Do Chinese vegetable farmers engage in mental budgeting for pest control?

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Mental budgeting and its current application

In neoclassic economic theory, money is supposed to be fungible, which means money is substitutable for each category in terms of income or expenditure. However, through experiments about daily expenses, Thaler (1985) demonstrates that the assumption of fungibility is not supported, which led him to introduce the concept of mental accounting. A component of mental accounting, mental budgeting is aimed at simplifying the decision making processes into two perspectives, where rational trade-offs between competing uses of funds are easily identified and expenses are tracked as a result of self-control (Thaler 1999). Unlike the assumption of classic rational choice, mental accounting theory holds that money is more fungible within a specific mental budget, but hardly to be fungible across different budgets.

Applying the concept of mental budgeting would have a profound impact on the understanding of farmers’ decision making in allocating monetary resources for inputs. Furthermore, understanding how farmers mentally budget could lead to better predictions of the effects of agriculture policies and programs connected to monetary support or incentives. Our study is based on data collected using a field survey among 393 vegetable farmers in Sichuan, China, to better understand whether or not vegetable farmers show the existence of mental budgeting. As a first step, we analysed whether farmers assign agricultural inputs to different categories. Secondly,
a mental budgeting scale with respect to agricultural inputs and the corresponding categories was constructed using Principal Component Analysis.

**The measurement of mental budgeting**

Typicality of agricultural inputs

As a prerequisite of mental budgeting, it is assumed that a farmer would subdivide expenditure for agricultural inputs into different categories. A typicality refers to when similar inputs are grouped together. In the vegetable farmer survey, an identification method introduced by Heath and Soll (1996) was adapted, focusing on three categories of variable agricultural inputs: seeds, fertilisers, and pest control measures. These three kinds of inputs represent the main variable costs of vegetable production in China. Other possible items such as costs for infrastructure (e.g. irrigation infrastructure and post-harvest infrastructure), machinery, land rent, or labour are assumed to be fixed within one season.

Following the principles of categorisation (HENDERSON and PETERSON 1992), seeds, fertilisers, and pest control measures are assumed to represent easily distinguishable goods which may be categorised with minimal thought and effort due to prior experience. Obviously, it might be possible that some inputs have dual use, such as Bt cotton seeds, which could be classified as seeds and a pest control measure at the same time. In the literature, this is referred to as cross typicality. However, in our survey it was not seen as a problem among respondents. If farmers categorised a specific agricultural input into a certain category, the respective expenses for this input will be subsumed within this category.

More specifically, ten specific agricultural inputs were presented to farmers during the survey and they were asked to assign them to three predefined categories.

The ten inputs were:
- vegetable seeds
- vegetable seedlings
- potash fertiliser
- nitrogenous fertiliser
- phosphate fertiliser
- organic fertiliser
- insect-proof lamps and nets
- pesticides with a high toxicity
- pesticides with a low-toxicity
- sexual attractants as a biological pest control measure

The respondents were asked to assign values to all of the input items for each category to indicate which input belonged to which category. A five-item Likert Scale ranging from 1 (very typical) to 5 (very untypical) was used. When a respondent could not allocate an item to one of the three categories, an option of filling in an 'X' was offered, which can be interpreted as null for the typicality rating.

**Figure 1** shows the results of the typicality questions for the selected agricultural inputs. It is worth noting that, as we were checking for cross typicality, the sum of the percentages could be higher than 100%. An overwhelming majority of responses fit our expectations: 393 (100%) and 360 (91.60%) farmers classified vegetable seeds and
seedlings as seeds, respectively. Only five farmers classify these two inputs additionally as fertilisers and pest control measures. The number of farmers who group the four types of fertilisers (potash, nitrogen, phosphate, and organic fertiliser) into the category fertiliser are 388 (98.73%), 388 (98.73%), 384 (97.71%), and 369 (93.89%), respectively. In addition, few farmers feel insect-proof lamps/nets, pesticides, and sexual attractants are seeds and fertiliser, but, not surprisingly, pest control measures. The exact numbers of each corresponding typicality rating term are 382 (97.20%), 370 (94.15%), 385 (97.96%), and 364 (92.62%), respectively. In sum, 299 farmers, i.e. 76.08% of the sample, categorise all agricultural input types according to professional practice. In addition, if only commonly used inputs are focused on (vegetable seeds, potash fertiliser, nitrogenous fertiliser, phosphate fertiliser, high-toxicity pesticides, and low-toxicity pesticides), 354 (90.08%) respondents categorise these items according
to conventional wisdom. More specifically, for the category of pest control measures, 362 (92.11%) show conventional typicality according to professional practice. There are various reasons for the very few cases of unexpected typicality. For instance, some farmers might be less familiar with some inputs, such as sexual attractants, and their classification might represent a lack of knowledge. It is also possible that some respondents simply made a mistake and do know better. However, even studies among students resulted in very few cases of unexpected classification. For instance, in a study by Heath and Soll (1996), students were asked to report typicality for ‘sports ticket’, with only one student not showing typicality for this item within the category ‘entertainment’. In addition, four students reported typicality for ‘sweatshirt’ in ‘entertainment’ instead of ‘clothes’, as the majority did.

**Mental budgeting scale**

The next step was to examine how flexibly farmers allocate money within and between these three categories, i.e. whether farmers engage in mental budgeting. In order to detect such a behaviour, scholars such as Antonides et al. (2011) and Homburg et al. (2010) propose the use of a mental budgeting scale. Such a scale is based on the aggregation of farmers’ responses to a set of four Likert Scale questions (see Figure 2). Farmers were asked to indicate the extent to which they agree or disagree (from 1 (totally agree) to 5 (totally disagree)) with various statements. The first question was aimed at discovering whether a farmer creates a financial plan (total or disaggregated budget) for agricultural inputs in general. The second question strived to understand whether such budgets are fixed or not. The third question tried to understand whether money is fungible within one budget category. Finally, the fourth question was geared at understanding whether money is fungible between the budget categories for agricultural inputs and other budgets. These four aspects form the core elements of determining the existence of mental budgeting among the farmers.

**Figure 3** shows the percentages of views for each mental budgeting scale statement. Between 35 and 64% of respondents agree with the individual statements,

<table>
<thead>
<tr>
<th>Mental budgeting scale statements</th>
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<tbody>
<tr>
<td>I set up a budget plan or reserve money for different agricultural expenses, such as seeds, fertilisers, pest control measures, etc.</td>
</tr>
<tr>
<td>If I spend more on either seeds, fertilisers, pest control measures, etc., the expenses in other categories remain as before.</td>
</tr>
<tr>
<td>I never spend more than a fixed amount on seeds, fertilisers, pest control measures, etc.</td>
</tr>
<tr>
<td>If I spend more on one agricultural input, I spend less on other inputs in the same category.</td>
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</tbody>
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Figure 3: Views towards the mental budgeting scale statements

1) I set up a budget plan or reserve money for different agricultural expenses.
2) I never spend more than a fixed amount on seeds, fertilisers, pest control measures, etc.
3) If I spend more on one agricultural input, I spend less on other inputs in the same category.
4) If I spend more on either seeds, fertilisers, pest control measures, etc., the expenses in other categories remain as before.

Figure 4: Summary of views towards all mental budgeting scale statements

- **26.46%** always agree
- **20.1%** always disagree
- **52.93%** neither always agree nor always disagree
- **0.51%** always neutral
whereas between 30 and 56% of respondents show opposite views for such statements. The percentage of respondents who did not select agree nor disagree (neutral) for the four individual statements is less than 10%.

Based on the procedure suggested by the relevant literature, farmers who agree with all four statements and farmers who disagree with all four statements are grouped into two subsamples. Similarly, all farmers who provided a neutral answer for all four statements form a third group, while all remaining respondents are classified into a fourth group. Figure 4 shows the resulting percentages of the four subgroups. For a subsample of 104 farmers (26.46%), we conclude that they utilise mental budgeting. Another 79 farmers, who responded ‘disagree’ or ‘totally disagree’ to all four statements, account for 20.10% of the sample. Only two farmers (0.51%) always responded neutral to all statements. The last mixed subsample consists of 208 farmers (52.93%), which is the largest group.

An alternative approach would be to group farmers based on a statistical procedure called Principal Component Analysis, which means respondents who are more similar in their responses would be separated from farmers showing a more instable response pattern. Principal Component Analysis (PCA) results in a factor score which aggregates the responses to the four questions for each respondent. The frequency of the factor scores is shown in Figure 5. The factor score consists of a farmer’s response to the four mental budgeting scale statements and ranges from 1 (totally agree) to 5 (totally disagree). Hence, a lower score implies that a farmer is more likely to apply mental budgeting for agricultural expenses. The PCA result shows that 187 farmers (47.58%) have a factor score below zero according to their mental budgeting scale statements. Thus, we conclude that these farmers show mental budgeting behaviour regarding agricultural expenses, which is higher than the share reported in Figure 4, but the subsample of ‘others’ is smaller, indicating that this statistical approach allows us to draw more information from the sample.

Insights of this study and implications for future studies

Our results indicate that the majority of the vegetable farmers surveyed categorise variable agricultural inputs into different groups. Mental budgeting is fully used by at least slightly more than one-quarter of the respondents or even up to close to half of the respondents according to the results of the Principal Component Analysis.
This result adds to the criticisms of the assumption of full fungibility in neoclassical theory. These findings imply that specific subsidies to reduce pesticide use might rather result in a substitution among pesticides rather than an increased use of labour or other inputs. The methodology of this study aimed at understanding mental budgeting can be applied to other situations, such as comparing allocation of money between agricultural and non-agricultural categories or the use of agricultural and non-agricultural income.

References

Sources and credits
Title   Farmers are harvesting the anti-season white radish in Meishan, Sichuan, China, 20th December 2020 © TopPhoto/Alamy Live News
► Sichuan in south-west China is also called the ‘land of abundance’. The province is more than 485,000 square kilometres in size and is one of the most important agricultural regions. The sheltered position of the Sichuan Basin gives the region 350 frost-free days per year. Besides tea for export, rice is the main crop here, but they also grow wheat, rape and many varieties of vegetables. (Sources: IVA-Magazin and wikipedia.)

p. 46 Two students at Sichuan Agricultural University interview a farmer. © Yangyi Zeng
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