Do tax and subsidy on unhealthy food induce consumer consumption for healthy food? Evidence from experiment in Surabaya, Indonesia

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Abstract

Background: This study investigates the impact of price changes on decision to buy particular foods among adults in Surabaya, East Java, Indonesia. Tax and subsidy were introduced for influencing decision buy particular foods, especially unhealthy foods that are predicted have consequences on health outcome. Unhealthy foods such as fast foods or junk foods, sugar sweetened beverages (SSB), salty, and fatty foods are reported as one of main causes of obesity incidence in most countries, such as Indonesia.

Design and method: Computer laboratory experimental is designed for investigating the impacts of difference rates of taxes and subsidy on decision to buy foods. Taxes and subsidies rate are designed from low (5%), moderate (15%), and high rates (25%).

Results: The findings are as follows. Firstly, participants do not respond immediately to price changes, that is, higher prices due to taxes and lower prices due to subsidies. Economic theory suggests that consumers demand for basic need such as foods is sensitive with change in price, they respond inversely to the price changes. However, the finding in this experimental study do not support this theory prediction. Secondly, 15% and subsidies are the threshold and the larger taxes and rate for changing consumer's choices on targeted foods.

Conclusion: This study concludes that low rates of taxes and subsidies for unhealthy and healthy foods make these targeted foods affordable for majority of consumers. Besides introducing higher rates of taxes and subsidies, promoting and encouraging healthy life style such as consuming fresh and healthy foods is another alternative policy option.

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Introduction

Incidence of obesity in Indonesia has increased significantly in recent years. According MoH and Indonesia[1] obesity rate was reported about 10.5% in 2007, it has increased into 14.8% in 213, and it is reached 21.8% in 2018. The figures indicate that the prevalence of obesity more than double during the last 10 years. Obesity rate in Indonesia is reported increased quickly during the implementation of physical distancing policy or work from home due to the spread of Covid-19 viruses.[2] The economic cost of obesity is very huge. Obese workers clearly less productive due to limited physical movement and less likely get reasonable wage rate. Once individual over weight and being obese, further health consequences cannot be avoided. Obesity is said as the mother of various non-communicable diseases such as diabetes, hypertension, stroke, and many more.[3,4] Health expenditure in terms of curing obese is significant and mostly become catastrophic among the poorer[5,6]

Household choices of daily consumption, that is, unhealthy diet is blamed as one determinant of obesity. Traditional economic theory justifies that consumer concern on food consumption is determined by price and consumer level of income.[7,8] Tasty but unhealthy food become more affordable recently, especially in developing countries.[9] The more affordable unhealthy food for the household, the larger incidence of obesity in the community.[10]

Changes in food price and furthermore on consumer relative income level are predicted as policy instrument to control over consumption on unhealthy food. Tax and subsidy are fiscal instruments for regulating unhealthy food. Some studies focus on impact of sin tax, that is, tax for preventing over consumption on unhealthy food, that is, sweet sweetened food and beverage (SSB), salty food, or fatty flavor added, and other studies focuses on subsidy. Studies that focus on impact of sin tax in developed countries found mix evidences. Sin tax policies effective reducing consumption of SSB in Denmark[11,12]; in Norway.[13,14] Other studies found significant improvement in diet habit, reducing unhealthy consumption as indicator of well accepted policy is reported by Pell et al.[15] for their studies in UK. On the other hand, some studies, either reported no significant impact or consumers tend to substitute their consumption on non-tax food but unhealthy. These finding are claimed by Cawley et al.[16] for their study in Oakland, USA; and Powell and Leider[17] in the case of Philadelphia, USA.

Government of Indonesia has planned to implement sin tax policy for preventing further obesity incidence. Based on experience on excise tax on tobacco control, no clear result from the implementation of the policy is observed. Some studies claimed why excise tax on tobacco in Indonesia is not success reducing cigarette consumption due to easy access to buy cigarette and price affordability.[18,19] This study investigate respond of consumer choices on unhealthy food when salience price changes due to tax and subsidy scenarios are implemented.

Previous studies mostly investigated consumption behavior in developed countries based on the several conditions. Firstly, the previous studies were conducted after the government formally announced sin tax policy, and the methods implemented mostly by surveying sales in large store or household consumption report. The price change only either due to tax for unhealthy food[20]; subsidy for healthy food[21,22]; combination of tax and subsidy[23]; providing food nutrition status.[24,25] This study investigates consumer's respond in price change, both due to tax or subsidy and information regarding nutrition content. Computer laboratory experimental study is implemented in this study.

Secondly, commercial food production is mostly well standardized in developed countries, while in developing countries like Indonesia this condition is not met and huge food stall can be found easily which selling not only cheap food but also lack of safe consumable standard. The food is mostly produced from household production, where no standard ingredient is used to meet low cost of production and competitive price. Therefore, sin tax policy on unhealthy food might be responded by substituting to non-tax targeted food. Thirdly, cultural practices by providing food such as food festival might less common in developed countries, while in Indonesia food festival is part of culinary event and mostly as part of domestic tourist attraction. Most of local food ingredient are made tasty, sweet and salty. Happiness in cultural celebration easily compensate high price of food.

This study implement computer laboratory study to investigate consumer respond to higher price on unhealthy food. The study was conducted in Surabaya city, East Java, Indonesia, in April 8 2021. Surabaya is choses due to the city icon for food culinary and is also the second metropolitan city in Indonesia after Jakarta. There were 40 participants participated in the within subject experimental design. Within subject design is preferred by the researchers for the following reasons. Firstly, the study should be implemented but effort eliminating the risk of contaminated by the Covid-19 viruses should be prioritized. Within subject design reduce the number of participant so lower risk of virus spread. Secondly, the study purpose is investigating individual respond in consumption choices when price changes due to tax and subsidy is implemented. This information is suit better in within subject design rather than the between one. Thirdly, as far as authors concerned, only the study of Shahab and Khoirunurrofik[26] that investigate the optimal excise tax of unhealthy food based on Indonesia micro household data that is, national survey on household socio economic condition or Susenas data in 2017. Shahab and Khoirunnurrofik study focused on average household spending on: instant noodle, snack for kids, processed meat, and bottle tea. This study however, investigate choices of food consumption which is direct consumable during the weekdays. This study chooses various illustration of most instagramable food and among teenager during the recent condition, when online food order is easily made by mobile phone application.

Therefore, this study contributes on empirical evidence how consumer respond in exogenous food and drink price changes. Do fiscal policy, that is, tax and subsidy effective to alter consumer's choices for unhealthy food? The experimental results indicate the following: firstly, participants do not respond to price increase in unhealthy (fast food) during the tax treatment session as well as in the subsidy treatment. Information regarding nutritional content of unhealthy food was provided in the video that presented in the last session. Neither hypothetical choices in computer screen nor the riel choices for lunch box at the end of session indicate that participant do not switch their choices from unhealthy to healthy choices. Even though the price differential is was designed almost double, that is, the price of one set unhealthy lunch box is equal to two boxes healthy lunch box, this do not make participant decide to choose the healthy one, because of healthy and cheaper. Second, the result reminds the same for the riel choices. Experimenter provided lunch box for participants before they went home. The choices for the lunch were *Nasi Padang* (fatty rice) and *Nasi Pecel* (rice with fresh and healthy vegetable). The result is more than 75% of participant prefer to have *Nasi Padang* for their lunch rather than *Nasi Pecel*.

Additional interview was conducted for 12 participants that responded experimenter WA chat and the interview was conducted through phone call. One participant who is a household wife said that she is rather buy processed food rather than cook for her family. She explained that buying processed food is not only more efficient in terms of time for food preparation, but also her family member willing to eat all the food without leftovers compare to food that she prepared herself. These choices also mean she can work at labor market for substituting extra time she has from time efficiency taking care of household duty. Other participants said that as long as she or he can afford the price of (unhealthy) food, she or he do not think much about the nutritional status. This comment is consistent among younger respondents as they less aware about potential health impact from current consumption habit. As long as the food is tasty and trending in social media, they can tolerate the higher price.

The organization of this paper as follows. After the introduction in the first part, it is followed by Material and Method. Next part is Experimental Result and Discussion. The last part is Conclusion and Policy Implication.

Material and method

This study examines the effect of salience price change on the preference of consuming healthy and unhealthy food using the computer laboratory experimental. Food prices are subjects to tax and subsidy. Healthy food is subsidized and unhealthy one is taxed to discourage consumption of unhealthy one. Video that presents bad eating habit and health consequences is applied as the alternative strategy looking at individual respond to information for choosing healthy versus unhealthy food and drink.

Participants were recruited based on voluntary agreement. The first condition was she or he have to agree for taking the SWAB antigen test 2 h before the experiment took place. This condition is required not only by the university research board for ethic test, but also for the safety reason, as pandemic Covid-19 still high risk of contagious. The experimenter offered the invitation for participating in experiment 2 weeks in advance. The participants were selected based on the criterion: male or female 18 years-old or over. The reason for this age criterion is at this stage individual is mature enough deciding which food is suite for their health and also both economically and rationally responsible for daily spending. Other criterion is subject should reside close-by the Airlangga University, Campus B; the place where computer laboratory experiment took place. This is required to make easier for the experimenter contacting and also observed the risk issues during the pandemic. There were 45 eligible participants came on the day of experiment, but only 40 included in experiment. The experimenter provided transport cost for those five participants and pleased they went home.

A within subjects experimental design was conducted with 11 difference conditions on April 2021. Total participants were 40 people, a mixed of students and non-students. There were 20 pairs of food, consist of healthy and unhealthy one. Both tax and subsidy were introduced progressively from 5%, 15%, and 25% during the intervention section. The experimental session started with the baseline session, where both healthy and unhealthy food have similar price. The next nine sessions were randomly chosen which consists of three session of salience tax added on unhealthy food with the rate 5%, 15%, and 25% subsequently; three session of subsidy for healthy food with similar rate with tax; and another three sessions that impose tax on unhealthy and subsidy on healthy choices simultaneously. After watching a-30 minutes' video about bad eating habit and poor nutritional content on the eaten food, another one session that exactly just repeating the baseline session is performed.

Illustration of participant recruitment.

| Start	Invitation is sent through What Apps group. There are 50 people responded and only 45 people coming on the experimental day
Criterion:	
Age	It must be above 18 years but below 60 years
Gender	Male and female
Occupation	Household wife, working, university student
Reside	Close by Campus B Airlangga University
Health issue	It has been vaccinated at least first doses and willing to do PCR test prior to 2 hours before the experiment started.
	After receive the PCR results, first come first served principle for choosing 40 participants that fit with the laboratory computer room.
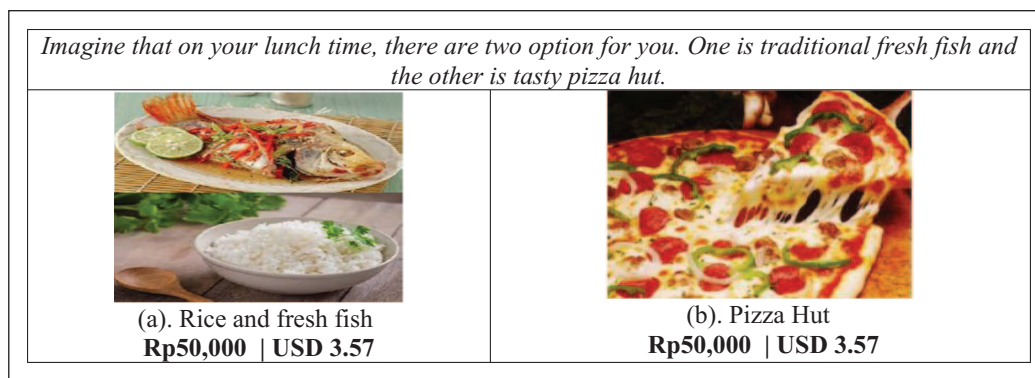
Figure 1. Session 1: Baseline condition, no price differences between choices (a) and (b).

Figure 2. Session 10: 25% subsidy for choice (a) and 25% tax added for choice (b).

There were 20 pieces of combination pictures appear on the participant's screen per session or condition. Every combination shows picture food for choice A, which is healthy food and picture for food B, which is fast food or unhealthy food. There were 11 sessions or condition in the experiment: session 1 is the baseline condition; three sessions for introduction of tax for unhealthy food; three sessions for introduction of subsidy for healthy food; three sessions for introduction of tax and simultaneously introduction of subsidy; and another one sessions similar with baseline condition but presented after the participant watching video information of calorie and nutrition on the food. Therefore, there were 11 sessions in the experiments. Session 2–10 were chosen randomly by the computer, but session 1 and session 11 as the beginning and end session for every participant.

The sample figure that appear on participant computer screen look like the figure below.

Figure 1 presents a random picture taken from 20 pairs picture in the screen with the baseline condition, and Figure 2 present session 10, where the price difference between 25% subsidy on choices A and 25% tax added on choices B. The price differences between healthy food and unhealthy one after the tax and subsidy is added presented in Table 1.

There were 20 pieces of figure with the price list summarizes in Table 1. Among the 20 pieces, some figures have similar prices combination.

Experimental pay-off

The experimental pay-off is designed following the formula below.

1.
$$\text{Pay-off} = \frac{\begin{array}{c}\text{number of participants} \\ \text{choose option A} \\ (\text{healthy choice})\end{array}}{\begin{array}{c}\text{numebr of participants} \\ \text{choose option B} \\ (\text{unhealthy choice})\end{array}} \times Rp300.000$$

2. The number of numerator and de-numerator in formula 1 is based on the random selection with number appears in the participant screen. This number reflecting number of series figure in particular rounds and particular sessions.

If a participant has the number,[1,10] this means the payment formula is calculated by the formula in her or his choices of figure appear sequence number 1 in session 10, that is, session with simultaneous policy tax 25% and subsidy 25% for choices A and B in sequent. The order of figures and session between participants is randomly determined

Table 1. Price differences between choices (a) and (b) due to tax and subsidy.

No	Choices and price at baseline condition		Tax added to choices B (Rp)			Subsidy added to choices A (Rp)		
	A (Rp)	B (Rp)	5%	15%	25%	5%	15%	25%
1	50,000	50,000	52,500	57,500	62,500	47,500	42,500	37,500
2	40,000	40,000	42,000	46,000	50,000	38,000	34,000	30,000
3	35,000	35,000	36,750	40,250	43,750	33,250	29,750	26,250
4	25,000	25,000	26,250	28,750	31,250	23,750	21,250	18,750
5	30,000	30,000	31,500	34,500	37,500	28,500	25,500	22,500
6	15,000	15,000	15,750	17,250	18,750	14,250	12,750	11,250
7	20,000	20,000	21,000	23,000	25,000	19,000	17,000	15,000
8	12,000	12,000	12,600	13,800	15,000	11,400	10,200	9000
9	10,000	10,000	10,500	11,500	12,500	9500	8500	7500

Table 2. Individual characteristic of participants.

No	Characteristics	Mean/proportion and standard deviation	Range value
1	Sex (female = 1)	0.575 (0.494)	(0;1)
	Male	17 (42.50)	
	Female	23 (57.50)	
2	Age	28.725 (9.698)	(19; 48)
3	Education level	3.95 (1.139)	(3;6)
	3. Senior high school	23 (57.50)	
	4. Diploma degree	0 (0.00)	
	5. Graduate student	13 (32.50)	
	6. Postgraduate	4 (10.00)	
4	Working status	1.55 (0.669)	(0; 2)
	0.House wife	4 (10.00)	
	1.University student	10 (25.00)	
	2.Working	26 (65.00)	

Source: Participant data.

by the computer program. The pay-off formula above reduce the potential for every participant to imitate other participant's choices as each of them has difference sequences of figure in their screen. Time to make decision is also quite limited, only 45 s per figure.

To make sure each participant understands the rule of the game, exercise time by clicking the option on the screen is introduced. This exercises were done by giving two cases for each session. After every two cases per session, pay-off is calculated.

Experimental result and discussion

Before presenting the experimental result, summary of individual characteristic of the participants is presented in Table 2.

In terms of gender, about 57% of the participants are female and the rest is male. The average age is close to 29 years with the youngest participant is 19 years old and the oldest one is 48 years. Majority of the participants have Senior High School, no participant has Diploma

degree, 13 participants have graduate degree and the rest four participants have postgraduate degree. Majority of participants were currently working (65%); 10 participants conducting their graduate degree (25%), and the rest four participants (10%) are household wife.

Table 3 summarizes questionnaire questions after the experimental sessions. It can be said that about 50:50 of participants prefer choosing healthy food as well as unhealthy one. The average price listed in the experiment was Rp20,290 with the standard deviation Rp10.632. The lowest price for subsidized food is Rp7500 (about 0.49 USD) and the highest one is Rp62,500 (about $0.47 USD). Regarding the eating habit (variable number 4–8), the data indicated that more 50% responds said they like to consuming tasty food (salty, sweet, and with high flavor added). Salty and fatty food are opted by about 70% of the participants. Option for enjoying fruit and vegetable as part of snack are less common compare with enjoying *donat* (high carbo cake) and fried chicken. No difference in proportion of participant choosing chocolate and vitamin supplement were found. The average monthly spending for food was

Table 3. Summary statistics.

No	Variable description	No. obs	Mean/Proportion	Min.	Max.
I	Choices (0 = healthy; I = unhealthy)	8.800	0.39 (0,49)	0	I
2	Price (Rp)	8.800	20.28922 (10.632,03)	7.500	62.500
3	Frequent of eating out	8.800	2.275 (0,67)	I	3
4	Consuming instant noodle	8.800	3.275 (0,65)	2	4
5	Consuming salty food	8.800	3.175 (0,70)	I	4
6	Consuming fatty food	8.800	2.80 (0,71)	I	4
7	Consuming fast food	8.800	2.975 (0,65)	2	4
8	Consuming sugary food	8.800	3.225 (0,69)	2	4
9	Choosing Fruit vs donat	8.800	1.225 (0,42)	I	2
10	Choosing vegetable vs fried chicken	8.800	3.35 (0,48)	3	4
11	Choosing vitamin complement vs cokelat	8.800	5.475 (0,50)	5	6
12	Average spending perkapita	8.800	2.125 (0,93)	I	4
13	Policy option	8.800	3.075 (0,96)	I	4

Source: Experimental data.

Percentage is in parentheses. Number 3–8; the options are: 1. very often; 2. often; 3. infrequently; 4. never; while number 9–11; the options of odd number for healthy choices and event number for unhealthy choices. Policy option (variable number 13) is classified as: 1. No price differences between healthy and unhealthy food; 2. Tax is added for unhealthy food; 3. Subsidy is given for healthy food; and 4. Simultaneous policy added tax in unhealthy food and subsidy for healthy one.

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(a)               Two-way ANOVA with Interaction
          Price versus Individual, Treatment tax and subsidy 5%

Source              DF          SS          MS      F      P
Individual          39   1.03929E+08     2664846  0.02  1.000
Treatment_t_s_5%     3   4.09716E+08   136571864  1.15  0.329
Interaction        117   1.29762E+08     1109073  0.01  1.000
Error             3040   3.62157E+11   119130709
Total             3199   3.62801E+11

S = 10915   R-Sq = 0.18%   R-Sq(adj) = 0.00%


(b)               Two-way ANOVA with Interaction
          Price versus Individual, Treatment tax and subsidy 15%

Source                  DF          SS          MS      F      P
Individual              39   8.47021E+08    21718498  0.18  1.000
Treatment_t_s_15percent  3   4.29539E+09  1431797242 12.18  0.000
Interaction            117   8.63312E+08     7378738  0.06  1.000
Error                 3040   3.57379E+11   117558910
Total                 3199   3.63385E+11

S = 10842   R-Sq = 1.65%   R-Sq(adj) = 0.00%


(c)               Two-way ANOVA with Interaction
          Price versus Individual, Treatment tax and subsidy 25%

Source                  DF          SS          MS      F      P
Individual              39   1.91054E+09    48988141  0.44  0.999
Treatment_t_s_25percent  3   1.28929E+10  4297637884 38.19  0.000
Interaction            117   2.14368E+09    18322045  0.16  1.000
Error                 3040   3.42118E+11   112538946
Total                 3199   3.59066E+11

S = 10608   R-Sq = 4.72%   R-Sq(adj) = 0.00%
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Figure 3. ANOVA table for food choices (Price) versus individual and policy treatment ((a) Tax and subsidy 5%, (b) Tax and subsidy 15%, (c) Tax and subsidy 25%).

between Rp2−3 million (USD 71.43 and 142.86). The majority of participant respond for the policy option was simultaneously implemented; introduce tax on unhealthy food and by the same time give subsidy for healthy food.

Figure 3 summarized Anova Table regarding consumer respond to price changes with respect to the introduction of tax and subsidy. The figure is divided into three parts, Figure 3 part (a) is summary for implementing soft policy; 5% tax added on unhealthy food and 5% subsidy for healthy one. Figure 3 part (b) and Figure 3 part (c) sequentially summarize policies with 15% dan 25% rate of tax and subsidy. Overall result indicates as follows. The introduction of 5% tax and 5% subsidy (Figure 3 part (a)) do not associate with change in preference from choosing unhealthy to healthy food. Neither individual characteristics or the policy instrument associate with the change in participants' respond. When tax and subsidy rate is increased into 15% treatment effects, that is, tax added to unhealthy food and subsidy into healthy one significantly associate with changes in participant choices from unhealthy products to the healthy or fresh one. The Statistics F-value high enough to reject the null saying no treatment effects on participant choices at alpha level of significant 1%. Similarly result is found with the policy 25% tax and subsidy. When the price differences between healthy and unhealthy choices, rational participant tend to choose the product that bring lower price with approximately equal chance for feeling full. Note that most of the wording in figures describe lunch time situation.

How do the participants motivated to change their choices? This experimental study is designed by introducing lunch time or snack relaxing time where they spend time for enjoying food. The price is settled represent market price in Surabaya at the time of experiment took place. Participant is not given transport cost for attending the experiment but they can optimize effort by deciding which option to choose in the experiment. The pay-off is designed into two steps. Firstly, pay-off is formulated as the ratio number of participant choose healthy food option divided by the rest participant that choose unhealthy one; this ratio is multiplied by Rp300.000 equivalence with USD21.43 by the time of experiment. Secondly, computer select randomly which number (1−20 figures in every round and in particular session). As the sequences of every figure and session is made random by the program, participant less likely cheat chat each other even though they have the chance to do so.

Conclusion and policy recommendation

Cases of obesity in Indonesia increase significantly during the last 10 years. The government of Indonesia is encouraged to design policy for regulating food consumption, especially the one with high sugar, salt, and fatty content. This policy is not yet implemented and is not well sounding. However, many initial discussion has been done among scientist, what is the best strategy to prevent the incidence of obesity. Thus study investigate how consumer respond to price changes in terms of introduction of excise tax on unhealthy food and subsidy for the healthy one. Policy is designed following low impact (5% tax and subsidy), medium impact (15% tax and subsidy) and high impact (25% tax and subsidy).

This study found that low tax and subsidy rate does not change the consumer choices from enjoying unhealthy food to the healthy one. However, when the rate is increased into 15% for both tax and subsidy, significant range in price clearly influence the food choice among the participant. The larger tax and subsidy rate, the more likely the representative participant change their choices. Further replication as well as apply the between subject design is needed to search regularity of the finding. Policy relevance with this finding is higher price is rationally responded by reducing consumption on not only unhealthy but also expensive food.

Contributions

All authors contributed equally. NMS leads the study and drafting the paper under the supervision of GW, RP, ERS, TW contribute on the intellectual contents. AC, AH and TH coordinated the experiment and analyzed the data. All team contribute on drafting the manuscript.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethics approval

This study has been approved by Ethics Committee of Faculty of Medicine Universitas Airlangga, Surabaya with number: 70/EC/KEPK/FKUA/2021

Study report

Significance for public health

Health statistic report of Indonesia indicate that not only obesity rate increase significantly during the last 5 years but also nutritional status among family member especially for childhood ages. Imbalance diet practices such as consuming junk foods is one of main causes for obesity and other Non-Communicable Diseases (NCDs) in Indonesia. Childhood obesity can influence individual success in later life. To prevents further health problem for the next generation, public policy should be designed either through price channel (taxes and subsidies policy) or impressive health promotion.

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Availability of data and material

The datasets analyzed in this study is available from the corresponding author on reasonable request.

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