
List, J.A., 2003. Does market experience eliminate market anomalies? The Quarterly Journal of Economics 118 (1), 41–71.
Milkman, K.L., Beshears, J., 2009. Mental accounting and small windfalls: Evidence from an online grocer. Journal of Economic Behavior & Organization 71 (2), 384–394.
Muehlbacher, S., Kirchler, E., 2013. Mental accounting of self-employed taxpayers: On the mental segregation of the net income and the tax due. Public Finance Analysis 69 (4), 412–438.
OECD, 1982. The OECD List of Social Indicators. OECD, Paris.
Park, A., 2006. Risk and household grain management in developing countries. The Economic Journal 116 (514), 1088–1115.
Piggott, N.E., 2003. The nested PIGLOG model: An application to U.S. food demand. American Journal of Agricultural Economics 85 (1), 1–15.
Pinstrup-Andersen, P., 2007. Agricultural research and policy for better health and nutrition in developing countries: A food systems approach. Agricultural Economics 37 (S1), 187–198.
Rajagopal, P., Rha, J.Y., 2009. The mental accounting of time. Journal of Economic Psychology 30 (5), 772–781.
Sibhatu, K.T., Qaim, M., 2018. Review: Meta-analysis of the association between production diversity, diets, and nutrition in smallholder farm households. Food Policy 77

(2018), 1–18.
Soman, D., 2001. The mental accounting of sunk time costs: Why time is not like money. Journal of Behavioral Decision Making 14 (3), 169–185.
Sussman, A.B., Alter, A.L., Paley, A., 2016. Mental accounting for food in exceptional contexts. In: Moreau, P., S. (Eds.), North American Advances in Consumer Research Volume 44. Association for Consumer Research, Duluth, MN, pp. 174–178.
Taylor, J.E., Adelman, I., 2003. Agricultural household models: Genesis, evolution, and extensions. Review of Economics of the Household 1 (1), 33–58.
Thaler, R.H., 1985. Mental accounting and consumer choice. Marketing Science 4 (3), 199–214.
Thaler, R.H., 1999. Mental accounting matters. Journal of Behavioral Decision Making 12 (3), 183.
Thaler, R.H., 2008. Mental accounting and consumer choice. Marketing Science 27 (1), 15–25.
Villa, K.M., Barrett, C.B., Just, D.R., 2011. Differential nutritional responses across various income sources among East African pastoralists: Intrahousehold effects, missing markets and mental accounting. Journal of African Economies 20 (2), 341–375.
Zhang, C.Y., Sussman, A.B., 2018. Perspectives on mental accounting: An exploration of budgeting and investing. Financial Planning Review 1 (e1011), 1–10.