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Biased effects of taxes and subsidies on portfolio choices

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HIGHLIGHTS

- Experimental study on the effects of taxes and subsidies on portfolio choices.
- Four treatments with either no tax, a tax, a subsidy or a tax and a subsidy.
- Net payoffs identical in all treatments so investment level should be constant.
- Find a highly significant negative impact from both types of intervention.

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ABSTRACT

We study how taxes and subsidies affect portfolio choices in a laboratory experiment. We find highly significant differences after intervention, even though the net income is identical in all our treatments and thus the decision pattern of investors should be constant. In particular, we observe that the willingness to invest in the risky asset decreases markedly when an income tax has to be paid or when a subsidy is paid. We investigate this result further in a range of variations of the baseline experiment and find our main result to be largely robust. However, as we reduce the number of states of nature the bias weakens considerably.

1. Introduction

In a recent experiment, Fochmann et al. (2012) find that a tax perception bias influences risk-taking behavior when subjects are able to offset losses from their taxable base. In this paper, we investigate whether a perception bias also has an effect in a more general investment problem with different types of government intervention. We look at the effects of both subsidies and taxes on portfolio choices in a laboratory experiment to see how they influence the choice between risky and risk-free assets. We find that imposing a tax and paying a subsidy both have a highly significant negative effect on the willingness to invest in a risky asset.

This paper adds to a small but growing literature on the effect of biases from government intervention. Chetty et al. (2009), for example, find that consumption decisions are influenced by the salience of sales taxes and show that the resulting distortions may have important welfare effects. Sausgruber and Tyran (2011) also find that biased tax perception can have an impact on welfare in the context of voting decisions. Gamage et al. (2010), Djanali and Sheehan-Connor (2012), and Fochmann et al. (forthcoming) observe that labor market decisions are distorted by a biased tax perception. Our contribution to this literature is twofold: (1) we shed further light on the effect of government intervention on investment decision and (2) we are to our knowledge the first to analyze the effect of subsidy perception on risk-taking.

2. Experimental design and hypothesis

In our setting, subjects have to decide on the composition of an asset portfolio in different choice situations. At the beginning

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Table 1
Returns of risky asset A and risk-free asset B (example).

State of nature	Risky asset A													Risk-free asset B
	No subsidy/tax	Subsidy				Tax				Subsidy–tax				No subsidy/tax, subsidy, tax, subsidy–tax
		Gross	Subsidy	Tax	Net	Gross	Subsidy	Tax	Net	Gross	Subsidy	Tax	Net	
1	1.000	0.667	0.333	–	1.000	2.000	–	1.000	1.000	1.333	0.667	1.000	1.000	1.300
2	1.100	0.733	0.367	–	1.100	2.200	–	1.100	1.100	1.467	0.733	1.100	1.100	1.300
3	1.200	0.800	0.400	–	1.200	2.400	–	1.200	1.200	1.600	0.800	1.200	1.200	1.300
4	1.300	0.867	0.433	–	1.300	2.600	–	1.300	1.300	1.733	0.867	1.300	1.300	1.300
5	1.400	0.933	0.467	–	1.400	2.800	–	1.400	1.400	1.867	0.933	1.400	1.400	1.300
6	1.500	1.000	0.500	–	1.500	3.000	–	1.500	1.500	2.000	1.000	1.500	1.500	1.300
7	1.600	1.067	0.533	–	1.600	3.200	–	1.600	1.600	2.133	1.067	1.600	1.600	1.300
8	1.700	1.133	0.567	–	1.700	3.400	–	1.700	1.700	2.267	1.133	1.700	1.700	1.300
Subsidy	No	50% of gross return				No				50% of gross return				No
Tax	No	No				50% of gross return				50% of gross return plus subsidy				No

of each situation, each subject receives an endowment of 100 Lab-points where 1 Lab-point corresponds to 1 Euro cent. The participants' task is to spend their endowment on two investment alternatives: asset A and asset B. The price for one asset of either type is 1 Lab-point.

The return of asset A is risky and depends on the state of nature. Eight states are possible and each state occurs with an equal probability of $\frac{1}{8}$. The return of asset B is risk-free and is therefore equal in every state of nature. The returns of both assets are chosen in such a way that asset A does not dominate asset B in each state of nature, but the expected return of asset A exceeds the risk-free return of asset B. The subjects know the potential returns on both assets in each state of nature before they make their investment decision.

The experiment consists of four treatments in which the presence of a tax and a subsidy is varied. In the no subsidy/tax treatment, no tax is levied and no subsidy is paid. In the subsidy treatment, a subsidy of 50% of the gross return is paid for each asset A, but no tax is imposed. In the tax treatment, a tax with a rate of 50% is levied on the gross return of each asset A, but no subsidy is paid. In the subsidy–tax treatment, a subsidy of 50% of the gross return is paid for each asset A, but in addition a tax has to be paid. In this case, the tax is 50% of the sum of the gross return of asset A and the subsidy. In all four treatments, the returns of the risk-free asset B are neither taxed nor subsidized. Before subjects make their investment decision, they are informed about the tax and subsidy situation.

Although the gross returns of asset A are treated differently across the treatments, they are transformed in such a way that the net returns remain the same (see Table 1 for an example). This leads to identical investment settings in all four treatments and the decision pattern should therefore also be identical across the treatments. Our hypothesis is:

Hypothesis. Investment in the risky asset A and the risk-free asset B is identical in all four treatments.

In each treatment, we have five decision situations in which we vary both the potential returns of asset A and the return of asset B. Each subject participates in each treatment (within-subject design) and therefore makes 20 investment decisions in total. To avoid learning effects, the order of these 20 decision situations is completely randomized for each subject.[1] Since we are only interested in the treatment differences, the risk attitude of the subjects is not of importance for our analysis. Participants with stable and unbiased preferences should follow the same decision pattern across the treatments independently of their individual attitude towards risk.

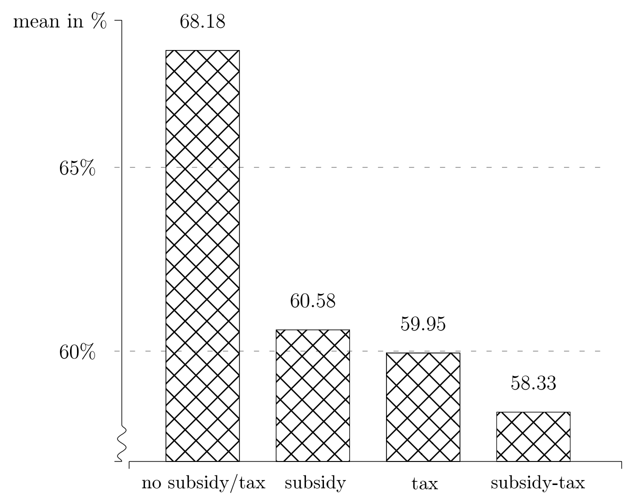

Fig. 1. Share of endowment invested in the risky asset A on average for each treatment (number of subjects: 119).

Despite the fact that we use a very simple setting, with simple tax and subsidy rates, several mechanisms are used to make sure subjects understand their decision environment. First, written instructions explain the calculation of the net returns in detail and provide one numerical example for each treatment. Second, each subject has to correctly solve one numerical example for each of the four treatments as a comprehension test. Third, subjects are provided with both a pocket calculator and a computerized "what-if"-calculator, which allows subjects to calculate their tax, subsidy, and net payoff at different investment levels in each decision situation.

All experiments were carried out at the computerized experimental laboratory at the Otto-von-Guericke University of Magdeburg (MaXLab) and were programmed with z-Tree (Fischbacher, 2007). To avoid income effects, we randomly selected five of the 20 decision situations to be paid in cash after the experiment was finished.

3. Results and discussion

3.1. Baseline experiment

Fig. 1 depicts the average share of endowment invested in the risky asset A for each treatment. In the no subsidy/tax treatment, subjects invested 68.18% of their endowment in asset A. Even though the net returns are identical in the other treatments, this

[1] This means that in each of the 20 rounds one of the five decision situations is randomly selected from any of the four treatments and presented to a subject instead of subjects receiving the choices in four blocks of five decision situations from the same treatment.

Table 2
Variation treatments.

	Variation 1	Variation 2	Variation 3	Variation 4	Variation 5
Average share of endowment invested in the risky asset A (in %)					
No subsidy/tax	68.45	71.98	76.53	83.73	71.87
Subsidy	63.20	64.02	54.69	75.65	63.86
Tax	56.08	65.68	68.28	78.23	68.93
Subsidy–tax	55.68	62.87	65.39	75.20	67.67
Statistical comparison (p-value, two-tailed)[a]					
No subsidy/tax vs. subsidy	0.0589	0.0030	<0.0001	0.0236	0.0019
No subsidy/tax vs. tax	<0.0001	0.0439	0.0003	0.0143	0.0932
No subsidy/tax vs. subsidy–tax	0.0001	0.0234	<0.0001	0.0007	0.1075
Subsidy vs. tax	0.0289	0.4971	<0.0001	0.6799	0.1772
Subsidy vs. subsidy–tax	0.0088	0.6374	0.0001	0.3306	0.2752
Tax vs. subsidy–tax	0.5547	0.4520	0.459	0.3814	0.7562
No. of subjects	25	24	46[b]	34	36

[a] The Wilcoxon signed-rank test is applied for the variation treatments 1, 2, 4, and 5 (treatments with within-subject design), the Mann–Whitney U test for variation treatment 3 (treatment with between-subject design).
[b] 12, 10, 11, and 13 subjects participated in the no subsidy/tax, subsidy, tax, and subsidy–tax treatment, respectively.

share decreased markedly when a subsidy was paid (60.58%) or a tax had to be paid (59.95%). This effect intensified weakly when a subsidy was paid and a tax imposed simultaneously (58.33%). All differences are highly significant ($p < 0.001$, Wilcoxon signed-rank test, two-tailed) compared to the no subsidy/tax treatment. Our hypothesis is therefore rejected for all these comparisons. The difference between the subsidy and the subsidy–tax treatment is weakly significant ($p = 0.077$). However, we found no significant differences between the tax and subsidy–tax treatment or between the subsidy and tax treatment.

These findings are not only at odds with our hypothesis but also with a range of biases discussed in the literature. If subjects had tax aversion (Sussman and Olivola, 2011), tax affinity (Djanali and Sheehan-Connor, 2012), or gross payoff illusion (Fochmann et al., forthcoming) then the bias would have had a different sign in the tax treatment than it did in the subsidy treatment. Since a subsidy is essentially just a negative tax, subjects with tax aversion (affinity) would receive a lower (higher) utility in the tax treatment and a higher (lower) utility in the subsidy treatment when compared to the no subsidy/tax treatment. They would thus have invested less (more) when the risky asset was taxed and more (less) when it was subsidized. This is not what we observed.

Our pattern does not indicate gross payoff illusion either. Since the gross payoff was higher than the net payoff in the tax treatment and lower than the net payoff in the subsidy treatment, subjects with the illusion that their gross payoffs are relevant would not have reacted the same to both types of intervention. They would have been drawn to the higher gross payoff in the tax treatment and the lower gross payoff in the subsidy treatment. The fact that we observe a fall in investment in both treatments can therefore not be readily explained by any of these existing theories.

Given that our main result seems at odds with existing work we checked how robust it was by carrying out a range of variations of the baseline experiment. The results are shown in Table 2 and discussed in Section 3.2.

3.2. *Variations of the baseline experiment*

The tax and subsidy rate in the baseline experiment was deliberately chosen to be quite extreme (50%). To see whether this is important for our results we ran an experiment in which we used a much lower rate. In *variation* 1 we used a tax and subsidy rate of 5% while leaving everything else unchanged. Given that the difference between the net and gross payoffs was now very small we might have expected subjects to react less strongly to the subsidy and tax in variation 1 than they did in the baseline experiment. However, the results were very similar to those in our initial experiment with investment in the risky asset falling sharply under each type of intervention, although the difference between the no subsidy/tax and the subsidy treatment is now only weakly significant. Thus we have strong support for our main result even when the difference between net and gross payoffs has been drastically reduced.

One explanation consistent with the finding that investment in the risky asset fell under both types of intervention is that subjects have an aversion to computational complexity, which reduces their utility from an asset that has been subsidized/taxed. To test this idea we ran an experiment (*variation* 2) in which we subsidized and/or taxed the risk-free asset B instead of the risky asset A. If aversion to computing net payoffs explains our findings then we would expect the opposite results in this variation than we observed in the baseline experiment. However, the results were in fact very similar with a subsidy and/or tax on the risk-free asset also leading to a reduction in investment in the risky asset. Thus, our main result holds in variation 2 suggesting that aversion to computational complexity is not a fitting explanation.[2]

Even though the baseline experiment was set up to be as simple as possible the environment was nonetheless complex enough to suggest that this may be playing an important role. To test this we ran experiments in which we again subsidized and/or taxed the risky asset but simplified the choice environment. We did this in two ways. In *variation* 3 we ran an experiment using a between-subject design. This gave each subject 20 rounds in which they were confronted with just one type of intervention. Stabilizing the environment in this way provided subjects with a greater opportunity to figure out strategies for dealing with the complexity of the environment. In this variation, just as in the baseline experiment, investment in the risky asset fell significantly under each type of intervention, confirming our main result in this more stable environment.

A key difference between variation 3 and the baseline is that there is now a significantly greater reduction in the subsidy treatment than in the other two treatments with intervention. However, it is worth noting that this difference was only observed in early rounds. In the tax and the subsidy–tax treatments there was no trend in their difference to the no subsidy/tax treatment over the 20 rounds. In the subsidy treatment, however, the difference to

[2] A further reason to doubt the computational complexity explanation is that our results are driven largely by subjects investing less in the risky asset under intervention (this made up on average 71% of the reduction) rather than subjects moving away from it completely. This intensive margin of reaction is harder to rationalize using computational complexity.

the no subsidy/tax treatment was much higher in early rounds and gradually fell to being of similar magnitude to the bias observed in the other two treatments. In the last five rounds, for example, the difference between the subsidy treatment and the other two treatments with intervention is no longer significant at the 10% level. But the difference between the no subsidy/tax treatment and the subsidy ($p = 0.0009$), the tax ($p = 0.0336$), and the subsidy–tax ($p = 0.0059$) treatments is still significant.

The second way in which we reduced the complexity of the environment was to reduce the number of states of nature. In *variation* 4 we reduced the states from eight to four and in *variation* 5 we reduced them to two. Investment in the risky asset again fell in all treatments with intervention in both these variations. While the difference between the treatments with and without intervention were smaller in variation 4 than in the baseline experiment they continue to be significant at the 5% level. With two states, however, the difference between the no subsidy/tax treatment and the tax and the subsidy–tax treatment are no longer significant at this level. Thus reducing the complexity along this dimension weakened the bias considerably.

4. Conclusion

The baseline experiment together with our five variations shows that the finding that investment in a risky asset falls in the presence of a tax and/or a subsidy is quite robust. This behavior is not consistent with theories such as tax aversion, tax affinity or gross payoff illusion, which would predict that tax and subsidy biases would have different signs. Further, our results do not appear to be driven by an aversion to computational complexity since investment in the risky asset also falls if we subsidize and/or tax the risk-free asset. However, reducing the complexity of the environment by reducing the number of states does seem to affect the strength of the bias. This indicates that the extent to which government intervention biases risk-taking behavior may fall with the complexity of the environment in which the intervention takes place.

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