U.S. Experience with Futures Transactions Taxes: Effects in a Highly Intermediated Market

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The transactions tax on futures sharply reduced trading volume on wheat and corn contracts during the 1920s and 1930s but had no apparent effect on volatility or market quality. I find no evidence of a tax effect on open interest: I hypothesize this is because the relative magnitude of the tax was significantly higher for intermediaries than for other participants. Instead, the tax appears to have substantially reduced intra-day trading but not longer-term positioning. Volume-related proxies of liquidity therefore exhibit a strong relation with tax rates, but other measures of market quality show no relation to tax rates. In the long-run, however, exchange members doubled the minimum tick size in order to retain a large number of market makers and offset the impact of the tax.

January 2016

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The transactions tax on futures sharply reduced trading volume on wheat and corn contracts during the 1920s and 1930s but had no apparent effect on volatility or market quality. I find no evidence of a tax effect on open interest: I hypothesize this is because the relative magnitude of the tax was significantly higher for intermediaries than for other participants. Instead, the tax appears to have substantially reduced intra-day trading but not longer-term positioning. Volume-related proxies of liquidity therefore exhibit a strong relation with tax rates, but other measures of market quality show no relation to tax rates. In the long-run, however, exchange members doubled the minimum tick size in order to retain a large number of market makers and offset the impact of the tax.

The effects of a tax on financial transactions depend on the underlying market structure. Most studies find a sharp decline in transaction volume after a tax is imposed, and market quality measures often decline. The puzzle investigated in this paper is that, when taxes were levied on futures transactions in the U.S., trading volume fell but market quality measures did not otherwise deteriorate. There is no evidence futures end-users changed their usage of the contracts due to the tax. In this highly intermediated market, however, the middlemen felt disproportionate effects. In the short run (measured in years), intermediaries stayed in the market even as their revenues per client transaction were slashed by, in some cases, more than half. In the long run, however, the intermediaries effectively doubled the minimum tick size in order to preserve their numbers and effectively pass through the tax to customers. The increase in the tick size remained long after the tax was abolished.

The U.S. federal government levied a tax on futures transactions for more than twenty years. The tax, which applied to sales for future delivery but not to transactions in the cash markets, varied from one basis point of the notional value of the transaction to five basis points. The tax applied to all commodities at the same rate, and there were no exemptions for market making. A futures transaction tax was originally put in place to raise revenue for the Spanish American War (1898-1901), revived to raise revenue for the First World War (1916-1918), and then put in place for general revenue purposes from 1919 to 1938. This paper provides the first empirical analysis of the tax and its effects over the 1921-1941 period.

The US experience is still relevant, because of multiple reasons, for 21st century policymakers considering the implementation of a transactions tax. First, the tax was imposed over decades of activity in the primary global derivatives market. Second, the tax varied exogenously because it was not tied explicitly to other market variables (such as expected volume) but was instead an outcome of the political process. Third, the analysis benefits from the substantial historical record, including extensive quantification and documentation of the market structure in existence at the time. Importantly, the length and variation of the tax rate allows analysis that is not feasible with recently imposed taxes. Long-run effects of the tax might only be visible after long periods of adjustment, especially if market participants hope to alter implementation of the tax. Given the prominence of the current debate regarding the introduction of financial transaction taxes in Europe and the US, it is important to extract all relevant lessons from past experience.

I find that the tax substantially reduced trading volume in wheat and corn futures. Regression estimates suggest that trading volume declined nearly 15% due to the tax when it was set at one basis point and declined more at higher levels of the tax. However, the tax did not have a direct, obvious effect on volatility or liquidity of futures markets. Unlike securities, futures contracts are in zero net supply; hence, I can measure the impact of the tax on end-users of the contracts by examining how open interest is affected by the tax. I find no significant change in open interest and conclude that the use of futures by end-users was not materially influenced by the tax. I conclude that the decline in transaction activity reflects less intermediation activity, rather than less activity by end-users of futures. This result is novel and is made possible by the use of futures market data (as opposed to securities market data) and the historical analysis of the market experience with the tax.

The conclusion is supported by direct examination of empirical proxies for liquidity and transaction costs. The Amihud (2002) measure, constructed as the ratio of absolute price changes to trading volume, is significantly lower at higher levels of the tax. If the analogous measure is constructed using the ratio of absolute price changes to changes in open interest, there is no evidence of a link to tax rates. Similarly, the closing range of daily prices shows no link to tax rates, nor does the Corwin-Schultz (2012) transaction cost estimator. These proxies are well explained by other effects such as market volatility, but they are not explained by the tax rate. There is little obvious evidence that market quality was diminished, although trading volume sharply declined. I conclude that there was a structural change in intermediation activity rather than an obvious relation to liquidity.

The modest direct impact on end-users of futures markets is underscored by the results of examining pricing behavior using synchronized data for cash and futures markets. The differential between cash and futures prices for wheat and corn is well explained during this period by the key, observable fundamental: visible supply (a proxy for convenience yield). In theory, the tax might have made futures less attractive to end-users, whether through a direct effect on returns or an indirect effect through diminished liquidity. The tax rate, however, appears to have had no material role in determining the relative prices of cash and futures.

End-users of futures faced little direct cost due to the transactions tax. A hedger or speculator concerned about prices moving hundreds of basis points was not overly concerned with a tax of one basis point. Intermediaries bore the brunt of the tax and faced a marginal tax rate that was orders of magnitude larger. If an intermediary made $6.25 from capturing the typical 1/8 of a cent spread between bid and asked prices, a tax of one basis point of notional value represented roughly an 8% marginal tax rate when the market maker captured the spread on wheat priced at a dollar per bushel. At five basis points, the marginal rate was 40%. If market makers “split” a transaction to trade at 1/16 of a cent, the marginal tax rate reached 80% on a five basis point tax. Further, the tax was paid whether the market maker made or lost money.[1]

However, end-users of futures ultimately faced a significant negative impact due to the disparity in the cross-sectional impact of the tax. In the short run, many market makers remained in the pit and continued to provide substantial liquidity, but they faced substantially diminished income

[1] The 80% marginal rate, for example, is computed as a tax of $2.50 per contract (0.05% tax rate x 5,000 bushels x $1.00 per bushel) on a tick value of $3.125 per contract (5,000 bushels per contract x 1/16 cent per bushel tick size).

due to the tax. In 1933, exchange members effectively voted to increase the minimum tick size by eliminating "split" transactions that traded at 1/16 of cent increments. All end users now faced this increased tick size that effectively raised the price of a contract by $3.125 in order to offset a $2.50 tax.

The tax was abolished in 1938. In spite of the tick size increase, market makers were still pressured by a marginal tax rate of approximately 20% at this time (a 3 basis point tax worth over $1.00 versus a tick value of $6.25). In the long run, the competitive pressures would have inevitably led to a smaller number of market makers with less aggregate intermediation capacity. Less intermediation capacity would have meant that significant quantities traded would have resulted in worse execution prices (i.e., trades would have had larger price impact).[2] The commodity futures regulator weighed in on the tax, telling Congress that the tax placed a particularly heavy burden on market makers. The Chief of the regulator testified that elimination of the tax would increase the "stability and flexibility" of the market. Congress eliminated the tax in 1938, although the tick size increase from six years earlier remained in place. No other federal taxes have since been levied on futures transactions.

The structure of the paper is as follows. The first section discusses related literature. The second section provides historical background of the markets as context, with both a historical narrative of the US experience with futures transactions taxes and a quantitative description of the interwar commodity futures market. Section three uses the Grossman and Miller (1988) model to generate predictions for the equilibrium effect of a tax on a highly intermediated market. The fourth section covers the empirical analysis that is central to the paper. The fifth section discusses the empirical results in their historical and institutional context. A final section concludes.

1. Related Literature.

The empirical literature specifically relating transactions taxes to activity in derivatives markets is small, but there is a complementary, larger literature concerning transactions taxes applied to securities markets. The strongest finding from either literature: higher transactions taxes have a strong, negative impact on trading activity. Trading volume is often mobile across borders, so to the extent that equivalent trades are available offshore, volume often migrates after taxes are imposed in a given jurisdiction. The other prominent conclusion generally emerging from the studies is that market quality measures, such as bid-ask spreads, often deteriorate once taxes are imposed. However, there is no unanimous finding relating transactions taxes to volatility.

[2] Grossman and Miller (1988), in discussing the viability of competitive equilibria in markets with costly participation, describe exchange-driven restrictions on the number of market makers and minimum tick sizes as "Part of the art of managing a futures exchange…" (p. 630).

The most recent evidence is from the European experience. Following the financial crisis of 2008, the European Union debated transactions taxes on securities and derivatives. Advocates of a EU-wide tax have had difficulty in achieving their goal, but transactions taxes were imposed in France and Italy. Colliard and Hoffmann (2015), Becchetti *et al.* (2014), and Meyer *et al.* (2014) examine the effects due to the French securities tax implemented in 2012. The tax programs reduced market quality: trading volume declined 20% even though market maker trades were exempt from the tax, but liquidity suppliers reduced market depth even as they kept spreads constant.

Studies of other tax rate changes found similar results. Pomeranets and Weaver (2011) conclude that increases in the New York State Securities Transaction Tax led to declines in market quality. Trading volume on the Taiwan Futures Exchange increased, and bid-ask spreads declined, but volatility was not particularly affected, following a May 2000 tax rate decrease for equity index futures (Chou and Lee (2002), Chou and Wang (2006)). Hu (1998) concluded that neither volatility nor turnover was generally affected when transaction taxes were changed in Asian markets over the 1975-1994 period. Umlauf (1993) documents the evisceration of Swedish equity market trading after a transactions tax was imposed in the 1980s.

A related literature connecting trading costs to volatility and trading volume in financial markets is relatively broad. Jones and Seguin (1997) found that the reduction in equity trading commission costs in May 1975 led to a decrease in volatility and increase in equity trading volume. In contrast, Liu and Zhu (2009) found that the 1999 deregulation of commissions in Japan led to increased price volatility. Surveying the literature, Wang and Yau (2012) conclude that there is no definitive link between transactions taxes and volatility, but that higher transactions taxes can dramatically reduce trading volume.

The general finding of Bjursell, Wang, and Yau (2012), Wang, Yau, and Baptiste (1998), and Wang and Yau (2000) is that higher transactions costs generate significantly lower trading volume and increase transactions costs and volatility for U.S. futures markets. They conclude that the elasticity of trading volume with respect to transactions costs is large enough that a tax of 2 basis points would completely eliminate futures trading in the major U.S. listed contracts. The key to this result is the magnitude of the assumed tax increase. For example, the authors find that such a tax would have added nearly $57 to the fixed transaction cost of $14.80 for S&P 500 futures contracts, leading to a 383% increase in costs due to the tax.

Rigorous theoretical analyses have shown that the welfare effects of transactions taxes in financial markets are ambiguous (Dow and Rahi (2000)). Recent work has highlighted that the impact of a particular tax depends on the cross-section of market participants, or the particular microstructure environment. Song and Zhang (2005) show that a tax may discourage noise traders who presumably increase volatility, but it will also discourage informed traders who aid price discovery. They also point out that a post-tax market that is thinner and less active might exhibit higher volatility to shocks. Pellizari and Westerhoff (2009) suggest that a transaction tax harms market quality in continuous double auction markets but would reduce market volatility in a specialist market.

In empirical work, Deng, Liu, and Wei (2014) examine cross-listed stocks in segmented markets and suggest that a tax might dissuade noise trading in markets dominated by uninformed traders but might dissuade informed trading in more mature markets. Colliard and Hoffmann (2015), studying effects of the 2012 transaction tax in France, highlight the liquidity provision of institutional investors and find significant erosion in market quality in stocks that do not rely on liquidity provision by tax-exempt market makers.

2. Historical Context

a. Narrative

The empirical focus of the paper is on the 1921-1941 period, but this represents only a portion of the transaction tax story for the US. Given the recent prominence of financial transaction taxes in the public sphere, including the post-2008 crisis introduction of taxes in France and Italy and protracted debates over a tax across the entire European Union, I augment the empirical analysis by providing broad historical context in this section.

Congress has enacted various taxes on derivatives, with the intention of either generating revenue or shaping/abolishing portions of the industry. The first U.S. federal derivatives tax appears to have been enacted in March 1863 on transactions in gold contracts. At the time, the greenback floated freely versus gold and a tax of 0.50% of the notional value plus 6% per annum (based on the tenor of the contract) was imposed in order to deter speculators from trading in gold. The tax was lowered in 1864 to 5 basis points, raised in 1865 to 10 basis points, and lowered yet again in 1866 to 1 basis point. It was finally abolished, along with stamp taxes on stocks, in 1872.

Agrarian sentiment against derivatives markets reached a peak in the early 1890s, and some of the proposed legislation in this vein included taxation measures designed to abolish derivatives trading. For example, the Butterworth Bill of 1890, never passed into law, would have imposed a licensing fee of $1,000 per year on dealers in futures and options, plus a tax of 20 cents per bushel of grain contracted (more than a 20% tax on the notional value for wheat) and 5 cents per pound on commodities such as cotton. Senator Ingalls of Kansas copied the language on taxation in a proposed amendment to the Sherman Anti-Trust Bill; Ingalls even moved that the title of the bill be changed to "A bill to suppress and punish unlawful trusts and combinations, to prevent dealing in options and futures, and for other purposes." The amendment did not make it into the final bill (McFarland, 1942). The Hatch Bill of 1892 required dealers to pay $2,000 per year and 20 cents for each bushel of grain dealt in. The Hatch Bill passed both the Senate and House but was not enacted into law.[3]

A few years later, Congress imposed a variety of taxes as wartime measures to fund the Spanish American War. Taxes were levied on a wide range of occupations and goods. For example, banks, brokers, pawnbrokers, owners of theaters, circuses, and bowling alleys were taxed. Stamp taxes were imposed on telegraph messages, medicines, perfumes, and chewing gum. Among the documentary taxes was a tax of 1 bp on commodity transactions on a board of trade. The taxes were enacted at the end of June 1898 and were repealed in 1902.

Legislation designed to impede futures transactions was proposed at times during the early part of the 20th century, but the most far-reaching legislation was not enacted. For example, Senator James Clarke of Arkansas proposed a rider on a tariff bill in 1913 that would have imposed a 50 cent per bale tax on cotton futures if the seller did not own physical cotton. Senator Cummins from Iowa later proposed an amendment for a 10 per cent tax on short sales of stock and on commodity futures.

Senator Thaddeus Caraway from Arkansas, in 1928, sponsored a bill to impose a 50 basis point tax on cotton and grain futures transactions. The bill was opposed by the Secretary of Agriculture and the head of the Grain Futures Administration and was defeated. Caraway introduced another bill the following year; that bill would have prevented the sale of cotton and grain futures unless the seller had, or could have, the commodity in hand.

Congress also relied for a time on prohibitive taxes to shape the market structure for futures. The Cotton Futures Act of 1914 imposed a 2 cent per pound levy on all cotton traded for future delivery, unless the contract met various guidelines regarding cotton grading and delivery. The Future Trading Act of 1921 levied a 20 cent per bushel tax on grain option contracts (i.e., a $1,000 tax on an option valued at $5) and levied a 20 cent per bushel tax on grain futures contracts unless a) the seller had grain to deliver or b) the contract was traded on a board of trade that was designated as a "contract market" by the Secretary of Agriculture. Part of the Act was declared unconstitutional (based on its use of the power to tax) and was speedily replaced by the Grain Futures Act of 1922, which relied on Congress's power to regulate interstate commerce instead. The Grain Futures Act did not regulate grain option contracts; the section of the Future Trading Act levying the 20 cent per bushel tax was not declared unconstitutional until January 1926, at which time futures option trading resumed on designated contract markets.

Legislation passed by Congress in the 20th century to impose taxes on futures trading was motivated more by a desire to generate revenue than by a desire to impede trading. Congress imposed a tax of one basis point on the notional value of futures trading in the Revenue Act of

[3] Cowing (1965) and Lurie (1979) provide useful discussions of "anti-option" sentiment during the late 19th century and early 20th century.

1914. The tax was abolished at the same time that many other war-time revenue measures ended, in the fall of 1916. A federal tax on futures trading was resurrected in late 1917 and was in continuous existence until 1938. The tax rate ranged over time from 1 to 5 basis points and applied to sales of all traded contracts at the same rate for a given period. The tax was paid by the seller of the futures contract, and it was evidenced by stamps applied to the trade memo.

The United States was not alone in levying taxes on grain futures transactions during this period. In 1923, the province of Manitoba levied a futures tax of 10 cents per 1,000 bushels of wheat and lower amounts for other grain futures, but the act was soon declared invalid.[4] Russell (1937) provided details on commodity contracts across the globe, and he noted that wheat futures transactions on the Liverpool grain market had a tax at 6s per contract (on a commission of £10 per contract), but there was no tax collected on London grain market transactions. Each trade on the Buenos Aires grain futures market was charged a registration fee of 16 pesos and a government tax of about 18 pesos, totaling about three quarters of a percent of the value.

Table 1 displays basic information on historical federal stamp taxes on futures contracts and summarizes some key facts of the discussion. A few key features of the taxes are worth noting. First, the taxes were initially imposed as emergency revenue measures during wartime. Taxes were imposed from 1898-1902 at a rate of 1 bp and from late 1914 to 1916 at a rate of 1 bp. The taxes were general revenue measures from late 1917 to 1938 and were not primarily associated with wars or with other objectives (e.g., to reduce speculation). Second, the Spanish-American war taxes applied equally to commodity transactions for future delivery or transactions for immediate delivery, but it was the exception. Taxes imposed in later years explicitly applied only to transactions for future delivery. Third, the tax rate fluctuated sharply, without an obvious time trend. The 1917 tax was imposed at 2 basis points (twice the wartime level), lowered to 1 bp in 1924, raised by 400% to 5 bp in 1932, lowered to 3 bp in 1934, and then eliminated in 1938.

Fees have also been levied on futures trading at the state level in the U.S. Missouri imposed a 25 cent per contract stamp tax on futures trades from 1907 to 1927, and Louisiana imposed a 2 basis point tax on futures contracts from 1934 to 1940. Occupational taxes have also been imposed on brokers over the years, especially in the South. For example, depending on the size of the town, North Carolina charged from $50 to $300, Alabama charged $250 to $500, Georgia charged $1,000, and Tennessee charged from $200 to $400 in 1907 (Department of Commerce and Labor, 1907). These taxes were often applicable to bucket shops.

No other federal tax has been levied on futures trading since 1938, although discussion of imposing a tax has been prominent at various times. Edwards (1992) and Schwert and Seguin (1993) discussed various federal proposals that had been made. Proposals have sometimes

[4] "Manitoba loses long battle to tax grain trade," *Winnipeg Tribune*, page 1, 24 March 1925.

surfaced outside the federal level, e.g., Chicago Mayor Richard Daley proposed, and quickly removed, a tax in his budget for 1974.[5]

Separate from a tax designed to reduce financial market activity or to raise general revenue, there have been discussions regarding a user fee to fund regulatory work. For example, the Futures Trading Act of 1992 mandated a study of the feasibility of a user fee for futures trading to offset funding for the Commodity Futures Trading Commission (CFTC), leading to a Government Accounting Office Study a year later (United States General Accounting Office, 1993). Such a user fee was contemplated in the Futures Trading Act of 1978 that first reauthorized the CFTC, was proposed by the Reagan administration for the 1983 fiscal year, and was subsequently proposed in federal budgets from 1991-1994, 1996, 2003, 2007-2010, and 2012-2015.[6] The Securities and Exchange Commission collects transaction fees on securities and security futures (fees on the latter are technically termed "assessments"). The National Futures Association collects transactions fees on transactions on futures and options on futures.

b. Quantitative description of interwar market structure

Given the political importance of agriculture in financial market discussions of the early 20th century, regulators collected copious data on trading activity during the interwar period. I use the data to quantify basic time series and cross-sectional features of the market in this subsection.

Table 2 displays summary statistics for futures trading activity and volatility in wheat, corn, and oats; the statistics cover tax regimes over the period 1921-1941. Trading volume is measured as the average daily volume of all contracts at the Chicago Board of Trade, and the volatility is the annualized Parkinson (1980) estimate based on the high and low prices of the nearby contract during the month. The striking observation is that the trading activity was generally trending downward over the period, with trading in the late 1930s and early 1940s less than half of the trading volume from the early 1920s. This occurred despite the removal of transactions taxes in 1938. The decline has been attributed to the substantial intervention of the federal government in farm programs to reduce volatility in agricultural prices (e.g., Working, 1954). The average volatility over the 1938-1941 sample is, in fact, the lowest value in the table across all three grains. Volatility does not appear to exhibit a particular trend, although the 1932-1934 period exhibited exceptionally high volatility. This period coincides with the highest tax rate in the sample (5 basis points), but it also coincides with the depths of the Great Depression. Similarly, open interest exhibits no obvious trend, although the highest levels of open interest occur during the middle part of the sample.

[5] "Mayor's plan to tax stock, commodities transfers assailed," *Chicago Tribune*, 19 November 1973.
[6] "Recovery of the cost of CFTC regulation … through transaction fees and license transfers the regulatory cost from the general taxpayer to the identifiable beneficiaries." Executive Office of the President, Office of Management and Budget, *Major Themes and Additional Budget Details, Fiscal Year 1983*, p. 218.

Quantification of the cross-section of trading activity is consistent with the observation that these futures contract markets were well-intermediated by scalpers, or pit locals. These traders typically held very small or no positions overnight, but they transacted large amounts of volume during the day. These intermediaries provided immediacy to longer-term buyers or sellers in exchange for the bid-ask spread. Scalpers were involved in a substantial amount of the trading volume. The available data suggests that from one-third to one-half of trade sides were associated with scalpers; the figure tended to be highest for wheat, lower for corn, and lowest for oats.[7] Other participants who traded with a generally longer holding period, often on behalf of other participants, can be classified into exchange members and exchange non-members.

Table 3 quantifies the cross-section of market activity in the wheat futures market. The Grain Futures Administration reported trading volume broken out by various participant types for a special study conducted on trading from January to October 1927 (United States Department of Agriculture (1930)). The raw data provides daily buy volume and sell volume by participant type for over half of the observed trading volume, where the original classification was performed by the Grain Futures Administration. I define the volume traded by trader type *i*, V_{it}, as the sum of buys and sells for day *t*, and the daily change in long and short open interest for trader type *i* as ΔOI_{it}^{LONG} and ΔOI_{it}^{SHORT}, respectively. The table reports averages of the following ratio and its components:

$$Ratio_{it} = \frac{\left|\Delta OI_{it}^{LONG}\right| + \left|\Delta OI_{it}^{SHORT}\right|}{V_{it}}$$

This ratio compares the gross position changes to the total trading volume for a given day; I average it across all days in the sample. A value near zero indicates that intraday trading rarely resulted in a gross position change, while a value closer to unity indicates that nearly all trading was associated with a change in position that was not offset by another trade that day. The table displays averages for the ratio's numerator, the denominator, the ratio, and the associated fraction of volume for each participant type.

Based on this metric, scalpers clearly exhibit trading behavior that differs from other traders and is consistent with the description of them as intermediaries. The ratio for scalpers is quite close to zero at 0.013 because they traded huge quantities (approximately 45% of the classified buys plus sells) and generally ended the day flat. Speculators traded 38% of the classified volume but, in aggregate, maintained large overnight positions; the ratio is therefore higher at 0.140. Spreaders, who transacted related contracts across exchanges or across expiries (e.g., Chicago wheat versus Kansas City wheat), accounted for just 6.3% of volume. Finally, accounts classified as predominately hedging accounted for 10.5% of the volume. Not surprisingly, these accounts

[7] These characteristics are quantified in various reports of the Grain Futures Administration; see the Appendix for more details.

maintained overnight positions to an even larger extent than predominately speculative accounts did; the ratio is correspondingly higher at 0.224.

Table 4 displays information on the transactions costs associated with wheat futures activity. One part of the cost is the commission charged for executing the trade (or the clearing fee charged to locals). Another part is the bid-ask spread implicitly paid each time a round-turn transaction was undertaken. The table displays, for each of the three commodities examined, the median clearing fee / commission charge for the three participant types, and the minimum bid-ask spread for the 1921-1941 sample period. Values are shown as percentage of the notional value of a 5,000 bushel contract. The table also shows, for convenience, a weighted average fee, where the weights reflect the typical participant breakdown for each commodity.

The table makes clear that scalpers paid extremely low clearing fees to the exchange. Exchange members paid five times as much as scalpers, and exchange non-members paid ten times as much. The exchanges were well aware that scalpers facilitated liquidity for longer-term traders (both members and non-members), and scalpers thrived in a low marginal profit, high volume business. Longer-term traders would not be as sensitive to transactions costs as scalpers, and they also had exogenous motivations to enter the futures market other than flipping a contract in order to profit by an eighth of a cent per bushel. The table also makes clear that blended transactions costs were relatively low for wheat but were three times as much for oats. This pattern partially reflects the heavier weighting of non-members, who paid the highest rates, relative to scalpers, in the less active markets.

The final two columns display the bid-ask spread, as a percentage of notional value of the contract, for two separate periods. Prior to August 1933, traders could split transactions by offering half the quantity of a trade at a specified price and offering half at one tick above that price. The effect was to average the total quantity over the two price points and therefore allow trades at a sixteenth of a cent per bushel increment rather than an eight of a cent per bushel increment. Obviously, constructing this measure as a percentage commingles the average price per bushel across time and across products with the discrete tick values. Wheat, with an average price per bushel just above $1.00, has the lowest bid-ask spread of 0.05% in the early part of the sample and 0.14% in the latter part. Oats has an average price of $0.40 per bushel and has the highest percentage spreads of 0.15% in the early part of the sample and 0.36% in the latter part. Corn's average price and spreads are about halfway between those for wheat and oats. The normalization is useful to gauge the magnitude of the tax to existing costs. For scalpers, the other real cost is the clearing fees; the bid-ask spread is more analogous to potential revenue. For non-scalpers, the costs include commissions as well as the bid-ask spread. The table makes clear that the magnitude of the tax was relatively small for some participants (e.g., non-exchange member participants in corn and oats) but huge for scalpers.

Traders were well aware of the costs of trading and tried to optimize their costs with respect to their trading style. Irwin (1933) examined the transaction level data of the traders who had been classified as "speculators" for the January – October 1927 wheat data and concluded that traders within this categorization were heterogeneous with respect to their trading frequency. In particular, he found that some of these traders were very active and maintained low end of day net exposures, whereas others were more directional and traded less frequently. He divided the traders into two groups. Of the 198 traders examined, the 85 in the "most active" grouping were predominately exchange members (72%) and the 113 in the "less active" grouping were predominately non-members (75%).

3. Theory.

This section explores the likely impact of a transactions tax in the futures market using the model of Grossman and Miller (1988). A key takeaway from the literature is that a "one-size fits all" conclusion regarding transactions taxes is elusive, and that the facts and circumstances for a given financial market should be taken seriously. Grossman and Miller's model focuses on the equilibrium provision of liquidity by intermediaries and is well-suited for examining futures markets. I consider the model's predictions for a fixed transaction cost increase for intermediaries (i.e., a tax) and show comparative static results for open interest, total trading volume, and the amount of trading volume that is intermediated by scalpers as the transaction tax changes. The model predicts that open interest and customer volume remains unchanged but that total trading volume declines due to a decline in scalper volume. Scalper volume declines because there are fewer market makers in equilibrium after the cost increase.[8]

The trade in the Grossman and Miller model is described as follows. At date one, a customer comes to the futures market to hedge a cash position with which he has been endowed (e.g., a hedger with a long physical position wishes to go short futures). Not finding another customer with an offsetting demand, the customer trades with market makers (scalpers) who facilitate part of the customer's desired trade (the customer wants to trade a total quantity denoted *i*). At date two, a customer with precisely the offsetting physical position of the original customer (e.g., a hedger with a short cash position wishes to go long futures) comes to the market. The late customer trades with the market maker and the early customer; both customers are now completely hedged and the market makers have no position.

The equilibrium volume in the model is described as follows. Given m market makers, the aggregate volume traded by these scalpers in equilibrium is $V^S(m) = i\left(\frac{m}{1+m}\right)$, and the total

[8] Throughout the paper, I interchangeably use the terms scalper, local, market maker, and intermediary, depending on the context.

volume traded in the model is $V(m) = i\left(1+\frac{m}{1+m}\right)$. Scalper volume ranges from zero to *i* and the total volume traded ranges from *i* to *2i* as the number of market makers ranges from zero to infinity; scalper volume ranges from zero to one-half as a fraction of total volume. Open interest, which we identify as the open positions after trading occurs in period 2 (i.e., the end of trading), is *i*, irrespective of the number of market makers.

The number of market makers, *m*, is made endogenous by assuming that potential market makers have a utility function over wealth parameterized as $U(w) = -e^{-aw}$and are subject to the equilibrium condition that the market maker's utility is the same as his initial utility; $EU(w_0 - c + (\widetilde{P_2} - \widetilde{P}_1)x_1^m = EU(w_0)$. In this equation, w_0 is initial wealth, *c* is a fixed, exogenous cost paid to become a market maker, x_1^m is the market maker demand function for period 1, and $\tilde{P}_t$is the price for the underlying at time *t*. For a risk aversion parameter *a* and initial cost *c*, Grossman and Miller effectively show that the number of market makers is given by the equation $m(ac) = \frac{a\left(var(P_2)var(i)\right)^{\frac{1}{2}}}{(e^{2ac}-1)^{\frac{1}{2}}} - 1$.

If the potential scalper's cost of participating moves from *c* to *c**, then the total volume when the cost is *c** (as a fraction of the volume under the original price *c*) is given by $V(m(ac^*))/V(m(ac)) = \frac{i\left(1+\frac{m(ac^*)}{1+m(ac^*)}\right)}{i\left(1+\frac{m(ac)}{1+m(ac)}\right)} = \left(\frac{2a\left(var(P_2)var(i)\right)^{\frac{1}{2}} - \left(e^{2ac^*}-1\right)^{\frac{1}{2}}}{2a\left(var(P_2)var(i)\right)^{\frac{1}{2}} - (e^{2ac}-1)^{\frac{1}{2}}}\right)$. Hence, if *c** > *c*, clearly $V(m(ac^*)) < V(m(ac))$. Equivalently, the higher participation cost reduces the number of market makers *m*, and scalper volume declines although customer volume is unchanged. Obviously, aggregate scalper volume as a fraction of total volume also declines as the participation cost rises.

The model formalizes the idea that market makers provide immediacy to traders who have longer trading horizons. Absent market makers, these longer-term trader might ultimately obtain the same positions, but they would do so with some delay. It follows that a decrease in the number of market makers would reduce the volume of trade without materially affecting the open interest. However, a higher participation cost for market makers reduces the amount of immediacy provided and reduces trading volume. The cross-sectional prediction from the model is that the volume decline would be larger for more intermediated markets; i.e., that wheat and corn would show a large effect and that oats would show the most modest effect.

4. Empirical Analysis.

This goal of this section is to use regression analysis to isolate the channels by which the transaction tax impacted the futures markets. The first phase of the analysis relates trading activity and volatility to the tax rate; it provides strong evidence that transaction volume declined due to the tax, but no evidence that open interest (i.e., longer-term positioning) was affected. The second phase is to search for evidence that the tax was important enough to drive a wedge between futures and physical market prices; I find no evidence that it does. The final phase of the empirical analysis is to relate empirical proxies for liquidity to the tax rate. Standard market variables such as volatility explain much of the variation in these measures of market quality. Additionally, the tax rate is a significant explanatory variable for volume-related liquidity measures, but the tax rate is not significantly related to other measures of liquidity. Taken together, these results appear consistent with the tax having a strong contemporaneous effect on trading volume but otherwise did not have a strong influence on the market.

a. Direct impact on market activity

i. Effect on quantities and volatility around event dates

This subsection presents the results from regressions designed to test for a shift in futures trading volume, or futures price volatility immediately after a change in the tax rate. The tables provide coefficients and associated t-statistics for regressions of the form:

$$y_t = \alpha_0 + \alpha_1 D_t + error_t., \tag{1}$$

where D_t is a dummy variable taking the value of unity following a change in the tax rate and zero before the change. The regressions are estimated using 30 trading days of data prior to, and 30 days of trading data immediately following, a change in the rate. The availability of data limits the analysis to wheat and corn contracts. Three versions of the regression in equation (1) are estimated for each event; the events are the effective dates of the changes in tax rates in 1924 (down), 1932 (up), 1934 (down), and 1938 (up). One regression has the log trading volume for the active futures contract on the left hand side, and two regressions have a log volatility measure on the left hand side. The first volatility regression utilizes the log of the day-to-day volatility of the futures price, measured as $Volatility_1 = (\pi/2)^{1/2}|\Delta ln(p_t)|$, while the second volatility regression utilizes the log of the intraday volatility of the futures price (i.e., the Parkinson (1980) estimator), measured as $1/(4\ln(2))\ x\ |High_t - Low_t|$.

Tables 5 and 6 display the daily regression results for wheat futures and corn futures, respectively. For convenience, the tables display both the pre-event and post-event predicted values of the left hand side variable. Both values are exponentiated for ease of interpretation; i.e., the table shows $\exp(\alpha_0)$ and $\exp(\alpha_0+\alpha_1)$. The general patterns from the regressions indicate that volume and intraday volatility moved inversely with tax rates, but the day-to-day volatility and the spread measure did not. For example, the regressions for 1934 suggest a 74% rise in wheat futures volume (from 21,000 contracts traded per day to 37,000 traded per day) and a 33% rise in corn futures volume (from approximately 8,000 to 10,500 contracts) when the tax rate moved from 5 bp to 3 bp. The regressions simultaneously predict a dramatic increase in intraday volatility by over 50 bp per day (from 1.2% to 1.8% in wheat and from 1.4% to 2.1% in corn).

The regressions are unambiguous with respect to volume: seven out of eight regressions show an inverse relation with taxes, with five of these significant at conventional levels. The regressions also show a discernable pattern for intraday volatility: six of eight regressions display an inverse relation with tax rates (four of them significantly so). Five of the eight day-to-day volatility regressions show an inverse relation, but only one of those is significant at conventional levels, suggesting much weaker evidence than for the intraday volatility regression.

While the regressions on daily data are suggestive regarding the impact of transactions taxes, they leave much to be desired. They do not take into account the differing magnitudes of the tax rate changes, nor do they take advantage of the long time series of data across the differing regimes. Next, I estimate regressions using the entire 1921-1941 sample to determine more systematic impacts of the transactions tax.

ii. Contemporaneous effects on quantities and volatility

I estimate the elasticities of trading volume, price change volatility, and open interest with respect to transaction taxes in this subsection. I find strong evidence that trading volume was negatively related to the tax rate, based on the monthly regressions utilizing the entire sample period from 1921 to 1941. There is no evidence that open interest was related to the tax rate, and there is a small amount of evidence that volatility was related to the tax rate.

The elasticity values are first estimated on the 21 years of monthly data using the specification

$$y_t = \sum_{i=1}^{21} \alpha_i + \sum_{j=1}^{12} \alpha_j + \beta ln(1 + \tau_t) + error_t, \tag{2}$$

where y_t is the dependent variable of interest, the α_i's are annual *marketing* year dummy variables, the α_j's are monthly seasonal dummy variables, and τ_t is the federal stamp tax rate applicable during the majority of month t. The marketing year for wheat is July through June of the following calendar year during this era, it is September through August of the following calendar year for corn, and it is June through May of the following calendar year for oats. Estimation is over the period January 1921 through December 1941. The omitted groups are the 1941-1942 marketing years (e.g., July to December 1941 for wheat). The regressions are estimated separately for each of the three commodity futures using data from the Chicago Board of Trade. Various studies of income tax effects have used similar methods to estimate elasticities by using time dummies or trend functions to isolate the relevant effect, e.g., Romer and Romer (2014), Saez (2004).

A value of β less than zero suggests that a higher tax rate decreases the dependent variable, which in the first exercise will be trading volume. In terms of magnitude, it is useful to note that an estimate of β equal to 1,000 implies a volume decline of slightly less than 10% when the tax rate changes from zero to 0.01%. Such a linear rule of thumb decreases in accuracy for larger values of β with, for example, β = -2,000 implying a volume decline of 18%.

It is worth elaborating that the regressions in this section assume that the tax rate is exogenous to the left hand side variables such as trading volume. In defense of this assumption, note that the purpose of the tax was to raise general revenue and was not targeted to raise revenue for a specific purpose. In the modern securities markets, this assumption would be less defensible: the Securities and Exchange Commission budget, for example, is offset by transactions fees. These fees, in turn, are mechanically set such that the predicted level of trading volume multiplied by the fee equals the target revenue. The generally positive correlation between trading activity and volatility further complicates analysis. Hence, the exogeneity assumption would require more careful examination if I were looking at the current environment. The historical narrative, however, suggests no obvious link between the dependent variables and the tax rates for the analysis presented here.

The dependent variable for the volume regressions is the log of average daily trading volume (all contracts combined) during month *t.* These elasticity estimates are in the first column of Table 7. In this and in all other cases, standard errors use the method of Newey-West (1987) with one lag. The elasticity estimates for trading volume have the expected sign and are statistically significant at conventional levels for wheat and for corn. The elasticity for wheat has a t-statistic of -1.98; the elasticity for corn has a t-statistic of -3.63.

The economic magnitude of the tax is given by the estimated percentage impact $(1+\tau)^{\beta}-1$. This function suggests that, compared to a zero tax, a one basis point tax reduced average daily volume by 13% for wheat, 14% for corn, and 5% for oats, although the estimate for oats is not significant. Two standard error confidence intervals constructed by the delta method suggest that the impact of a one basis point tax was in the range (-25.8%, -0.8%) for wheat, in the range (-21.6%, -7.0%) for corn, and (-22.8%, 12.6%) for oats. A five basis point tax had predicted effect of -51% and -54% for wheat and corn, respectively. The two standard error confidence interval is (-86.3%, -15.7%) for wheat and (-73.5%, -34.1%) for corn. The predicted impacts are quite large, although the confidence intervals are also quite large.

There are estimates of modern elasticities of grain futures trading volume with respect to transactions costs. Wang, Yau, and Baptiste (1998) estimate the elasticity for the CBOT Wheat contract at -0.116 (with a standard error of 0.20) for the period January 1990 – April 1994. Bjursell, Wang and Yau (2012) estimate the elasticity at -0.98 (with a standard error of 0.09) for the period January 2007 – December 2010. Wang and Yau (2011) use a value of $16.01 for observed transactions costs in their analysis. For wheat prices of roughly $6 per bushel during the second, this translates into transactions costs of roughly 5 bps. Therefore, Wang and Yau's results suggest that a one basis point increase in transactions costs (due to a tax) would lead to a 20% decline in trading volume (20% increase in costs times an elasticity of minus one). This is comparable to the 13% predicted decline in the model under consideration here.

Table 7 also provides the estimates for the volatility regressions in the second data column; the dependent variable is the log of the Parkinson (1980) High-Low range volatility estimate during month *t.* The results provide some evidence that the tax rate is correlated with the level of the tax rate, but it is not statistically significant for wheat or oats. There is statistical significance at conventional levels for corn, however. For a one basis point tax, the predicted impact on volatility is -9% for corn, with a two standard deviation confidence interval of (-14.7%, -3.4%). A five basis point tax has a predicted impact of -38% with a confidence interval of (-57.1%, -18.4%).

It is more intuitive to examine the counterfactual implied by the model, by assuming that the tax rates had been zero for each month in the sample. The observed median monthly volatility was 22.4% for corn, and the median counterfactual with zero taxes was 27.4% (the median monthly difference is four volatility points). Hence, the model predicts that volatility would have been four to five volatility points higher in absence of the tax. Divide these figures by the square root of 300 to convert them into implied typical price movements per trading day, and the observed volatility was 1.3% per day with a counterfactual of 1.6% if the tax rate were zero. The economic magnitude of the effect is not large and is less than a reduction in variation of 2 price ticks per day (0.35% = 2 x 0.125 cents / 72 cents per bushel). Despite the statistical significance of the volatility elasticity, I conclude that the tax might have slightly dampened market moves but that volatility would have remained in the same general range (i.e., in the 20 – 30% range).

The third data column of Table 7 displays the results of the regressions when month-end open interest is the dependent variable. There is no evidence that the tax rate exerted a direct effect on the overall open interest in the contracts. In fact, while all of the estimated coefficients for these regressions are positive (which would correspond to an increase in open interest as the tax rate increased) the low t-statistics suggest a lack of a systematic relationship between taxes and open interest.

Finally, the rightmost column of Table 7 displays the results of regressing the ratio of volume to open interest on the dummies and the tax rate. As expected given the results of the volume and open interest regressions, there is substantial evidence that this ratio is inversely related to the tax rate for wheat and corn. The t-statistics are -2.24 and -2.16, respectively.

iii. Contemporaneous effects on pricing

The empirical evidence thus far suggests that end-users of futures did not modify their day-to-day activity in futures trading due to the transactions tax. One other source of impact on end-users is through the pricing of futures relative to the cash market. The tax during the interwar period was levied on the sale of futures contracts but was not levied on cash market sales. If the existence of the tax drove a wedge between the two prices, then end-users would have borne that burden. Did the tax make futures prices noticeably cheaper or more expensive relative to cash prices as it fell or rose? The following regression results show that the convenience yield is readily explained by the visible supply variable. However, there is no statistically significant evidence that the tax rate impacted futures pricing relative to the cash market.

The exchanges were vocal that the tax, especially when levied at five basis points, put the smooth functioning of agricultural futures markets at risk of collapse. When the tax was raised to this level, journalists wrote "President Hoover and leaders in Congress were warned today by a committee representing nine principal American commodity exchanges that grain farmers of the nation faced the possibility of heavy penalties and a breakdown of marketing machinery during the heavy movement of the crops this Summer unless the tax on futures trading was reduced."

The exchanges declared that "A grave situation has developed as a result of the utterly prohibitive tax. Genuine alarm prevails through agriculture and the agricultural trades that the startling restriction of markets may make it impossible to absorb the new incoming crop. … there is real danger that during the heavy crop movement period the weight of hedges may prove too great for the markets. … Congress, without such action [to reduce the tax] can only be construed as utterly disregarding the welfare of agriculture in this pressing emergency."[9]

Consider the archetypal hedger/speculator model for agricultural commodities. If hedgers shorted futures in order to hedge the physical commodity and were insensitive to price (i.e., had a perfectly inelastic demand for short futures), then the futures price would adjust based solely on the willingness of speculators to go long the futures (i.e., the speculative demand curve for long futures exposure). If the demand curve for speculative futures exposure were to shift materially downward due to the transactions tax, a sharp drop in futures prices might result. This effect could be a direct result of lower expected returns or, more interestingly, an indirect result due to lower liquidity in the market. Higher taxes would mean lower futures prices, after controlling for the cash market conditions.

The empirical work shown below attempts to operationalize the tax's impact in a way that is consistent with the ideas expressed by the exchanges. The analysis relies on the traditional Theory of Storage for its structure. The basic theory is that the futures price at a given point in time reflects the cash market price (S_t), the financing cost (measured at the annual rate r), and the convenience yield associated with storing the physical commodity (measured at the annual rate c) (Brennan, 1958). For a futures contract evaluated at date t and expiring at date T, the

[9] "Reduction in Futures Tax Urged Upon Hoover; High Levy Called Threat to Crop Marketing," *New York Times,* July 14, 1932.

equilibrium relation among these variables is $F_{t,T} = S_t e^{(r-c)(T-t)}$. In the regressions, I examine whether the tax rate is useful in explaining the observed relation between futures and cash market prices after controlling for this theoretical relation. In order to operationalize the regression, I first solve for the convenience yield (which measures the relative value of holding futures market exposure versus cash market exposure) and test if its values are well-described as a function of the visible supply and the tax rate.

The regression associated with this hypothesis has the following form:

$$\frac{\ln(F_{t,T}) - \ln(S_t)}{(T-t)} - r = \alpha + \beta \ln(Visible\ Supply_t) + \gamma(tax\ rate_t) + error_t.$$

The dependent variable in the regression equals minus one times the convenience yield *c* as a function of futures and cash prices and the time to expiry *(T-t)*. The right hand side of the regression contains the log of the visible supply, which is an observable economic variable that is likely to affect the convenience yield, *c*; marginal convenience yield is high when inventories are low and declines as inventories rise. Hence, theory suggests that the visible supply coefficient would be positive and statistically significant. The right hand side of the regression also includes the tax rate, allowing the rate to drive a wedge between futures and cash market prices.

The regressions use end-of-month or mid-month cash market prices, as available, and contemporaneous futures prices from January 1921 until December 1938 for wheat, corn, and oats. Data sources include Hoffman (1932), Howell (1948), and Working (1934). The relation between open interest, hedging activity, and visible supply was quite strong during the interwar period, justifying the use of visible supply as a proxy variable for convenience yield in these tests.[10] Towards the end of the sample, this relation begins to break down, as government supports of grain prices intensified. Hence, I end these regressions at the end of 1938 (see the unpublished appendix for details on data construction). Table 8 displays the results of the regressions.

The regressions show a strong contemporaneous relation between the pricing of futures contracts relative to cash market prices and the visible supply of the underlying commodity. The coefficient on the visible supply variable is statistically significantly negative, with t-statistics in the -3 to -6 range. The fit of the equations is quite good, with R^2 values in the 30-65% range. This is clear evidence that, during the interwar period, the Theory of Storage explains the relative pricing of futures and cash quite well. The data are strong enough to reject the idea that the pricing was random; observable variables explain a significant portion of the variability. With

[10] Visible supply data for wheat are adjusted to remove cash holdings of the Federal Farm Board's Grain Stabilization Corporation, which held virtually the entire visible supply in summer 1931 (unintentionally cornering the market). The regression results are not qualitatively different when dummy variables are included for May and June 1931.

respect to the tax rate, however, there is no strong evidence that the futures prices or the convenience yield were related to the tax rate. The regressions do not support this interpretation of the exchanges' warnings of a "grave situation".

Alternatively, hedger demand for futures might not be perfectly inelastic and might depend on the tax rate. High taxes on futures transactions might lead hedgers to increase the convenience yield ascribed to holding the physical commodity. This could be due to a direct effect or a liquidity-induced, indirect effect. In this case, a simple regression allowing for this effect includes the log of visible supply on the right hand side and an interaction term between the visible supply and the tax rate. In empirical tests (reported in the unpublished appendix), the results of this test are almost identical to the ones described above. There is little evidence to support the idea that the tax rate had a material impact on futures pricing relative to the cash market prices.

b. Direct impact on Liquidity

It is perhaps not surprising that the transactions tax impacted futures trading volume, but the open question is whether liquidity was impacted. The next set of regressions is designed to address the question as directly as possible. The regressions use standard proxies for liquidity as dependent variables and allow the tax rate to impact the proxy as an independent variable. The regressions also control for standard explanatory variables for market liquidity: volatility of the underlying asset and open interest of the futures contract.

The regression specification has the form

$$\ln(Illiquidity_t) = a + b_0 \ln(Volatility_t) + b_1 \ln(OI_t) + b_2 \ln(1 + \tau_t) + error_t.$$

To account for endogeneity between contemporaneous values of dependent and independent variables, the regressions are estimated using instrumental variables, with one lag each of the open interest and volatility as instruments.

I use four illiquidity proxies in the regression analysis; two are pure price-based measures and two are variants of the Amihud (2002) measure. I construct the Corwin and Schultz (2012) illiquidity measure using the daily high, low, and closing price (mid-point of closing range) of a nearby futures contract. The "Closing Range" variable represents daily prices in various parts of the futures trading pit at the time of market closure each day. I also construct an Amihud measure using the absolute value of the log price change divided by the absolute change in open interest for the nearby futures contract. Finally, I construct a standard Amihud measure that is the ratio of the absolute value of the log price change divided by the daily contract volume for the nearby futures contract.

These illiquidity statistics are computed using daily data hand collected from various statistical bulletins produced by the USDA. The daily data are aggregated into monthly statistics and used in regressions spanning the period August 1923 (after open interest data become available) to December 1938. The data cover wheat and corn futures contracts.

These statistics are expected to provide reasonable measures of various aspects of illiquidity in commodity markets. Marshall *et al.* (2012) conclude that the standard Amihud measure is highly correlated with intraday measures of transactions costs for modern commodity futures data, and they also find evidence that the Corwin-Schultz estimator is related to intraday transactions costs.

Table 9 displays the regression results. The first data column, labeled “Volatility”, illustrates that the illiquidity measures are strongly positively related to the contemporaneous volatility of the underlying futures contract. All of the coefficients are positive and all but one have t-statistics greater than two. The second data column, labeled “Open Interest”, shows some explanatory power. The coefficient is negative in all but one case, but there is only modest evidence for statistical significance. Two of the eight associated t-statistics are highly significant, both for corn regressions.

The third data column, labeled “Tax Rate”, is the one of major interest. The results indicate that the coefficient on the log of one plus the tax rate is highly significant in two of the eight regressions. The significance shows up in both the wheat regression (t-statistic of 2.53) and the corn regression (t-statistic of 5.31), but only for the Amihud statistic. The coefficient does not appear statistically important in any of the other displayed regressions.

The regression results clearly show that the illiquidity statistics are not random; they systematically vary with important market variables. However, these measures do not covary predictably with the transaction tax rate, except for the single statistic that is volume-based. Higher tax rates are associated with less volume, as seen in the regressions displayed earlier, but those same sets of regressions provided no evidence of volatility covarying with tax rates. This result carries through to the Amihud statistic, which shows less volume per unit of volatility at higher tax rates.

Similarly, the previous regression results show no evidence of a link between tax rates and open interest, and this message is the same one conveyed in the Amihud illiquidity statistic regression using changes in open interest for the denominator. There is no evidence that the typical change in open interest per unit of volatility varies predictably as tax rates change.

I conclude from these regressions that market liquidity was not tightly linked to the tax rate. For both wheat and corn, and for three of the four measures of illiquidity, the regressions provide no evidence that the tax rate was a driver of trading liquidity. However, the strong link between the Amihud measure and tax rates is suggestive of a structural shift in intermediary behavior rather than a broad-based change in trading activity across all types of market participants.

5. Discussion.

The other traders in the wheat futures pit booed him. That was the response to the first pit trader who attempted to make a trade at a sixteenth of a cent after the five basis point tax (on notional value) was implemented. Although the minimum tick size was nominally one-eighth of a cent per bushel, traders could readily "split" one transaction: half of the contracts at one tick and half at the next higher tick. But traders who attempted to split a trade just after the tax was implemented were greeted with such a hostile, loud response by their peers that the transactions were rarely completed.[11] The tax mattered greatly to market makers.

The scalpers had been paying $0.50 in taxes per contract, and the eighths they were attempting to capture were worth $6.25 per contract. But the new tax rate implemented in 1932 was approximately $2.50 per contract, paid whether the scalper made a profit or loss on a trade. If one thinks of market makers as earning the bid-ask spread on a "round-trip" transaction, then the tax of $5.00 per round-trip represented an 80% reduction in their proceeds from such a trade. If trades were executed at sixteenths instead of eighths, the same $2.50 tax meant their potential profit was now less than a quarter of what it would have been the day before. Not surprisingly, exchange members eliminated split transactions a year later. Figure 1 displays the closing range of prices (a proxy for the bid-ask spread, or market liquidity) for wheat and corn futures; the rule change in July 1933 is clearly evident.

Exchange members had long been vocal in opposing the tax. In 1924 testimony against the 2 basis point tax in effect at the time, the Chicago Board of Trade's representative claimed "Everybody who deals in grain, either as a buyer or a seller, knows that the Chicago wheat market and grain market are depressed. Why? We think very largely because they being taxed practically out of existence. … This has so depressed the Chicago wheat market that something like 40 per cent of the traders have quit and a very large amount of the trading has gone to other markets."[12]

Nonetheless, exchange rules regarding the minimum tick size remained constant until July 1933, after the tax rate had been raised to 5 basis points. Government intervention during the late 1930s to stabilize commodity prices acted to reduce trading volume. Exchange members actively kept this constraint in place: an amendment to re-authorize split quotations was rejected 433 to 97 in 1939. Interestingly, at the same meeting, the members voted down an amendment to raise minimum commission charge on job lots originating outside Chicago.[13] Hence, it appears that

[11] "New U.S. Taxes Arouse "Boos" in Wheat Pit," by O.A. Mather, *Chicago Daily Tribune*, 22 June 1932, p.1.

[12] Philip Campbell, representing Chicago Board of Trade, Revenue Revision, 1924, Hearings before the Committee on Ways and Means House of Representatives (p. 231). The Grain Futures Administration noted that the alleged movement of U.S.-based speculators to other markets was a "myth": Report of the Chief of the Grain Futures Administration, 1931, p.10.

[13] "Chicago Pit's Members Balk Rule Changes," *Chicago Daily Tribune*, 30 March 1939, p.1.

members opted to keep in place the tick size constraint (which was invisible to outside customers) while rejecting a visible price increase to customers. The empirical results presented in this paper suggest that the brunt of the tax was borne by the market makers in the trading pit, and customer volume was not materially impacted by the tax. Even so, the pit remained highly competitive. Volatility did not appear to increase due to a thin market, and measures of market depth and liquidity based on prices and open interest were not directly affected by the tax. A simplistic reading of the results would suggest that the tax did not materially affect the functioning of the market, except for reducing the profits of some middlemen.

The futures market regulator did not agree with this simplistic conclusion that the tax "did not matter". In particular, the Chief of the Commodity Exchange Authority (CEA), in testimony entered in the Congressional record, argued that the tax should be abolished. A second-best option was to reduce it from 3 basis points to 1 basis point, albeit with a removal of the tax exemption for "scratch" trades (i.e., a buy and a sell transaction at the same price). The Chief explicitly recognized that the highly competitive market maker activity was central to the proper functioning of the futures market. He stated that reducing the tax would lead to "…a larger volume of trading and a corresponding increase in the stability and flexibility of the market which will be of value both to producers and consumers."

He stated that "It would be of value to the commodity markets if this tax could be eliminated entirely. It places a particularly heavy burden on the scalpers who give flexibility to the market. In fact, without the presence of scalpers a futures market cannot function efficiently in that hedgers desiring to sell a future as protection against loss would be compelled to sell at a lower price and hedgers desiring to buy a future as protection against the sale of flour would be compelled to pay a higher price than justified."[14]

The CEA Chief's statement that reducing the significant tax burden on scalpers would add to the "stability and flexibility of the market" can be interpreted in more modern terms. Recent research highlights the importance of intermediary inventory capacity. Kirilenko, *et al.* (2014) investigated the "Flash Crash" of May 2010 and concluded that the sharp intraday movement in S&P 500 e-mini contract prices was due to a large amount of customer demand that temporarily overwhelmed intermediary capacity. Intermediaries were unable to absorb all of the customer demand near the current price and were unable to find enough immediately available customers to take the other side of the desired trades. The price temporarily dropped sharply as the market absorbed this imbalance. Hendershott and Menkveld (2014) study New York Stock Exchange

[14] J.W.T. Duvel, Chief, Commodity Exchange Administration, Revenue Act of 1938, Hearings Before the Committee on Finance United States Senate, Seventy-Fifth Congress Third session on H.R. 9682 An Act to Provide Revenue, Equalize Taxation and for Other Purposes, Part 4, March 30, 1938. (p. 115-6)

specialists and find economically large price pressure effects due to risk-averse intermediaries supplying liquidity to investors with asynchronous arrival times.

In light of studies such as these, one argument against the tax is that the long-run effect was to reduce the risk-bearing capacity of market makers. The earlier discussion of Grossman and Miller's (1988) model suggests that trading volume due to intermediaries declines in a post-tax equilibrium because the number of market makers declines. In practice, the typical liquidity measures of the futures markets show no obvious relation to the tax rate, but the aggregate risk-bearing capacity of the traders in the pit surely declined. This effect might have been gradual, as scalpers recognized that the tax was subject to change or removal. Scalpers also faced frictions in transferring to other lines of work and may have opted to bear the reduced revenues and profit in the short run.

6. Conclusion.

Federal stamp taxes on futures transactions during the 1920s and 1930s led to fairly immediate, contemporaneous changes in trading volume. The analysis in this paper suggests that a one basis point tax on the sale of wheat futures contracts reduced average daily trading volume by 13%. However, end-users of futures – the traditional hedgers and speculators – did not materially adjust trading activity because of the tax. The reduction in volume reflected a decline in intermediation activity.

Despite the measurable change in trading volume, several measures of market illiquidity show no obvious correlation with the tax rates. The Corwin-Schultz (2012) transaction cost statistic, the closing range of futures prices, and a version of the Amihud (2002) statistic using open interest (absolute price change divided by change in open interest) each show no contemporaneous changes attributable to tax rates. These statistics do covary, however, with standard explanatory variables such as the volatility of the futures price.

The tax rates do show a strong link to the traditional Amihud (2002) statistic (absolute price change divided by trading volume): higher tax rates suggest a higher measure of the statistic. Given the structure of the market and the body of results, I interpret this finding to mean less intermediation volume rather than less liquidity.

The intermediaries (i.e., locals or pit scalpers) were the ones who bore the most significant tax burden in the short run. The tax rate was a tiny fraction of the notional value of a futures contract, but it was the same order of magnitude as the expected return for intermediaries. A speculator or a hedger who had a horizon of weeks or months and concerned himself with price changes of, say, 5 to 10% per month might have viewed a 5 basis point tax as virtually irrelevant:

the equivalent of coming into the market a few seconds earlier or later. The market maker who had a holding period of, say, 5 minutes and hoped to make $6.25 as an intermediary might view that 5 basis point marginal tax (worth $2.50) quite differently.

The end-users bore the tax burden in the long run, however. Exchange members effectively voted to double the minimum tick size a year after the tax rate was raised to its highest level. This action was designed to put a floor on the minimum profit for a market maker's transactions and effectively allow the tax burden to be passed on to the end-user. The doubling of the tick size raised the contract price by $3.125 in order to offset a tax of $2.50. The tick size increase remained in place long after the tax was abolished.

The Chief of the Commodity Exchange Authority (CEA) recommended that Congress abolish the tax because of its disproportionate impact on intermediaries. Standard models suggest that higher transaction costs for intermediaries means fewer intermediaries and less aggregate intermediation capacity. Recent research, such as Hendershott and Menkveld (2014), focuses on the importance of intermediary capacity in price discovery. Kirilenko *et al.* (2014) explain the 2010 "Flash Crash" as an intermediation capacity issue. While the regressions presented in this paper show no compelling evidence that liquidity was contemporaneously correlated with tax rate changes, they are silent about the long-run implications of the tax such as a reduction in intermediation capacity.

Policymakers have recently imposed transactions taxes in parts of Europe and continue discussing implementation of transactions taxes in the U.S. and across Europe. The analysis in this paper highlights that the facts and circumstances of a particular market are important for understanding the impact of a given tax. The implications of a tax for a dealer market dominated by a few large dealers and end-users might be quite different than the implications for a highly intermediated futures market with many pit traders who engage in scalping activity. Similarly, a floor-based futures market with scalpers physically located in the pit might react quite differently than a virtual market with an electronic central limit order book. The composition of market participants, the institutional details of the market, and the precise implementation method all affect the impact of a tax.

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Tables and Figures

Table 1.

Federal Stamp Taxes Imposed on Futures Transactions in the United States, 1898-1938

Description	Start Date	End Date	Taxed Transactions	Rate as percent of notional value
Spanish-American War Tax	July 1, 1898	June 30, 1902	Futures and cash	1 basis point
Federal Tax	Dec 1, 1914	Sep 8, 1916	Futures	1 basis point
Federal Tax	Dec 1, 1917	July 2, 1924	Futures	2 basis points
	July 3, 1924	June 20, 1932	Futures	1 basis point
	June 21, 1932	May 9, 1934	Futures	5 basis points
	May 10, 1934	June 30, 1938	Futures	3 basis points

Table 2.

Average Trading Volume, Price Volatility, and Open Interest in Grain Futures, 1921 - 1941

Period	Tax Rate	Average Daily Volume (millions of bushels)			Average Monthly Volatility (Annualized)			Average Open Interest (millions of bushels)		
		Wheat	Corn	Oats	Wheat	Corn	Oats	Wheat	Corn	Oats
Jan 1921 – June 1924	2 bp	32.8	15.9	5.2	22.4%	22.5%	24.1%	89.5	56.9	21.9
July 1924 – June 1932	1 bp	39.8	16.5	3.7	25.0%	26.3%	26.9%	116.4	58.1	37.3
July 1932 – Apr 1934	5 bp	29.1	8.8	2.8	34.7%	39.4%	44.0%	140.2	71.4	37.8
May 1934 – June 1938	3 bp	27.1	8.0	2.6	22.9%	24.3%	26.9%	101.6	44.9	32.6
July 1938 – Dec 1941	0 bp	15.9	3.8	1.0	22.0%	20.3%	23.6%	74.0	37.6	12.5

Table 3.

Wheat Futures: Average Daily Aggregate Position Change and Volume by Participant Type, Jan – October 1927 (1,000s of bushels)

	Participant Type			
	Scalpers	Speculators	Spreaders	Hedgers
Average Aggregate End-of-Day Position Change	175.9	1,690.0	429.0	734.7
Average Daily Volume (Buys + Sells)	14,625.7	12,319.4	2,022.7	3,395.0
Ratio of Aggregate Position Change to Daily Volume (Average)	0.013	0.140	0.239	0.224
Percent of Classified Daily Volume	45.2	38.1	6.3	10.5

Table 4.

Median Values of Commission and Minimum Spread, as Percentage of Notional Value, 1921 - 1941

	Price / bu ($)	Weighted Average Commission / Clearing Fees	Clearing Fees: Scalpers*	Commission: Members	Commission: Non-Members	Minimum Spread (1/1921 – 7/1933)	Minimum Spread (8/1933 - 12/1941)
Wheat	1.05	0.10%	0.02%	0.12%	0.24%	0.05%	0.14%
Corn	0.72	0.15%	0.03%	0.17%	0.35%	0.08%	0.21%
Oats	0.40	0.32%	0.06%	0.32%	0.63%	0.15%	0.36%

Computations performed on data covering the period January 1921 – December 1941.

Minimum bid-ask spread is computed using the minimum tick size (half a tick prior to August 1933 and one tick afterwards). CBOT contracts were tradable in split quotations until July 29, 1933. Contracts could explicitly be traded with one half of the total traded at a given tick and one half traded at the next tick, resulting in trades at sixteenths.

* Clearing Fees for trades other than scratch trades. Clearing fees for scratch trades were 1/25 the clearing fees ($0.05 vs. $1.25 per contract) for non-scratch trades.

Table 5. Daily Regression Results: Wheat Futures

The table displays results from univariate regressions on daily data for wheat futures on the Chicago Board of Trade. For each row, the estimated regression is of the form

$y_t = \alpha_0 + \alpha_1 D_t + error_t$,

where D_t is a dummy variable taking a value of zero for the 30 trading days prior to the tax rate change and unity for the 30 trading days after the tax rate change. Independent variables are defined as follows: rows labeled "Volume" utilize the log of trading volume for the active wheat contract, rows labeled "Volatility$_1$" utilize the log of $(\pi/2)^{1/2}|\Delta ln(p_t)|$, rows labeled "Volatility$_2$" utilize the log of $1/(4\ln(2))\ x\ (High_t - Low_t)$, where $High_t$ and Low_t are the daily high and low, respectively, of the log futures price. Values shown in the table are for exp(α_0) (pre-event) and exp($\alpha_0 + \alpha_1$) (post-event). Newey-West t-statistics with two lags are displayed; coefficients having t-statistics with absolute magnitude greater than two are shaded.

Year	Change in Tax Rate	Independent Variable	Pre-event	Post-event	t-statistic for change
1924	-1 bp	Volume	24,588	44,694	4.03
		Volatility$_1$	0.91%	1.62%	3.12
		Volatility$_2$	0.90%	1.35%	3.42
1932	+4 bp	Volume	28,926	17,805	-5.51
		Volatility$_1$	1.68%	1.60%	-0.31
		Volatility$_2$	1.39%	1.31%	-0.49
1934	-2 bp	Volume	21,139	36,821	3.12
		Volatility$_1$	1.46%	1.37%	-0.25
		Volatility$_2$	1.23%	1.77%	2.00
1938	-3 bp	Volume	27,548	21,278	-3.13
		Volatility$_1$	1.32%	0.99%	-1.16
		Volatility$_2$	1.53%	1.06%	-3.48

Table 6. Daily Regression Results: Corn Futures

The table displays results from univariate regressions on daily data for corn futures on the Chicago Board of Trade. For each row, the estimated regression is of the form

$y_t = \alpha_0 + \alpha_1 D_t + error_t$,

where D_t is a dummy variable taking a value of zero for the 30 trading days prior to the tax rate change and unity for the 30 trading days after the tax rate change. Independent variables are defined as follows: rows labeled "Volume" utilize the log of trading volume for the active wheat contract, rows labeled "Volatility$_1$" utilize the log of $(\pi/2)^{1/2}|\Delta ln(p_t)|$, rows labeled "Volatility$_2$" utilize the log of $1/(4\ln(2))\ x\ (High_t - Low_t)$, where $High_t$ and Low_t are the daily high and low, respectively, of the log futures price. Values shown in the table are for $\exp(\alpha_0)$ (pre-event) and $\exp(\alpha_0 + \alpha_1)$ (post-event). Newey-West t-statistics with two lags are displayed; coefficients having t-statistics with absolute magnitude greater than two are shaded.

Year	Change in Tax Rate	Independent Variable	Pre-event	Post-event	t-statistic for change
1924	-1 bp	Volume	13,491	20,860	3.10
		Volatility$_1$	1.13%	1.53%	1.10
		Volatility$_2$	0.98%	1.48%	2.38
1932	+4 bp	Volume	3,395	3,362	-0.07
		Volatility$_1$	1.49%	1.76%	0.80
		Volatility$_2$	1.24%	1.31%	0.42
1934	-2 bp	Volume	7,946	10,538	1.39
		Volatility$_1$	1.37%	1.85%	1.32
		Volatility$_2$	1.36%	2.11%	2.47
1938	-3 bp	Volume	4,639	6,608	3.40
		Volatility$_1$	0.72%	0.88%	0.73
		Volatility$_2$	0.75%	0.89%	1.16

Table 7. Estimated elasticities

The table displays results from univariate regressions of a) log of average daily trading volume ("Volume"), b) log of monthly Parkinson volatility estimate ("Volatility"), c) log of month-end open interest ("Open Interest"), and d) average daily volume divided by month-end open interest ("Volume/Open Interest"). Regressions use monthly data and maximally cover the period January 1921-December 1941; regressions involving open interest begin the August 1923. Regressions are separately estimated for each commodity and each independent variable. Newey-West t-statistics with three lags are displayed; coefficients having t-statistics with absolute values greater than two are shaded.

Commodity		Volume	Volatility	Open Interest	Volume/ Open Interest
Wheat	Elasticity	-1428.8	-1363.0	93.2	-1572.1
	(t-statistic)	(-1.98)	(-1.43)	(0.25)	(-2.24)
	Adjusted R^2 (%)	65.3	42.8	78.6	67.8
Corn	Elasticity	-1544.4	-947.2	85.6	-993.8
	(t-statistic)	(-3.63)	(-3.05)	(0.64)	(-2.16)
	Adjusted R^2 (%)	75.6	31.1	75.8	68.6
Oats	Elasticity	-522.6	-639.0	187.8	-691.2
	(t-statistic)	(-0.56)	(-0.89)	(0.33)	(-1.85)
	Adjusted R^2 (%)	79.0	40.6	88.1	65.6

Table 8.

Impact of the tax on futures pricing

The table displays results from regressions

$$\frac{\ln(F_{t,T})-\ln(S_t)}{(T-t)} - r = \alpha + \beta ln(Visible\ Supply_t) + \gamma(tax\ rate_t) + error_t.$$

Regressions use monthly data and cover the period January 1921-December 1938. Corn and oats data are unavailable for the period October 1930-June 1931. Regressions include an AR(1) correction. Coefficients having t-statistics with absolute values greater than two are shaded.

Commodity	Intercept (t-statistic)	Ln(Visible Supply) (t-statistic)	Tax Rate (t-statistic)	Adj. R^2
Wheat	-1.06	0.24	-107.39	37.0%
	(-8.01)	(7.76)	(-0.67)	
Corn	-0.65	0.22	-167.59	59.0%
	(-6.40)	(7.13)	(-0.68)	
Oats	-0.56	0.14	37.92	55.2%
	(-4.76)	(4.27)	(0.17)	

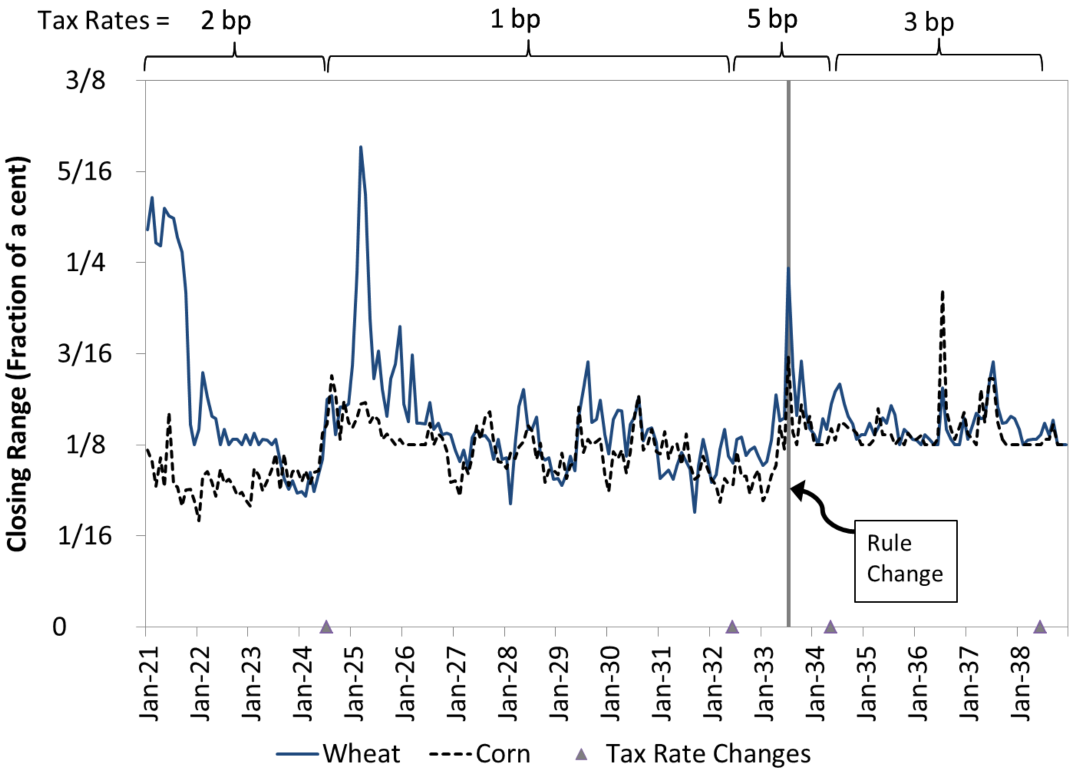
Table 9.

Relating futures market liquidity and tax rates

The table displays results from regressions of various illiquidity proxies on three explanatory variables: the log of Parkinson volatility of the futures contract, the log of month-end open interest of the futures contract, and the log of one plus the transactions tax rate. The regressions are estimated separately for each illiquidity proxy and for each commodity (wheat and corn). Regressions utilize monthly observations spanning the period August 1923 to December 1938. Illiquidity measures are constructed using daily data within each month. T-statistics based on Newey West (1987) standard errors with 3 lags are shown in parentheses below coefficients; coefficients with t-statistics greater than two in absolute magnitude are shaded.. The column marked "GR^2" displays the Pesaran and Smith (1994) Generalized R^2.

Illiquidity Measure	Commodity	Volatility	Open Interest	Tax Rate	GR^2
Corwin-Schultz	Wheat	0.95 (9.27)	-0.17 (-1.42)	-27.46 (-0.18)	40.0
	Corn	1.09 (9.17)	-0.05 (-0.62)	-121.50 (-0.55)	35.9
Closing Range	Wheat	0.33 (3.55)	-0.09 (-1.14)	-106.54 (-0.63)	17.3
	Corn	0.10 (1.73)	0.00 (0.04)	7.75 (0.05)	1.8
Amihud (Open Interest)	Wheat	0.60 (2.24)	-0.46 (-1.33)	16.53 (0.04)	1.4
	Corn	0.89 (4.28)	-1.36 (-8.00)	360.76 (0.80)	27.3
Amihud (Volume)	Wheat	0.68 (4.24)	-0.35 (-1.65)	1025.91 (2.53)	22.2
	Corn	0.47 (2.92)	-1.01 (-7.37)	2471.09 (5.31)	50.6

Figure 1. Futures Closing Range, 1921-1938



APPENDIX TO

"U.S. Experience with Futures Transaction Taxes"

NOT FOR PUBLICATION

Contents

Detail on Trading Fees/Commissions

Table A1. Computation of Weighted Average Fees / Commissions per Contract

Commission Type	Fees / Commissions per contract	Volume Weights		
		Wheat	Corn	Oats
Scalper (Scratch Trades)	$0.05	30.0%	30.0%	20.0%
Scalper (Non-Scratch Trades)	$1.25	20.0%	20.0%	20.0%
Member	$6.25	19.2%	17.8%	21.4%
Non-Member	$12.50	30.8%	32.2%	38.6%
Weighted Average cost per contract		**$5.32**	**$5.40**	**$6.42**

Total scalper volume estimates and scratch trade volume estimates

The assumption in the computations above utilize the approximations of 50% scalping volume for wheat and corn and 40% scalping volume for oats. Scratch trades are assumed to be 30% of all volume for wheat and corn and 20% for oats. These values are assumed to hold on all dates. The Grain Futures Administration estimated that 50% of all wheat trades in 1923 involved a scalper, and that about 30% of all trades were scratch trades (Report on the Grain Trade, Vol. 7, p. 101). It further estimated that, for the period 1921-1923, that about 30% of all wheat trading was scratch trades, 28% in corn, and 20% in oats. "These figures are estimates based on and corresponding with the averages obtained from direct computations relating, for wheat, to the first 4 months of each of these 3 years, and for corn and oats to the last 3 months of 1922 and the first 4 months of 1923." (United States Department of Agriculture Statistical Bulletin no. 6, Oct. 1924, Grain Futures: Daily Data, p.3.) Table A2 provides quantitative detail on the available estimates of scalping volume during this era.

Table A2. Fraction of Futures Volume with a Scalper Involved

Period	**Wheat**	**Corn**	**Oats**
Jan 1916 – April 1917[a]	33%	29%	11%
May 1917 – Dec 1917[b]	N/A	41%	27%
Jan 1925 – April 1925[c]	53%	N/A	N/A
Jan 1927 – Oct 1927[d]	45%	29%	N/A

Notes:

a. Report on the Grain Trade, Vol 7, p. 100. These values may underestimate the volume attributable to scalping activities, especially scratch trades (trades made on the same day at the same price), which may not have been reported to the extent that other trades were reported.
b. Report on the Grain Trade, Vol 7, p. 100. Trade in wheat futures was suspended during this period.
c. U.S Department of Agriculture (1926), Grain Futures Administration, *Fluctuations in Wheat Futures*, (US 69th Congress, 1st Session, Senate Document No. 135).
d. U.S Department of Agriculture (1930), Grain Futures Administration, *Reports by Members of Grain Futures Exchanges*, Part 2 (US 71st Congress, 2nd Session, Senate Document No. 123).

Member vs. Non-Member volume

The estimates of member and non-member volume in Table A1 are split according to the proportions implied by Table A3. The assumption is that 50% of volume is due to non-scalpers in wheat and corn and 60% of volume is due to non-scalpers in oats.

Table A2 displays the Federal Trade Commission provides volume estimates for 1916-1917 by commission type, where "House Trades" reflect the minimum pit brokerage costs paid to a broker for a trade.

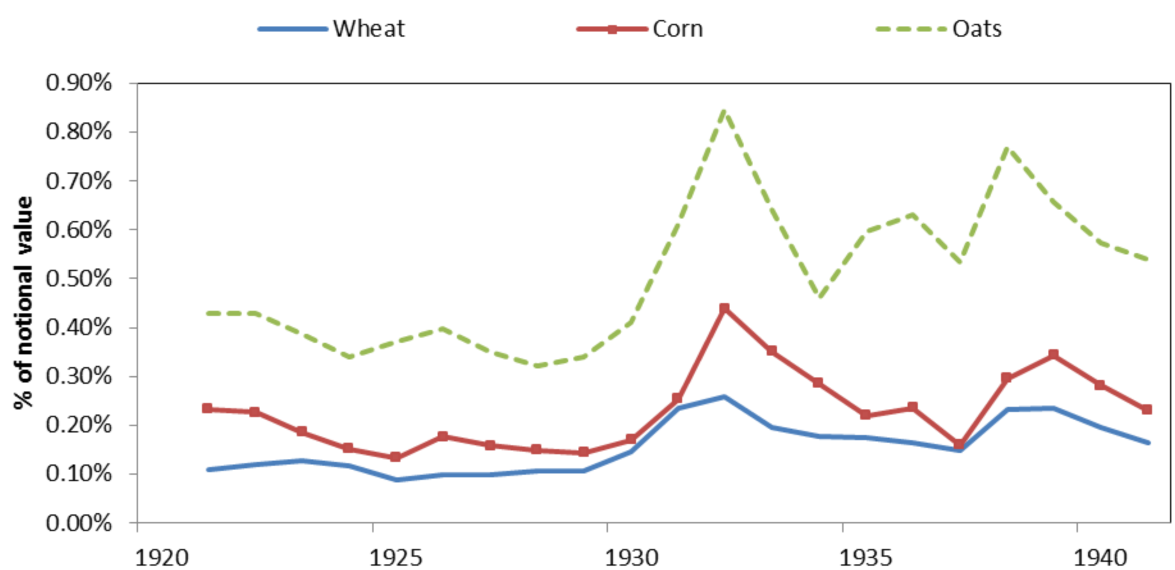
Table A3. Weighted Average Costs of Trading, from Federal Trade Commission data

		Cost / contract ($)	Wheat (% of volume)	Corn (% of volume)	Oats (% of volume)
Trade Type	House Trades	0.75	13.38	16.07	19.54
	Cleared for Others	1.25	33.39	34.42	20.24
	Made for Members	6.25	20.41	17.62	21.45
	Made for Non-Members	12.50	32.82	31.89	38.77

Source: Federal Trade Commission Report on the Grain Trade, vol. 7, pp. 111-112

Figure A.1

Value of weighted average commission costs plus minimum spread as percentage of notional value, 1921-1941.



Detail on Estimated Impact of Tax (Standard Errors computed via Delta Method)

Figure A.2: Estimated Impact of Tax on Futures Trading Volume.

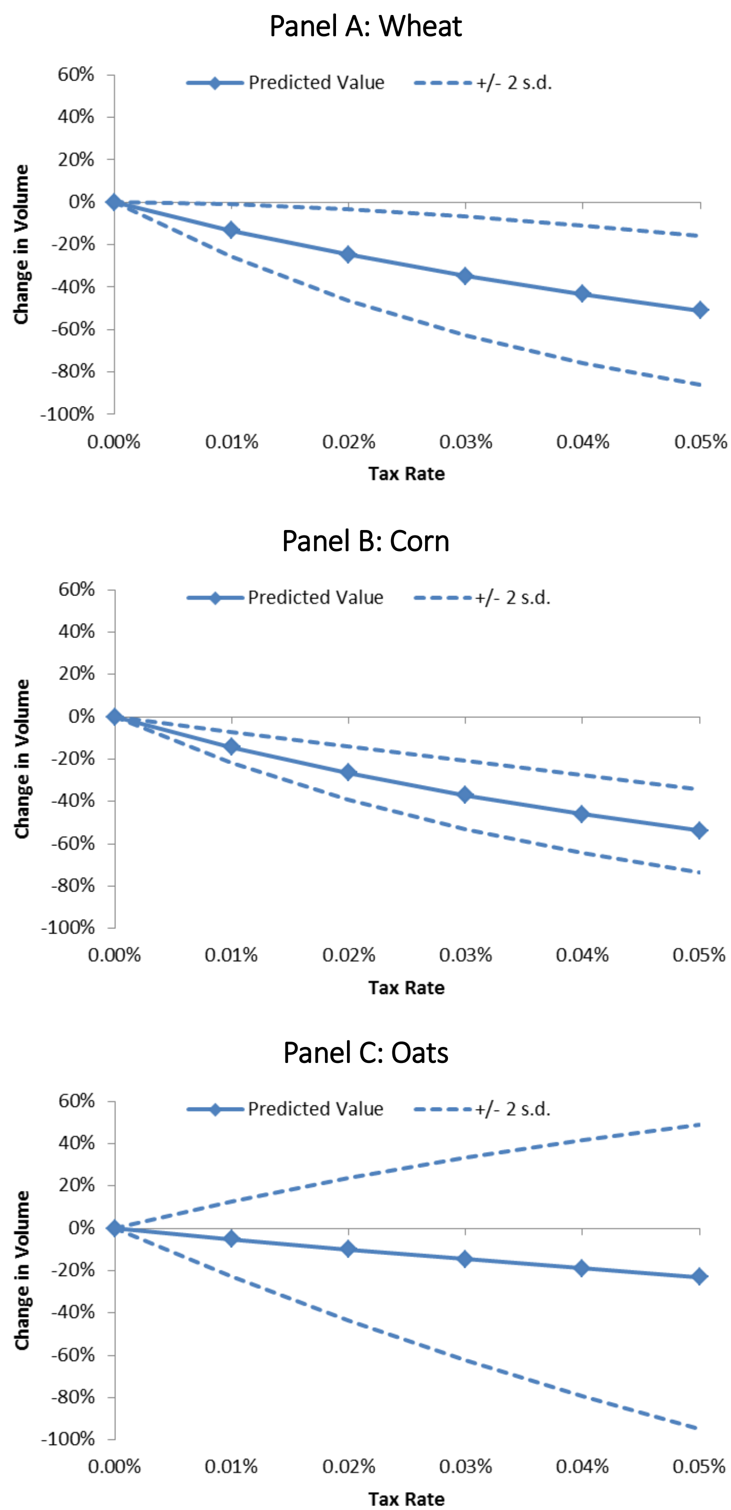


Figure A.3: Estimated Impact of Tax on Futures Open Interest.

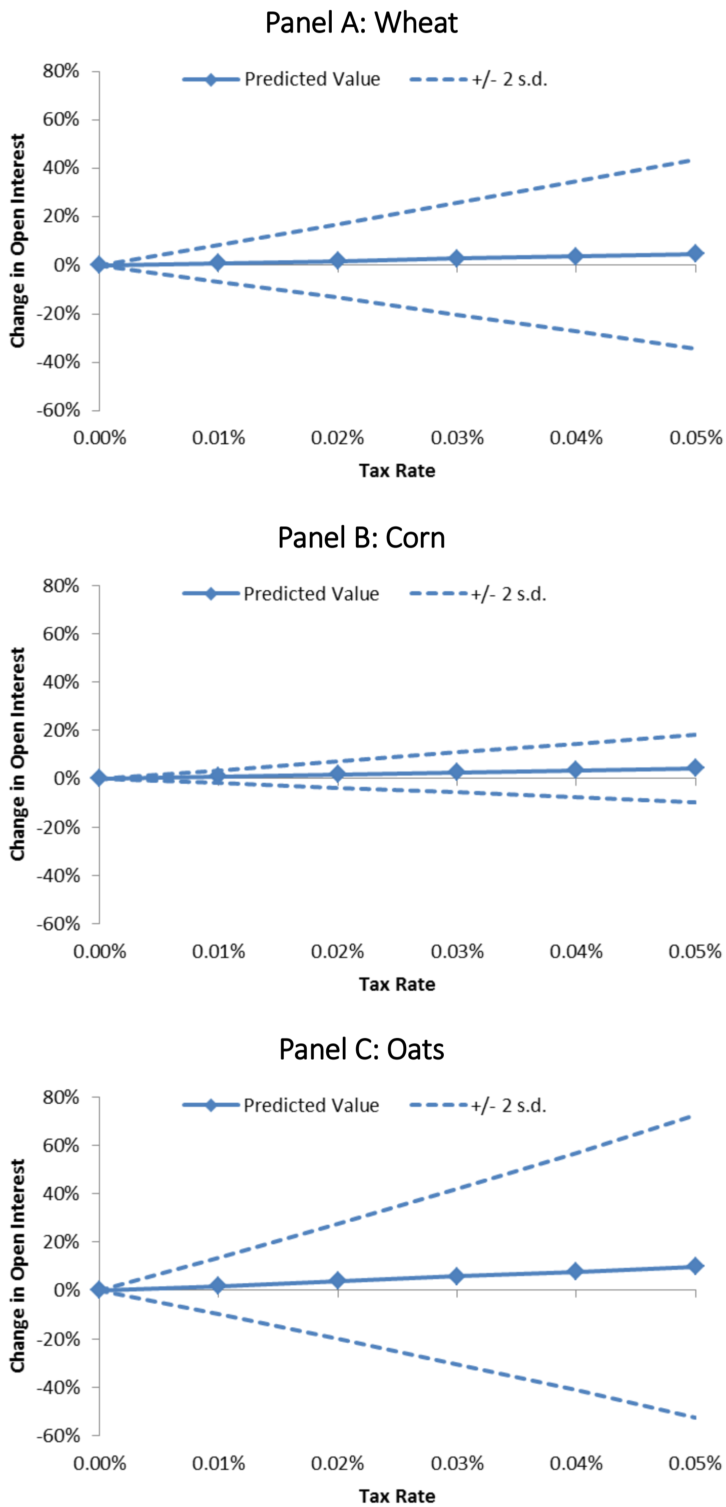
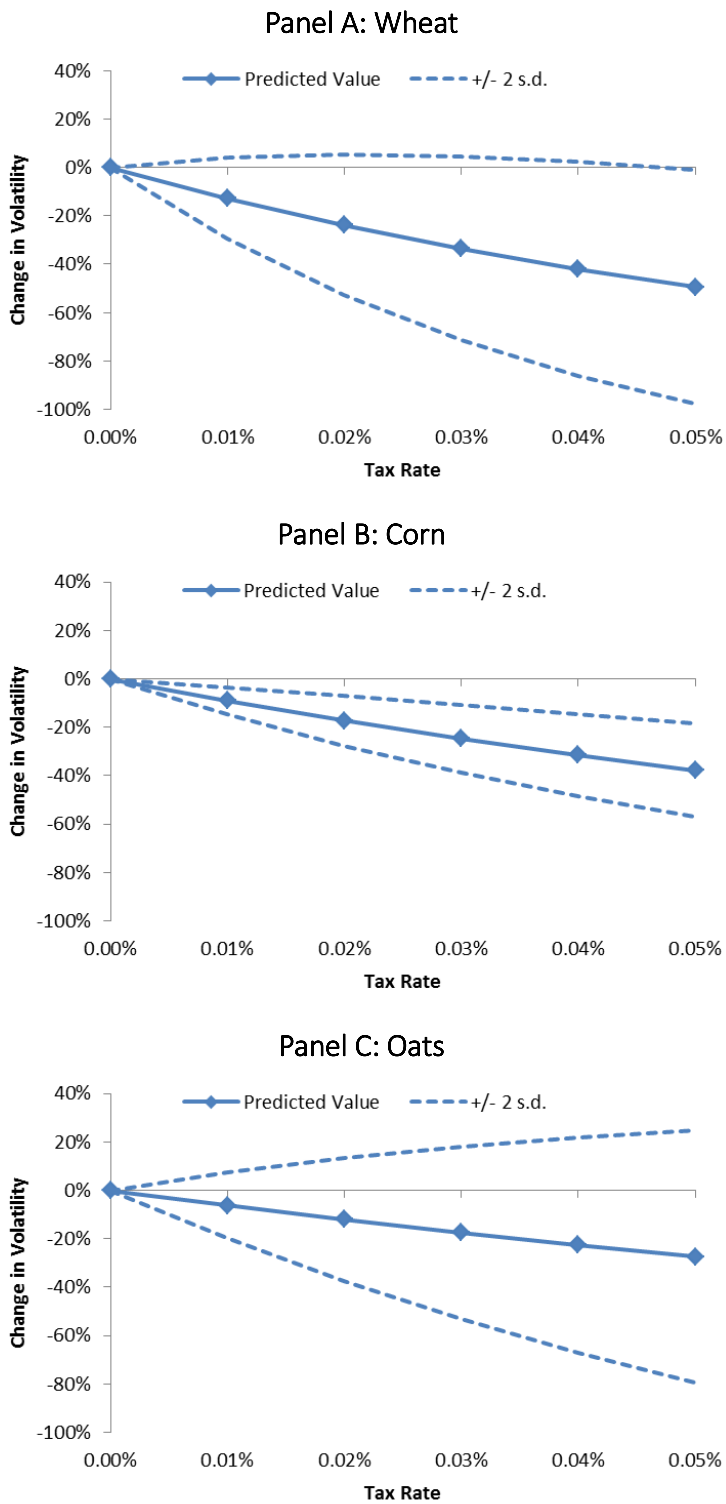


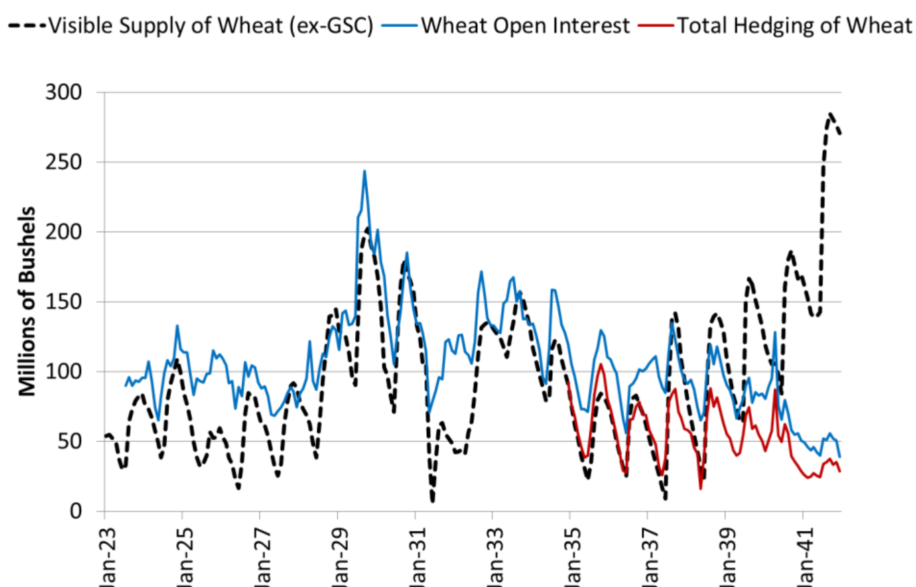
Figure A.4: Estimated Impact of Tax on Futures Volatility.



Detail on Hedging and the Visible Supply of Wheat

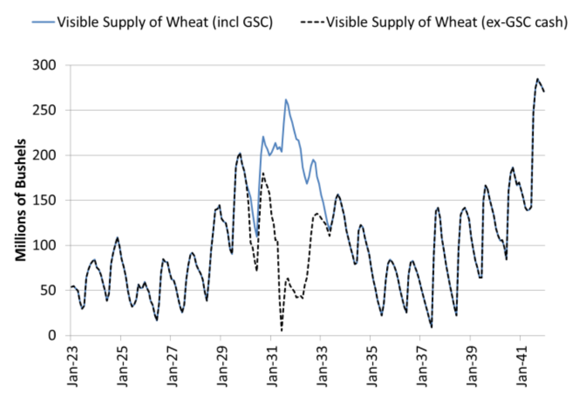
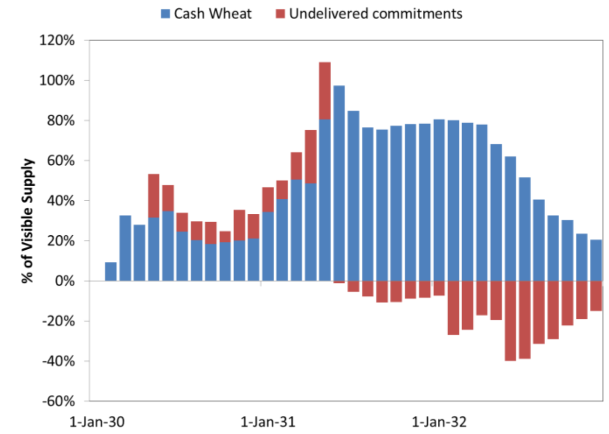
Figure A.5: Wheat futures hedging and the visible supply of wheat

The chart displays the visible supply of wheat (NBER series m05001d and m05001e) less the Grain Stabilization Corporation cash wheat holdings for 1930-1932 (from Anne E. Peck, "The Futures Trading Experience of the Federal Farm Board." *Futures Trading Seminar Proceedings*, Vol. IV, Chicago Board of Trade, Chicago, IL, 1976, pp.23-56), the open interest of CBOT wheat futures, and the total (long plus short) hedging of wheat with CBOT futures (from the Commodity Exchange Authority). The chart validates the strong relation between visible supply and futures hedging during the 1920s and 1930s, with the relation weakening at the end of the period due to the influence of the Commodity Credit Corporation.



Working ("Whose Markets? Evidence on Some Aspects of Futures Trading," *Journal of Marketing*, 19(1): 1-11, 1954) describes the dynamics:

"When surplus stocks of wheat accumulated in the late 1920's, leading to increased hedging, open contracts rose on all markets. When the Grain Stabilization Corporation took over much of this surplus in 1930-31, so that the stocks were no longer hedged, open contracts dropped. When a new surplus appeared at the end of the 1930's, federal loans and direct holding by the Commodity Credit Corporation created an actual shortage of wheat supplies in commercial hands, and hedging and open contracts in wheat futures dropped sharply."

Raw and Adjusted Visible Supply of Wheat	Grain Stabilization Corp. Holdings as % of Visible Supply
	

Note that the chart adjusts for the GSC holdings but not for the Commodity Credit Corporation (CCC) data. The total amount of wheat pledged as collateral or held by the CCC is available annually and is shown in the following table (from United States Department of Agriculture, *Agricultural Statistics*, 1942, p. 730).

	1938	1939	1940	1941
Quantity (millions of bushels)	85.7	167.7	278.3	347.4

Appendix Supplement to Table 8 (Impact of the tax on futures pricing)

The table displays results from regressions

$$\frac{\ln(F_{t,T})-\ln(S_t)}{(T-t)} - r = \alpha + \beta ln(Visible\ Supply_t) + \gamma ln(Visible\ Supply_t)x(tax\ rate_t) + error_t.$$

Regressions use monthly data and cover the period January 1921-December 1938. Corn and oats data are unavailable for the period October 1930-June 1931. Regressions include an AR(1) correction. Coefficients having t-statistics with absolute values greater than 2 are shaded.

Commodity	Intercept (t-statistic)	Ln(Visible Supply) (t-statistic)	Interaction (t-statistic)	Adj. R^2
Wheat	-3.53 (-8.60)	0.68 (8.40)	-42.87 (-1.34)	40.3%
Corn	-0.68 (-7.17)	0.23 (6.19)	-25.38 (-0.34)	58.9%
Oats	-0.56 (-4.95)	0.14 (3.73)	28.07 (0.40)	55.2%