Do Tobin taxes help stop stock price bubbles?

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Abstract

Purpose – This study aims to report on experimental asset markets designed to examine the impact of a levy on trade, as well as the taxation authority's ability to raise tax revenue when markets are subject to mispricing. Some have suggested that a transaction tax will discourage irrational speculation and lead to more efficient markets, but others argue that a higher cost of trading will prove to be an impediment to trade with no useful outcomes.

Design/methodology/approach – The authors' goal is to provide insight on the impact of a transaction tax in a very specific asset market. The authors chose this design because the robustness of the bubble and crash pattern points to an environment that is particularly appropriate for the study of the effectiveness of a transaction tax in promoting efficient pricing. Furthermore, in a laboratory, the authors can control for extraneous factors that are problematic in the study of naturally occurring environments.

Findings – The authors examine whether a securities transaction tax promotes efficiency in markets that are prone to mispricing and find little evidence that a tax on trade will reduce speculation.

Research limitations/implications – This study's experimental environment is, of course, an abstraction of naturally occurring markets and it may be that the model excludes important aspects.

Social implications – The authors find that a tax on financial transactions allows the taxation authority to raise significant revenue with little impact on pricing or trading volume.

Originality/value – To the best of the authors' knowledge, this study is the first systematic examination of a transaction tax on outcomes in a market that is prone to mispricing.

Keywords Financial markets, Financial markets and institutions, Behavioral economics

Paper type Research paper

> [. . .] Americans are apt to be unduly interested in discovering what average opinion believes average opinion to be; and this national weakness finds its nemesis in the stock market [. . .]. The introduction of a substantial government transfer tax on all transactions might prove the most

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serviceable reform available, with a view to mitigating the predominance of speculation over enterprise in the United States (Keynes, 1964, pp. 159-160).

1. Introduction

The taxation of transactions in securities markets is not a new idea, though the appropriateness remains hotly debated in the USA. With the exception of the USA, most large, industrialized nations tax financial transactions (Summers and Summers, 1989) [1]. In the aftermath of the Wall Street Crash of 1929, the renowned British economist John Maynard Keynes promoted a tax on trades in financial markets to reduce excess speculation and volatility in American financial markets (Keynes, 1964). In response to the 1987 market crash, a financial transaction tax was deliberated and rejected by the U.S. Congress and, since then, such a tax has been proposed and again rejected a number of times (Pollin *et al.*, 2003).

Of course, volatility is necessary in an informationally efficient market as prices adjust to new information. The goal of a transactions tax is to reduce trading that is not information based, so-called noise trading. Opponents of a tax on financial transactions argue that such a levy would lead to lower market liquidity and could actually increase volatility. A tax is an impediment to all trades, even those that promote market efficiency (Kupiec, 1996). James Tobin, whose proposal of a currency transaction tax or Tobin tax has gained international attention, argues that although a tax on transactions would penalize all traders, speculative, short-term traders will be more strongly impacted (Tobin, 1978). Other proponents argue that a tax on financial transactions will curb excess volatility and short-term speculation (Summers and Summers, 1989; Pollin *et al.*, 2003). Another possible benefit of a tax on financial transactions is the tax revenue itself. Regulators could view a transaction tax as beneficial if such tax increases government revenue, particularly if there is no deleterious impact on market efficiency. Recently, a tax on financial transactions has been discussed among US presidential candidates as a way to raise tax revenue (Rappeport and Kaplan, 2019; Sorkin and de la Merced, 2020).

The impact of a transactions tax in markets remains contested in the USA. While some policymakers and pundits argue that a transaction tax will discourage irrational speculation and lead to more efficient markets, others argue that higher trading costs impede trade. In this paper, we examine whether a securities transaction tax promotes efficiency in markets that have been shown in prior research to consistently produce prices that are detached from economic value. As we will review in the following section, a particular experimental market structure reveals pricing shown to be irrational. We use an experimental method because it allows us to control the expected payoff of the asset so we can actually observe when prices are not "right," as when prices do not reflect public information. In our experimental design, we know when the traded asset, referred to as a stock, is mispriced because we know the possible payoffs, as do the traders. If traders use the information available to them, they can easily compute the expected value of a share of stock, which is also referred to as the underlying economic fundamental value (FV). This examination cannot be conducted in naturally occurring markets because when information is constantly arriving, there is uncertainty about future payoffs. No one knows the underlying FV, even famed investor Warren Buffett. Because we know the economic value of the stock in our laboratory setting, we can manipulate the incidence of a transactions tax and directly observe its impact on market outcomes.

The remainder of this paper is organized as follows. Section 2 provides a review of related literature and presents the framework for our study. Section 3 describes the experimental procedures and design. Section 4 reports the results. Section 5 contains a discussion of the results and concluding remarks.

2. Review of the experimental literature and framework for study of a transactions tax

Unfortunately, theoretical work and empirical evidence have been unable to resolve the debate surrounding the benefits and costs of a tax on transactions. Though it is well recognized that asset prices should reflect underlying economic value in a well-functioning capital market, it is not clear how to get there. In Scheinkman and Xiong's asset pricing model, a small transaction tax can reduce speculative trading but has little impact on asset price bubbles or excess volatility (Scheinkman and Xiong, 2003). An asset price bubble is detected when an asset trades at prices that deviate from the underlying economic FV, which in our trading environment is simply the expected value assuming risk neutrality. In contrast to Scheinkman and Xiong, Kupiec reports that in his general equilibrium model, a transaction tax leads to higher volatility and lower equilibrium prices (Kupiec, 1996). Others also report that a transaction tax is associated with poor market outcomes. For example, in their empirical analysis of the French experience, Colliard and Hoffman (2017) conclude that a financial transaction tax reduces market liquidity and quality.

We provide insight on the impact of a transaction tax in a very specific asset market structure because it allows us to observe whether a tax results in more or less pricing efficiency. We follow Smith *et al.* (1988) who first report bubbles and crashes in experimental asset markets. In their study, subjects trade shares of a single asset with a finite life and common dividend, determined at period end based on a known probability distribution. Multiple shares of a single asset are traded and all know the possible payoffs and their probabilities. There is no private information or information asymmetry. It seems natural to wonder why there are any trades when all participants have the same information. Though traders have the same information, they have different beliefs about others. As argues Camerer (1989), bubbles or deviations from fundamentals can be rational because traders expect to benefit from trading on mispricing.

Assuming risk neutrality, the fundamental economic value (FV) is easily computed as the number of remaining trading periods multiplied by the expected dividend per period. For example, in our markets, each share held at the end of a period earns either 0 or 10 francs, the experimental currency, with equal probability. Thus, the expected dividend is easily calculated as 5 francs per period. Traders are endowed with shares when they first enter the market, dividends are paid on shares held at the end of each period, and shares carry across periods. Our markets include 12 trading periods and each share is worth nothing at the end of the 12th period after the last dividend is paid. In the last trading period, the FV is 5 francs because when there is only one period left in the market, traders who hold the stock earn only one dividend. The dividend is equally likely to be 0 or 10 francs so the FV is 5 francs. With two periods remaining, traders holding a share earn two dividends, each with expected value of 5, so the FV of the stock is 10. Working backward this way, referred to as backward induction, the economic value in any period of one unit of the stock is 5 francs times the number of periods remaining. Thus, the FV falls in step fashion from the first to last period of the experimental market. Smith *et al.* (1988) report large upward deviations in trading prices from FV, followed by crashes back to the risk neutral value as trading nears its conclusion, a finding that has been replicated by numerous studies (Palan, 2009, 2013). Clearly, this design is not reflective of the pattern of stock prices typically observed, particularly in the USA in recent years in which prices, in general, have an upward trajectory. Researchers have considered other patterns in FV to ensure that confusion among experimental traders is not the source of mispricing. With flat or increasing FVs, more akin to the experience in naturally occurring stock markets, researchers continue to report mispricing (Palan, 2013). Nonetheless, we adopt the design with declining FV to allow us to compare to the large literature reporting on markets that have been shown to produce mispricing.

In a laboratory, we can control for extraneous factors that are problematic in the study of naturally occurring environments. Though not an exact replication of naturally occurring markets, we chose the design of Smith *et al.* (1988) because the robustness of the bubble and crash pattern. This is an environment that is particularly appropriate for the study of the effectiveness of a transaction tax in promoting efficient pricing. In using the design, we can compare our results to a long literature to better understand unusual results, if observed. Though King *et al.* (1993) report that a fee on transactions has little effect on bubble measures, our study is the first systematic examination of a transaction tax on outcomes in a market that is prone to mispricing [2]. Here we vary the tax structure to delve into the impact of a transaction tax on market outcomes, as well as the revenue generated by the taxation authority.

In our baseline treatment, transactions are not taxed (no tax). In additional treatments, we manipulate the structure of the tax. First, we include a flat tax on both sides of every transaction. Clearly in our markets with declining FV, the relative cost of a transaction increases significantly across periods with a flat tax. Nonetheless, we view this tax structure as a conservative starting point because the first transaction tax implemented in the UK was a stamp tax on all transactions. In addition, in their laboratory study of noise trading, Bloomfield *et al.* (2009) examine the effect of a flat transaction tax on each side of a trade and conclude that the tax reduces noise trading [3]. However, the tax also reduces informed trading in their markets so that the informational efficiency of the market is not improved. In addition to the flat tax, we also include treatments in which trades are taxed as a percentage of the transaction price, which aligns more closely with taxes implemented internationally (Pollin *et al.*, 2003, Table 1). For both flat and percentage taxes, we manipulate the level of the tax because outcomes may differ significantly across tax burdens.

In financial markets experiments, a double auction market structure is commonly used. These markets were sometimes implemented using open outcry in early studies (Plott and Sunder, 1988). More recently, researchers take advantage of software that allows trading on an electronic platform. We use, as have many researchers, the *Z-tree* (Zurich Toolbox for Readymade Economic Experiments) software (Fischbacher, 2007) which is convenient and graciously provided to researchers free of charge [4]. Traders transact in real time over a number of market periods using the *Z-tree* platform. Participants can post bids and asks for multiple units, or act as price-takers.

To summarize the price evolution in our markets and allow the comparison to prior studies, we chose six bubble measures which allow us to gauge whether there is a bubble in observed stock prices assuming risk neutrality. The risk neutrality assumption should not be a problem in studies of asset price bubbles because if, as might be expected, traders are risk averse and prices should be lower, not higher as reflected in an asset price bubble. A large number of bubble measures have been reported in experimental studies which can complicate the comparison of findings (Palan, 2009; Stöckl *et al.*, 2010). The first three bubble measures we include are commonly reported in experimental bubbles studies [5]. First, we compute the average number of periods for which the mean price is greater than the FV. Evidence of a bubble is provided when the mean price exceeds the FV. Second, we report positive duration which is computed as the average of the maximum number of

Treatment		No. of sessions	Trader type	Endowments Shares(units)	Cash(francs)	Tax
Panel A: Experimental design						
1	No tax	5	X	60	1,000	0
			Y	20	3,400	
2	Low flat	5	X	60	1,000	1 franc
			Y	20	3,400	
3	High flat	5	X	60	1,000	2 francs
			Y	20	3,400	
4	Low percentage	5	X	60	1,000	0.1%
			Y	20	3,400	
5	Moderate percentage	5	X	60	1,000	10%
			Y	20	3,400	
6	High percentage	4	X	60	1,000	20%
			Y	20	3,400	

Panel B: FVs Periods remaining	FV with no taxation
12	60
11	55
10	50
9	45
8	40
7	35
6	30
5	25
4	20
3	15
2	10
1	5

Notes: Each session includes ten traders, half of each type, with the exceptions of the third session in treatment 1 and the third session of treatment 6, each of which includes nine traders, five (four) of type X (Y). The asset has an equal probability of paying 0 and 10 francs in each of 12 periods in all treatments. In treatments 2 and 3, a flat tax franc is paid on both sides of every transaction. In treatments 4, 5 and 6, a tax is paid on each side of every trade with the tax computed as a percentage of the transaction price. Panel B reports the FV of one share if there is no tax paid. The expected dividend is 5 francs per share per period. The FV is five times the number of trading periods remaining because each share held carries over across periods and is worthless after the final dividend is paid in period 12

Table 1.
Experimental design

consecutive periods with price increases relative to FV when the increase produces a price that exceeds FV [6]. Positive duration provides stronger evidence of a bubble because it measures the most *consecutive* periods of mispricing. Third, we report the peak deviation which measures the magnitude of the bubble using the normalized peak deviation in price from FV [maximum observed $(P_t - FV_t)/FV_t$]. This bubble measure gives insight into the height of a bubble, if one is present.

We also use two additional bubbles measures following Stöckl *et al.* (2010), and also reported in Ackert *et al.* (2016). These measures may be superior to others used in prior studies because they promote comparability and satisfy desirable criteria, such as being independent of the number of trading periods (Stöckl *et al.*, 2010). The fourth bubble measure is the relative absolute deviation (RAD), a measure of the absolute level of mispricing which is calculated as:

$$RAD = \frac{1}{N}\sum_{t=1}^{N} |\overline{P}_t - FV_t| / |\overline{FV}| \quad (1)$$

where t is the trading period, N is the total number of periods, $\bar{P}_t$ is the period mean trading price and $\overline{FV}$ is the mean underlying risk-neutral FV across periods. RAD is generally easy to interpret, which is an appealing aspect of this measure for researchers. For example, when RAD = 0.10, the average mean price per period is 10% away from the average FV, either above or below. The fifth bubble measure we report is the relative deviation (RD) which gauges overvaluation and is computed as:

$$RD = \frac{1}{N}\sum_{t=1}^{N} \left(\overline{P}_t - FV_t\right) / |\overline{FV}|. \quad (2)$$

In contrast to RAD, RD is calculated based on signed average price deviations from FV. When RD is positive (negative) the asset is overvalued (undervalued).

The sixth bubble measure we use is overpriced transactions or the percentage of transactions that exceed the maximum possible payout (Palan, 2009). Transactions at extreme prices may be evidence of irrationality and could also suggest that traders speculate that another will pay an even higher price. In our design, recall that the dividends can be 0 or 10 francs. Suppose, for example, there are five trading periods remaining. The most any trader could receive for a share that is held is dividends of 10 francs times 5 periods or 50 francs. If the stock trades at prices above 50 francs, overvaluation is suggested. The most the share could be worth is 50 francs and the probability of that outcome is quite low at $0.50^5 = 0.03125$. When trades are observed above 50 francs in this example, there is no disagreement that a bubble is evident.

Finally, we provide a measure of price volatility in our markets. As we discussed earlier, in addition to disagreement about the impact of a transaction tax on market price efficiency, there is a lack of consensus of the impact of a tax on price volatility. Deviation allows us to gauge the deviation in price from FV. We follow King *et al.* (1993) who measure normalized absolute price deviation or price distance from FV using all transactions across periods and then normalizing by the number of shares outstanding [7]. This measure allows us to gauge price volatility across treatments with various tax rules.

In the following section, we provide details surrounding the experimental procedures and design, as described generally earlier. Our goal is to gain insight into the impact of a tax on transactions in markets that are observed to generate prices exceeding FV.

3. Design of experimental stock market

The asset market experiments were conducted at a large Chinese university. A total of 29 market sessions were conducted [8]. The experimental design, summarized in panel A of Table 1, includes six treatments. First, to provide a baseline, we begin with a treatment in which transactions are not taxed (no tax). Next, we include two treatments with a flat tax on each side of every share transacted of 1 (2) franc(s) referred to as the low flat (high flat) treatment. In the final treatments, trades are taxed as a percentage of the transaction price per share with manipulations of 0.1%, 10% and 20%, referred to as low, moderate and high percentage tax schemes. In King *et al.*'s (1993) design, the flat transactions fee was 10 cents on each side of a transaction. With a FV of \$3.60 at the beginning of trading, the total tax imposed on traders of 20 cents is less than 10% of the underlying economic value. To explore the impact of a transactions tax on market outcomes and the revenue generated by the taxation authority, we vary the tax structure from quite a small per transaction tax of 1 franc to an economically significant tax of 20% on each side of a transaction, or 40% in total.

Ten traders participated in each session, except in the third session in treatment 1 (no tax) and the third session of treatment 6 (high percentage), each of which included nine traders [9]. The 288 participants were students enrolled in business and economics. All participants were inexperienced in that none had participated in an earlier session. Traders earned from ¥31.78 to ¥140.92 for participating, with an average (median) payout of ¥81.22 (¥80.90). The sessions required approximately 1½ h to complete. Each market session consisted of 12 3-min periods, organized as a computerized double auction market using the *Z-tree* software (Fischbacher, 2007). Traders were endowed with shares of stock and trading currency and were not permitted to short sell or borrow additional capital.

Upon arrival, traders received a set of instructions [10]. They then read along as one of the experimenters went through the instructions and addressed all procedural and technical questions. Each trader was endowed with shares of a single, identical stock as well as the experimental currency, referred to as "francs." As summarized in panel A of Table 1, each market included two trader types with different endowments of shares and cash. Though endowments varied across the two trader types, each trader had a total expected portfolio value of 4,600 francs in all treatments. End of period holdings of francs and shares carried over to the subsequent trading period. Following Smith *et al.* (1988), the stock traded in our markets had a known dividend generating process and finite lifespan. In all sessions, the stock paid a dividend of 0 or 10 francs at the end of each period. Traders learned that the dividends were equally likely, randomly determined and cross-sectionally and intertemporally independent. After the final dividend was paid at the end of period 12, shares ceased to exist and had zero value. Thus, FV was easily computed using backward induction as the expected dividend (5 francs) times the number of remaining periods. Even in markets with transaction taxes, the FV of an endowed share is the expected dividend times the number of periods remaining as that is the expected payout for a share held and not transacted. With 12 periods, the stock had an initial FV of $12 \times 5 = 60$ francs, as reported in panel B of Table 1. In treatments 2–6, traders were fully aware of the transaction tax and the computer program automatically reduced earnings by the taxes due at the end of each trading period.

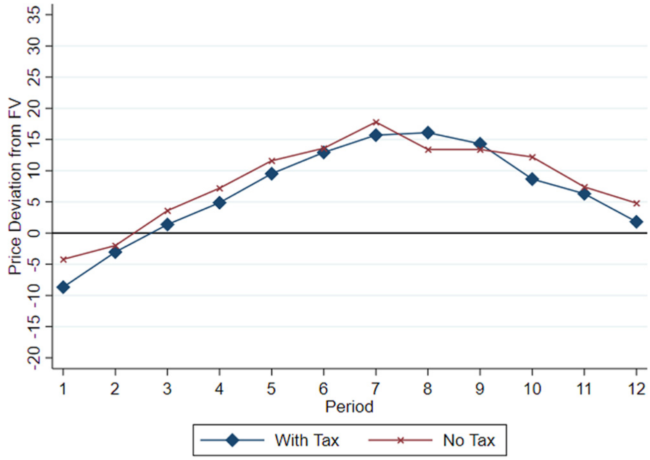
At the conclusion of a session, a trader's final cash balance was privately displayed on the computer screen. Participants completed a post-experiment questionnaire that elicited subject attributes including sex, educational background, economic status and reactions to the experiment. Each participant was called forward (privately) to check and receive cash earnings before filling out a receipt and leaving the room.

4. Market behavior and tests of the impact of a transaction tax

In this section, we begin with descriptive data to assess price behavior in the experimental markets, followed by formal statistical tests.

4.1 Observed market behavior

Figure 1 shows the mean price deviation from FV per period aggregated for the five treatments in which a tax is levied on shares transacted (with tax), as well as for the treatment without a tax (no tax) [11]. If the stock was priced at its FV, the mean price deviation would be zero. Consistent with earlier research, prices reflect the typical bubble pattern. Early in trading, prices begin below FV but quickly bubble up with valuations



Notes: The figure shows the mean price deviation from FV per period in francs aggregated for the five treatments in which a tax is levied on shares transacted (with tax), as well as for the treatment without a tax (no tax). A price deviation above (below) zero indicates overvaluation (undervaluation) in relation to the expected FV

Figure 1.
Time series of price deviations from FVs

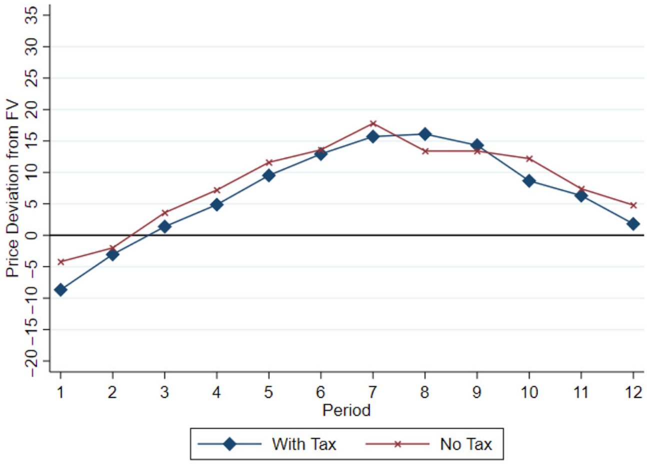
above fundamentals. In the baseline no tax treatment, as well as the tax treatments, prices crash to FV as the market comes to a close and trading winds down [12].

Figure 2 illustrates the evolution of the number of shares traded across periods, again aggregated for the five treatments in which a tax is levied on shares transacted (with tax), as well as for the treatment without a tax (no tax). The average number of shares traded per period across all markets is 51.57. Not surprisingly, the graph suggests that trade in the no tax market is relatively high, compared to markets with a tax on transactions.

4.2 Descriptive statistics

Table 2 reports summary statistics across treatments. First, we consider deviations in price from FV. As described earlier in the paper, we chose six bubble measures to summarize the price evolution in our markets. We also include four additional measures related to markets outcomes, as described subsequently. Table 2 reports the average value of each measure across sessions in each treatment [13]. Here we describe the market outcomes, with formal statistical tests of differences across tax schemes in the subsequent section.

The measures of mispricing reported in Table 2 provide evidence of consistent mispricing in our markets, as frequently reported by others in the literature. We observe that approximately half, or more, of the periods are characterized by prices that exceed FV, i.e. in more than 6 of 12 trading periods in all (tax or no tax) treatments mean $P_t > FV_t$. In addition, positive duration suggests that the mispricing is persistent. Positive duration suggests that price increases relative to FV in 4.8 periods, on average, with no tax on transactions. We see positive duration is of similar magnitude with a high flat tax, and somewhat lower with other tax schemes, with the exception of high Positive duration for the moderate percentage tax. For most treatments, the magnitude of the bubble is economically



Notes: The figure illustrates the evolution of the number of shares traded across periods, aggregated for the five treatments in which a tax is levied on shares transacted (with tax), as well as for the treatment without a tax (no tax)

Figure 2.
Time series of shares traded

Table 2.
Summary statistics

Measure	Treatment No tax	Low flat	High flat	Low (%)	Moderate (%)	High (%)
Periods when mean $P_t > FV_t$	7.800	5.600	7.400	6.600	10.400	7.000
Positiveduration	4.800	3.200	4.800	4.400	5.800	3.000
Peakdeviation	2.193	1.254	1.258	2.027	2.145	0.842
RAD	0.347	0.232	0.335	0.300	0.557	0.225
RD	0.250	0.014	0.231	0.132	0.531	0.047
Overpriced transactions	0.035	0.011	0.036	0.037	0.083	0.018
Deviation	24.213	14.314	10.920	15.973	22.393	9.512
Tradingvolume	795.200	680.600	421.200	747.200	546.600	522.500
Total trader earnings	5,000	48,638.800	48,315.200	49,150.550	44,804.090	43,071.710
Tax revenue	0.000	1,361.200	1,684.800	49.449	5,195.914	6,928.286

Notes: The table reports the average value of measures of mispricing for sessions in a treatment. First, the table reports the average number of periods for which the mean price (P_t) is greater than the FV (FV_t). Positive duration is the average number of consecutive periods with a price increase relative to FV when the increase produces a price that exceeds FV. Peak deviation measures the magnitude of a bubble using the normalized peak deviation in price from FV [maximum observed $(P_t - FV_t)/FV_t$]. The RAD measures mispricing, calculated using equation (1). The RD is a measure of overvaluation computed using equation (2). Overpriced transactions indicate the percentage of transactions that exceed the maximum possible payout. Deviation is a measure of price deviation from FV. Trading volume is the average of the total number of shares traded across sessions. The final two rows report total trader earnings and total tax revenue averaged across sessions for each treatment large as reflected in peak deviation. For example, with the moderate percentage tax, the bubble peaks at over twice the level of the FV, on average. The RAD measure is also suggestive of mispricing. Price is at least 22.45 from FV and as much at 55.7% from FV in the moderate percentage tax treatment. In this treatment, we observe that the mispricing is particularly sizable with overpricing of 53.1% (RD). We observe some overpriced transactions, particularly in the treatment with the moderate percentage tax (8.3%).

The final rows of Table 2 report additional summary information on behavior in our markets. Price volatility as measured by deviation is somewhat higher for the no tax and moderate percentage tax treatments. Trading volume is the average of the total number of shares transacted across sessions. We observe that the volume of trade is quite a bit lower in the high flat tax treatment. In fact, the number of shares traded with a high flat tax is about half of the number with no tax. The final two rows report total trader earnings and tax revenue averaged across sessions within each treatment. Of course, when there is no levy on transactions, traders accrue the maximum rewards (50,000 francs) and the tax authority raises no revenue. Also, as expected, when the tax is higher, traders earn lower profits and more tax revenue is generated [14].

Interestingly but not surprisingly to some, we do not observe, in general, a decline in the size of the observed bubbles as we move across treatments from low to higher tax burdens. We find no evidence to support the conjecture that an increase in the tax burden of a trade may prevent the execution of trades that have the potential of moving a bubbling price toward the true, underlying FV. Next, we describe formal statistical tests for differences across treatments.

4.3 Comparisons across markets with different tax schemes

Table 3 reports tests for treatment effects to provide evidence on the significance of differences in the behavior across groups. We use a two-sample Wilcoxon rank-sum (Mann–Whitney) test of the null hypothesis that the treatment groups are drawn from the same population (Siegel and John Castellan, 1988). Table 3 reports comparisons across treatment pairs, where the no tax treatment serves as the baseline.

Table 3. Tests for treatment effects

	Treatment				
Measure	Low flat	High flat	Low (%)	Moderate (%)	High (%)
Periods when mean $P_t > FV_t$	*0.06**	0.39	0.39	*0.02***	0.52
Positiveduration	0.16	0.46	0.75	0.52	0.17
Peakdeviation	0.25	0.35	0.92	0.46	0.33
RAD	0.35	0.46	0.60	*0.05***	0.14
RD	*0.05***	0.60	0.25	*0.02***	0.14
Overpriced transactions	0.20	0.58	0.75	0.25	0.62
Deviation	0.60	0.46	0.92	0.60	0.22
Trading volume	0.75	*0.05***	0.92	0.17	0.18
Total trader earnings	*0.00****	*0.00****	*0.00****	*0.00****	*0.00****
Tax revenue	*0.00****	*0.00****	*0.00****	*0.00****	*0.00****

Notes: We test whether a tax on transactions in a market leads to a significant difference in each measure, as compared to markets with no tax. The table compares the average value of each measure reported in Table 2 across treatment pairs with the no tax treatment serving as the baseline. *P*-values are from a two-sample Wilcoxon rank-sum or Mann–Whitney test of the null hypothesis that the groups are drawn from the same population where $^{*}p < 0.10$, $^{**}p < 0.05$ and $^{***}p < 0.01$

For each paired comparison, the table reports two-sided p-values with asterisks indicating significance levels. For most comparisons of mispricing across treatments, significant differences are not indicated. The low flat tax treatment differs from the no tax in terms of the number of periods with mean price exceeding FV, as well as RD. Similarly, we see some significant differences in bubble measures with the moderate percentage tax but the bubbles are *larger* with this tax, as compared with no tax. The moderate percentage tax does not seem to promote efficient pricing as both bubbles measures are actually *larger* with the tax, as compared to no tax [15]. Overall, we find little evidence that a tax on transactions will improve pricing in markets prone to bubbles.

Table 3 also reports tests for other market outcomes across treatments, with the no tax treatment again serving as the benchmark. We observe a significant difference in the trading volume with a high flat tax structure, where the number of shares traded is significantly lower than in the absence of a tax. Finally, we observe highly significant differences in total trader earnings and tax revenue for all tax regimes, as compared to the no tax treatment.

5. Discussion of results, future research and concluding remarks

This paper reports the results of experimental asset markets in which market participants trade a finitely lived asset with public knowledge of the fundamental generating process. In some markets, traders pay a tax on each share transacted with the tax burden and structure varying across treatments. While much research has investigated pricing efficiency in these so-called bubbles markets, no prior study systematically considers whether trader irrationality can be curbed by a transaction tax. We find *no evidence* to support the view that a financial transaction tax will improve pricing efficiency in a frothy market. Recall that we manipulate the impact of a transaction tax on trading behavior. To do so, we varied the tax structure from a small, flat tax of 1 franc to a rather imposing tax of 20% on each side of a transaction, or 40% in total. We continue to observe significant mispricing even with an economically significant tax of 40%.

Our experimental results are consistent with the model of Scheinkman and Xiong (2003) in which a transaction tax can reduce speculation but has little impact on price bubbles or excess volatility. Our results do not support the view that a tax on financial transactions will check short-term speculation as suggested by Summers and Summers (1989) and Pollin *et al.* (2003). However, our results are consistent with Baker (2008) who argues that significant tax revenue can be raised by a financial transaction tax, even if volume falls substantially. Though we find that trading volume is significantly lower with a high flat tax, tax revenues grow while pricing efficiency is not impacted significantly.

A governing body seeks to raise revenue to allocate to uses that are deemed valuable to society. As the 2020 presidential election in the USA approached, candidates considered a wide variety of proposals, including taxing capital, wealth and financial transactions (Lorenzo and Becker, 2019). A financial transaction tax is gaining momentum with the current US administration (Egan, 2021). While a decision-making authority will seek to raise revenue to address current social issues such as income inequality, undesirable externalities want to be avoided. This study finds that a financial transaction tax is potentially an appropriate tool to raise funds without imposing costs on society such as reduced pricing efficiency in markets.

We encourage additional research into the tools authorities can use to raise revenue without imposing unwanted costs on its citizens. In our experimental environment, there is no private information or opportunity for information dissemination through prices. Future research on the impact of a transaction tax on pricing efficiency with asymmetric information may provide new insight into market outcomes.

Market participants are an important segment of the economy who serves a crucial role in the efficient allocation of capital. Our experimental environment is, of course, an abstraction of naturally occurring markets and it may be that the model excludes important aspects. For example, it is possible that a transaction tax could lead to undesirable distortions across market segments. Though some questions remain unanswered, our evidence supports the view that while a tax on transactions may prove to be a desirable restraint on mispricing in stock markets (Scheinkman and Xiong, 2003), the tax authority can generate significant revenue (Baker, 2008).

Notes

1. 1. While a significant transaction tax is not in place in the USA, the Securities and Exchange Commission taxes the registration and transfer of new issues (Pollin *et al.*, 2003).
2. While there are earlier experimental investigations of the impact of a transaction tax on market outcomes in other settings, to the best of our knowledge, no earlier study with the exception of King *et al.* (1993) looks at the impact on efficiency in a market prone to mispricing. For example, Hanke *et al.* (2010) and Kirchler *et al.* (2011) examine the impact of a Tobin tax in currency markets. In addition, Huber *et al.* (2012) consider how a transaction tax affects the fat tails and volatility clustering typically observed in price returns. Also, as described subsequently, Bloomfield *et al.* (2009) examine the behavior of noise traders with a tax on trade.
3. Bloomfield, O'Hara and Saar's environment is designed to examine the behavior of noise traders who have no information-based motivation for trade. In our markets, no trader has superior information. Across periods in their design, participants trade different assets. Our goal is distinct in that we seek to examine behavior in a market known to produce mispricing.
4. This software is provided to experimental researchers by the University of Zurich, Institute for Empirical Research in Economics. See www.iew.unizh.ch/ztree/index.php.
5. See, for example, Ackert *et al.* (2006) and Ackert *et al.* (2016).
6. See Palan (2009), equation 4.14.
7. See Palan (2009), equation 4.5.
8. In addition, we conducted several pre-tests. The results are not reported here as we refined several aspects of the design resulting in substantive procedural changes.
9. We attempted to include ten traders in each session but because of no-shows two sessions included nine participants. These sessions had five (four) type X (Y) traders.
10. The complete instructions are included in an Appendix in English that is available upon request. The instructions were translated to Chinese and cross-checked by two native Chinese speakers.
11. Figures displaying average prices by treatment reveal a similar pattern. In addition, the experience based on median transaction prices give a similar view behavior in our markets.
12. There is variability across markets in the evolution of prices over time. The price behavior in some sessions was not consistent with the typical bubble pattern, but it is not uncommon to have sessions that do not display the usual bubble and crash pattern. Smith *et al.* (1988) reported that bubbles were common but are by no means universal. Smith, Suchenek and Williams report that 37% of their markets did not exhibit the usual pattern. In addition, Ackert *et al.* (2009) report that about half of their markets fail to indicate the usual bubble pattern.
13. Inferences are similar using median values.

14. The sum of total trader earnings and tax revenue should be 50,000 francs. The sum for the low percentage treatment differs from this because a computer glitch halted trading in one session after period 11 so that period 12 data were incomplete.
15. Recall that our goal is to examine the role of a transaction tax in markets that are subject to mispricing. We recognize that the cash-to-asset ratio varies across our treatments which could impact overvaluation (Caginalp *et al.*, 1998; Kirchler *et al.*, 2012). However, we observe that the higher tax with the moderate percentage tax is associated with greater mispricing as compared to the no tax. Thus, changes to the cash-to-asset ratio cannot explain our results.

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