Tax and Subsidy Incidence in Negotiations*

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Abstract

The liability side equivalence (LSE) theory is tested in a market institution where trades are negotiated. Buyers tend to have an advantage in repeated negotiations without a tax or subsidy policy. It dissipates when buyers are taxed or subsidized, or when sellers are taxed. When sellers are subsidized, the advantage that buyers have in private negotiations increases and buyers capture more of the subsidy than sellers. LSE predictions are not met. Buyers and sellers are impacted differently by tax and subsidy policy. We believe much of this difference lies with reference points buyers and sellers have when they negotiate.

Key Words: Negotiation; subsidy; tax; market experiments

JEL Codes: D00; H22; C91

I. Introduction

Tax and subsidy liability-side equivalence (LSE) is taught as an economic principle. The theory states that the burden (or incidence) of a tax (subsidy) is independent of who pays (receives) the tax (subsidy) (Mankiw, 1997, pp. 121-124, Perloff, 2009, pp. 65-66). The economic incidence depends on the relative supply and demand elasticities and should remain the same regardless of who pays tax or receives the subsidy.[1] Closely related to this concept is the notion that a unit tax on sellers shifts the supply schedule to the left, increasing the out-of-pocket cost for each unit produced by an equivalent amount. A subsidy to sellers shifts the supply schedule to the right, reducing the out-of-pocket production cost of each unit. Similar effects occur on the buyer's side of the market with a subsidy (tax) increasing (reducing) the buyer's benefit for each unit.

So unit taxes and subsidies should have the same impact on prices and quantities as any market force that would induce an equivalent shift of schedules. It is the case, however, that the market institution, i.e. the trading rules by which transactions are made, have distinctive and sometimes unpredictable impacts on equilibrium outcomes.[2] By extension we believe the market institution will impact the incidence of a tax and subsidy, and do so in ways that are unpredictable. In this paper we study the how a unit tax and subsidy influence market outcomes when the transactions are negotiated in a free-flowing environment.

Empirical tests for LSE are limited because of the lack of data. Supposed natural experiments that switch between buyers and sellers paying a tax or receiving a subsidy are not

[1]See Ruffle's 2005 explanation of liability-side equivalence.

[2]See for example Phillips et al. 2014 for a comparison of auction and negotiation equilibrium outcomes under identical supply and demand conditions. We have found in other experiments that negotiation tends to favor the buyer in transactions; prices tend to converge to levels below the intersection of supply and demand.

free of other market and policy influences. The LSE principle has been experimentally tested in a number of other institutional market environments with mixed results. The evidence, if anything, shows that market institutions matter. If tax liability-side equivalence theory does not hold in one type of market environment, it may hold in another type. In our opinion a market institution is at least in part responsible for framing effects and biases (anchoring, subject, etc.) that may not support LSE. Importantly, when negotiations decide the exchange of goods and services, our experiments will bring evidence to bear on the incidence of unit taxes and subsidies.

An early experimental study on tax LSE was a three level double-auction (three buyers, three middlepersons, and three sellers) experiment comparing tax incidence of different consumption taxes (Kachelmeier et al. (1994)). The main focus was to test the incidence of three different types of consumer taxes: a sales tax, a gross-receipts tax imposed on retailers, and a value-added tax. According to theory, all three should have the same incidence as long as tax rates were held constant. The first half of the periods in each treatment were run without a tax, and the other half of the periods were run with one of the taxes imposed. Their results offered some support of LSE theory, but deviations from the theory in this experiment indicated that those who paid the tax actually had less economic incidence.[3]

Another study on LSE by Kerschbamer and Kirchsteiger (2000) used a modified version of the ultimatum game to test the theory. One player is given a sum of money and proposes how to split the sum between the two players. The other player can accept or reject the proposal. If the

[3]It is interesting to note that Kachelmeier et al. (1994) avoided the usage of the word “tax" and opted for the phrase “adding a charge" for each transaction. This is a change in the framing from other studies and different results may have been observed if the word “tax" had been used in their study.

proposal is accepted, then the two players split the sum the way player one proposed. If the proposal is rejected, neither player receives anything. Ten or twelve subjects went through multiple rounds with a new partner in each round. A tax is levied only if an offer was accepted. Each session either had a tax imposed for the entirety of the periods or no tax at all for use as a baseline. Contrary to Kachelmeier et al. (1994), Kerschbamer and Kirchsteiger (2000) find that the party who paid the tax bore a higher burden of the tax. They argue that fairness may be playing a role in this application of tax liability-side equivalence, as it has in other ultimatum games. If the player chosen to split a sum of money does not have to earn the money, this player may feel inclined to share more of the sum than theory predicts. Also, if a player is simply given a subsidy, the non-subsidized party may not think this is fair and try to negotiate for a larger share of that subsidy. Similarly, if a player is taxed for a reason not apparent to the participants, the non-taxed player may be more willing to share that tax.

Ruffle (2005) argues that Kerschbamer and Kirchsteiger's ultimatum games are “a very special case, sensitive to a plethora of contextual variables, framing and other perceptual effects, issues of fairness, intentions and property rights." A criticism of the ultimatum game is that it is a very special market interaction that is not as applicable to the real world as are double auctions, posted-offer markets, or repeated negotiation open to counter-offers and bids. The ultimatum game is a simple and very structured bargaining environment that allows limited interaction between traders, especially with re-matching after each proposal.

Borck et al. (2002) used posted-offer markets aimed to be a middle ground between double auctions (Kachelmeier et al., 1994) and the ultimatum game (Kerschbamer and Kirchsteiger, 2000) and claims this framework provides a “stronger test of the theory" than previous studies. It is also argued that the posted-offer market framework is better representation of real-world markets than double auctions and the ultimatum game. Their game assesses a unit tax in two treatments; one treatment had a tax on the three buyers and the other a tax on the three sellers. Half of the periods were run without a tax and the other half with the tax imposed. Borck et al. find that their experiment supports liability-side equivalence with no significant evidence for more pronounced statutory incidence.

Riedl and Tynan (2005) test, “tax liability-side equivalence in efficiency-wage markets of the gift-exchange type,” labor markets, studying how wages, efforts, and rents are affected by who the tax is levied upon. In a gift-exchange labor market, firms offer the pool of workers a wage and each worker picks a wage from the pool and an effort level. Riedl and Tynan use Kerschbamer and Kirchsteiger's (2000) reasoning that fairness plays a role in their results to motivate their experiment saying that, “fairness norms have been shown to be important in competitive gift-exchange labor markets, [and] it is an open question whether tax liability-side equivalence holds in such markets." These exchanges are akin to an ultimatum game.

In the primary treatment a tax was levied on one side of the market for the first sixteen periods and then levied on the other side for the remaining sixteen periods. In another treatment, in the second sixteen periods, a tax was assessed on workers for eight periods and then switched and levied on firms for the remaining eight periods and vice-versa. Riedl and Tynan find that tax liability-side equivalence holds in all of their treatments

Ruffle's (2005) study takes place in a pit market, or otherwise described as an oral double auction, where eight to fifteen pairs of buyers and sellers negotiate in an open space. Each buyer can only purchase one unit and each seller only has one unit to sell. Unit values (for buyers) and unit costs (for sellers) are randomly assigned each period and then bargaining commences. For half of the experiment, trading commenced without subsidies or taxes while the other half a single tax or subsidy was assessed to one side of the market. Ruffle's findings show strong support for liability-side equivalence theory.

II. Policy

Subsidies and taxes are a common policy tool for creating incentives across a variety of markets, industries, and issues. If it is the case that LSE does not hold for all types of market institutions, which appears to be the case, then it is important for policy makers to be aware of how the subsidy or tax is likely to be handled in the target market setting. Private negotiations are a prevalent market framework where little work has been done to examine LSE.

Many agricultural commodities are sold through negotiations (Bowers, 1984) and are heavily subsidized. In livestock sectors of agriculture, such as fed cattle, negotiation has become a dominant method of price discovery. For the period October 2002 – March 2005, Taylor et al. (2007) report individually negotiated pricing was the most common method used to establish prices for fed cattle purchases (57.13% of head sold). In other sectors of agriculture, e.g. grain markets, it is also common for producers and processors to negotiate terms of trade. Negotiation is replacing auctions as the trading institution of choice.[4]

Alternative fuels such as ethanol have been heavily subsidized. The statutory incidence of the subsidies is largely on the side of the producer or mixer of the ethanol. In 2007, ethanol subsidies measured to $0.60 per gallon of ethanol (EIA, 2007). Ethanol production has increased extraordinarily since the early 1980's, when ethanol production was close to zero to over 14 billion gallons in 2011 (Tyner, 2012). This extra usage of corn has helped lead to an increase in corn prices over that time (Tyner 2012). Negotiated sales of corn for ethanol production have

[4]Privately negotiated contracts coordinated transactions for 39 percent of the value of all U. S. agricultural production in 2008 compared to 11 percent in 1969 (MacDonald and Korb, 2011).

increased dramatically.[5]

There are on-going discussions over taxes and subsidies of greenhouse gas emissions and its storage. The Environmental Non-Government Organization (ENGO) argues that carbon capture utilization and storage (CCUS) is a capable way "to achieve large emission reductions (ENGO, 2012)." This has led to numerous bills introduced and some passed in Congress dealing with CCUS. This legislation frequently contains tax and subsidy policy. Furthermore, in order to store and sequester carbon, firms that produce carbon must negotiate with potential "buyers." The primary market institution is negotiation.

Enhanced oil recovery (EOR) is a noteworthy method of utilizing pure CO_2. EOR uses CO_2 to recover stranded oil from depleted oil reservoirs by circulating CO_2 through oil reservoirs. The CO_2 acts as a solvent in a reservoir more efficiently clearing oil from geologic formations. Currently, tax credits for CO_2 sequestration allows for a \$20 per metric ton subsidy of CO_2 disposed in secure geologic storage and \$10 per metric ton for CO_2 used for EOR (26 USC §45Q).[6] The EPA, on the other hand, has proposed taxes on emitted CO_2 gasses. As legislation develops, sellers and buyers in CCUS can look forward to an increased mosaic of taxes and subsidies where the sale of CO_2 for EOR is negotiated in contracts of various lengths, some stretching fifteen years.[7]

[5]Marketing contracts for corn grew from 15 percent of production in 2001 to 26 percent of production by 2008 (MacDonald and Korb, 2011). Much of this increase in contracting is attributed to ethanol production. U.S. corn-based ethanol production was 13.2 billion gallons in 2010, accounting for nearly 40 percent of total U. S. corn use in the 2010 crop year (Du and McPhail, 2012).

[6] These credits only apply for the first 75,000,000 metric tons of qualified CO_2. According to the IRS, as of June 1, 2014 only 27,114,815 metric tons (36.2%) of the limit had been qualified under the policy (IRS Notice 2014-40).

[7] Some states, such as Illinois and Montana require that all new coal plants utilize 90% CCUS and other states, such as California, New York, and Washington have emissions standards that are not as strong (ENGO 2012). California contributes 1.8% of global greenhouse gas emissions, and policymakers view CCUS as an essential part to reduce this number. California has been a major player in CCUS policy in recent years including long-term liability, pore space ownership, accounting for CO_2, power purchase agreements for CCUS generated electricity, investments in

These examples illustrate how important it is to investigate the economic incidence of subsidy and tax policy in negotiations. If the influence of a subsidy or tax violates LSE, who benefits or is hurt? The experimental results will allow for better-guided policy in markets characterized by negotiation.

III. Experimental Design

A set of laboratory market experiments are constructed in order to measure tax and subsidy incidence in negotiation. The experiments allow for control of outside factors, thus providing a method to isolate and observe the behavior of agents and market changes in response to altering one facet of the market, such as adding a tax or subsidy. The resulting data panel allows us to forecast and compare trends in equilibrium.

Seven different treatments are designed to understand how taxes and subsidies impact bargaining behavior. Three of these treatments are baselines that have different demand and/or supply schedules with no levied taxes or subsidies. From these baselines a tax or subsidy is levied, and impact is measured against the baseline equilibrium. Policy treatments with either a tax or a subsidy are conducted for the entirety of a session. There are at least five replications of all bargaining designs. Each session consisted of eight subjects.

These experimental designs are very similar to those constructed by Nagler et al. (2013) and Menkhaus, Phillips, and Bastian (2003). Trading was conducted through four buyer-seller pairs by typing bids and offers over a computer network for a one minute bargaining round. During a

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CCUS research and development, support for an EOR infrastructure, and a demonstration to show CCUS's feasibility (Burton, 2012).

According to a report by the Congressional Budget Office in June 2012, $6.9 billion has been invested in developing carbon capture and storage development since 2005. Much of this investment has been directed toward forwarding the carbon capture and storage technology and construction of carbon capture and storage capable power plants.

round a buyers and seller could freely enter bids and offers. Within a bargaining round there was no limit on the number of counter bids and offers a subject count make; bids and offers need not alternate in a sequence. Participants were arranged so they could not see each other's computer screens and were assigned a random number in order to provide privacy and anonymity. New participants were recruited for each session in order to maintain the same experience level across subjects.

All sessions followed the same standard procedure. At the beginning of each session, students were presented with instructions that outlined the market design and payment procedures; including how to trade, calculate profits and earnings, as well as a description of the unit tax or subsidy if the session was part of a treatment that included one. All participants were aware if a tax or subsidy was used in their session. After the instructions were read and questions answered, one or more practice rounds were conducted using different values than the actual experiment. See the appendix for instructions read to subjects for both the baseline and tax/subsidy treatments.

Each experimental session consisted of 20 or more trading periods; there was a 20% chance of the game ending in each period after period 20. Participants did not know when the session would end in order to avoid unusual trading behavior in the final rounds. The first 20 periods of a session are used in the analysis. Buyers were motivated to maximize the difference between unit redemption value (for the buyers) and the trade price. Sellers tried to maximize the difference between trade price and cost. Participants possessed a private table of unit redemption values and unit costs for each of eight units they could trade. Buyers had identical redemption schedules and sellers had identical cost schedules. These schedules for each baseline treatment are provided in Table 1. The bold values in the table identify the intersection of the supply and demand schedules.

Each trading period consisted of three one-minute bargaining rounds. At the end of a round traders were randomly re-matched. Buyers and sellers began trading sequentially from the highest redemption value unit for buyers or lowest cost unit for sellers; agents could trade up to eight units during a three-round trading period. Buyers and sellers made profits determined by the difference between their redemption value and the negotiated price or the difference between the negotiated price and the unit cost, respectively. Participants were fully informed of the time remaining in a bargaining round, the current round, and period number.

During each round, traders entered bids and offers to their randomly selected trading partner and continued to do so until the bid and offer matched. Sellers were required to make progressively lower offers and buyers were required to make progressively higher bids. Participants were able to see their entire cost or redemption schedule as well as their current bid and offer on the unit up for sale. The screen calculated a subject's earnings if they should accept the current bid or offer. Participants were not able to view their trading partner's redemption or cost values, but would know the value of a levied tax or subsidy. It is possible in the second or third bargaining rounds that profitable trades were limited if redemption values were below the unit cost of the next available unit. The screen informed subjects of this event, and they waited to be re-matched.

After each trading period, or set of three bargaining rounds, participants were provided with a summary of their trades for that period, as well as the earnings they made that period, the previous period, and overall. At the end of the experiment, participants were paid based on the profits they made through trading plus ten dollars for participating. The exchange rate was one hundred tokens equals one dollar. Sessions lasted between an hour and a half and two hours depending on how many practice rounds were completed. Participants earned an average of $24.30 in addition to the show-up fee of $10.

The three baseline designs as labeled in tables 1and 2 are: Baseline I (BL80: baseline with an equilibrium price of 80 tokens), Baseline II came from a decrease in the seller's cost schedule of 20 tokens per unit (BL70: baseline with an equilibrium price of 70 tokens), and Baseline III derived from an increase in the buyer's redemption schedule of 20 tokens per unit (BL90: baseline equilibrium price of 90 tokens). These three baselines are meant to bracket tax and subsidy forecasts if LSE is satisfied.

Equilibrium market outcomes are predicted by the aggregate supply and demand relationships, which are simple step functions (see Figures 1, 2, and 3). For instance in figure 1, in the baseline treatment (BL80) with four buyer-seller pairs, the equilibrium price is expected to be 80 tokens with an equilibrium quantity traded between 16 and 20 units. At this equilibrium, predicted profits per period are 100 tokens for the buyer and 100 tokens for the seller. Combined expected profits for all four buyers and all four sellers are 800 tokens per period. Relative market earnings are the difference between seller and buyer earnings each period and are expected to be zero.

All subsidies and taxes were 20 tokens per unit traded. At the start of an experiment all buyers and sellers were informed, in the instructions, of a subsidy or tax and its amount. The four tax and subsidy treatments are described as follows:

• From baseline I (BL80) a buyer subsidy of 20 tokens is set. This treatment is referred to as Buyer Subsidy: DS90. Demand is increased by 20 tokens through the subsidy, and the predicted equilibrium price is 90 tokens, just as it is in baseline II (BL90). *If DS90 mimics BL90, LSE is supported. Buyers and sellers are expected to share the subsidy equally.*

• From baseline III (BL90) a buyer tax of 20 tokens is set. This treatment is referred to as Demand Tax: DT80. Demand is decreased by 20 tokens through the tax, and the predicted equilibrium price is 80 tokens, just as it is in baseline I (BL80). *If DT80 mimics BL80, LSE is supported. Buyers and sellers are expected to pay equal shares of the unit tax.*

• From baseline I (BL80) a seller subsidy of 20 tokens is set. This treatment is referred to as Seller Subsidy: SS70. Supply is increased by 20 tokens through the subsidy, and the predicted equilibrium price is 70 tokens, just as in baseline II (BL70). If *SS70 mimics BL70, LSE is supported. Buyers and sellers are expected to share the subsidy equally.*

• From baseline II (BL70) a seller tax of 20 tokens is set. This treatment is referred to as Seller Tax: ST80. Supply is decreased by 20 tokens through the tax, and the predicted equilibrium price is 80 tokens, just as in baseline I (BL80). *If ST80 mimics BL80, LSE is supported*. *Buyers and sellers are expected to pay equal shares of the unit tax.*

Table 2 provides a description of each baseline and tax or subsidy treatment with more detail on expected trades, agent earnings, and total earnings or surplus in the market. The above statements in italics are testable propositions.

Figure 2 illustrates both baselines I (BL80) and baseline II (BL70). If the market begins at BL70 and sellers are taxed 20 tokens, then ST80 should overlay with BL80. If the market begins at BL80 and sellers are subsidized 20 tokens then SS70 should overlay with BL70. Equilibrium price will be 70, trades will be 20-24 units, and available surplus is 1200 tokens (figure 2; table 2). Figure 3 provides a similar illustration for baseline I and baseline III (BL90). Here if the market begins at BL90 and there is a buyer tax of 20 tokens, then DT80 should overlay with BL80. If the market begins at BL80 and there is a buyer subsidy of 20 tokens, DS90 should overlay with BL90. Equilibrium outcomes for DS90 and BL90 are price of 90 tokens, 20-24 units traded, 1200 tokens available surplus (figure 3; table 2).

IV. Results

The experiment data analysis and proposition testing utilizes a combination of the results from a convergence model regression and graphical considerations.

Once all treatments had been completed and the data compiled, a convergence model regression was estimated in order to describe the results empirically. The convergence model used for this data is similar to the model used by Ashenfelter et al. (1992) and Noussair, Plott, and Riezman (1995). This model was developed to describe convergence levels for different treatments and can be used for statistical hypothesis testing:

$$Z_{it} = \sum_{j=1}^{i} \alpha_j D_{jt} \left[\frac{(t-1)}{t}\right] + \sum_{j=1}^{i} \beta_j D_{jt} \left(\frac{1}{t}\right) + u_{it},$$

where Z_{it} is the variable we want to test for convergence over $t = (1, \dots, 20)$ trading periods. This could be average price, quantity, or profits. The total number of treatments is i, with the current treatment denoted by j. The dummy variable D_{jt} is one for the treatment of interest j, and zero otherwise. The coefficient β_j is the starting level of our variable of interest, Z_{it}, whose weight decreases as t increases. The coefficient α_j is the convergence level for the treatment of interest and is weighted opposite that of β_j. We will have two values, a starting value (β_j) and an ending, or convergence, value (α_j). The errors are captured in u_{it} and verified for normality using the Shapiro-Wilks and D'Agonstino-Spearman tests The convergence model allows us to do hypothesis testing of cross-treatment differences. Specification tests guided corrections for heteroscedasticity, and contemporaneous correlation given the panel nature of the data.

Within the convergence model specification, tremendous weight is given to the first period, and essentially anchors the start of the convergence path to the first observation. So long as the data follows an asymptotic shape, this rarely presents an issue, however, if the experiment data follows a more linear path up or down, the model specification can result in convergence level coefficient estimates that are either below or above the levels shown graphically. Based on these observations, the convergence model is estimated on a restricted sample of the data starting with the 2^{nd} period. The resulting estimates of an asymptotic convergence level are then more consistent with the graphical analysis.

Data were collected on price, number of trades, buyer and seller profit, as well as total profit. Figures 3 and 4 show the median price for each period and session. The convergent medians for price, number of trades, relative earnings, and total earnings are reported in Table 3. Using the median is consistent with Ruffle (2005) and captures more of the variation in individual sessions.

V. Baseline Values

The baseline markets have asymptotic values that do not necessarily match predictions from the intersection of supply and demand. Figures 3 and 4 generally show for example that actual prices approach the predicted equilibrium from below, and in all baseline cases of BL70, BL80 and BL90 the reported asymptotes after 20 periods of trading experience are below and significantly different from the competitive equilibrium prediction (Table 3). In all cases, trades are less than the predicted number. For example, the number of trades in BL90 is 15.10, almost 5 trades fewer than the theoretical expectation of 20.

Lower prices and fewer units traded result in total earnings (total surplus) below those predicted. Table 3 reports the absolute difference in seller and buyer earnings as SE-BE. For all three baselines the difference should be zero at the intersection of supply and demand. A negative difference, such as -35.28 in BL80 shows that the negotiations favor buyers. There are actually two dimensions to analyzing the results, the first being the experiment results relative to theoretical equilibrium predictions, and the second being a test of the LSE propositions of the subsidy or tax treatments relative to their baseline outcomes. It is actual baseline values as reported in Table 3 that guide the determination incidence for any particular tax or subsidy case.

VI. Demand Tax (DT80): Moving the Market from BL90 to BL80

BL90 has a price asymptote of 86.51 and BL80 has an asymptote of 75.16. When buyers are taxed, we observe a convergence price of 76.44 tokens, which is not significantly different than the BL80 price of 75.16. In theory, a per unit tax of 20 tokens would shift the BL90 price down by 10 tokens with the tax split equally between buyers and sellers, and the case of a buyer/demand tax this appears to be true with buyers bearing 50.4% and sellers 49.6% of the tax. This even split of the tax incidence does however preserve that the underperformance of sellers seen across the baseline scenarios.

The equilibrium number of trades per round for BL80 and DT80 are below their respective theoretical predictions. Both treatments have a predicted equilibrium of 16 trades, but only 14.32 trades are realized in BL80 and 15.24 in DT80, both testing significantly different than 16.

Relative earnings are reported as SE-BE in Table 3. The low prices in BL80 and BL90 generate relatively more earnings for buyers. Relative differences are -35.28 and -25.09 respectively. When demand is taxed in DT80 the relative difference in buyer and seller earnings is more or less preserved at -25.87 which is consistent with the even split of tax incidence.

In short, LSE appears well-supported in the case of a buyer tax with the incidence being carried equally between buyers and sellers, even to the point of preserving the observed buyer advantage in this market setting.

VII. Supply Tax (ST80): Moving the Market from BL70 to BL80

In this case the baseline contexts are BL70 and BL80. A supply tax is decreasing supply and moving the intersection of supply and demand from 70 to 80. The asymptote prices from bargaining are respectively, 68.75 and 75.16 as reported in Table 3. The ST80 tax equilibrium converges to 81.06 tokens, which is significantly different from the BL70 and BL80 asymptotes but very close to the competitive predicted equilibrium of 80 as confirmed in the graphical results show in Figure 4. When sellers are taxed, they strike relatively better bargains in private negotiations indicated by successfully negotiating a price nearly six tokens higher than the observed price of the BL80 treatment. Buyers pay an average price that is 12.31 tokens higher than the observed BL70 price, or 61.5% of the 20 token tax imposed on the BL70 schedule for sellers. Interestingly, sellers are apparently more aggressive in their bargaining when being taxed as compared to the case when they are not (BL80).

The number of trades made in ST80 is 13.97 which is not significantly different than the 14.32 baseline trades made in BL80. Both the BL80 and ST80 treatments have an expected equilibrium of 16 trades, which are of course relatively lower than the 18.27 baseline trades of BL70 after the tax.

Given the observed imbalance in tax incidence, it is not surprising that seller's earnings are much closer to the buyer's earnings compared to the baseline market results of BL80 and BL70. Buyers do better than sellers in baselines BL80 and BL70 earning 35.28 and 8.95 tokens more than sellers, respectively. When a tax is levied on the sellers, sellers make 5.90 tokens more than buyers each period. The supply tax ST80 favors sellers in repeated bi-lateral negotiations, and while LSE is not-well supported relative to the BL80 baseline, the introduction of the tax seems cause sellers to be more aggressive in their bargaining. This change in baseline role-behavior, actually leads to convergence estimates that are more consistent with theoretical competitive predictions, than are the bilateral negotiations absent the tax on sellers.

VIII. Demand Subsidy (DS90): Moving the Market from BL80 to BL90

The demand subsidy treatment DS90 starts with the baseline BL80 supply and demand schedules and then pays a 20 token subsidy to the buyer for each unit traded. This treatment is expected to have the same equilibrium as the baseline BL90, and according to LSE we would expect prices to converge to a level near the BL90 treatment at 86.51 tokens. When buyers are subsidized, the observed price converges to 90.50 tokens – much closer to the theoretical expectation of 90 tokens. The asymptote prices in DS90 exceed those realized in BL90 by about 4 tokens, and referring to Figure 3, despite starting at the same level as the baseline BL90, the subsidized prices are much quicker to ascend and converge on 90 tokens.

The BL80 price converges to 75.16 tokens, implying that the subsidy in DS90 increases prices by 15.34 tokens from the subsidy-free baseline, suggesting that sellers capture 76.7% of the 20 token subsidy paid to the buyers. Moreover, prices are higher than the BL90 case, suggesting that the presence of the buyer subsidy changes the relative role-behavior of sellers. This is similar to the impact of observed in the seller tax ST80 treatment. The advantages buyers had without the subsidy as evidenced by the lower than expected baseline asymptotes in BL80 and BL90 has disappeared.

The convergent number of trades in DS90 increases from 14.32 in BL80 to 17.37 tokens per period, while trades in in BL90 are just 15.10. The subsidy significantly increases trades over both baselines. This increase in trades occurs because the price is closer to the theoretically expected equilibrium of 90 tokens. At this price, buyers and sellers are able and willing to make trades closer to the equilibrium expectation of at least 20 units.

Sellers do much better in relative earnings in treatment DS90 than in either baseline treatment. In the baseline BL90 and BL80 treatments, buyers make 25.09 and 35.28 tokens more than sellers, respectively. When buyers are subsidized by 20 tokens, sellers earn 4.32 tokens more per period than buyers, which is 29.41 tokens more relative to buyers in the BL90 treatment. Relative to the BL90 outcome, LSE is not well-supported, and buyers appear to become less aggressive in their bargaining relative to sellers when subsidized. It is interesting to note, that this does not appear to happen when buyers are taxed as we saw with DT80 and BL80.

IX. Supply Subsidy (SS70): Moving the Market from BL80 to BL70

Finally, like the demand subsidy treatment, the supply subsidy treatment SS70 starts with the BL80 supply and demand schedules, but has a 20 token subsidy for the seller for each unit sold. This is expected to have the same equilibrium as the BL70 treatment. Referring to Table 3, BL80 had a price asymptote of 75.16, and the BL70 an asymptote is 68.75.

When the subsidy is given to the supply side of the market, the prices converged to 67.98 which is not significantly different the BL70 level of 68.75. With a SS70 price just 7.18 tokens less than BL80, sellers appear to have captured roughly 12.82 tokens, or 64.1% of the 20 token subsidy relative to BL80. However, considering that BL70 itself is only 6.41 tokens less than BL80 with no significant price difference between BL70 at 68.75 and SS70 at 67.98, it seems that LSE is essentially supported in the case of a seller subsidy, though not as strongly as in the case of DT80.

The convergent number of trades that occurs when the sellers are subsidized falls below the theoretically expected 20 trades. However, the baseline BL70 converges to 18.27 trades, whereas SS70 trades converge to only 16.80 trades per period, perhaps due to lower prices in the subsidy treatment.

While buyer earnings in the BL80 treatment were 35.28 tokens more than sellers, this premium was somewhat eroded in the BL70 and SS70 cases with the buyers earning only 8.95 and 11.28 tokens more per period than sellers.

X. Analysis and Discussion

Summarizing the results above, LSE for tax and subsidy policies in a market characterized by bilateral negotiations appears to depend on which side of the market the policy is imposed upon, and the lack of LSE in certain cases may actually correct imbalances related to buyer-seller role behavior.

In all three of the baseline treatments BL70, BL80 and BL90, buyers generally outperform sellers. Many previous studies have observed this behavior in negotiations, including Bazerman, Magliozzi, and Neale (1985), Neale and Bazerman (1985), Eliashberg et al. (1986), Huber and Neale (1986), McAlister, Bazerman, and Fader (1986), Neale and Northcraft (1986), and Neale, Huber, and Northcraft (1987). Phillips et al. (2014) confirm this in other recent experimental treatments.

The role of buyer or seller is known to affect the behavior of participants in negotiations. Neale, Huber, and Northcraft (1987) postulate that Prospect Theory (Kahneman and Tversky, 1979) plays a role; where losses are viewed greater in value than are gains. In negotiations, a buyer views the negotiated price as what she gives up in the transaction, a loss from the redemption value of that unit. The seller views the negotiated price as a gain over the cost of producing the unit. If Prospect Theory is playing a role in negotiations, then we could expect the buyers to view their loss at a greater value than the seller's gain. The equilibrium price of each treatment could be explained as a balancing point where the buyer's perceived value of the difference between her redemption value of that unit and the negotiated price equals that of the seller's perceived value of the difference between the negotiated price and cost to produce that unit. Our results suggest the relative bargaining stance of buyers and sellers seems to be altered, however, when shocked by subsidies or taxes.

In the seminal strategic bargaining models of Rubinstein (1982), and others such as Roth et. al (1979, 1982, 1985) the same basic result is that risk aversion is a disadvantage in bargaining, and may manifest as impatience. These results have also been supported by some experimental evidence shown in Murnighan, Roth and Schoumaker (1988). The party who is less patient, and/or more risk averse, will perform less well than the other party. Applied to the present context, it would seem that in bilateral negotiations sellers exhibit role-behavior consistent with being more risk averse and impatient relative to buyers.

In an interesting study published in the Journal of Pyschology, Zerres et al (2013) conducted an experiment involving the unilateral and bilateral training of buyers and sellers engaged in negotiations. What they found was that unilateral training of either the buyer or the seller was only effective if the trained party was the seller. This is further evidence that (1) there are real asymmetric role-behavior effects related to negotiations, and (2) that these role asymmetries may be somewhat correctable through the training (or perhaps greater experience) of sellers..

In this study, several experimental treatments are undertaken to test LSE robustness when taxes and subsidies are levied, with asymmetric results. While LSE predictions were generally observed when sellers were subsidized or when buyers were taxed, the opposite was true in reverse. Namely, that LSE predictions were not satisfied when sellers were taxed, or buyers were subsidized, and in both cases the sellers were the beneficiaries of the policy which stood to reverse the seller role-behavior disadvantage typically observed in this market setting. Taxes and subsidies move market outcomes in the direction predicted, but not always to the degree predicted, and even to different degrees depending on who pays the tax or gains the subsidy.

Except when the seller is subsidized, sellers benefit from a tax or subsidy.

It is likely that fairness plays into our results. Since all participants know the tax or subsidy, the party that is not taxed or subsidized may not act in the same manner as they would if there was no policy. Another motivating factor to the change in behavior is the lack of motivation for the policy. The participants are not given a reason why they are being taxed or subsidized. In the tax treatments, the taxed players may not think that the tax is fair since there is no justification for the tax, which could motivate the taxed players to become more aggressive in negotiating a better price and shifting as much of the burden of the tax to their trading partner as they view possible. Without a justification for the tax, the non-taxed players may not think that the tax is fair and concede in negotiations and share the burden of the tax. When a subsidy is involved, the participants are not given a reason why the other players are given a subsidy. This could motivate the non-subsidized players to become more aggressive in negotiations and try to capture as much of the subsidy as they can. The subsidized players may not understand why they were chosen to receive the subsidy, which could lead them to share the subsidy in negotiations. Notions of fairness are very likely to affect the results of these experiments.

There is an asymmetry in the results of the subsidies. When buyers are subsidized, the converged price is much closer to the theoretical equilibrium. When sellers are subsidized, the price converges further away from the theoretical and baseline (BL70) equilibriums. The supply subsidy treatment is the only policy treatment that does not make sellers more competitive. One reason for this could be the fairness argument. Since the subsidy is public knowledge, sellers may think that since the buyers do not earn the subsidy the sellers do not deserve the full subsidy leading them to bargain less aggressively in order to negotiate a lower price. Alternatively, there could be a moral hazard argument indicating that when one side or the other receives a subsidy, they become less aggressive in their bargaining.

Chae (2002) theoretically develops a model of tax incidence using normal assumptions on consumers borrowing from models of wage bargaining and prospect theory. If the parties are engaged in bargaining and one of the parties is taxed or subsidized, then Chae finds that, “the burden of taxes is always shared by the non-taxed party...and the benefit of subsidies is always shared by the non-subsidized party." Chae concludes that, “a bargaining party that is less risk averse has more bargaining power." It could be that buyers are less risk averse than sellers in these market experiments in the absence of taxes or subsidies. When sellers are taxed, using Chae’s argument, we would expect the buyers to incur more of the tax than sellers. If we compare this to the central baseline, this is what we see. In all but the demand subsidy treatment, this argument can be made.

Menkhaus, Phillips, and Bastian (2003) also see that converged quantities in private negotiations are lower than what is predicted. This is also realized in our results with equilibrium quantities between one and five trades lower than predicted. Low trades can be partially explained by the matching problem, where there are bad pairings in the final trading round of the period. If one person in the pairing cannot make a profitable trade the computer system will not let the pair trade. Another explanation may be that since equilibrium prices are not what is expected, the final trades made in the last trading round may not be made as one of the traders is expecting a certain price, which may not be profitable for the other trader.

XI. Conclusion

Many negotiated market institutions have unit taxes and subsidies. Agricultural commodities have been subsidized since 1933, and a wide range of markets are touched by taxes and subsidies to some degree, and the applicable institutions continue to evolve such as the emergence of markets governing greenhouse gasses.These experiments expand our understanding of the interaction between bargaining behavior and policy. LSE does not explain this interaction, in large part because market outcomes in bargaining institutions do not conform well to predictions made by the intersection of supply and demand.

If the goal of policymakers is to increase commodity sales *and* make commodity producers more competitive in negotiations, the best policy action based on our results is to subsidize the buyers of that market, not the suppliers, or to actually tax the suppliers (sellers). Our results show that producers will do better in negotiating, capturing a greater portion of the subsidy (or avoiding a tax) than if the subsidy were actually given to producers, or the tax imposed on the buyers.This is counterintuitive and contradictory to what has been done in almost a century of policy implemented by the U.S. government. When the seller is subsidized, our results show that the seller is less competitive in negotiations than the buyer. Unfortunately, the focus on taxes and subsidies in politics is on statutory incidence rather than economic incidence. In many bargaining environments shifting a subsidy or tax from the seller to the buyer or vice versa would be an extreme shift in policy. But one that warrants consideration when bargaining decides transactions. These results suggest that LSE is not well supported, and the realized economic incidence is altered greatly from theoretical expectations, when transactions are primarily negotiated between two parties.

Table 1. Unit Value Redemption Value (RV) and Cost Used in Baseline Treatments

Treatment	**Baseline I: BL80**		**Baseline II: BL70 (Supply Shift)**		**Baseline III: BL90 (Demand Shift)**	
Unit	RV	Cost	RV	Cost	RV	Cost
1	120	40	120	20	140	40
2	110	50	110	30	130	50
3	100	60	100	40	120	60
4	90	70	90	50	110	70
5	**80**	**80**	80	60	100	80
6	70	90	**70**	**70**	**90**	**90**
7	60	100	60	80	80	100
8	50	110	50	90	70	110

Bold values indicate equilibrium

Table 2. Treatment Descriptions

Treatment Name (Acronym)	Schedule	Policy	Expected Equilibrium Price	Expected Trades	Expected Total Earnings
Baseline I: BL80	Baseline schedule. Table 1	None	80	16-20	800
Baseline II: BL70 (Supply Shift)	Seller costs decrease by 20 tokens. Table 1	None	70	20-24	1200
Baseline III: BL90 (Demand Shift)	Redemption values increase by 20 tokens. Table 1.	None	90	20-24	1200
Seller Tax: ST80	Baseline II: BL70	20 token tax on sellers for each unit sellers sell	80	16-20	800
Seller Subsidy: SS70	Baseline I: BL80	20 token subsidy for sellers for each unit sellers sell	70	20-24	1200
Buyer Tax: DT80	Baseline III: BL90	20 token tax on buyers for each unit a buyer buys	80	16-20	800
Buyer Subsidy: DS90	Baseline I: BL80	20 token subsidy for buyers for each unit buyers buy	90	20-24	1200

Table 3. Market Outcomes*

Treatment	Price	Number of Trades	Relative Earnings (SE-BE)	Total Earnings (tokens)	Ratio Realized/Expected Earnings	Buyer (Seller) Incidence
Seller Tax: ST80	81.06 (0.49)	13.97[c] (0.348)	5.90 (3.15)	737.45[h] (10.25)	0.922	61.5% (38.5%)
Baseline I: BL80	75.16[a] (0.37)	14.32[c] (0.185)	-35.28[e] (2.57)	739.99[h] (5.82)	0.925	NA
Buyer Tax: DT80	76.44[a] (0.453)	15.24[d] (0.210)	-25.87[e,f] (3.30)	756.86 (4.75)	0.946	49.6% (50.4%)
BaselineIII:BL90	86.51 (0.690)	15.10[d] (0.304)	-25.09[e,f] (6.38)	1,035.09 (14.53)	0.863	NA
Buyers Subsidy: DS90	90.50 (0.425)	17.37 (0.297)	4.32 (4.88)	1,104.34 (10.19)	0.920	23.3% (76.7%)
Baseline II: BL70	68.75[b] (0.388)	18.27 (0.229)	-8.95[g] (3.71)	1,131.82 (5.81)	0.943	NA
Seller Subsidy: SS70	67.98[b] (0.435)	16.80 (0.264)	-11.28[g] (2.88)	1,092.01 (11.72)	0.910	35.9% (64.1%)

* Letters a-h indicate values that tested to be significantly similar at α=0.05 level.

Figure 1. Supply and Demand Schedules for Baseline I: BL80 and Baseline II: BL70 and Seller Tax and Subsidy Treatments ST80 and SS70.

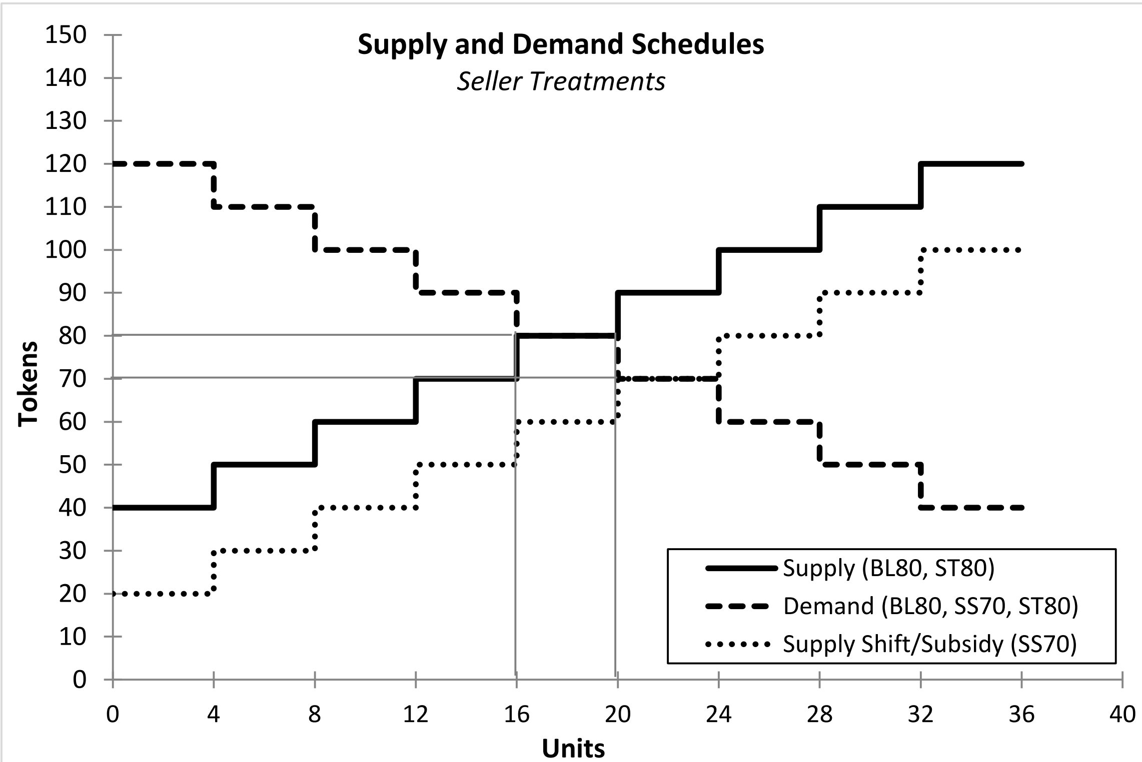


Figure 2. Supply and Demand Schedules for Baseline I: BL80 and Baseline III: BL90 and Buyer Tax and Subsidy Treatments DT80 and DS90.

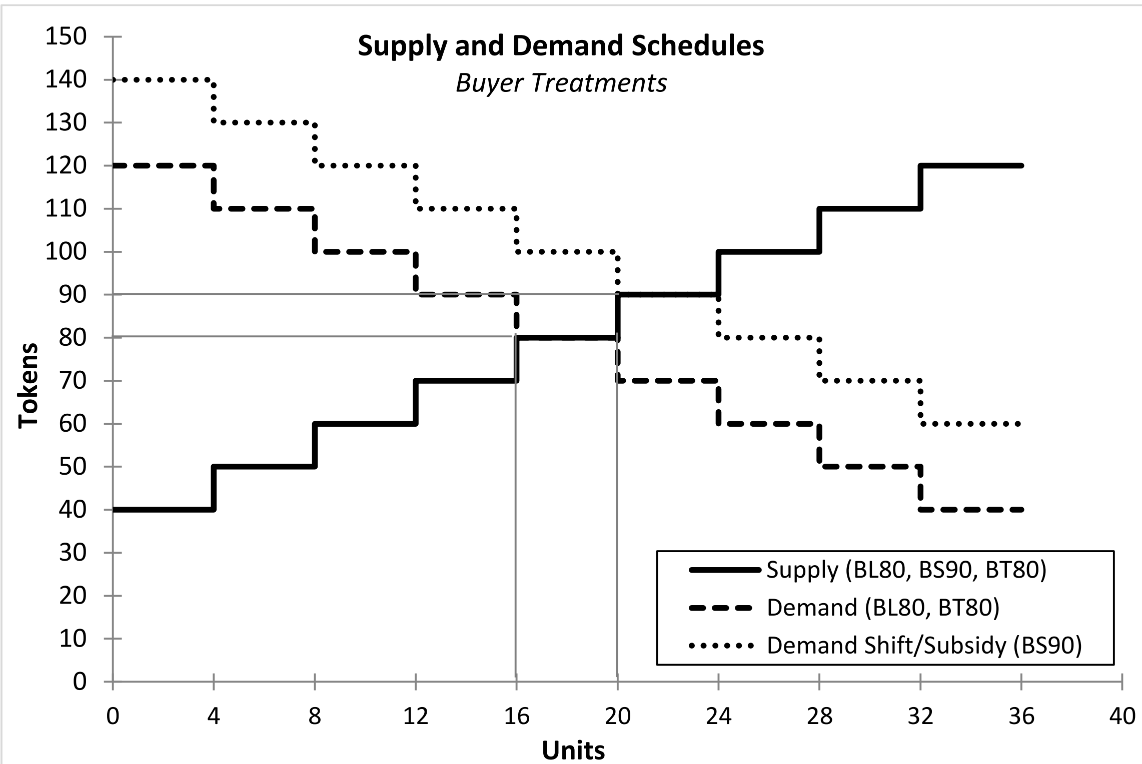


Figure 3. Graphical Results for Subsidy Trade Prices

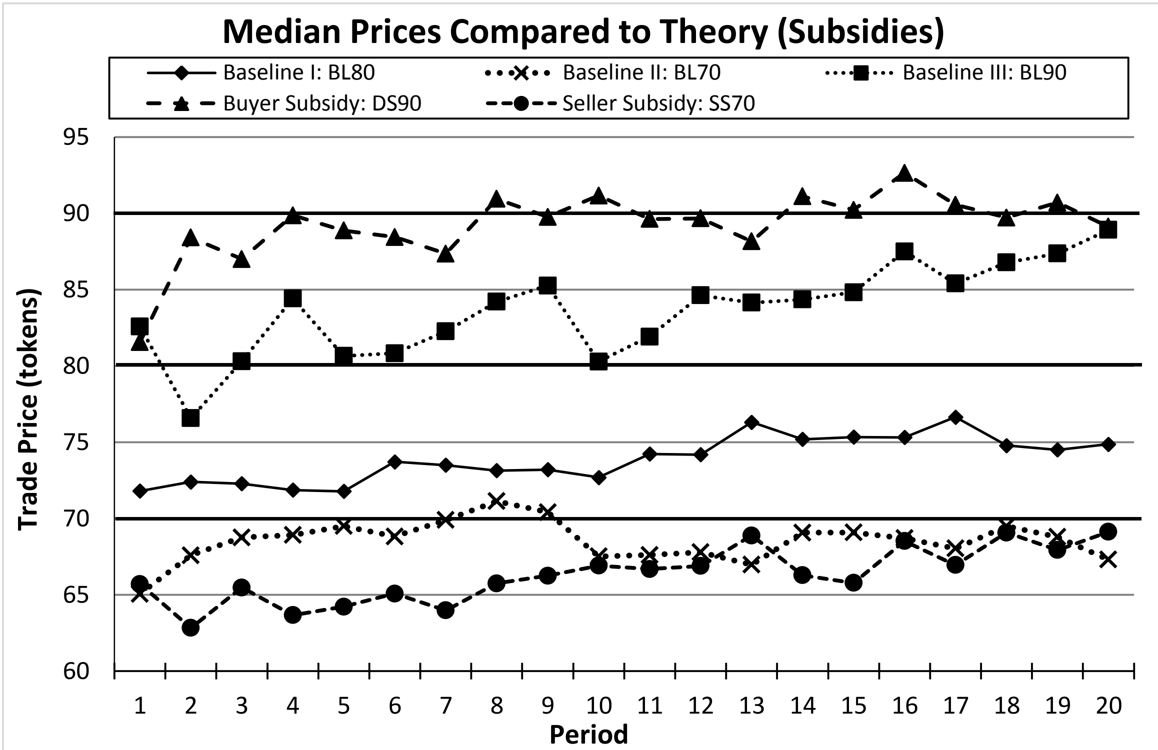
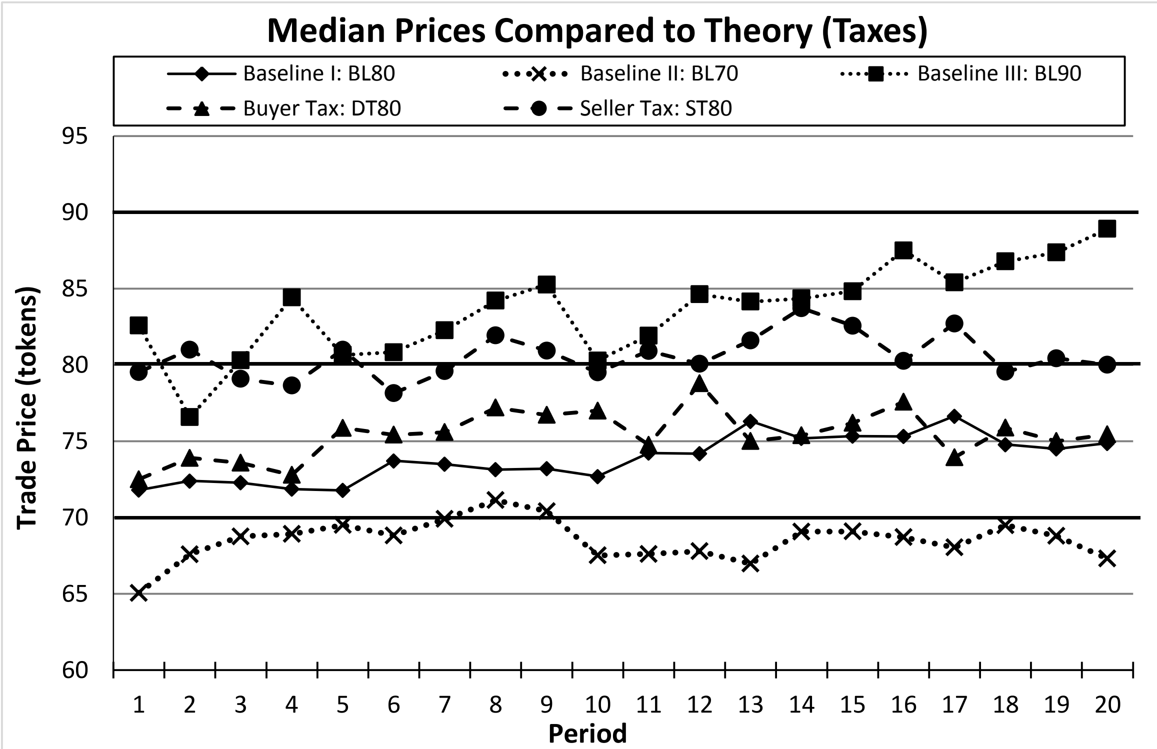


Figure 4. Graphical Results for Tax Trade Prices



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Appendix: Instructions for Baseline

Introduction

This is an experiment in the economics of market decision making. In this experiment, we will set up a market in which some of you will be BUYERS and some of you will be SELLERS.

The commodity you are trading is referred to as a "unit". Sellers make earnings by producing units at a cost and selling these units to buyers. Buyers, however, make earnings by purchasing units from sellers and then redeeming (or reselling) these units to the experimenter.

The experiment earnings are recorded in a fictitious currency called tokens, and token earnings are exchanged for cash at the end of the experiment. The exchange rate for redeeming tokens into cash is **100 tokens = $1.00** and your earnings will be shown to you on the computer. Each of you will be given **$10.00 worth of tokens** to begin the experiment, and you may keep this money PLUS any additional money you earn by accumulating tokens.

Buyers and sellers will be randomly paired and will exchange units for tokens in a computerized market over a sequence of trading cycles. Each trading cycle will have three 60 second trading sessions or rounds during which pairs of buyers and sellers negotiate trades and prices. Each trading cycle consists of what is commonly referred to as a forward market as trades are negotiated before the units are actually produced. A trade is a binding agreement between buyer and seller. In other words, the seller agrees to produce a unit for the buyer, and the buyer agrees to pay the seller for that unit.

All trading is conducted over the computer network. At the end of each trading cycle or period, any unit sold is automatically produced, and the cost of production is deducted from the seller's token balance. Again, unit **Sellers** make money by negotiating prices above their costs. **Buyers** make money by negotiating unit purchase prices below their values (i.e. buy low and sell high). The computer will automatically keep track of your earnings, and adjust your token balances accordingly.

A list of sales or purchases you have made and your adjusted token balance will be displayed on the computer screen at the end of every trading cycle. After you have viewed this information and clicked on OK, a new trading cycle with three trading rounds will begin.

Nobody knows when the experiment will end. There will be at least 20 trading periods, but after period 20 there will be an 80 percent chance of continuing to play an additional period until the game ends.

We will conduct one or more practice periods to familiarize you with the mechanics of the computerized market before the actual experiment begins. During the practice period(s) the information you see will be different than it is in the actual experiment.

You must be sure to carefully analyze all of the new values once the actual experiment begins.

Specific Instructions to Buyers

During each trading cycle you are free to purchase up to 8 units and you will be given a list of values for those units similar to the table below. For the first unit that you buy during a trading cycle you will receive the amount listed as the UNIT VALUE for Unit 1. In this hypothetical example this amount is 80 tokens. For the second unit that you buy you will receive the amount listed for Unit 2, which is 70 tokens in this example, and so on for the other units. Values for all 8 units will be displayed on your computer screen.

Unit 1 is worth 80 tokens
Unit 2 is worth 70 tokens
Unit 3 is worth 60 tokens
Unit 4 is worth 50 tokens
Unit 5...

The earnings from each unit that you purchase (which are yours to keep) are computed by taking the difference between the unit value and the purchase price of the unit bought. That is,

Your Earnings = Unit Value - Purchase Price

Suppose, for example, that you buy 2 units in a trading cycle. If you pay 60 tokens for the first unit and 45 tokens for the second unit, your earnings are:

Earnings for Unit 1 = 80 - 60 = 20

Earnings for Unit 2 = 70 - 45 = 25

Total earnings = 20 + 25 = 45 tokens

During the experiment this trading information will be summarized on the computer screen at the end of each trading cycle. Buyers also should be aware that they will not be allowed to spend more tokens buying units than what they have in their beginning balance in any one cycle.

Specific Instructions to Sellers

During each trading cycle you are free to sell up to 8 units and you will be given a cost schedule for producing those units similar to the table below. This table tells you the UNIT COST for each unit that you sell to a buyer.

The first unit that you sell during a trading cycle will cost you the amount listed under UNIT COST for Unit 1. In this hypothetical example this amount is 20 tokens. The second unit that you sell will cost you the amount listed for Unit 2, which is 30 tokens in this example, and so on for the other units. The cost of producing each of the 8 units will be displayed on your computer screen.

Unit 1 will cost 20 tokens to produce
Unit 2 will cost 30 tokens to produce
Unit 3 will cost 40 tokens to produce
Unit 4 will cost 50 tokens to produce
Unit 5...

The earnings from each unit that you sell (which are yours to keep) are computed by taking the difference between the sale price and unit cost of the unit sold for each sale.

Your Earnings = Sale Price - Unit Cost

Let's suppose that in the forward market you sell Unit 1 for 50 tokens, Unit 2 for 45 tokens and Unit 3 for 45 tokens. Your earnings would then be:

Earnings for Unit 1 = 50 – 20 = 30

Earnings for Unit 2 = 45 – 30 = 15

Earnings for Unit 3 = 45 – 40 = 5

Total earnings = 30 + 15 + 5 = 50 tokens

During the experiment this trading information will be summarized on the computer screen at the end of each trading cycle. Sellers also should be aware that they will not be allowed to incur a production cost greater than the amount in their beginning token balance in any one cycle.

Trading Rules for the Unit Market

Only one unit may be bought and sold at a time. A BUYER makes BIDS to the seller to purchase a unit. A “bid” is a proposed price at which a buyer is willing to purchase a unit. Bids must become progressively higher. In other words, if the first bid for a unit is 50 tokens, then the second bid must be higher than 50. Suppose the second bid is 55 tokens, then the third bid must be higher than 55, and so on.

A SELLER makes OFFERS to the buyer to sell a unit. An "offer" is a proposed price at which a seller is willing to sell a unit. Offers must become progressively lower. In other words, if the first offer to sell a unit is for 60 tokens, then the second offer must be lower than 60. Suppose the second offer is 55 tokens, the third offer must be less than 55, and so on.

There is one further set of restrictions on bids and offers. The reason for these restrictions is just common sense. A buyer's bid cannot be higher than what is labeled on the computer screen as the SELLER'S CURRENT OFFER. In other words, a buyer cannot attempt to pay a price that is higher than that for which the seller is willing to sell.

Similarly, a seller's offer cannot be lower than what is labeled as the BUYER'S CURRENT BID. In other words, a seller cannot attempt to sell at a price below that which the buyer is willing to pay. In fact, the computer will not allow such bids and offers.

After a seller and buyer have made a trade, the trading price will be listed on both the buyer's and seller's screens. After a trade has been made, bid and offer values are cleared from the screen. A buyer and seller pair may then resume entering bids and offers for additional units. Trades are made between buyer and seller pairs for 60 seconds (one minute). After 60 seconds has elapsed, buyers and sellers are again randomly paired and the next trading round begins.

Each trading cycle has a maximum time limit of 3 minutes or three 60 second trading rounds. A market will be terminated automatically if profitable trades cannot be made by the randomly matched buyer and seller.

Making Trades

A bid is made by typing the bid and pressing the ENTER key. Similarly, an offer is made by typing the offer, and pressing the ENTER key. During a market, a buyer will be making bids at the same time that a seller is making offers.

It should be apparent that the difference between the BUYER'S CURRENT BID and the SELLER'S CURRENT OFFER gradually decreases. A trade is made when the BUYER'S CURRENT BID equals the SELLER'S CURRENT OFFER. Suppose the BUYER'S CURRENT BID is 55 tokens and the SELLER'S CURRENT OFFER is 60 tokens. If a buyer decided that he or she was willing to purchase the unit for 60 tokens, he or she could type the number 60 and then press ENTER.

There is, however, a quicker method to do this. As soon as the buyer saw the SELLER'S CURRENT OFFER was 60, he or she could simply click on "Accept." Whenever a buyer "Accepts", he or she automatically makes a bid which equals the SELLER'S CURRENT OFFER or, in other words, "accepts" the SELLER'S CURRENT OFFER.

As another example for sellers, suppose again that the BUYER'S CURRENT BID is 55 and the SELLER'S CURRENT OFFER is 60. If a seller decided that he or she was willing to sell the unit for 55 tokens, he or she could type the number 55 and then press ENTER.

Again, there is a quicker method to do this. As soon as the seller saw the BUYER'S CURRENT BID was 55, he or she could click on "Accept." Whenever a seller "Accepts", he or she automatically makes an offer which equals the BUYER'S CURRENT BID or, in other words, "accepts" the BUYER'S CURRENT BID.

Your Name and W Number

Before the practice session, the computer will ask for your name and W number which is your 9-digit student number. This information is kept confidential, but it is important to the funding agency as proof of your participation. The bids and earnings of people in the experiment are confidential. Please do not look at someone else's screen and do not speak to another participant once the experiment begins. You may ask the experimenter questions at any time during the experiment. Are there any questions before we conduct the practice session?

Instructions for Demand Subsidy Treatment

Introduction

This is an experiment in the economics of market decision making. In this experiment, we will set up a market in which some of you will be BUYERS and some of you will be SELLERS.

The commodity you are trading is referred to as a "unit". Sellers make earnings by producing units at a cost and selling these units to buyers. Buyers, however, only make earnings by purchasing units from sellers and then redeeming (or reselling) these units to the experimenter. **In this experiment BUYERS will also be paid a per unit subsidy for every unit they successfully purchase from the sellers.**

The experiment earnings are recorded in a fictitious currency called tokens, and token earnings are exchanged for cash at the end of the experiment. The exchange rate for redeeming tokens into cash is **100 tokens = $1.00** and your earnings will be shown to you on the computer. Each of you will be given **$10.00 worth of tokens** to begin the experiment, and you may keep this money PLUS any additional money you earn by accumulating tokens.

Buyers and sellers will be randomly paired and will exchange units for tokens in a computerized market over a sequence of trading cycles. Each trading cycle will have three 60 second trading sessions or rounds during which pairs of buyers and sellers negotiate trades and prices. Each trading cycle consists of what is commonly referred to as a forward market as trades are negotiated before the units are actually produced. A trade is a binding agreement between buyer and seller. In other words, the seller agrees to produce a unit for the buyer, and the buyer agrees to pay the seller for that unit.

All trading is conducted over the computer network. At the end of each trading cycle or period, any unit sold is automatically produced, and the cost of production is deducted from the seller's token balance. Unit sellers make money by negotiating prices above their costs. Buyers make money by negotiating unit purchase prices below their values (i.e. buy low and sell high). The buyers will also earn a subsidy payment for each unit sold. The computer will automatically keep track of your earnings, and adjust your token balances accordingly.

A list of sales or purchases you have made and your adjusted token balance will be displayed on the computer screen at the end of every trading cycle. After you have viewed this information and clicked on OK, a new trading cycle with three trading rounds will begin.

Nobody knows when the experiment will end. There will be at least 20 trading periods, but after period 20 there will be an 80 percent chance of continuing to play an additional period until the game ends.

We will conduct one or more practice periods to familiarize you with the mechanics of the computerized market before the actual experiment begins. During the practice period(s) the information you see will be different than it is in the actual experiment. **You must be sure to carefully analyze all of the new values once the actual experiment begins.**

Specific Instructions to Buyers

During each trading cycle you are free to purchase up to 8 units and you will be given a list of values for those units similar to the table below. For the first unit that you buy during a trading cycle you will receive the amount listed as the UNIT VALUE for Unit 1. In this hypothetical example this amount is 80 tokens. For the second unit that you buy you will receive the amount listed for Unit 2, which is 70 tokens in this example, and so on for the other units. Values for all 8 units will be displayed on your computer screen.

Unit 1 is worth 80 tokens
Unit 2 is worth 70 tokens
Unit 3 is worth 60 tokens
Unit 4 is worth 50 tokens
Unit 5 is worth 40 tokens
Unit 6...

Remember, BUYERS will also receive a per unit subsidy for every unit purchased. **For this example, assume that the subsidy payment to buyers is 20 tokens for each purchased.** The earnings from each unit that you purchase (which are yours to keep) are computed by taking the difference between the unit value and the purchase price of the unit bought and adding the subsidy for each sale.

Your Earnings = (Unit Value – Purchase Price) + Per Unit Subsidy

Suppose, for example, that you buy 3 units in a trading cycle and you pay 60 tokens for Unit 1, 55 tokens for Unit 2, and 55 tokens for Unit 3. Your earning would then be:

Earnings for Unit 1 = (80 – 60) + 20 = 20 + 20 = 40

Earnings for Unit 2 = (70 – 55) + 20 = 15 + 20 = 35

Earnings for Unit 3 = (60 – 55) + 20 = 5 + 20 = 25

Total earnings = 40 + 35 + 25 = 100 tokens

Because of the subsidy, buyers can actually purchase a unit at a loss (above the unit value) and still make a net profit after earning the subsidy. For example, if the buyer purchased Unit 4 and

Unit 5 for 59 tokens each they would lose money on the trade by itself but still earn a profit with the subsidy:

Earnings for Unit 4 = (50 – 59) + 20 = (-9) + 20 = +11

Earnings for Unit 5 = (40 – 59) + 20 = (-19) + 20 = +1

During the experiment this trading information will be summarized on the computer screen at the end of each trading cycle. Buyers also should be aware that they will not be allowed to spend more tokens buying units than what they have in their beginning balance in any one cycle.

Specific Instructions to Sellers

During each trading cycle you are free to sell up to 8 units and you will be given a cost schedule for producing those units similar to the table below. This table tells you the UNIT COST for each unit that you sell to a buyer.

The first unit that you sell during a trading cycle will cost you the amount listed under UNIT COST for Unit 1. In this hypothetical example this amount is 20 tokens. The second unit that you sell will cost you the amount listed for Unit 2, which is 30 tokens in this example, and so on for the other units. The cost of producing each of the 8 units will be displayed on your computer screen.

Unit 1 will cost 20 tokens to produce
Unit 2 will cost 30 tokens to produce
Unit 3 will cost 40 tokens to produce
Unit 4 will cost 50 tokens to produce
Unit 5...

The earnings from each unit that you sell (which are yours to keep) are computed by taking the difference between the sale price and unit cost of the unit sold for each sale.

Your Earnings = Sale Price - Unit Cost

Let's suppose that in the forward market you sell Unit 1 for 50 tokens, Unit 2 for 45 tokens and Unit 3 for 45 tokens. Your earnings would then be:

Earnings for Unit 1 = 50 – 20 = 30

Earnings for Unit 2 = 45 – 30 = 15

Earnings for Unit 3 = 45 – 40 =   5

Total earnings = 30 + 15 + 5 = 50 tokens

During the experiment this trading information will be summarized on the computer screen at the end of each trading cycle. Sellers also should be aware that they will not be allowed to incur a production cost greater than the amount in their beginning token balance in any one cycle.

Trading Rules for the Unit Market

Only one unit may be bought and sold at a time. A BUYER makes BIDS to the seller to purchase a unit. A "bid" is a proposed price at which a buyer is willing to purchase a unit. Bids must become progressively higher. In other words, if the first bid for a unit is 50 tokens, then the second bid must be higher than 50. Suppose the second bid is 55 tokens, then the third bid must be higher than 55, and so on.

A SELLER makes OFFERS to the buyer to sell a unit. An "offer" is a proposed price at which a seller is willing to sell a unit. Offers must become progressively lower. In other words, if the first offer to sell a unit is for 60 tokens, then the second offer must be lower than 60. Suppose the second offer is 55 tokens, the third offer must be less than 55, and so on.

There is one further set of restrictions on bids and offers. The reason for these restrictions is just common sense. A buyer's bid cannot be higher than what is labeled on the computer screen as the SELLER'S CURRENT OFFER. In other words, a buyer cannot attempt to pay a price that is higher than that for which the seller is willing to sell.

Similarly, a seller's offer cannot be lower than what is labeled as the BUYER'S CURRENT BID. In other words, a seller cannot attempt to sell at a price below that which the buyer is willing to pay. In fact, the computer will not allow such bids and offers.

After a seller and buyer have made a trade, the trading price will be listed on both the buyer's and seller's screens. After a trade has been made, bid and offer values are cleared from the screen. A buyer and seller pair may then resume entering bids and offers for additional units. Trades are made between buyer and seller pairs for 60 seconds (one minute). After 60 seconds has elapsed, buyers and sellers are again randomly paired and the next trading round begins.

Each trading cycle has a maximum time limit of 3 minutes or three 60 second trading rounds. A market will be terminated automatically if profitable trades cannot be made by the randomly matched buyer and seller.

Making Trades

A bid is made by typing the bid and pressing the ENTER key. Similarly, an offer is made by typing the offer, and pressing the ENTER key. During a market, a buyer will be making bids at the same time that a seller is making offers.

It should be apparent that the difference between the BUYER'S CURRENT BID and the SELLER'S CURRENT OFFER gradually decreases. A trade is made when the BUYER'S CURRENT BID equals the SELLER'S CURRENT OFFER. Suppose the BUYER'S CURRENT BID is 55 tokens and the SELLER'S CURRENT OFFER is 60 tokens. If a buyer decided that they were willing to purchase the unit for 60 tokens, they could type the number 60 and then press ENTER.

There is, however, a quicker method to do this. As soon as the buyer saw the SELLER'S CURRENT OFFER was 60, they could simply click on "Accept." Whenever a buyer "Accepts", they automatically make a bid which equals the SELLER'S CURRENT OFFER or, in other words, "accepts" the SELLER'S CURRENT OFFER.

As another example for sellers, suppose again that the BUYER'S CURRENT BID is 55 and the SELLER'S CURRENT OFFER is 60. If a seller decided that they were willing to sell the unit for 55 tokens, they could type the number 55 and then press ENTER.

Again, there is a quicker method to do this. As soon as the seller saw the BUYER'S CURRENT BID was 55, they could click on "Accept." Whenever a seller "Accepts", they automatically make an offer which equals the BUYER'S CURRENT BID or, in other words, "accepts" the BUYER'S CURRENT BID.

Your Name and W Number

Before the practice session, the computer will ask for your name and W number which is your 9-digit student number. This information is kept confidential, but it is important to the funding agency as proof of your participation. The bids and earnings of people in the experiment are confidential. Please do not look at someone else's screen and do not speak to another participant once the experiment begins. You may ask the experimenter questions at any time during the experiment. Are there any questions before we conduct the practice session?