Experimental Evidence on Tax Salience and Tax Incidence

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Abstract

While a basic theoretical principle in public economics assumes that individuals optimize fully with respect to the introduction of a tax, a growing body of research is proving that several heuristics are in place when people take decisions. We re-examine the well-known Liability Side Equivalence principle in the light of the concept of salience. While these two topics have been extensively investigated in isolation, this paper innovates on the previous literature in that it focuses on their joint effects. Is tax incidence dependent on whether the subjects face a salient rather than a non-salient tax? Does the salience of a tax exert a different effect depending on who is legally committed to bear the tax burden? We address these questions through a laboratory experiment in which one unit of a fictitious good is being traded through a double-auction market institution. Based on a panel data analysis, our contribution shows that point of collection matter and determine the economic incidence of tax. Additionally we found that the joint effect of salience and statutory incidence does not alter the informative efficiency, but has a positive effect on buyers' allocational efficiency when the tax is levied on sellers.

Keywords: Tax incidence, Tax salience, Liability Side Equivalence, choice behaviour, laboratory.

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1. Introduction

Tax salience and the implication of tax perception was first recognised by John Stuart Mill (1848), who stated that:

> *"Perhaps […] the money which [the taxpayer] is required to pay directly out of his pocket is the only taxation which he is quite sure that he pays at all. […]. If all taxes were direct, taxation would be much more perceived than at present; and there would be a security which now there is not, for economy in the public expenditure."*

Sausgruber and Tyran (2005) investigated whether the incorrect perception of the tax can translate into distorted fiscal choices by using a referendum mechanism. This tax misperception can be traced to the so-called phenomenon of fiscal illusion, which more generally suggests that, when government revenues are not completely transparent or are not fully perceived by taxpayers, the cost of government is seen to be less expensive than it actually is. They showed that subjects who are experienced with one tax regime make better decisions in the other tax regime than subjects without such experience. Therefore the direct tax regime leads to correct tax perception.

In a seminal paper, Chetty et al. (2009) studied the impact of tax salience on consumers' price perception as well as the subsequent effect on the demand for the taxed goods. The authors implemented a field experiment at a Northern California grocery: while preserving the usual practice of posting tax-exclusive prices for control group products, the authors posted a tag reporting tax-inclusive prices below the original price tag for treatment group products. As a main result, Chetty et al. (2009) found that consumers were less prone to buy those products for which the tax-inclusive price was shown. More interestingly, given the demand price elasticity, they found that the demand reduction induced by showing tax-inclusive prices was roughly the same as that induced by a price increase equal to the excluded sales tax from the shelf. As a consequence, the only plausible conclusion was that consumers simply did not account for the tax scheme in making their purchasing decisions. In other words, the lesser salient the tax was, the lesser it was accounted for.

Several papers report findings which are consistent with those of Chetty et al. (2009), see for example Sausgruber and Tyran (2008, 2011), Finkelstein (2009), Gallager and Muehlegger (2008). Then, the main insight we learn from this literature is that people overweight more prominent information, with the consequence that when the tax is less salient it induces a smaller response in subjects' behaviour.

Our contribution re-examines the well-known Liability Side Equivalence (LSE) principle in the light of the concept of tax salience, which is the extent to which taxes are visible to taxpayers. While these two topics have been extensively investigated in isolation, this paper innovates on the previous literature in that it focuses on their joint effects. Does the level of tax salience or tax visibility matter towards the determination of economic incidence of an excise tax? Does LSE continue to hold with the variation in the level of tax salience? Since salience and statutory incidence should not provide unlike distributional outcomes taking them in isolation, we expect that any interaction among them will not impact on the informative and allocational efficiency of the market.

Tax incidence is nowadays one of the most debated issues in public economics. The relevance of the topic comes from the fact that, in order to study the distributional effect of a tax system, it becomes crucial to understand who ultimately suffers the burden of the tax. In this sense, the LSE principle holds

that the burden of a unit tax on buyers and sellers is independent of who actually pays the tax. In the Handbook of Public Economics, Fullerton and Metcalf (2002) distinguish between "economic incidence" and "statutory incidence": that is the person who is legally committed to pay the tax may not be the person who ultimately bears the real tax burden. Thus, according to neoclassical public economic theory, the economic incidence of a tax depends solely on the relative elasticity of supply and demand, i.e. the more inelastic one bears a greater burden. In other words, buyers will bear more of the tax burden if demand schedule is more inelastic than supply and *vice-versa*. Nevertheless, there is growing literature (see, for example, DellaVigna, 2009; Chetty et al., 2009; Slemrod, 2008; Biswas et al., 1993; Krishna et al., 2002), showing that other issues, such as behavioural and institutional factors might affect tax incidence. In this sense, Cox et al. (2017) investigated the influence of market institutions on tax incidence. Due to the co-existence of many types of markets, each with different properties and mechanisms for the determination of price and quantities traded between sellers and buyers, it is plausible to suppose that different market configurations might lead to different incidence results. Cox et al. (2017) addressed two important research questions: Is tax incidence independent of the assignment of the liability to pay tax in experimental markets? Is tax incidence independent of the market institution in experimental markets? Comparing a double-auction institution with a posted-offer market[2] Cox et al. (2017) reject both the hypotheses that tax incidence is independent of the assignment of liability to pay and that tax incidence is independent of the market institution[3].

While some research has shown that the theoretical prediction of LSE holds in actuality (see, for example, Bork et al. 2002; Ruffle, 2005; Kachelmeier et al. 1994), other studies have reported opposite results (see, for example, Kerschbamer and Kirschsteiger, 2000). Interestingly, the latter study argues that statutory incidence may play a role in situations where social norms affect the final outcome: for instance the statutory incidence might create a sort of "moral commitment" to pay the tax. Indeed, implementing an ultimatum game *à la* Guth et al. (1982) in which the tax is levied on the proposer in one treatment and on the responder in the other treatment, Kerschbamer and Kirschsteiger (2000) report evidence that the market side on which the tax is levied exhibits a greater tax burden. Riedl and Tyran (2005) experimentally test LSE in a gift-exchange labor market and find that "a change in tax regimes does not significantly affect relevant market outcomes like the distribution of incomes between workers and firms, even in the short run".

Gamage and Shanske (2011) argued that in theory, offsetting the tax burden can also alleviate most conflicts between the revenue-raising advantages of reducing market salience and the concerns related to wealth distribution, but they are uncertain of the extent to which the needed offsetting tax rate-adjustments will be politically feasible in practice. Theoretically speaking, we know that both salience and statutory incidence should not induce economic distortions until prices continue to reflect clearly all the available information at subjects' hand and should lead to the theoretically predicted equilibrium.

[2] In experimental double-auction markets buyers and sellers are free to declare a price quote for one unit of the fictitious commodity within certain time constraints. Each exchange covers a single unit of commodity and is realized when one of the parties accepts the price quote proposed by the other party. In posted-offer markets the seller publishes the prices of goods possibly limiting the amount for sale and the buyer decides to buy this good on the basis of a comparison between the prices published by different sellers.

[3] Particularly, the change in market institution has a greater impact on tax incidence than a change in the assignment of the liability.

In the real world, subjects face different tax schedules, each of them with different degrees of salience depending on the complexity of the tax rules that individuals face. We can think about differences between direct and indirect taxes as a simple and meaningful example.

One of the main cores of public economics lies in the analysis of the effects of taxation on social welfare. The well-known literature on optimal taxation provides answers to policymakers' demands in order to implement appropriate tax policy design. The fundaments of optimal taxation theory refer essentially to the contributions of Diamond and Mirrlees (1971) for the optimal commodities tax schedule, Mirrless (1971) and Atkinson and Stiglitz (1976) for the optimal income tax schedule. However, as pointed out above, several behavioural and cognitive biases can overstretch the theoretical assumptions of such theorems, thus making their implications less relevant in terms of tax policy designs.

Our contribution innovates on previous literature in two main points. First we focus on the impact of tax salience and incidence in terms of market allocational and informational efficiency; second our laboratory experimental design allow us to investigate tax salience and tax incidence in a double auction (DA) market institution. The choice of this trading institution is due to the evidence that countless experiments have shown that these markets exhibit a rapid price convergence to the competitive equilibrium price as well as efficient allocations (see, for example, Smith, 1976; Smith and Williams, 1983; Smith *et al*., 1982)[4].

One important thing to note here is that, while most of previous research works (i.e. Chetty et al., 2009; Finkelstein, 2009; Gallager and Muehlegger, 2008) essentially identified the effects of tax salience in a posted offer (PO) market institution (since they were field experiments), our laboratory experimental tools give us the advantage of testing tax salience in a DA market.

In such framework we implement a within-subject design experiment in which, after preliminary controlling for the isolated effect of tax salience and incidence – comparing, *ceteris paribus*, salient with non-salient tax specifications and taxes on buyers with taxes on sellers respectively–, we further investigate their joint effect by varying both the subject who bears the burden and the salience of the tax.

2. Experimental design

2.1. An overview

We conducted a laboratory experiment in which subjects traded one unit of a fictitious good in a double-auction market. The experiment[5] was programmed and conducted using the software z-Tree (Fishbacher, 2007). The experimental design consists of nine tasks (see Table 1):

Table 1: Summary of Experimental Tasks

Task	Task Tag	Task Description
1	NT	No Tax
2	STB4	Salient Tax on Buyer (4 ECU)

[4] For this reason, double auction markets have also been widely used as a benchmark for testing the performance of other institutions (see, for example, Ketcham *et al*., 1984).

[5] Figure 1A in the appendix depicts a screenshot of the experimental market place for a seller in the task with no tax imposition.

3	STS4	Salient Tax on Seller (4 ECU)
4	STB8	Salient Tax on Buyer (8 ECU)
5	STS8	Salient Tax on Seller (8 ECU)
6	NSTB4	Non-salient Tax on Buyer (4 ECU)
7	NSTS4	Non-salient Tax on Seller (4 ECU)
8	NSTB8	Non-salient Tax on Buyer (8 ECU)
9	NSTS8	Non-salient Tax on Seller (8 ECU)

1. A task in which subjects face an induced stationary demand and supply schedule[6] with no tax imposition (NT);
2. A task with subjects facing a demand schedule with reservation prices that are implicitly reduced by the amount of a 4 ECU excise tax on buyers (STB4);
3. A task with subjects facing a supply schedule with cost values that are implicitly incremented by the amount of a 4 ECU excise tax on sellers (STS4);
4. A task with subjects facing a demand schedule with reservation prices that are implicitly reduced by the amount of an 8 ECU excise tax on buyers (STB8);
5. A task with subjects facing a supply schedule with cost values that are implicitly incremented by the amount of an 8 ECU excise tax on sellers (STS8);
6. A task in which subjects face the no tax task schedules and buyers are told there will be a 4 ECU excise tax (NSTB4);
7. A task in which subjects face the no tax task schedules and sellers are told there will be a 4 ECU excise tax (NSTS4);
8. A task in which subjects face the no tax task schedules and buyers are told there will be an 8 ECU excise tax (NSTB8);
9. A task in which subjects face the no tax task schedules and sellers are told there will be an 8 ECU excise tax (NSTS8).

Particularly, in ST tasks it is assumed that showing a price or a cost value, which includes the excise tax, makes it more perceptible and therefore more salient. However, in NST tasks, reservation prices do not include the tax, and subjects face a cognitive cost of computing the actual price or cost in the presence of a lower tax salience. Setting two different sizes of the excise tax (4 and 8 ECU) allows us to determine whether a higher tax may lead to different effects on traders' behaviour *ceteris paribus*. In this way, we can be assured that ST tasks will have the same parameterizations of NST tasks and will be comparable from a theoretical standpoint. In fact, the translation of supply and demand schedules due to explicit tax imposition in NST tasks will lead to equivalence with ST task schedules. Clearly, the ST tasks can accurately represent situations in which the "in-front-of-the-shelf" consumer is shown the tax-inclusive price. Conversely, NST tasks represent situations in which the consumer is shown the tax-exclusive price. In this case, as frequently happens, the tax will be added (and hence it will become more salient) only at the checkout.

[6] All tasks in each session refer to supply and demand schedules of no tax task although they are suitably modified in ST tasks to ensure theoretical equivalence conditions with NST tasks.

The experiment was conducted in the "Lee" Laboratory for economic research at the University "Jaume I" of Castellón (Spain). Participants were 138 undergraduate students, particularly freshmen. We ran six sessions over some regular days in September 2014. Each session consisted of the nine tasks reported above and lasted about 100 minutes; the tasks order within each session was carefully randomized to avoid order effects. The subjects' role (buyer or seller) as well as costs and values were randomly assigned at the beginning of each task and remained fixed throughout the entire task, but they differed across tasks. After reading a hard copy of the instructions, subjects were allowed to ask questions either publically or privately to clarify any doubts. Trading occurred adopting Experimental Currency Units (ECU) as a proxy for real money. At the end of each session, subjects were paid their cumulative earnings at the conversion rate of 10 ECU = 1€. An example of the instructions is teported in Appendix C.

2.2 Session description

In each session buyers and sellers trade the good in a double-auction market that is opened for 90 seconds in each trading period. The trading screen of all participants always displays the lower "ask" and the higher "bid". One contract is closed whenever a seller accepts the outstanding "bid" or a buyer accepts the outstanding "ask". Traders are sited in a manner that their privacy is protected; also they are not allowed to communicate with one another. This procedure is identical for all tasks. Each session includes 9 tasks. In each task (of the first session) 12 buyers and 12 sellers can trade 1 unit of a fictitious good[7]. In a given task, subjects first trade in 2 "practice" periods (which have not been considered for final payment) and then in 7 "real" periods. We induce different demand and supply curves in each market. The demand and supply schedules remain fixed over periods in a given task, but they differ across tasks to gauge tax salience impact. In the NT task, subjects trade with the stationary demand and supply schedule in the absence of tax as shown in Figure 1.

The predicted equilibrium occurs where the curves intersect the quantity equal to 11, and the price between 44 and 46 (we assume 45 as the equilibrium price for surplus calculus). As mentioned above, in the four ST tasks, the amount of the excise tax has been deducted from values or added to costs, depending on the legal responsibility to pay the tax. In the STB4 task the demand schedule is shifted by 4 ECU compared to the NT setting. This means that the tax is imposed on the buyer and values have been adjusted for the respective tax amount. In this case the equilibrium occurs with a quantity equal to 10 and a price equal to 43 ECU (see Figure 2A in the appendix). In terms of incidence, the STS4 task is theoretically equivalent to the previous (see Figure 3A in the appendix). The supply schedule is shifted by 4 ECU because sellers are legally committed to pay the tax. The equilibrium occurs with a quantity equal to 10 and a price equal to 47 ECU. The introduction of an 8 ECU excise tax determines an equilibrium quantity equal to 9 for both STB8 and STS8 tasks and an equilibrium price equal to 41 ECU and 49 ECU respectively. The supply and demand schedules related to these tasks are shown in Figures 4A and 5A respectively.

[7] In the second session we have 11 buyers and 11 sellers; in the third session 12 buyers and 11 sellers; in the fourth session 15 buyers and 14 sellers; in the fifth and sixth sessions 10 buyers and 10 sellers.

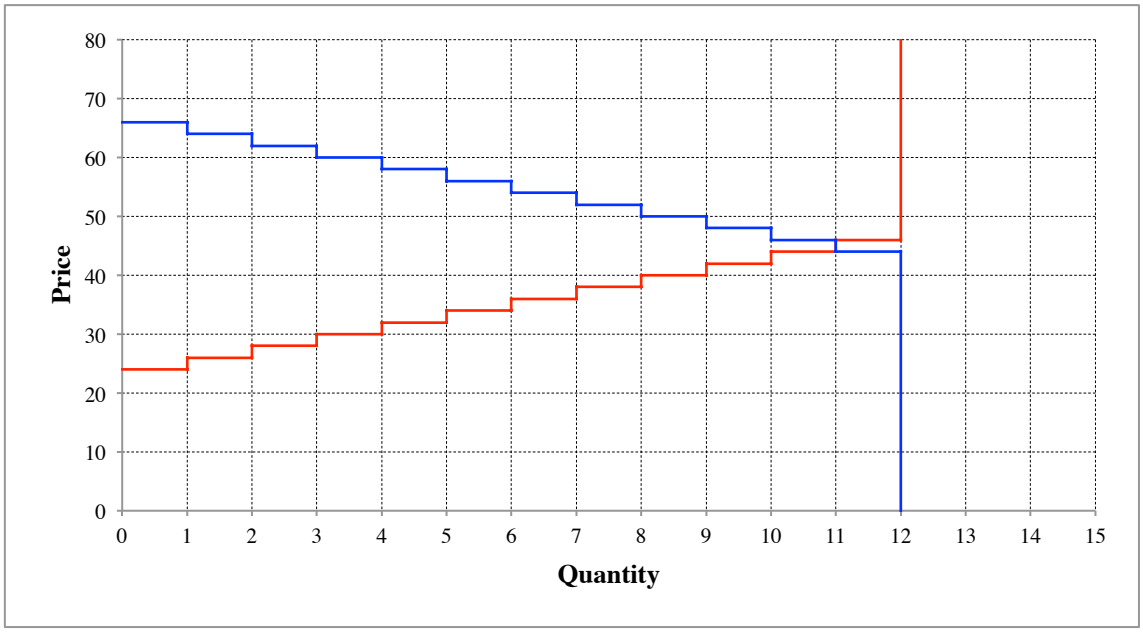

Figure 1: Demand and Supply schedule in NT tasks (Session1)

In contrast, NST tasks always resort to the no-tax demand and supply schedules. We know from theory that the imposition of an excise tax will shift schedules by the exact tax amount, as subjects must necessarily consider taxes in their personal assessment. In particular, if the tax is imposed on the buyer, the maximum that he is willing to pay will be equal to the sum of the good's price and the tax. Likewise, if the tax is imposed on the seller, the tax will be considered as an additional cost to those already incurred in the production and/or sale activities. This implies, for example, that if the buyer is aware of the application of an excise tax, then he should rationally consider paying the tax in the maximum assigned value, resulting in a downward shift of its demand curve. On the other hand, the seller should rationally consider the tax as an additional cost that will raise its supply curve. This way, ST and NST tasks are theoretically equivalent and allow a proper assessment of the effects of greater or lesser tax salience. More precisely, the STB4 task is equivalent to the NSTB4 task; the STS4 task is equivalent to the NSTS4 task; the STB8 task is equivalent to the NSTB8 task and the STS8 task is equivalent to the NSTS8 task. In Appendix A, we list all the theoretical and experimental values of price, quantity, total surplus, as well as buyers and sellers' surplus (see Tables from 1A to 12A).

In order to assess the impact of our different tax specifications on market performance, we employ two different measures, namely the allocational market efficiency and the informative market efficiency. We briefly discuss the two measures in the next section.

3. Measures of Market Performance

3.1. Allocational Efficiency

Theoretically speaking, the equivalence relationship of the salient (ST) and non-salient (NST) tax specifications implies that buyers and sellers should equally share profits from the trading activity. Clearly, our experimental design requires a different calculation of the surplus for different tasks. Since in ST tasks subjects face tax-inclusive values, the surplus is equal to $S_b = v - p$ for buyers and $S_s = p - c$

for sellers, where S_b and S_s are buyers and sellers' surplus, respectively; v denotes the private reservation values, p is the unit price and c is the cost. Differently, in NST tasks, subjects deal with tax-exclusive values and have to face the cognitive cost to discount the tax size in their reservation and cost values. In the latter cases, buyers' surplus is computed as $S_b = v - (p + \tau)$ and sellers' surplus as $S_s = p - (c + \tau)$, where τ denotes the unit tax.

Market allocational efficiency is calculated as follows:

$$e = \frac{\sum_{i \in traders} pr_i}{s_s + s_b} \times 100$$

This index, introduced by Gode and Sunder (1997), is defined as the ratio between the total actual profit and the theoretical profit. While the former is the sum of profits made by each trader – where pr_i stands for the profit of trader i – the latter is the sum of theoretical buyers and sellers' surplus. This index converges to 100% whenever subjects extract the maximum potential profit from trading. We decompose this index to compute both buyers and sellers' allocational efficiency. In the former case we only consider profits earned by buyers (in the numerator) and the potential buyers surplus (in the denominator); in the latter case we only account for sellers realized profits (in the numerator) and for the potential sellers surplus (in the denominator). Splitting this index up into buyers and sellers' allocational efficiency allows us to investigate the effect of the different tax specifications on both buyers and sellers' allocational efficiency.

3.2. Informational efficiency

Following Vernon Smith (1962), we measure the accuracy of the price discovery process by computing the root mean square error between each of the *n* transaction prices (for i=1…n) over a given period and the equilibrium price (p_0) of that period, expressed as a percentage of the equilibrium price. Substantially, the Smith's Alpha captures the standard deviation of actual prices over the theoretical equilibrium value.

$$\alpha = \frac{100}{p_0} \sqrt{\frac{1}{n} \sum_{i=1}^{n} (p_i - p_0)}$$

Then, a lower value of this index is desirable, since it would imply that trading prices exhibit lower deviations from the market equilibrium price.

4. Experimental Results

4.1 Price Convergence and Descriptive Statistics

Probably the easiest way to summarise our results is to portray graphs of the traded prices in each of the 7 periods within each of the 9 tasks throughout the 6 sessions. Figures 2 through 7 correspond to Sessions 1 through 6. On the horizontal axis we plot time (in seconds) whereas the vertical black lines break up the experimental session into its 9 tasks and the vertical dotted lines break up the tasks into its 7 periods[8]. The

[8] We do not show the results for the practice periods.

black line reports *trades* – and the vertical axis shows the price at which the trade took place. The horizontal dashed lines represent the theoretical equilibrium price.

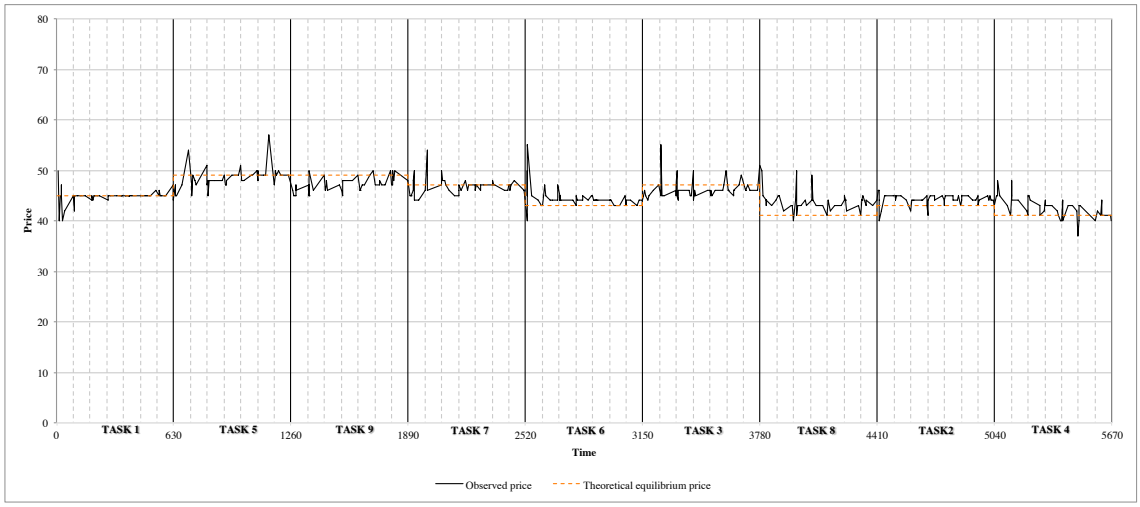

Figure 2: session 1

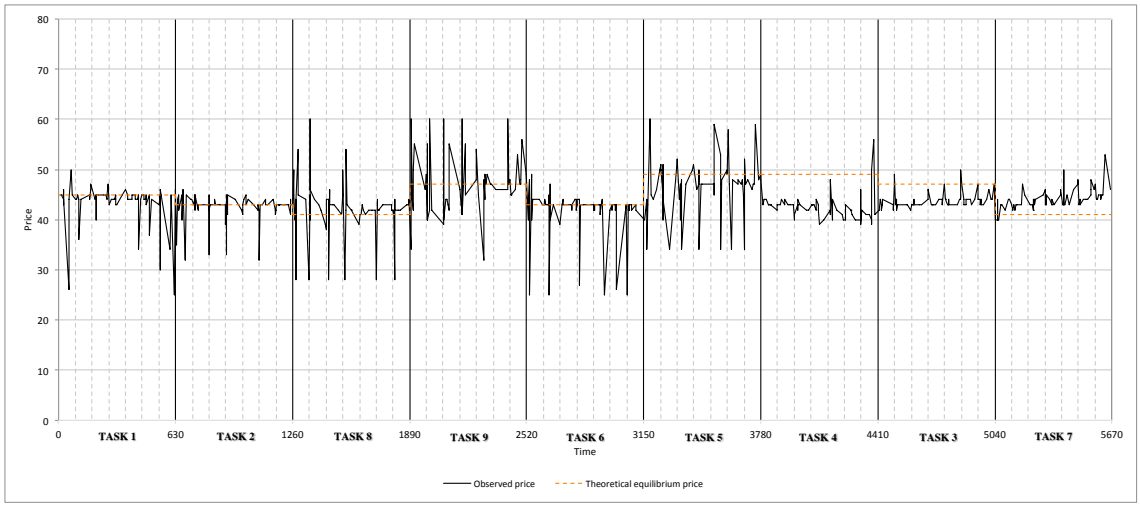

Figure 3: session 2

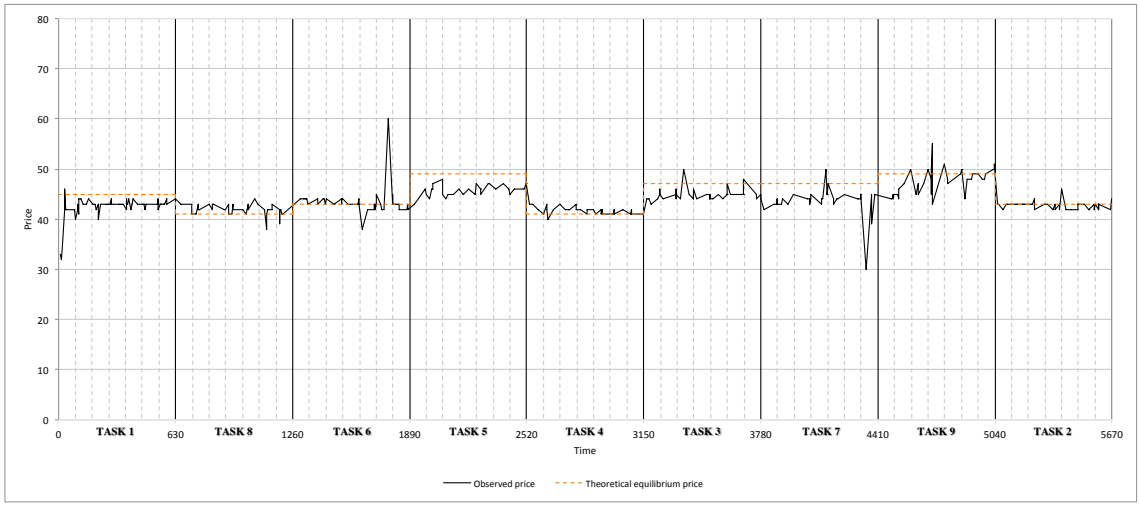

Figure 4: session 3

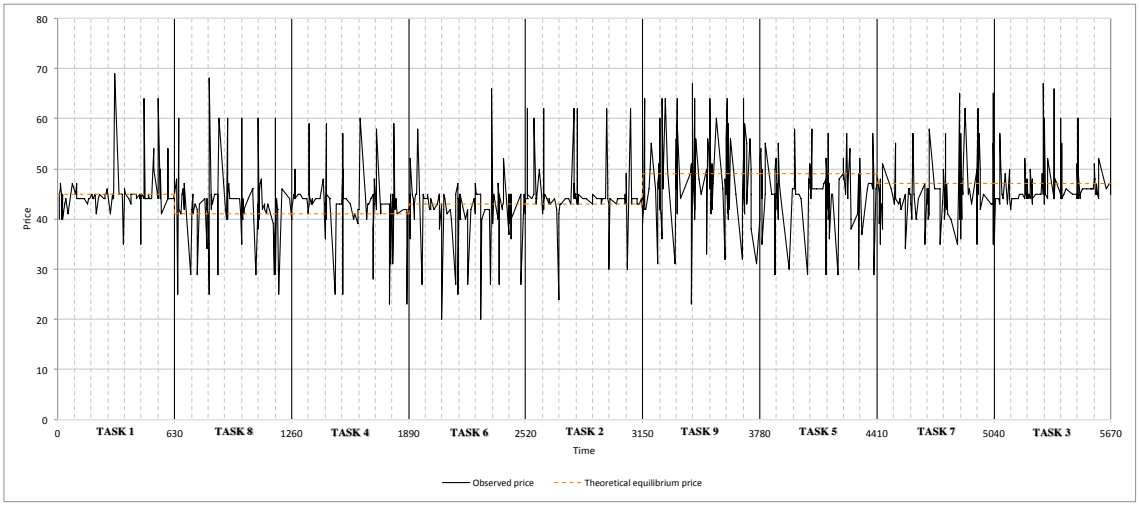

Figure 5: session 4

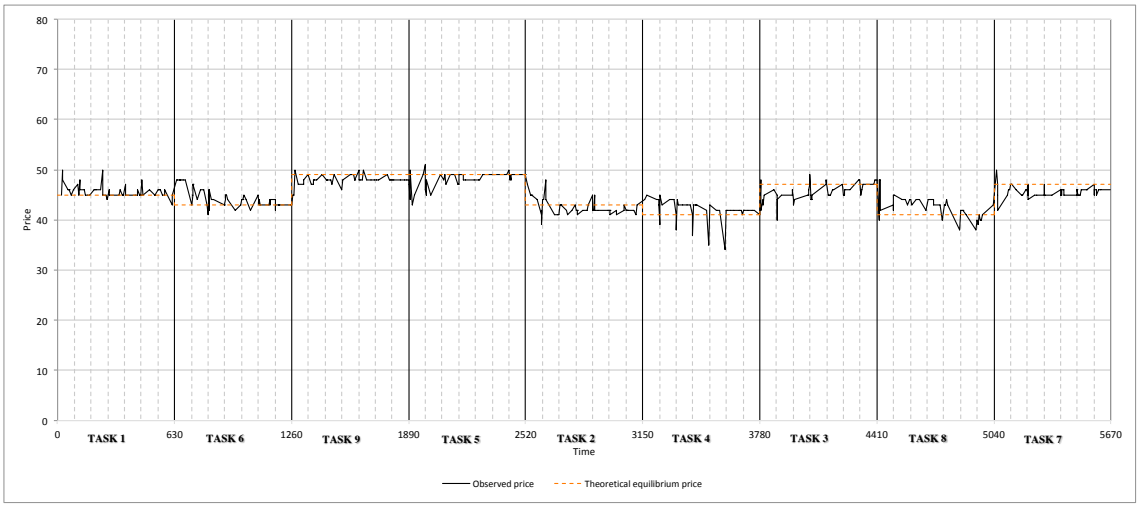

Figure 6: session 5

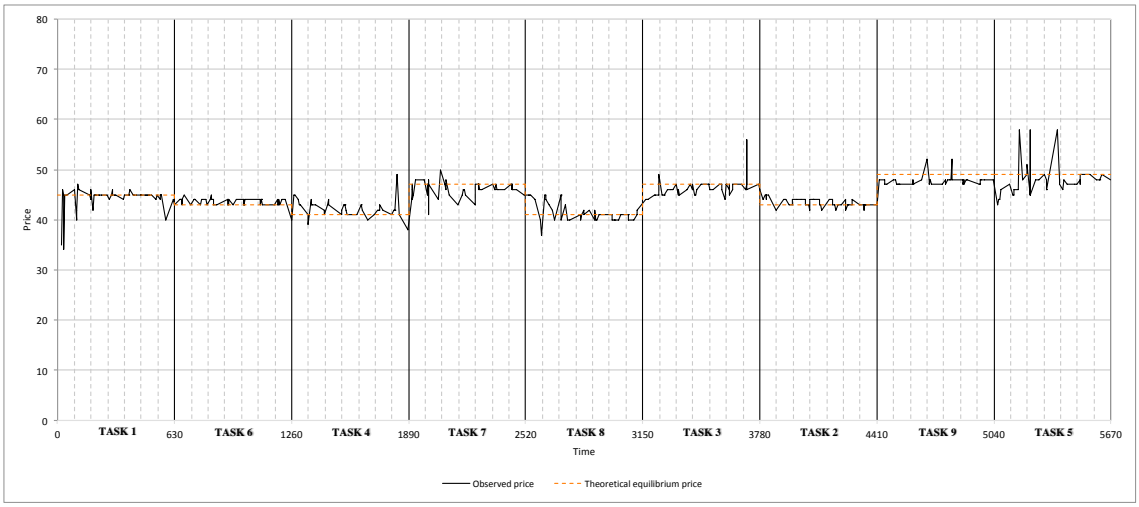

Figure 7: session 6

A number of things are immediate from these graphs. First, that there was trade. However, the most important feature is convergence of price data. We observe convergence in all periods, yet the speed

of convergence might be different in the various tasks. We are primarily interested in explaining how the different tax conditions (as reported in table 1) affect our two market performance indicators.

Table 2 reports some descriptive statistics from our experiment.

Table 2: Summary of Experimental Results

	Session 1									Session 2								
	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9
Equilibrium Price	45	43	47	41	49	43	47	41	49	45	43	47	41	49	43	47	41	49
Actual Price (mean)	43.4	42.51	43.83	42.5	46.4	41.54	44.02	41.9	46.65	44.8	44.1	46.25	48.54	42.56	44.44	46.9	43.69	47.26
Smith Alpha (mean)	8.26	5.9	7.46	6.53	12.56	11.42	7.59	12.56	12.79	2.08	3.59	4.13	6.14	3.95	4.45	2.93	6.62	15.45
Buyer AE (mean)	113.2	101.4	124.9	80.07	122.6	113.1	122.4	84.83	116.8	95.8	80.5	104.7	70.63	105.6	69.71	94.8	26.58	102.4
Seller AE (mean)	85.35	92.28	67.42	113.9	65.08	83.42	68.14	105	69.84	97.5	114	88.92	121.4	88.09	116	89.5	135.3	70.63
	Session 3									Session 4								
	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9
Equilibrium Price	45	43	47	41	49	43	47	41	49	45	43	47	41	49	43	47	41	49
Actual Price (mean)	45.7	42.58	45.46	41.96	48.07	44.37	45.72	42.65	47.92	44.9	44.7	46.96	42.68	45.32	41.85	45.2	42.5	47.73
Smith Alpha (mean)	2.85	3.57	4.66	5.51	3.01	4.33	3.52	6.14	2.67	8.81	13.8	12.81	16.85	15.94	15.45	14.1	18.69	18.1
Buyer AE (mean)	87.5	93	111.1	81.35	107.5	79	117.5	65.07	117.1	89.7	79.5	93.15	81.69	126.7	106.4	109	74.02	102.4
Seller AE (mean)	103.1	92.42	77.26	114.7	81.34	118.1	76.67	124.6	62.3	99.8	107	98.71	107.7	65.28	88.69	81	108	79.22
	Session 5									Session 6								
	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9
Equilibrium Price	45	43	47	41	49	43	47	41	49	45	43	47	41	49	43	47	41	49
Actual Price (mean)	44.34	42.77	44.93	41.76	45.8	43.44	43.72	41.96	47.47	44.3	43.4	46.22	42.31	47.9	43.62	46.1	41.59	47.76
Smith Alpha (mean)	3.9	1.48	5.04	2.39	6.89	3.83	8.28	3.6	5.62	3.9	1.48	5.04	2.39	6.89	3.83	8.28	3.6	5.62
Buyer AE (mean)	102.9	91.83	107.6	78.57	95.23	72.01	110.2	65.47	101.6	103	91.8	107.6	78.57	95.23	72.01	110	65.47	101.6
Seller AE (mean)	91.29	94.75	67.34	95.23	49.2	105.2	54.22	106	70.63	91.3	94.8	67.34	95.23	49.2	105.2	54.2	106	70.63

To better interpret the sensitivity of the allocational and informative efficiency with respect to our tax conditions, we report session by session their simple-average value over the 7 periods within each task. A few things are very interesting and quite common across sessions. We note that, with respect to the "control" condition where the market is not taxed, buyer's allocational efficiency increases in odd tasks - i.e. in all the cases when sellers are legally obliged to pay the tax – and decreases in the opposite case. The reverse pattern is detected on sellers' allocational efficiency. The extent to which these patterns on buyers and sellers' allocational efficiency are affected by the salience of the excise tax is not clearly detectable from the table. Regarding the Smith's Alpha, a preliminary visible effect is that it generally increases as a tax is introduced, thus implying a negative relation between the informative efficiency and the introduction of the tax.

4.2. Econometric analysis

To efficiently exploit the within subjects design of our experiment as well as to estimate the causal effects of our tax specifications on the allocational and informative efficiency of the market, we use the following fixed effects regression:

$$y_{i,t} = \mu + \beta_1 \mathrm{NT}_{i,t} + \beta_2 \mathrm{STB4}_{i,t} + \beta_3 \mathrm{STS4}_{i,t} + \beta_4 \mathrm{STB8}_{i,t} + \beta_5 \mathrm{STS8}_{i,t} + \beta_6 \mathrm{NSTB4}_{i,t} + \beta_7 \mathrm{NSTS4}_{i,t} + \beta_8 \mathrm{NSTB8}_{i,t} + \beta_9 \mathrm{NSTS8}_{i,t} + \alpha_i + \varepsilon_{i,t}$$

where $y_{i,t}$ is a generic placeholder for the dependent variable we take into account.

We run the model four times being the total, buyers', sellers' allocational efficiency and the Smith's Alpha our dependent variables; while the right hand side remains equal in the three cases[9]. The subindex i denotes the market and the subindex t refers to each time period, μ stands for the intercept term; α_i incorporates a set of unobservable variables which are assumed to be time invariant within each

[9]Since the allocational efficiency is expressed in percentage points, when it is accounted as a dependent variable, the natural logarithm of the left hand side is taken into account, i.e. a log-linear model is studied

cross-sectional unit; and $\varepsilon_{i,t}$ is the residual error component, assumed to be independent and identically distributed. Heteroskedasticity-consistent standard errors are estimated to accounted for potential auto-correlation within each market[10]. The right-hand side incorporates nine dummy variables. In particular, NT takes on value 1 when the tax is absent (i.e. in the first task) and 0 otherwise; STB4 (STS4) assumes value 1 when a salient tax of 4 ECU is levied on buyers (sellers); STB8 (STS8) assumes value 1 when a salient tax of 8 ECU is levied on buyers (sellers); NSTB4 (NSTS4) assumes value 1 when a non-salient tax of 4 ECU is levied on buyers (sellers); NSTB8 (NSTS8) assumes value 1 when a non-salient tax of 8 ECU is levied on buyers (sellers). From the perspective of an economist, it makes a lot of sense to assume the No Tax (NT) condition as the omitted (reference) variable of the model, since it implies that each dummy coefficient has to be interpreted as the (sample) mean difference in the dependent variable between the condition incorporated in the dummy whose coefficient is being studied and the NT condition. For instance, when our dependent variable is the Smith's Alpha, the coefficient of the dummy regressor STB4 captures the (average) effect on the dependent variable produced by a shift from the condition where no tax is levied to the condition where the buyer is legally committed to pay a salient tax of 4 ECU. More precisely, the coefficient of STB4 is equal to the average Smith's Alpha when a 4 ECU salient tax is levied on buyers minus the average Smith's Alpha when no tax is levied. Therefore, assuming NT as the reference category of the model allows us to benchmark the effect of each tax specification on the "control" case in which subjects do not have to pay the tax.

After estimating the model above, to bring light on the effects of salience and incidence on the market performance, we test for the effects of our conditions performing Wald tests over the difference between the dummy coefficients belonging to different conditions. That is, to test for the null hypothesis of absence of differences between two conditions, we consider the null hypothesis:

$$H_0 = \beta_r - \beta_s = 0$$

where *r* and *s* identify the two conditions we want to investigate.

The results of the model are reported in Appendix B (Table 1B). More interestingly, here we focus on the post-estimation pairwise comparisons between the conditions of interest. In tables from 3 to 5 we report the pairwise comparisons between the dummy coefficients regarding the buyer allocational efficiency, the seller allocational efficiency, and the Smith's Alpha, respectively. Within each table, in

[10] At this point a concern could arise. One of the OLS underlying assumptions is the normality of residuals. This assumption is necessary to construct F and t statistics to test hypotheses on estimated coefficients. In the absence of normality, the exact distribution of these statistics remains unknown and strictly dependent on data and parameters (Greene, 2003). Some widely used formal test of normality would be the Skewness and Kurtosis test (SK), the Shapiro-Wilk test (SW) and the Jarque-Bera (JB) test. However, these tests have been shown to be very sensitive at picking up departures from normality that are too small to really matter thus invalidating inferences from regressions (Acock, 2014). Particularly, they tend to result in a significant test when there is only a small deviation from normality in large samples (when there is a considerable robustness against violating normality assumption). On the other hand, in presence of small samples (let's say, less than 30 observations) when violations of normality are feared to be more awful, they may be underpowered to detect substantial departure from normality. Now, we have a pretty large sample (378 obs) and this large sample not only could contribute to the tests being statistically significant but also limits the concern we have about violating the normality of residuals assumption. The basic theory of inference from OLS is based on the assumption that residuals themselves follow a standard normal distribution. But actually, there is a vast and influential literature establishing that inferences are pretty robust to dodgy violations of normality in a wide variety of circumstances (see Greene, 2003 pp. 104-108; Woolridge, 2009 pp. 175-178, Verbeek, 2004 pp. 34-38 among others). Generally, large-sample asymptotic properties seem to suggest that absent normality of errors, when the sample size grows, the normal distribution becomes an increasingly better approximation of the true (but unknown) distribution. As long as the Central Limit Theorem holds one should use critical values from the t or F distribution even in absence of normality (White, 2014). When the underlying distribution of a statistic cannot be assumed to be normal-distributed or in presence of skewed residuals, a more powerful methodology to make exact inferences would be the bootstrapping (Efron, 1992; Efron and Tibshirani, 1986; Hinckley, 1988). After running our four models, we replicate our econometric estimates with bootstrapped standard errors clustered at the market level (with 5,000 replications) to provide a far more incisive robustness check. Bootstrapping methods allow for constructing an almost exact approximation of the sampling variation of our parameters thus improving inferences on our data. We report post-estimation pairwise-comparisons for our estimates with bootstrapped standard errors in Tables 3B, 4B, 5B and 6B in the Appendix B.

panel A we study the effect of salience in isolation, in panel B we study the effect of the statutory incidence in isolation, in panel C we investigate the joint effect of salience and statutory incidence, and in panel D we analyse tax size effects.

Table 3: Buyers' allocational efficiency.

Salience Impact	
STB4 – NSTB4	0.090
	(0.100)
STB8 – NSTB8	0.376
	(0.250)
STS4 – NSTS4	-0.034
	(0.035)
STS8 – NSTS8	-0.071
	(0.085)

Panel A

Statutory Incidence Impact	
STB4 – STS4	-0.175***
	(0.020)
STB8 – STS8	-0.179
	(0.133)
NSTB4 – NSTS4	-0.298**
	(0.084)
NSTB8 – NSTS8	-0.626**
	(0.1960)

Panel B

Salience-Statutory Incidence Impact	
STB4 – NSTS4	-0.208***
	(0.026)
STB8 – NSTS8	-0.250***
	(0.061)
STS4 – NSTB4	0.264**
	(0.096)
STS8 – NSTB8	0.555***
	(0.128)

Panel C

Excise Amount Impact	
STB4 – STB8	0.077
	(0.079)
STS4 – STS8	0.072
	(0.097)
NSTB4 – NSTB8	0.363*
	(0.171)
NSTS4 – NSTS8	0.035
	(0.027)

Panel D

Note. Pairwise comparison across conditions for buyers' allocational efficiency. For each pairwise comparison the number outside the brackets represents the difference between the dummy coefficients; the number inside the brackets represents the standard error. Levels of significance are indicated as follows: *** = p<0.01, ** = p<0.05, * = p<0.1.

We find that salience in isolation does not exert any significant effect on buyers allocational efficiency, neither when the tax is levied on buyers nor when it is levied on sellers. This result holds for any tax size (see Panel A). Conversely, except for the only case in which we consider a salient tax of 8 ECU, statutory incidence has a great effect on buyers' allocational efficiency. Indeed, from Panel B, we see that buyers' allocational efficiency significantly increases in all the cases when the seller is legally committed to pay the excise tax, independently of whether the seller has to pay a salient or non-salient tax. Putting together the effects of salience and incidence in insolation, we derive very interesting results when moving to their joint effect. In particular, within each pairwise comparison in Panel C, both the subject who is legally hit by the tax and the salience of the excise tax change. Panel C shows that buyers' allocational efficiency always increases when the tax is levied on sellers, whether it is salient or not (and in both sizes). Looking at the comparison in the first two rows, we see that a non-salient tax on sellers increases buyers' allocational efficiency more than a salient tax on buyers. The greater effect of the non-salient tax on sellers may be due to the fact that the seller is legally committed to pay or to the fact that the tax is non-

salient (alternatively, it may be due to both effects). However, from Panel A, we learn that, when the seller has to pay the excise tax, buyers' allocational efficiency does not change (with respect to the situation without tax) depending on whether the tax is salient or not. Then, having a seller who has to pay a salient rather than a non-salient tax does not change buyers' allocational efficiency. Simultaneously, from Panel B we learn that a salient tax on sellers increases buyers' allocational efficiency more than a salient tax on buyers, thus implying that the results in the first two rows of Panel C depends on the subject who is legally committed to pay rather than on the salience of the tax. The same reasoning applies to the results in the last two rows of Panel C, where the sign of the difference between the dummy coefficients is reversed with respect to the first two rows. Finally, we hardly find significant differences when, *ceteris paribus*, the amount of the tax moves from 4 to 8 ECU (see Panel D).

Table 4: Sellers' allocational efficiency.

Salience Impact		**Statutory Incidence Impact**	
STB4 – NSTB4	-0.027	STB4 – STS4	0.254***
	(0.063)		(0.044)
STB8 – NSTB8	-0.105	STB8 – STS8	0.406**
	(0.069)		(0.153)
STS4 – NSTS4	0.117*	NSTB4 – NSTS4	0.399**
	(0.053)		(0.104)
STS8 – NSTS8	-0.017	NSTB8 – NSTS8	0.494***
	(0.142)		(0.057)
Panel A		Panel B	

Salience-Statutory Incidence Impact		**Excise Amount Impact**	
STB4 – NSTS4	0.372***	STB4 – STB8	-0.025
	(0.075)		(0.073)
STB8 – NSTS8	0.389***	STS4 – STS8	0.127
	(0.060)		(0.112)
STS4 – NSTB4	-0.282**	NSTB4 – NSTB8	-0.102*
	(0.089)		(0.041)
STS8 – NSTB8	-0.511***	NSTS4 – NSTS8	-0.008
	(0.103)		(0.088)
Panel C		Panel D	

Note. Pairwise comparison across conditions for sellers' allocational efficiency. For each pairwise comparison the number outside the brackets represents the difference between the dummy coefficients; the number inside the brackets represents the standard error. Levels of significance are indicated as follows: *** = p<0.01, ** = p<0.05, * = p<0.1.

The results we find on sellers' allocational efficiency are very much similar to those for buyers. As previously noted, we find that salience in isolation does not affect sellers' allocational efficiency neither in the case in which buyers are legally committed to pay the tax nor when sellers have to pay the tax (except for a single instance in which sellers are legally committed to pay an excise of 4 ECU, where only a weak significant effect is detected). On the contrary, statutory incidence really matters. This time,

sellers are able to extract more profit when buyers are legally obliged to pay the excise tax, regardless of whether buyers have to pay a salient or non-salient tax. Similarly to the case of buyers, Panel D shows that the size of the tax exerts a weak significant effect only in one case.

Table 5: Informative efficiency.

Salience Impact		**Statutory Incidence Impact**	
STB4 – NSTB4	-2.246**	STB4 – STS4	-1.548*
	(0.721)		(0.738)
STB8 – NSTB8	-2.263**	STB8 – STS8	-2.300
	(0.814)		(1.393)
STS4 – NSTS4	-0.928	NSTB4 – NSTS4	-0.231
	(0.830)		(1.415)
STS8 – NSTS8	-1.470	NSTB8 – NSTS8	-1.507
	(1.668)		(1.700)
Panel A		Panel B	
Salience-Statutory Incidence Impact		**Excise Amount Impact**	
STB4 – NSTS4	-2.477	STB4 – STB8	-1.299**
	(1.420)		(0.411)
STB8 – NSTS8	-3.770	STS4 – STS8	-2.050*
	(1.991)		(0.909)
STS4 – NSTB4	-0.697	NSTB4 – NSTB8	-1.316*
	(0.883)		(0.568)
STS8 – NSTB8	0.367	NSTS4 – NSTS8	-2.593
	(1.156)		(2.436)
Panel C		Panel D	

Note. Pairwise comparison across conditions for informative efficiency. For each pairwise comparison the number outside the brackets represents the difference between the dummy coefficients; the number inside the brackets represents the standard error. Level of significance are indicated as follows: *** = p<0.01, ** = p<0.05, * = p<0.1.

While in terms of allocational efficiency salience in isolation does not bring any effects, it turns out to be relevant from the perspective of the informative efficiency. In fact, we find that when the buyer is legally committed to pay the tax, regardless of the tax size, a salient tax (rather than a non-salient one) significantly improves the convergence of trade prices toward the equilibrium price, with a consequent decrease in the Alpha of Smith. Very surprisingly, the same cannot be said considering the case in which sellers have to pay the excise tax, where we do not detect significant effects on the Smith's Alpha (see Panel A). Coming to statutory incidence in isolation, except for a weak significant effect detected on the first row of Panel B, it never impacts on the informative efficiency of the market, neither when the tax is salient nor when it is non-salient. Consequently, the joint effect of salience and statutory incidence does not alter the informative efficiency. Finally, Panel D shows that a *ceteris paribus* increase in the tax size deteriorates the convergence of trade prices toward the equilibrium price (except for the last row in panel B, where the comparison is not significant).

As a further consideration, we report in table 2B (Appendix 2B) the post-estimation pairwise comparisons coming from the model where we use the total allocational efficiency as a dependent variable. We clearly see that the total allocational efficiency does not undergo any particular effect, neither from salience and statutory incidence[11] in isolation nor from their combined effect. Of course, the effects of our tax specifications on the total allocational efficiency can be thought as a summation of the effects detected on buyers and sellers' allocational efficiency. For instance, the fact that the total allocational efficiency is not sensitive to whether buyers are legally committed to pay a salient rather than a non-salient tax might be due to a sort of "compensation effect" in which buyers and sellers' allocational efficiency move in the opposite direction or to the evidence that neither buyers nor sellers' allocational efficiency change. Tables 3 and 4 (Panels A) show that the latter conjecture holds. In this sense, it becomes worth noting that a change in the side of the market on which the excise tax is levied does not produce any effect on the aggregate allocational efficiency, independently of the visibility (salience) of the tax. This means that levying an excise tax on buyers rather than on sellers – whether or not it is salient - does not produce deadweight loss. This time, a redistribution effect is behind the scene. Indeed, Tables 3 and 4 (Panels B) show that buyers' allocational efficiency increases (whether the tax is salient or not) when sellers are legally committed to pay the tax and the other way around, respectively. Thus, statutory incidence leads to a redistribution effect, regardless of the salience of the tax.

Conclusion

In spite of the centrality of theoretical predictions in public economics, the recent advances in behavioural economics have emphasized the role of several heuristics and cognitive biases in affecting subjects' decisions and their response to taxation. Tax salience and tax incidence have been two of the most discussed topics in recent years, especially because of their relevance in terms of policy implications. For instance, the idea that consumers may be sensitive to the visibility of a tax might incentive the policy maker to use salience as a fiscal tool. Furthermore, the extent to which behavioural and institutional factors influence the allocation of the tax burden between buyers and sellers deserves careful investigation because of its implications on the distributional effects of a tax system.

Over the last decade, these issues have increasingly motivated many researchers to focus on behavioural responses to taxes. Exploiting the big advantages coming from the recent development of the experimental techniques, our contribution sheds light on the impact of tax salience and tax incidence on both the allocational and informative efficiency in a single-unit double auction market.

We used the index advanced by Gode and Sunder (1997) to measure the allocational efficiency, and the Smith's alpha as a measure for the informative efficiency. From theory, we expect that paying a salient rather than a non-salient tax should not induce any difference in subjects' behaviour. We also know that levying the tax on buyers rather than on sellers should lead to equivalent results. In our work, in addition to testing experimentally the effect of salience and incidence in isolation, we go one step forward, since we innovate on their combined effect. More precisely we ask whether the salience of a tax

[11] Except one case in which a significant effect is detected when comparing a non-salient tax of 4 ECU on sellers with a non-salient tax of 4 ECU on buyers, which however disappears when the tax size moves to 8 ECU.

exerts a different effect depending on who is legally committed to pay and whether tax incidence depends on whether the subjects face a salient rather than a non-salient tax.

We find that buyers' allocational efficiency does not change depending on whether the excise tax is salient or not, and that this result holds when both buyers and sellers are legally committed to pay the tax respectively. The same result is detected for sellers' allocational efficiency. Conversely, we find that buyers' allocational efficiency appreciably increases in all the cases in which the seller is legally obliged to pay the tax, and that this happens regardless of whether the tax is salient or not. In a similar fashion, sellers' allocational efficiency experiences an upward move when buyers have to pay the tax, whether it is salient or not. In aggregate, we find that a change in the market side on which the tax is levied does not diminish the total allocational efficiency with respect to a situation in which the market is not taxed, neither when the tax is salient nor when it is not. Very interestingly, this evidence is not due to both buyers and sellers extracting the same surplus with respect to the no tax condition, but it is rather due to the fact that buyers experience a sharp increase in their allocational efficiency when the counterpart (sellers) has to pay and vice versa. Noteworthy, we observe a redistribution effect which informs the policy maker that, although the effect of statutory incidence on the overall allocational efficiency of the market is neutral, changing the point of collection of an excise tax produces positive effects on the marked side which is not taxed. Our results also suggest that this mechanism actually holds regardless of the salience of the tax. When it comes to informative efficiency, our results lead us to conclude that, regardless of salience, levying the tax on buyers rather than on sellers does not impress a different pace in prices convergence toward equilibrium. Particularly, we find that a salient tax boost the convergence process but only when it is levied on buyers, which makes still more valuable our effort to start thinking of salience and incidence in a joint fashion.

We believe our contribution has a considerable innovation force, mainly originating from two sources. First, we provide a laboratory controlled test of what has been so far investigated through the use of field experiments and theoretical models. In opposition to field experiments which investigated the topic in posted offer markets, our laboratory study allowed us to innovate on salience and incidence in double auction markets, which are instead widely recognized because of their property to generally achieve efficient allocations and proper information dissemination. As a downside, this also makes our results hardly comparable with most of previous research on the topic. Second, our contribution takes the considerable step further of providing evidence on the combined effect of salience and incidence, thus (i) informing the policy maker from a wider perspective, and (ii) showing how framing of prices may affect subjects' decisions (see Tversky and Kahneman, 1986). In this sense, we express our auspicious that future research can take progress in this direction.

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Appendix A

Figure 1A: Screenshot of the experimental market place for a seller in the task NT

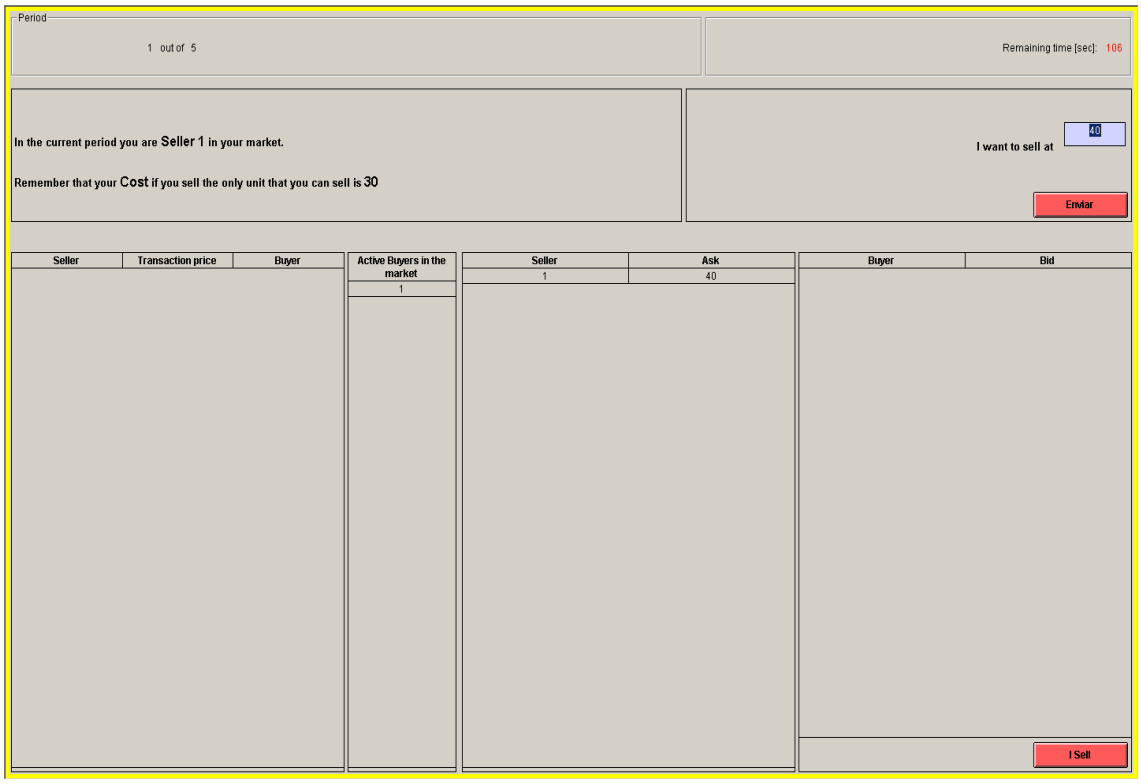

Figure 2A: Demand and Supply schedule in STB4 task

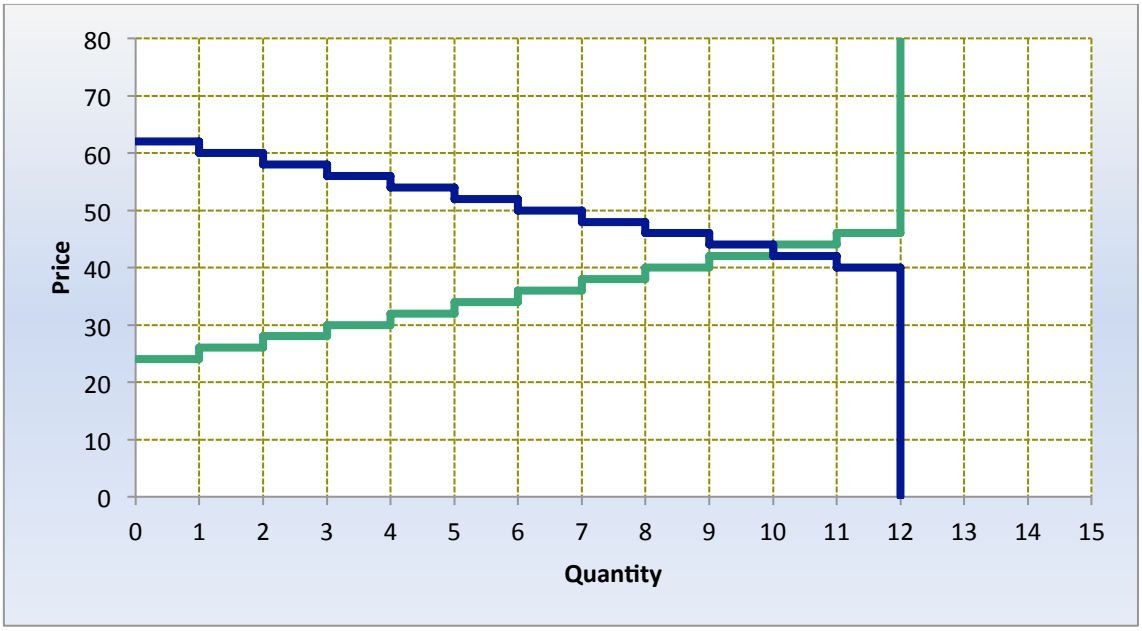

Figure 3A: Demand and Supply schedule in STS4 task (Session 1)

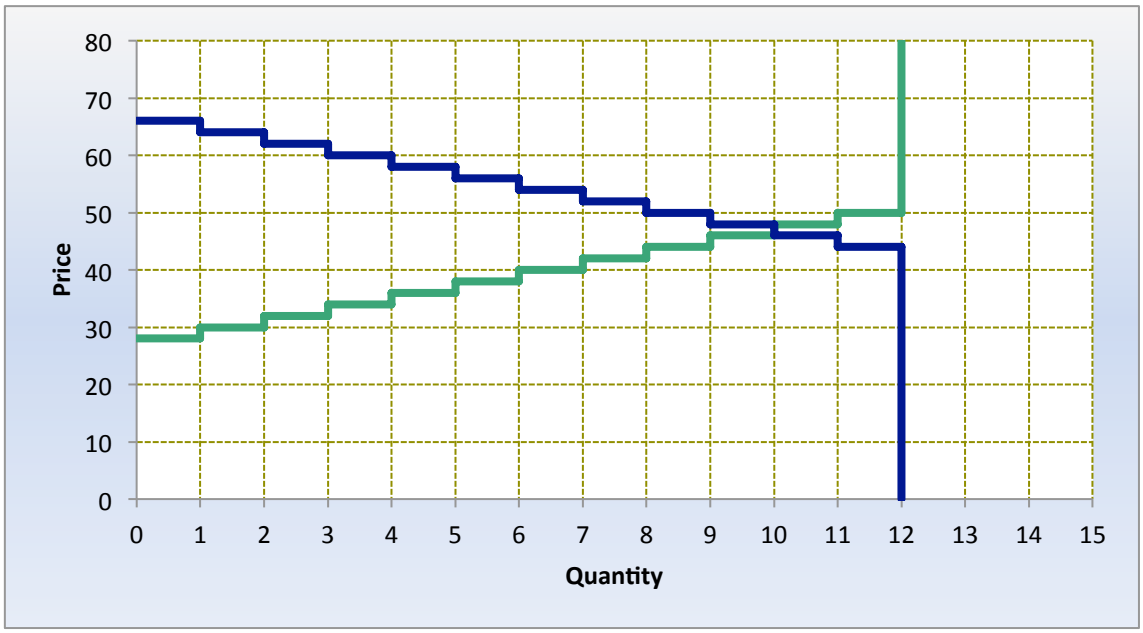

Figure 4A: Demand and Supply schedule in STB8 task (Session 1)

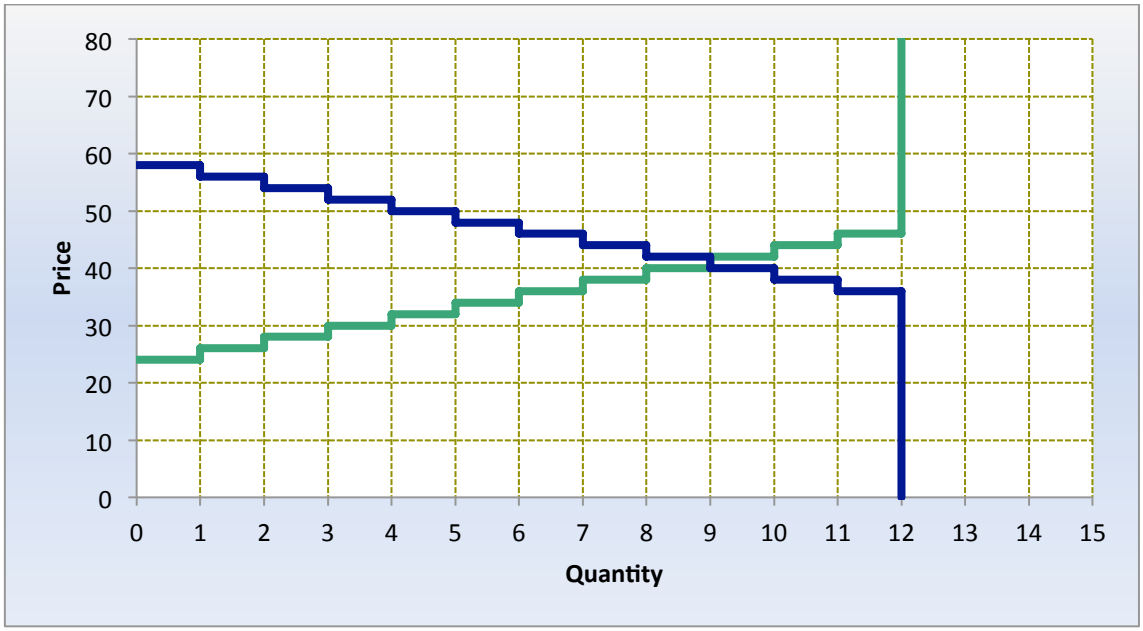

Figure 5A: Demand and Supply schedule in STS8 task (Session 1)

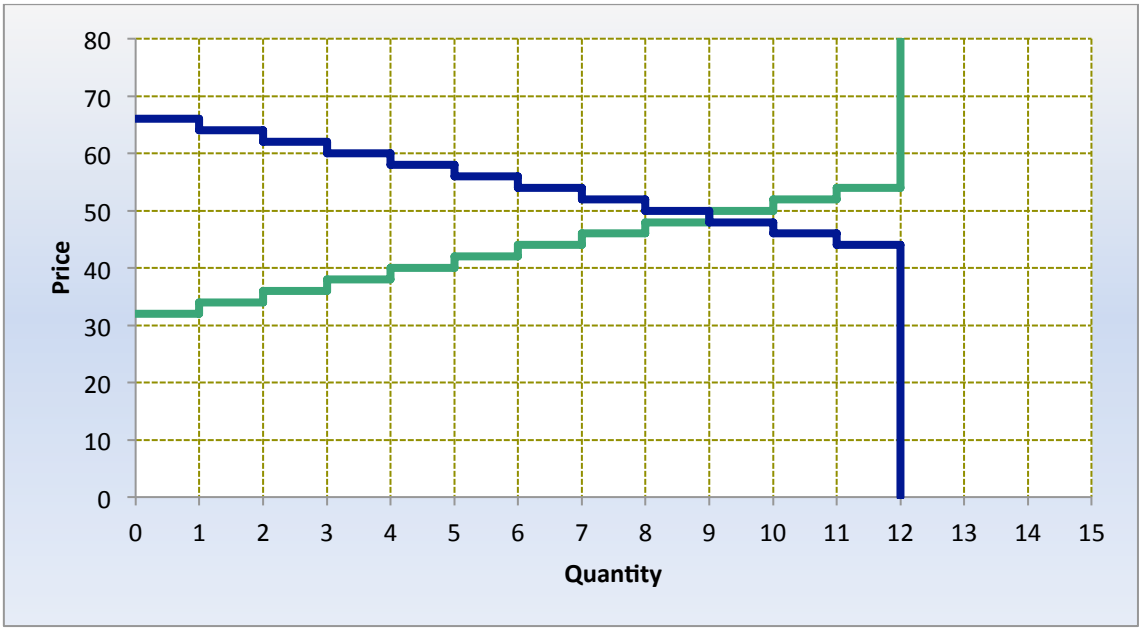

Table 1A: Theoretical values from Session 1

	Theoretical Values						
Task	Equilibrium Price	Equilibrium Quantity	Equilibrium Surplus	Buyers' Surplus	Sellers' Surplus	Buyers' Surplus (%)	Sellers' Surplus (%)
1	45	11	242	121	121	50	50
2	43	10	200	100	100	50	50
3	47	10	200	100	100	50	50
4	41	9	162	81	81	50	50
5	49	9	162	81	81	50	50
6	43	10	200	100	100	50	50
7	47	10	200	100	100	50	50
8	41	9	162	81	81	50	50
9	49	9	162	81	81	50	50

Table 2A: Theoretical values from Session 2

	Theoretical Values						
Task	Equilibrium Price	Equilibrium Quantity	Equilibrium Surplus	Buyers' Surplus	Sellers' Surplus	Buyers' Surplus (%)	Sellers' Surplus (%)
1	45	8	128	64	64	50	50
2	43	7	98	49	49	50	50
3	47	7	98	49	49	50	50
4	49	6	72	36	36	50	50
5	41	6	72	36	36	50	50
6	43	7	98	49	49	50	50
7	47	7	98	49	49	50	50
8	49	6	72	36	36	50	50

9	41	6	72	36	36	50	50

Table 3A: Theoretical values from Session 3

	Theoretical Values						
Task	Equilibrium Price	Equilibrium Quantity	Equilibrium Surplus	Buyers' Surplus	Sellers' Surplus	Buyers' Surplus (%)	Sellers' Surplus (%)
1	45	8	128	64	64	50	50
2	43	7	98	49	49	50	50
3	47	7	98	49	49	50	50
4	41	6	72	36	36	50	50
5	49	6	72	36	36	50	50
6	43	7	98	49	49	50	50
7	47	7	98	49	49	50	50
8	41	6	72	36	36	50	50
9	49	6	72	36	36	50	50

Table 4A: Theoretical values from Session 4

	Theoretical Values						
Task	Equilibrium Price	Equilibrium Quantity	Equilibrium Surplus	Buyers' Surplus	Sellers' Surplus	Buyers' Surplus (%)	Sellers' Surplus (%)
1	45	13	338	169	169	50	50
2	43	12	288	144	144	50	50
3	47	12	288	144	144	50	50
4	41	11	242	121	121	50	50
5	49	11	242	121	121	50	50
6	43	12	288	144	144	50	50
7	47	12	288	144	144	50	50
8	41	11	242	121	121	50	50
9	49	11	242	121	121	50	50

Table 5A: Theoretical values from Session 5

	Theoretical Values						
Task	Equilibrium Price	Equilibrium Quantity	Equilibrium Surplus	Buyers' Surplus	Sellers' Surplus	Buyers' Surplus (%)	Sellers' Surplus (%)
1	45	8	128	64	64	50	50
2	43	7	98	49	49	50	50
3	47	7	98	49	49	50	50
4	41	6	72	36	36	50	50
5	49	6	72	36	36	50	50
6	43	7	98	49	49	50	50
7	47	7	98	49	49	50	50
8	41	6	72	36	36	50	50
9	49	6	72	36	36	50	50

Table 6A: Theoretical values from Session 6

Task	Theoretical Values						
	Equilibrium Price	Equilibrium Quantity	Equilibrium Surplus	Buyers' Surplus	Sellers' Surplus	Buyers' Surplus (%)	Sellers' Surplus (%)
1	45	8	128	64	64	50	50
2	43	7	98	49	49	50	50
3	47	7	98	49	49	50	50
4	41	6	72	36	36	50	50
5	49	6	72	36	36	50	50
6	43	7	98	49	49	50	50
7	47	7	98	49	49	50	50
8	41	6	72	36	36	50	50
9	49	6	72	36	36	50	50

Table 7A: Experimental values from Session 1

Task	Experimental Values						
	Equilibrium Price*	Equilibrium Quantity**	Equilibrium Surplus ***	Buyers' Surplus	Sellers' Surplus	Buyers' Surplus (%)	Sellers' Surplus (%)
1	45	11	240	137	103	57	43
2	43	11	194	102	92	52	48
3	43	10	192	125	67	65	35
4	42	9	157	65	92	41	59
5	47	10	152	99	53	65	35
6	43	10	198	113	85	57	43
7	44	10	191	123	68	64	36
8	42	10	153	69	84	45	55
9	46	9	151	94	57	62	38

*median equilibrium price **median equilibrium quantity ***average equilibrium surplus

Table 8A: Experimental values from Session 2

Task	Experimental Values						
	Equilibrium Price*	Equilibrium Quantity**	Equilibrium Surplus***	Buyers' Surplus	Sellers' Surplus	Buyers' Surplus (%)	Sellers' Surplus (%)
1	45	8	124	61	62	49	50
2	44	7	95	39	56	41	59
3	46	7	95	51	44	54	46
4	48.5	6	70	38	32	54	46
5	43	6	69	25	44	36	64
6	44	7	91	34	57	37	63
7	47	7	90	46	44	51	49
8	44	7	58	10	49	17	84
9	47	6	62	37	25	60	40

*median equilibrium price **median equilibrium quantity ***average equilibrium surplus

Table 9A: Experimental values from Session 3

Task	Experimental Values						
	Equilibrium Price*	Equilibrium Quantity**	Equilibrium Surplus***	Buyers' Surplus	Sellers' Surplus	Buyers' Surplus (%)	Sellers' Surplus (%)
1	45	8	122	56	66	46	54
2	42	7	91	46	45	51	49
3	45	7	92	54	38	59	41
4	42	6	71	29	41	41	58
5	49	6	68	39	29	57	43
6	44	7	97	39	58	40	60
7	46	7	95	58	38	61	40
8	43	6	68	23	45	34	66
9	48	7	65	42	22	65	34

*median equilibrium price **median equilibrium quantity ***average equilibrium surplus

Table 10A: Experimental values from Session 4

Task	Experimental Values						
	Equilibrium Price*	Equilibrium Quantity**	Equilibrium Surplus***	Buyers' Surplus	Sellers' Surplus	Buyers' Surplus (%)	Sellers' Surplus (%)
1	44	13	320	152	169	48	53
2	44	13	269	114	154	42	57
3	45	13	276	134	142	49	51
4	43	12	229	99	130	43	57
5	46	11	232	153	79	66	34
6	44	13	281	153	128	54	46
7	45	13	274	157	117	57	43
8	42	12	220	90	131	41	60
9	46	13	220	124	96	56	44

*median equilibrium price **median equilibrium quantity ***average equilibrium surplus

Table 11A: Experimental values from Session 5

Task	Experimental Values						
	Equilibrium Price*	Equilibrium Quantity**	Equilibrium Surplus***	Buyers' Surplus	Sellers' Surplus	Buyers' Surplus (%)	Sellers' Surplus (%)
1	45	8	120	58	62	48	52
2	43	6	91	45	46	49	51
3	45	7	86	53	33	62	38
4	42	5	63	28	34	44	54
5	46	4	52	34	18	65	35
6	43	7	87	35	52	40	60
7	44	5	81	54	27	67	33
8	42	6	62	24	38	39	61
9	48	5	62	37	25	60	40

*median equilibrium price **median equilibrium quantity ***average equilibrium surplus

Table 12A: Experimental values from Session 6

Task	Experimental Values						
	Equilibrium Price*	Equilibrium Quantity**	Equilibrium Surplus***	Buyers' Surplus	Sellers' Surplus	Buyers' Surplus (%)	Sellers' Surplus (%)
1	45	8	124	66	58	53	47
2	43	7	95	45	50	47	53
3	46	7	93	50	43	54	46
4	42	6	67	27	40	40	60
5	48	5	63	37	25	59	40
6	44	7	96	44	53	46	55
7	46	7	94	51	43	54	46
8	41	6	65	28	37	43	57
9	48	6	66	40	27	61	41

*median equilibrium price **median equilibrium quantity ***average equilibrium surplus

Appendix B

Dep. Variables:	Total Allocative Efficiency	Buyers' Allocative Efficiency (1)	Sellers' Allocative Efficiency (2)	Smith's Alpha (3)
STB4	-0.024**	-0.098**	0.048	0.007
	(0.007)	(0.031)	(0.035)	(1.242)
STS4	-0.047	-0.077*	-0.206**	1.555*
	(0.026)	(0.036)	(0.051)	(0.643)
STB8	-0.040	-0.175*	0.073	1.305
	(0.028)	(0.072)	(0.054)	(1.571)
STS8	-0.119	0.005	-0.333**	3.605**
	(0.067)	(0.104)	(0.127)	(0.937)
NSTB4	-0.029	-0.187	0.075	2.252*
	(0.024)	(0.100)	(0.048)	(1.034)
NSTS4	-0.069	0.111*	-0.324***	2.483*
	(0.035)	(0.047)	(0.079)	(1.027)
NSTB8	-0.094**	-0.550**	0.178***	3.569*
	(0.030)	(0.198)	(0.031)	(1.557)
NSTS8	-0.088***	0.076	-0.316***	5.076*
	(0.015)	(0.050)	(0.043)	(2.159)
Constant	4.571***	4.584***	4.543***	4.971***
	(0.023)	(0.050)	(0.029)	(0.900)
Observations	378	378	378	378
Overall R2	0.096	0.3022	0.4366	0.0859
N. of Markets	6	6	6	6

Table 1B. Fixed effects regression. In (1) the dependent variable is the buyers' allocational efficiency, in (2) the dependent variable is sellers' allocational efficiency, in (3) the dependent variable is the Alpha of Smith. Numbers in in parentheses are robust standard errors clustered at market (session) level of significance are indicated as follows: *** = p<0.01, ** = p<0.05, * = p<0.1.

Table 2B: Total Allocational Efficiency

Salience Impact		**Statutory Incidence Impact**	
STB4 – NSTB4	0.005	STB4 – STS4	0.023
	(0.022)		(0.021)
STB8 – NSTB8	0.054	STB8 – STS8	0.079
	(0.029)		(0.040)
STS4 – NSTS4	0.022	NSTB4 – NSTS4	0.040**
	(0.013)		(0.013)
STS8 – NSTS8	-0.031	NSTB8 – NSTS8	-0.006
	(0.057)		(0.018)
Panel A		Panel B	

Salience-Statutory Incidence Impact		Excise Amount Impact	
STB4 – NSTS4	0.045	STB4 – STB8	0.016
	(0.032)		(0.023)
STB8 – NSTS8	0.048*	STS4 – STS8	0.072
	(0.020)		(0.041)
STS4 – NSTB4	-0.018	NSTB4 – NSTB8	0.064**
	(0.012)		(0.019)
STS8 – NSTB8	-0.025	NSTS4 – NSTS8	0.018
	(0.060)		(0.024)
Panel C		Panel D	

Note. Pairwise comparison across conditions for total allocational efficiency. For each pairwise comparison the number outside the brackets represents the difference between the dummy coefficients; the number inside the brackets represents the standard error. Levels of significance are indicated as follows: *** = p<0.01, ** = p<0.05, * = p<0.1.

Table 3B: Buyers' allocational efficiency (with bootstrapped standard errors).

Salience Impact		Statutory Incidence Impact	
STB4 – NSTB4	0.090	STB4 – STS4	-0.175***
	(0.088)		(0.018)
STB8 – NSTB8	0.376*	STB8 – STS8	-0.179
	(0.226)		(0.120)
STS4 – NSTS4	-0.034	NSTB4 – NSTS4	-0.298***
	(0.032)		(0.074)
STS8 – NSTS8	-0.071	NSTB8 – NSTS8	-0.626***
	(0.076)		(0.177)
Panel A		Panel B	

Salience-Statutory Incidence Impact		Excise Amount Impact	
STB4 – NSTS4	-0.208***	STB4 – STB8	0.077
	(0.023)		(0.070)
STB8 – NSTS8	-0.250***	STS4 – STS8	0.072
	(0.055)		(0.087)
STS4 – NSTB4	0.264***	NSTB4 – NSTB8	0.363**
	(0.085)		(0.154)
STS8 – NSTB8	0.555***	NSTS4 – NSTS8	0.035
	(0.115)		(0.024)
Panel C		Panel D	

Note. Pairwise comparison across conditions for buyers' allocational efficiency. For each pairwise comparison the number outside the brackets represents the difference between the dummy coefficients; the number inside the brackets represents the standard error. Levels of significance are indicated as follows: *** = p<0.01, ** = p<0.05, * = p<0.1.

Table 4B: Sellers' allocational efficiency (with bootstrapped standard errors).

Salience Impact		Statutory Incidence Impact	
STB4 – NSTB4	-0.027	STB4 – STS4	0.254***
	(0.056)		(0.039)
STB8 – NSTB8	-0.105*	STB8 – STS8	0.406***
	(0.062)		(0.138)
STS4 – NSTS4	0.117**	NSTB4 – NSTS4	0.399***
	(0.049)		(0.093)
STS8 – NSTS8	-0.017	NSTB8 – NSTS8	0.494***
	(0.128)		(0.052)
Panel A		Panel B	

Salience-Statutory Incidence Impact		Excise Amount Impact	
STB4 – NSTS4	0.372***	STB4 – STB8	-0.025
	(0.067)		(0.066)
STB8 – NSTS8	0.389***	STS4 – STS8	0.127
	(0.054)		(0.102)
STS4 – NSTB4	-0.282***	NSTB4 – NSTB8	-0.102***
	(0.079)		(0.036)
STS8 – NSTB8	-0.511***	NSTS4 – NSTS8	-0.008
	(0.093)		(0.079)
Panel C		Panel D	

Note. Pairwise comparison across conditions for sellers' allocational efficiency. For each pairwise comparison the number outside the brackets represents the difference between the dummy coefficients; the number inside the brackets represents the standard error. Levels of significance are indicated as follows: *** = p<0.01, ** = p<0.05, * = p<0.1.

Table 5B: Infromative efficiency (with boostrapped standard errors).

Salience Impact		Statutory Incidence Impact	
STB4 – NSTB4	-2.246***	STB4 – STS4	-1.548**
	(0.658)		(0.667)
STB8 – NSTB8	-2.263***	STB8 – STS8	-2.300*
	(0.739)		(1.255)
STS4 – NSTS4	-0.928	NSTB4 – NSTS4	-0.231
	(0.745)		(1.278)
STS8 – NSTS8	-1.470	NSTB8 – NSTS8	-1.507
	(1.514)		(1.532)
Panel A		Panel B	

Salience-Statutory Incidence Impact		Excise Amount Impact	
STB4 – NSTS4	-2.477*	STB4 – STB8	-1.299***
	(1.280)		(0.368)

STB8 – NSTS8	-3.770**	STS4 – STS8	-2.050**
	(1.789)		(0.818)
STS4 – NSTB4	-0.697	NSTB4 – NSTB8	-1.316***
	(0.799)		(0.513)
STS8 – NSTB8	0.367	NSTS4 – NSTS8	-2.593
	(1.039)		(2.202)
Panel C		Panel D	

Note. Pairwise comparison across conditions for informative efficiency. For each pairwise comparison the number outside the brackets represents the difference between the dummy coefficients; the number inside the brackets represents the standard error. Level of significance are indicated as follows: *** = p<0.01, ** = p<0.05, * = p<0.1.

Table 6B: Total Allocational Efficiency (with bootstrapped standard errors)

Salience Impact		**Statutory Incidence Impact**	
STB4 – NSTB4	0.005	STB4 – STS4	0.023
	(0.020)		(0.019)
STB8 – NSTB8	0.054**	STB8 – STS8	0.079**
	(0.026)		(0.036)
STS4 – NSTS4	0.022*	NSTB4 – NSTS4	0.040***
	(0.012)		(0.011)
STS8 – NSTS8	-0.031	NSTB8 – NSTS8	-0.006
	(0.051)		(0.016)
Panel A		Panel B	
Salience-Statutory Incidence Impact		**Excise Amount Impact**	
STB4 – NSTS4	0.045	STB4 – STB8	0.016
	(0.028)		(0.021)
STB8 – NSTS8	0.048***	STS4 – STS8	0.072**
	(0.018)		(0.037)
STS4 – NSTB4	-0.018*	NSTB4 – NSTB8	0.064***
	(0.011)		(0.017)
STS8 – NSTB8	-0.025	NSTS4 – NSTS8	0.018
	(0.054)		(0.021)
Panel C		Panel D	

Note. Pairwise comparison across conditions for total allocational efficiency. For each pairwise comparison the number outside the brackets represents the difference between the dummy coefficients; the number inside the brackets represents the standard error. Levels of significance are indicated as follows: *** = p<0.01, ** = p<0.05, * = p<0.1.

Appendix C

Instructions

Welcome to the experiment

This is an experiment on decision making in financial markets. The experiment is straightforward and the instructions are easy to understand. If you follow them carefully and make good decisions, you could earn a considerable amount of money, which will be paid to you in cash at the end of the experiment.

Experiment Overview

In this experiment you participate in a simple market. The market will take place over a sequence of 9 tasks of 7 trading periods each. You may think of each trading period as a "business or trading day". In this market a generic asset ("financial good") is being traded and, at any moment during each trading period, you can buy – if you are a buyer – or sell – if you are a seller – the asset. The money used in this experiment is "Experimental Currency Units" (ECU). Your cash payment at the end of the experiment will be in Euro. The conversion rate will be 10 ECU to 1 Euro.
In this experiment you make money by trading the asset.

General Instructions

The market consists of a number of buyers and sellers. There are 9 tasks to be completed. Each task contains 7 trading periods. Each trading period will last 90 seconds during which you can trade the asset in exchange for experimental money. The first two periods are trial periods, useful to understand the trading mechanism. In these trial periods no money will be paid as earned profit. The remaining 7 trading periods are "real" periods and they will count for your earnings. At the beginning of each trading period, if you are a buyer you will receive the information of your reservation price, i.e. the maximum price you are willing to pay to buy the good; if you are a seller you will receive the information of your cost, i.e. the minimum price you are willing to accept to sell the good, and one unit of the good.
Therefore, summarizing the above informations:

- Each market consists of a number of buyers and sellers.

- Each market is open for 90 seconds in each period.
- During that time, buyers and sellers can enter bids (offers to buy) and asks (offers to sell) in the market
- Each buyer has a maximum amount he/she is willing to pay. The profit of the buyer after purchasing one unit is:

  Maximum willingness to pay minus *Price*
- Each seller has a cost, that is, the minimum price he/she is willing to accept to sell the unit. The benefit of the seller is:

  Price minus *Cost*
- If a buyer or seller does not close any transactions during that period their profit is zero.
- Each buyer (seller) can only buy (sell) one unit.
- In the following we will see the screens and how the software works

Buying and selling the asset

At the beginning of each trading period, the screen will show you your type (buyer or seller) and your maximum willingness to pay (for buyers) or your cost (for sellers).

How to use a computerized market

As reported in Figure 1, on the upper left-hand corner of the screen you will see the trading period in which you are trading. On the upper right-hand corner of the screen you will see how much time is left in the current trading period. In the left panel at the center of the screen you will see your role and your maximum willingness to pay (cost), in the right panel you will see a field where you can enter the price at which you are willing to buy (if you are a buyer) or to sell (if you are a seller). In the bottom of the screen you will see four panels.

Buyer's role

1. Buying an asset by sending an offer to buy

If you are selected as a buyer, you are asked to make an offer to buy the asset, by entering the price at which you are willing to buy.
To offer to buy a unit of the asset, enter the price at which you would like to buy in the box labeled "I will buy at" in the second raw (right panel) of the buyer screen (figure 1), then click on the button "Submit" on the bottom of the same panel.
The third panel from the left in the bottom part of the screen will show a list of offers to buy, each submitted by a different participant. The highest offer to buy will be always placed on the bottom of the list. Your own offer will appear in a blue color.

2. Buying an asset by accepting an offer to sell

Alternatively, you can select an offer to sell from the last panel from the left in the bottom part of the screen by clicking on it. If you click on the "buy" button at the bottom of this column, you will purchase one unit of the asset at the selected price. When you accept an offer to sell, it will disappear from the list. If you also previously submitted an offer to buy, it will disappear from the offers to buy because you can buy only one unit of the asset.

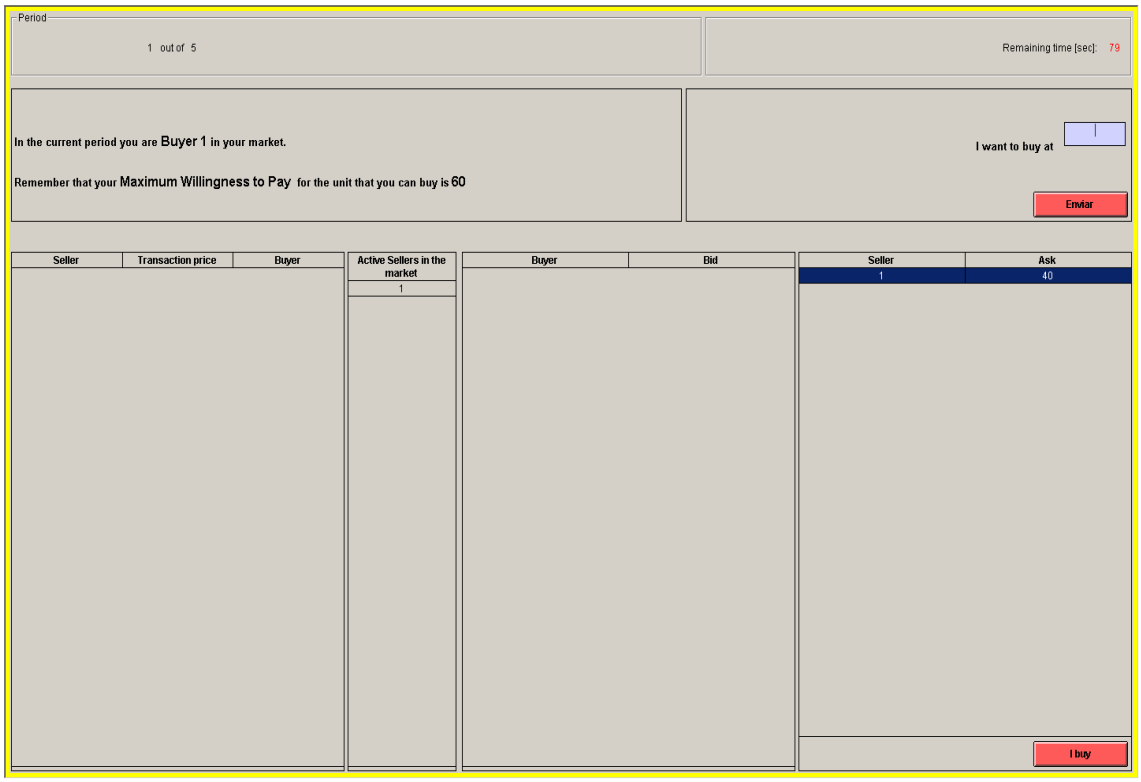

Figure 1: Buyers' screenshot

Seller's role

1. Selling an asset by sending an offer to sell

If you are selected as a seller, you will be asked to make an offer to sell the asset, by entering the price at which you are willing to sell. To offer to sell a unit of the asset, enter the price at which you would like to sell in the box labeled "I will sell at" in the second raw (right panel) of the seller screen (figure 2), then click on the button "Submit" on the bottom of the same panel.

The third panel from the left in the bottom part of the screen will show a list of offers to sell, each submitted by a different participant. The lowest offer to sell will be always placed on the bottom of the list. Your own offer will appear in a blue color.

2. Selling an asset by accepting an offer to buy

Alternatively, you can select an offer to buy from the last panel from left, in the bottom part of the screen by clicking on it. If you click the "sell" button at the bottom of this column, you will sell one unit of the asset at the selected price. When you accept an

offer to buy, it will disappear from the list. If you also previously submitted an offer to sell, it will disappear from the offers to sell because you can sell only one unit of the asset.

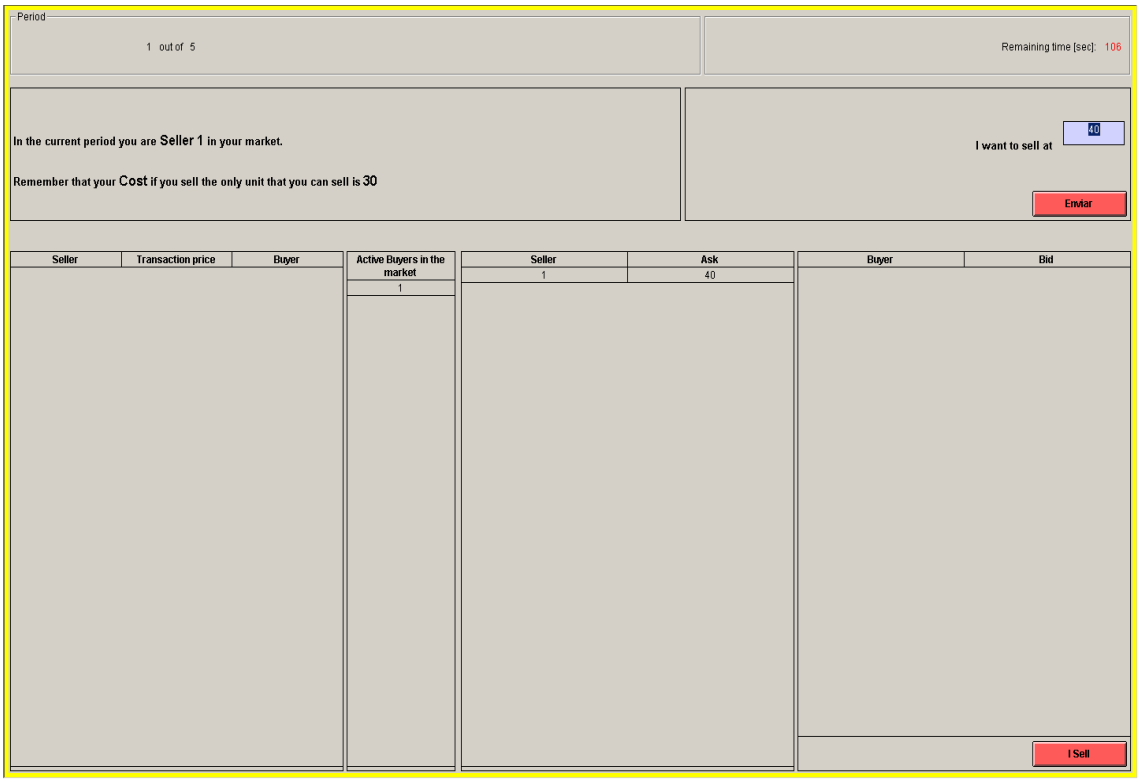

Figure 2: Sellers' screenshot

Your Earnings

As reported in figure 3 and 4, at the end of each trading period your profit will be equal to your "*Money before payment of dividends*" minus "*Initial Money*" plus "*Your total dividend*".

At the end of the experiment, your final earnings will be equal to the sum of your profits in each of the sixty-three "real" trading periods (the trial periods do not count).

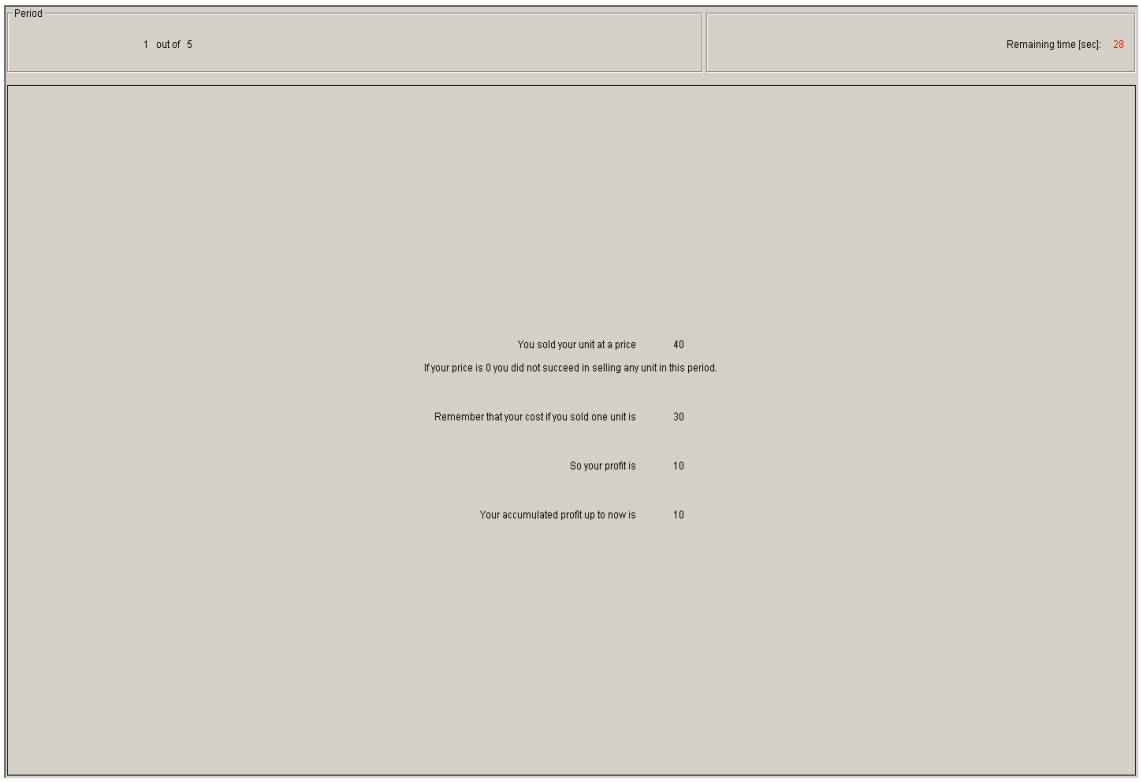

Figure 3: Seller's earnings

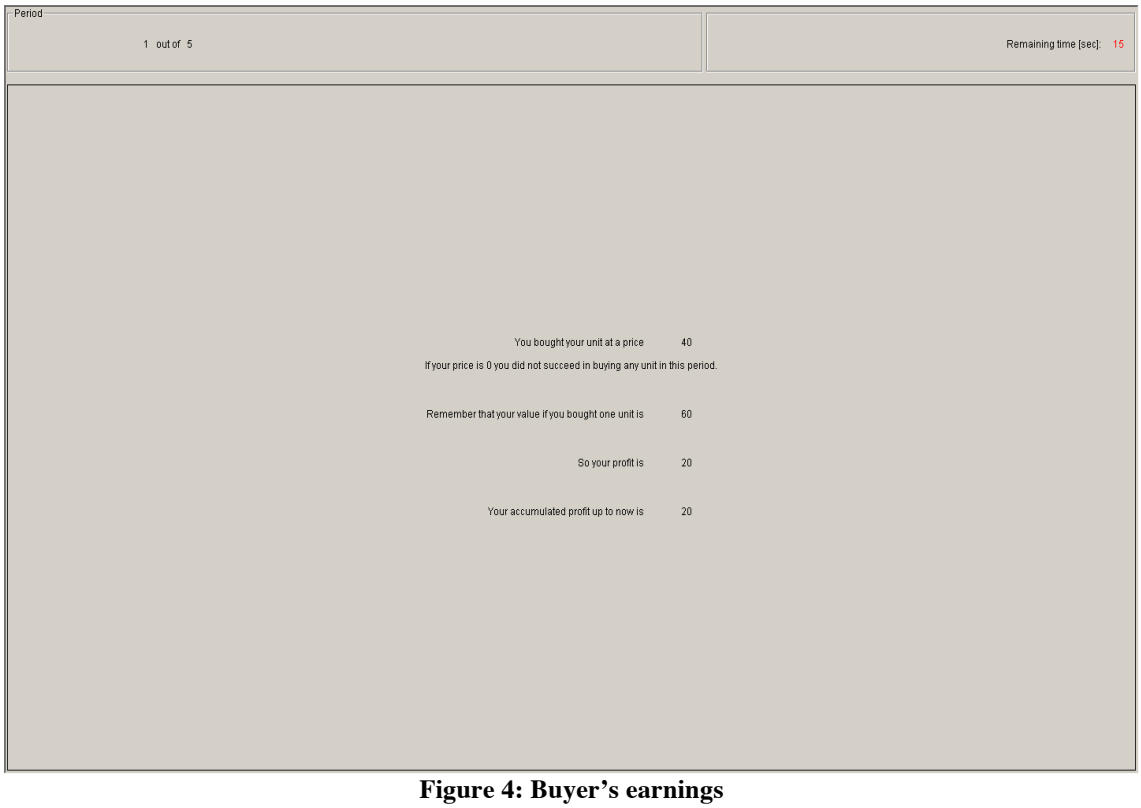

Figure 4: Buyer's earnings