

Lane Transit District Payroll Tax Revenue Analysis

Presented to the University of Oregon Department of Economics,
satisfying research project requirement for
EC 419, The Economic Analysis of Community Issues II

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Spring 2007

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Introduction:

The Lane Transit District (LTD) provides public transportation services to much of Lane County, Oregon. LTD receives revenue from several different sources, including fares, revenue from payroll and self-employment taxes levied within LTD's service district, federal and state payments to cover non-taxable government employees within the service district, a special fund from tobacco taxes, as well as federal grants. The payroll and self-employment taxes represent the largest single contributor to LTD's revenue (\$23 million, or almost 70% of total revenues for 2005-2006). The Oregon Department of Revenue provides LTD with monthly firm-specific records of these taxes. With this data available, LTD is interested in the creation of a statistical analysis of several features of their payroll tax base as well as a prediction of underpayment. This project seeks to conduct these analyses for tax years 2002-06.

To begin the analysis of LTD's payroll tax base, we first gain a general understanding of the behavior of the payroll tax revenue across our sample years. We compare the total tax revenue collected across 2002-06 as well as the amount paid by the top 15 tax revenue contributing firms for the first year of our data (2002) and the final full year (2005). This comparison helps to give us an overall sense of how the payroll tax revenue has grown in recent years and to see if some firms have had a considerably larger or smaller growth in the amount they contribute to this payroll tax over the sample years. Our findings show a general trend of growth as well as analogous growth for most of the top 15 contributing firms from 2002-05.

Once we have a good understanding of the recent trends of LTD's payroll tax revenue, our focus shifts to the determination of which industries may be underpaying this tax. In order to make this determination we use Bureau of Labor Statistics (BLS) records for wage bills paid within Lane County. After making minor adjustments to both this and our LTD payroll tax

revenue data set, we perform an industry-level comparison of the amount of wages paid to the tax revenue collected and see how close this relationship (the “tax ratio”) is to the mandatory tax rate of 0.6%. While there is of course a small amount of variance above and below this benchmark, we are able to determine those industries that are paying at considerably low levels and identify them as potential underpayers. Our results show that the management of companies (NAICS 55) is likely an industry where underpaying is occurring.

Next, we generate five statistics quantifying major differences between industries in preparation of measuring their effects on the tax paying behavior of these industries. First, we calculate the amount of churning that occurred in the different industries across our 2002-06 data range. Specifically, churning refers to the number of entries and exits of firms into and out of the payroll tax revenue data set. Next, we calculate the relative volatility of tax payments in each industry. Third, we determine the average firm size of each industry. The fourth and fifth statistics we look at are the number of firms within an industry and the mean tax payment amount of each specific industry.

Once completing calculations of these five statistics as well as the tax ratio for each industry, we analyze the relationship between the two. Specifically, we create a regression that expresses whether or not we would expect to see a specific change in the tax ratio as a result of a specific change in the value of one of the statistics. Our regression shows that only the number of firms in an industry and the mean payment of an industry are significant at explaining changes in the tax ratio.

Finally, we analyze the behavior of the overall tax ratio paid by the entire tax base across our sample years. This gives us the chance to check for any trends that may be occurring as well as provides us the means to predict any revenue loss that may occur from an overall tax ratio that

is below the benchmark of 0.6%. For 2005, we estimate LTD's revenue loss to be approximately \$460,000.

Literature Review:

The topic of tax evasion has been thoroughly explored by the IRS going back to early measurement programs in the 1960s. General academia has been slower to study the topic; however the last 15 years have seen more thorough research. This literature review focuses on the topic of tax evasion even though the larger project delves into other questions of the tax base including churning and volatility of payments. The reason is that questions based on specific tax bases do not lend themselves well to general academic papers.

Both the government and academia have had difficulty in measuring tax evasion since the act of evading taxes, by nature, is supposed to be concealed. The difficulty in measurement is compounded by the question of what is considered to be tax evasion, as well as the difficulty of telling when it has taken place. Papers have generally taken two different approaches in measuring tax evasion, namely direct and indirect. Indirect measures of tax evasion aggregate data on a macro level, while direct measures assess tax evasion on an individual level.

Measuring corporate tax evasion also proves difficult due to the nature of the data often used. Estimates can be done with financial audits compared with tax receipts, but this presents more problems. The accuracy of financial audits revealing the true level of corporate noncompliance is hard to judge. Corporations have incentives to hide or conceal if they have already been caught in noncompliance. The nature of data also creates difficulty with obtaining it due to confidentiality issues.

The IRS is increasingly allowing academics to have access to limited data to perform research beyond what the IRS has already done and continues to do. It is important to

understand the nature and causes of tax evasion because increased knowledge of this subject will allow the government to more efficiently and effectively write tax laws. With efficient and effective tax laws the government will likely make fewer unproductive expenditures into detection, while firms will make fewer unproductive investments into concealment.

Brown and Mazur (2003) discuss in their paper how the IRS defines subsets of noncompliance and the measurement tools used to quantify each. The subsets of noncompliance are filing, reporting, and paying, which together sum up to equal the total tax gap. Filing compliance measures the percent of required returns that are filed on time. Reporting compliance is a measure of the percent of true tax liability that is reported. Payment compliance is a measure of reported tax that is timely paid.

Filing compliance is calculated with two different sources; the Census Bureau's Current Population Survey (CPS) and a separate database that is maintained by the IRS. The CPS is used to calculate the number of individuals with a tax liability while the IRS database is used to compare the number of individuals who filed their returns on time. The process of taking two separate data sources and merging the data is very similar to how we compare the tax payments from the LTD data and the wage bill data from the BLS. In the IRS study, the rate for simply filing on time was only 90.7% in 2000.

The IRS measures payment compliance with the Voluntary Payment Compliance Rate (VPCR). The VPCR measures the total tax paid timely on timely filed returns relative to the total taxes reported on timely filed returns. For 2000, the IRS estimated the VPCR measure to be 98.7%.

Reporting compliance is measured by the Voluntary Reporting Rate (VRR), a descendent of the Taxpayer Compliance Measurement Program, discussed shortly. The rate is calculated by

the proportion of tax liability accurately reported on timely filed returns. VRR was measured at between 91% and 92% in 1988 for individual tax returns.

Before the VPCR and VRR measurement programs there was the Tax Compliance Measurement Program (TCMP). The TCMP, started in the early 1960's, was the IRS's first attempt to quantify levels of noncompliance. The program originally looked at individual tax forms (form 1040) and over the years has analyzed various different tax forms as well as special issues. In the 1980's, TCPM studies started to suggest that compliance depended on both industry and geographic location. In 1995, the decision was made to conduct a new major study that would analyze industries regardless of the organizational form of the businesses within the industry (i.e. corporations, S-corporations, or partnerships.) This study would be the first time the IRS compared companies across form types.

However, the study encountered several major obstacles. The different organizational types pay taxes differently, with S-corporations and partnerships paying taxes on the individual tax forms of the partners and shareholders. Also, the basic legal definition of income varies between corporations and partnerships. Another issue was the classification of specific business into the correct industry, regardless of the organizational type. For instance, veterinary services are classified as agricultural under the various partnership tax forms, but are classified as miscellaneous services under corporation tax forms.

The study tried to be consistent by using the Standard Industrial Classification (SIC) system (a forerunner of the NAICS codes used in our analysis) but again ran into problems. Taxpayers are not required by law to report their SIC codes on their tax returns. Even when taxpayers do report their SIC code, they may do so inaccurately. Looking at corporations that indicated they belonged to a heavy industry code provides a useful example: After being

audited, 83% of companies were found to actually belong to the code, 14% were reclassified as building trade contractors, and 3% percent were reclassified into various other codes. Overall, 20% of corporations ended up in a miscellaneous category for missing, invalid, or unable-to-classify codes. In much the same way as this report, the misclassification problem was partially addressed by aggregating specific industries into broader industry codes.

Gutmann (1977) was one of the first economists outside of the IRS to explore the underground part of the economy and develop an indirect measurement of the sector. He defined the underground economy as the portion of GDP that was not captured through conventional measures used by the government. Intuitively, he observed that the money supply in circulation of \$380.68 per capita in 1976 was suspiciously high. Tracking and comparing the two components of money stock (currency and demand deposits) yields a gauge of the underground economy. As more currency is in circulation compared with demand deposits, illegal activity is increasing. Conversely, as currency goes down compared with demand deposits, illegal activity is decreasing. Gutmann used the pre-World War II relationship between currency and demand deposits as a benchmark. Then, assuming the postwar increase in the relationship was due to increased illegal activity and tax avoidance, he estimated the amount of money used in illegal activity in 1976 and calculated the underground economy as being worth 9.4% of GDP in that year.

Rice (1992) wrote the first academic paper using corporate tax compliance data supplied by the IRS. The data set included 30,000 small corporations. Rice created an economic model to explain the data he was given and to discover the determinants of noncompliance. He found that corporations that were required to disclose information publicly were less likely to be in noncompliance. Hence, firms either being publicly traded or in highly regulated industry were

less likely to evade taxes. Corporate profits had divergent effects on corporate tax compliance. Businesses with low profits had incentives to evade taxes to increase the bottom line. However, businesses with large profits had incentive to evade taxes because they were less likely to be audited. Therefore, corporations whose profits had greater variance from the mean profit of the industry were more likely to be in noncompliance. Though the marginal tax rate had a negative relationship with noncompliance, Rice found that a one dollar decrease in tax revenue would return only 5.3 cents in increased compliance.

Kamdar (1997) analyzes the responsiveness of tax noncompliance to independent factors such as the tax rate, audits, and penalties. The paper uses time series data on corporate compliance coupled with regression analysis to determine the relationship between these independent factors and corporate tax compliance. In doing so, this paper questions the popular beliefs of each of the independent variables' presumed effects. Since there are theoretical models claiming a negative relationship between penalties and tax compliance, as well as empirical models claiming an insignificant relationship, Kamdar questions the true nature of the relationship. Except for a handful, most prior papers have claimed audit rates are significant. Prior papers have not come to a consensus if there is a significant relationship between the marginal tax rate and the level of compliance. Kamdar found that audit rates have a significant effect on tax liability reported, specifically a one-percent increase in audit rates increases tax liability reported by 0.336 percent. He found that penalties do not have a statistically significant affect on reported tax liability. The marginal tax rate seems to not affect noncompliance, as it was not statistically significant in 6 alternative specifications used.

Bayer and Sutter (2007) look at the resources used to both conceal tax evasion by tax payers and the resources used to detect tax evasion by tax collectors. They look at the amount

used in both tax concealment and detection, along with the frequency of tax evasion and its dependence on the tax rate. The paper finds that the socially inefficient effort of tax evasion is not based on the fines of detection. The paper sets up a concealment-detection contest between the tax evader and the tax collector. Tax evaders can invest in various vehicles of concealment, where the more money invested, the lower the likelihood of being caught. The tax collector, on the other hand, can invest more money to detect tax evasion, where the more money that he invests, the more tax evasion the collector will detect.

The paper finds that tax rates are the main factor driving the frequency of tax evasion. The finding that tax rates do drive frequency of evasion contradicts many other papers within the field. These papers found that fines have an insignificant effect on the frequency of evasion. The 2007 paper agrees with other experimental literature on the dependence of tax evasion on tax rates, while econometric based papers tend to disagree. Bayer and Sutter attribute the cause of the difference to the standardized measurement of tax evasion used in experimental approach, yielding more consistency, and hence better results. They also explain that the difference is partially because in past experimental models, subjects did not have the ability to invest in concealment, which they assume most companies do after being caught for tax evasion. With their new assumption they agree with previous econometric research that past audits have little effect on tax evasion, even though their study is experimentally based.

Hanlon, Mills, and Slemrod (2005) use IRS operational audits in conjunction with appeals data and confidential tax return data to analyze the levels of noncompliance of firms. They establish the level of noncompliance through the level of underreporting discovered in the audits, adjusted for successful audit appeals. Then, with the known tax noncompliance of various firms, they search for relationships between noncompliance and firm traits such as size,

industry, being publicly traded, multinationality, form of executive compensation, and governance characteristics. In the paper, Hanlon, Mills, and Slemrod also study the relationship between corporate tax noncompliance and the effective tax rate.

The paper finds that medium firms have the lowest levels of noncompliance, while larger or smaller firms were increasingly noncompliant. Foreign firms tended to have smaller levels of inaccuracy in their reporting compared with purely domestic firms. Multinational firms have higher levels of inaccuracy in their reporting compared with firms only operating in the United States. Private firms tended to have higher levels of noncompliance compared with public firms. When analyzing the effect of executive compensation, higher levels of either exercisable stock options or large relative bonuses lead to higher levels of non-compliance. There was no relationship found between a measure of shareholder power and accuracy, and very little relationship between lower effective tax rates and deficiencies. They concluded that the corporate noncompliance rate was close to 13 percent, which is in line with IRS estimates of the tax gap.

With increasing data availability from the IRS there has been greater ability to study tax evasion and determine how to minimize it. Most studies now use audits and tax returns in conjunction with other more study-specific data to compute levels of noncompliance. Then, with the determined levels of noncompliance, studies are able to analyze the independent factors on tax evasion such as marginal tax rates, penalty levels, and frequency of audits. Studies also look at what characteristics cause firms to be more or less likely to commit tax evasion. Within the academic community there are still disagreements on whether tax rates do or do not affect compliance. The effect of tax rates on noncompliance is important for LTD to consider as they raise their tax rates.

Hypothesis Development:

The impetus for conducting this project is LTD's concern that those industries that can more easily not pay the proper tax will indeed do so. Since the revenue collected through these taxes represents approximately 70% of LTD's total revenue, even a small deviation from the mandatory tax rate of 0.6% could represent a large loss of revenue for LTD. For instance, if we assume no current underpayment (a tax ratio of 0.6%), then a slight drop to 0.59% would represent a loss of approximately \$380,000 of revenue annually.

In regards to our initial view of the overall trend of LTD's payroll tax revenue since 2002, we would expect to see growth in revenues collected. Since Oregon began to come out of economic recession in 2003, the tax revenues collected since that year should show growth. Since the years 2003-2006 have been strong years for Oregon's economy, we would expect to see that growth continue through our data. As a result of this general growth, we also expect to see analogous growth across each of the top contributing industries.

As for the five industry characteristic statistics outlined in the introduction to this paper, we hypothesize as to how exactly they will each affect the tax paying behavior of firms. For the churning of firms within a specific industry, we would expect that industries with a high degree of churning will have a higher amount of underpaying since new comers may not know of the LTD payroll tax and since exiting firms may be less likely to pay properly if they know they will not be in business much longer. For average firm size, we would expect that smaller firms would be more able to "slip under the radar" and thus an industry that had a smaller average firm size would probably have increased underpaying. Though the Hanlon, Mills, and Slemrod paper found that medium-sized firms were the least likely to be underpaying, it did so using tax return data for specific firms. What we look at is slightly different. Firm size in this report is an index

determined at the industry level, and our hypothesis thus differs from the results of the 2005 paper. As for the volatility of tax payments, we would expect that industries whose firms on average have a higher variance in their payments are more likely to underpay. This is because the higher variance is probably generated by firms who do not pay each period but then make up for it at a later date. Rather than paying regularly, they may be attempting to get by without paying in the first place. As for number of firms, an increase of this statistic in an industry will have averaging effects that will likely bring the tax rate actually paid closer to the benchmark and underpaying will thus decrease. For an increase in mean payment amount, if we hold the wage bill amount constant, then the mean payment amount divided by the wage bill amount (the tax ratio) will increase and underpaying will thus decrease.

As for our analysis of the tax rate paid by the entire tax base across the sample years, we would expect to see little or no variation at the annual level.¹ The reason is simply that the largest firms that contribute to the tax revenue are in all likelihood very well established and have set long-standing trends in their taxpaying behavior. If, for instance, a trend showing major increases in underpayment were occurring, then it is likely that these firms would be audited for breaking their long-standing trends. The increased auditing would likely decrease underpayment and reverse the trend. As a result, we expect that revenue loss, if it is indeed occurring, is generally constant.

Data Analysis:

The data requirements for this project are twofold. The first set of data that we use, and indeed the availability of which provided impetus for embarking on this project, is that of tax revenue paid by specific industries to LTD. Secondly, and just as necessary as the tax data, is

¹ Notwithstanding the effects on underpaying that are the result of the relative health of the economy. Whether an economic recession causes underpaying to increase or decrease is an interesting research question that is beyond the scope of this project.

data showing the wage bills for each firm that pays employees within the LTD service district. In essence, the wage bills show how much should have been paid, while the tax revenue data shows what was paid.

The LTD tax revenue data we received shows monthly taxes paid by individual firms for the 2004-06 tax years. Most of the entries were originally in a sort of double-entry format; one entry showing a debit and the other a credit. As a result, we had to make the data more concise by removing one of the entries (but only doing so if both entries show the same figure). In addition, we sum the monthly tax amounts to quarterly tax amounts so as to match the aggregation level of the BLS wage bill data (explained shortly). Though the data originally included specific firm names, LTD was concerned with these firms' privacy and thus removed the names. Instead, each firm has been assigned a specific code so that LTD can later match up anything interesting we may discover about a specific firm by using this code. In addition, each entry includes a NAICS (North American Industrial Classification System) code to show the industry to which the taxpayer belongs.

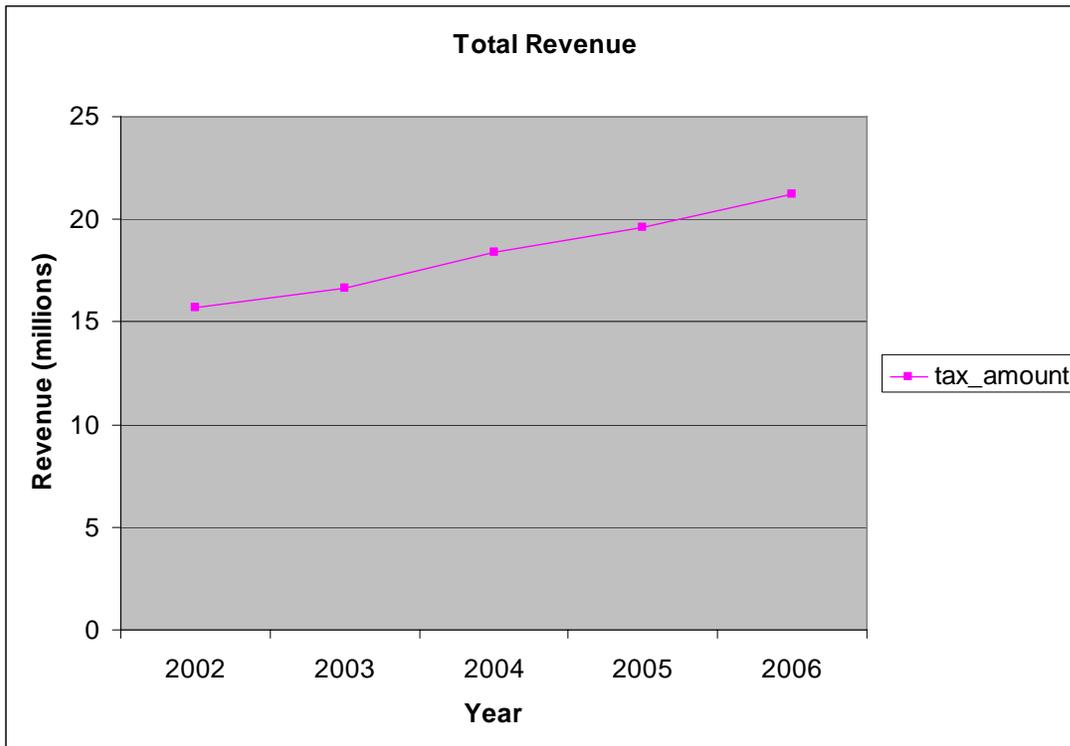
The BLS wage bill data we have access to shows the quarterly wages paid of all industries within Lane County (including industries paying wages outside of the LTD service district) The entries in this data set are shown at industry levels as opposed to firm levels. They are expressed solely in terms of NAICS codes.

As for the different data sets used to determine our industry-level characteristics, each except for average firm size can be derived from the LTD payroll tax revenue data. For average firm size, we utilize the work of John Ichiro Jones. Jones' paper provides us with a table indicating the average firm size of the various industries, expressed by average number of employees.

Basic Statistics and Underpaying Analysis with Results:

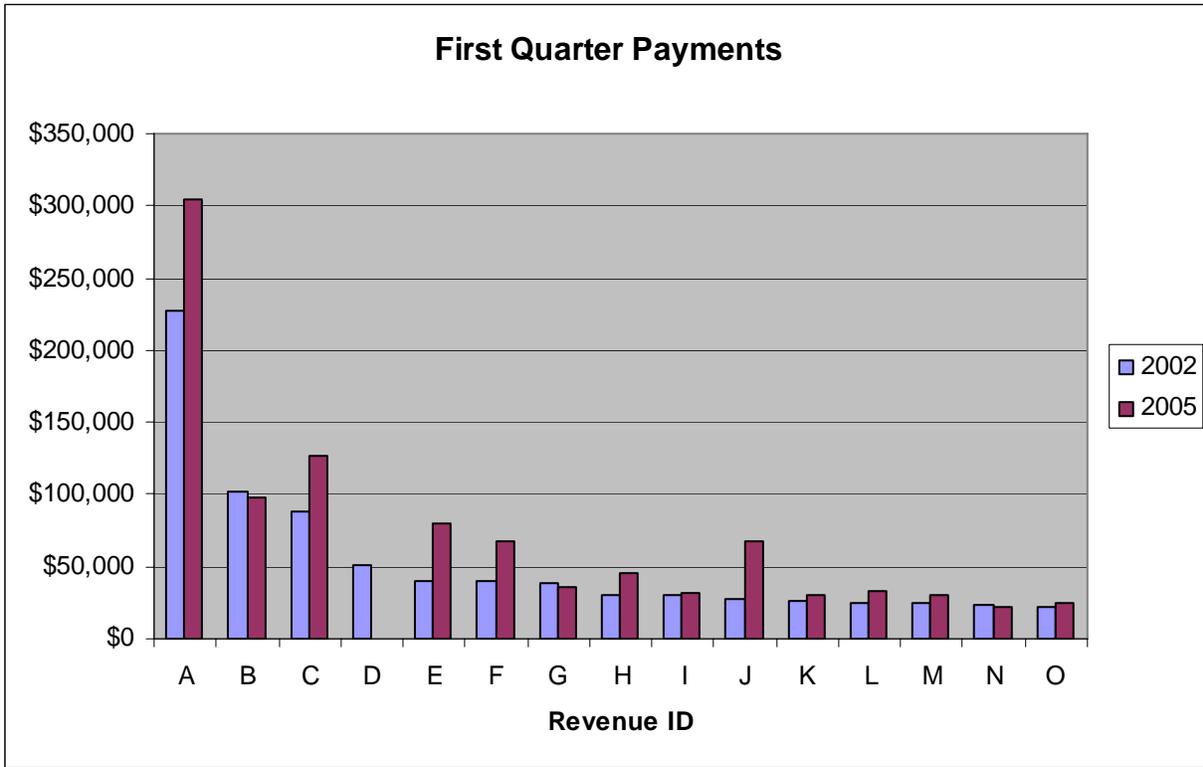
The first analysis we conduct to more fully understand LTD's tax base is a simple comparison of the tax revenue collected in general and from the top firms that contribute to LTD's payroll tax revenue across our sample years. To determine the nature of the trend of total tax revenue collected, we simply add all the tax payments for each tax year of the LTD data and plot the results. In addition, we chart the growth of each of the top 15 individual contributors from 2002 to 2005.

Figure A: This figure shows the general trend of LTD's tax revenue from 2002 to 2006. Since we do not have complete data for tax year 2006, the final portion of this trend represents a prediction.



As one can see in Figure A, we do indeed have a general growth trend of payroll tax revenue across our sample years. This is to be expected since Oregon's economy has grown steadily since approximately mid-2002. One would expect that (outside of the possible effects of economic expansion/recession cycles) this trend will continue.

Figure B: This figure shows the change in revenue for the top 15 contributing firms to LTD's payroll tax revenue from 2002 to 2005.



The results displayed in this figure are not as clean-cut as those in Figure A. We can see that for the majority of the top 15 contributing firms we have growth from the first quarter of 2002 to the first quarter of 2005. However, for firms B, G, and N we actually see a drop in their payments. Though it is likely that this is the result of either misclassification error or an actual drop in the wages paid by these specific firms, it is also possible that this could be the result of underpaying. Firm D is also of interest since it is present in 2002 but missing in 2005 (this is of particular concern since it is a major contributor to payroll tax revenue).

Now that we have looked at trends in LTD's tax revenue, we move on to the industry-level comparison of what should have been paid to LTD, based on a 0.6% payroll tax rate, with what actually was paid to LTD. While the tax data from LTD tells us tax revenues, we use Lane County wage bill data provided by the BLS to determine what should have been paid.

Essentially, the methodology of making this comparison centers on breaking up both the wage bill and tax revenue data by industry, year, and quarter, dividing the tax revenue amount of a specific industry by the wages paid of that same industry, and checking the quotient (the “tax ratio”) against the 0.6% benchmark.

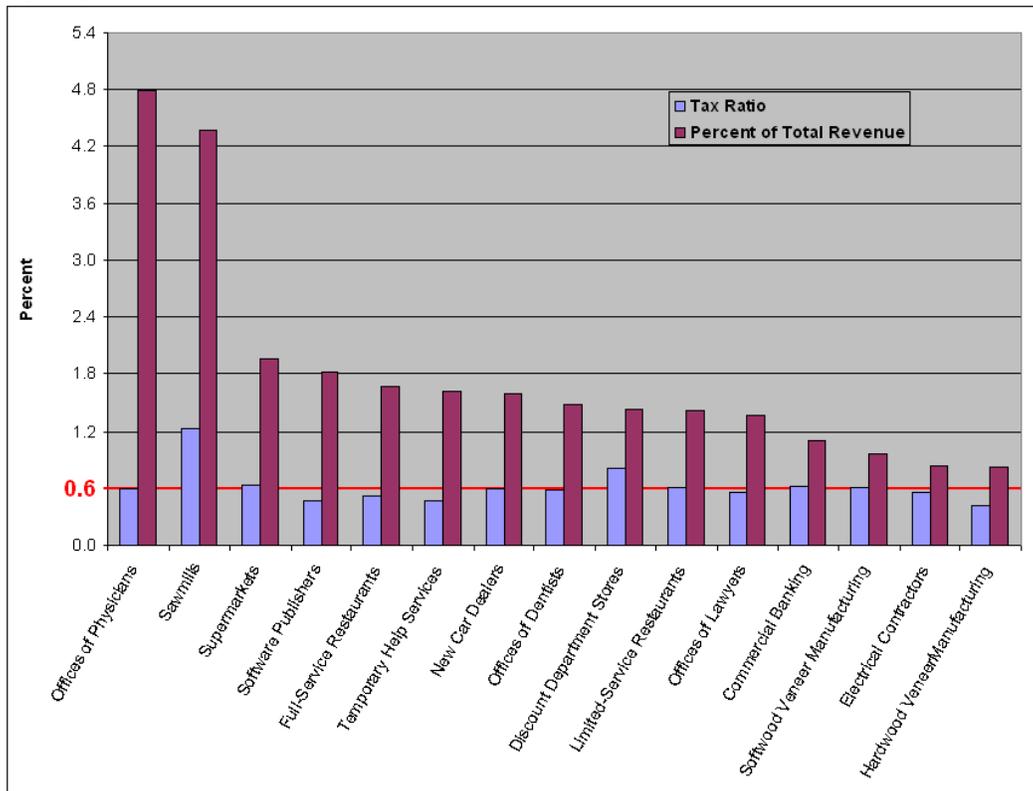
In converting the data from its raw form to something that is usable in such a calculation, we have to complete several major steps. First, when breaking up the data by industry, we are interested in conducting analyses using both 6-digit and 2-digit NAICS codes. In dealing with NAICS codes, a higher number of digits indicates a more disaggregated classification of a particular industry. For example, a 6-digit code may indicate plywood manufacturers, while a 3-digit or 2-digit code may indicate wood products manufacturing in general.

For 6-digit NAICS codes, we begin by dropping codes that were not observed in both data sets and codes that indicate industries that are not subject to LTD’s payroll tax (i.e. religious institutions, charitable organizations, etc). With a matching list of 6-digit codes for both data sets, it is necessary to adjust the BLS wage bill amounts to reflect industry within the LTD service district and not Lane County as a whole. In order to make this adjustment, we calculate the percentage of Lane County’s urban population that lives within the district and then reduce all wage bill data to that percentage (94.675%). In conducting this adjustment, we make an assumption that the size of each individual industry within the district is proportionate to the size of that same industry that is within Lane County but outside the district. Though this is likely a reasonable assumption for our analysis, a deeper analysis into low payers may be required.

Once the adjustment has been made, we generate the tax ratio for each of the 6-digit codes. As one can see from the figure below, the majority of the industries are paying relatively close to the 0.6% benchmark. We note that there are also a number of industries that show up as

paying too much. For at least the largest instances of overpayment, it is most likely the case that there is misclassification in the NAICS codes between the two data sets. In the figure below, for example, hardwood veneer manufacturing (NAICS 321211) shows up as low, while sawmills (NAICS 321113) shows up as high. Since these two industries are relatively close in the coding system, it is likely the case that some tax revenue was misclassified as part of 321113 instead of 321211, leading to both industries' deviations from the 0.6% benchmark.

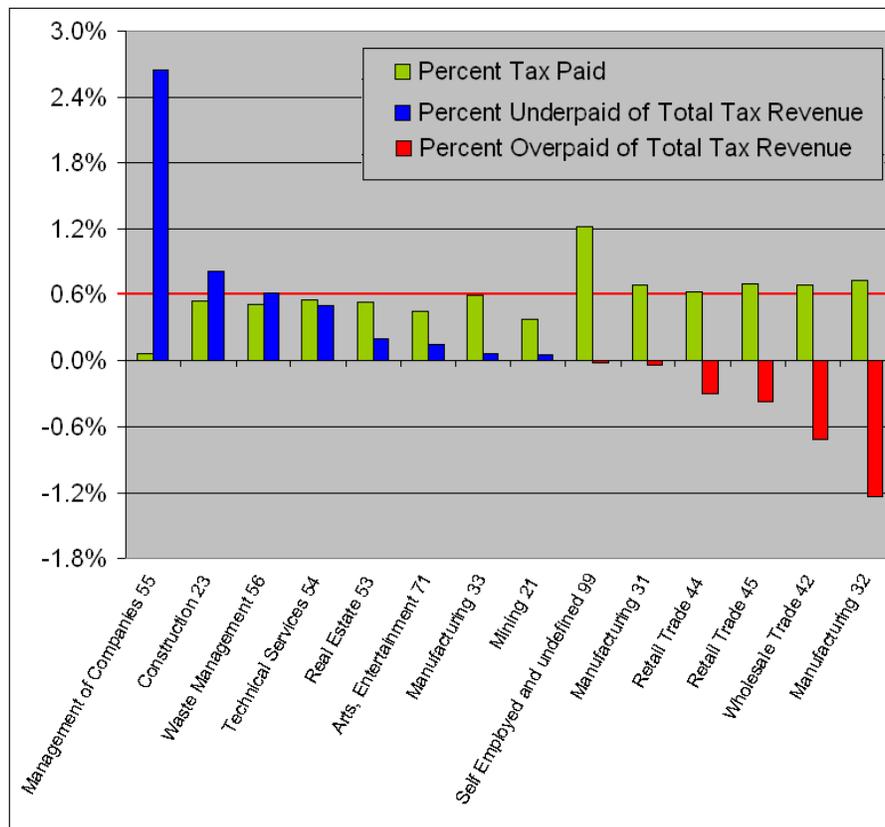
Figure C: This figure shows the percent tax paid (tax ratio) and percent of total revenue for the top 15 industries that contribute to LTD payroll tax revenue (6-digit NAICS aggregation level, 2005 tax year).



In order to lessen the effects of misclassification errors at the 6-digit NAICS level, we follow the example set forth by the IRS in the development of their Tax Compliance Measurement Program and aggregate the industries into more general categories. We begin this process by aggregating each observation in both data sets from whichever aggregation level it was at previously (6, 3-digit, etc.) to its respective 2-digit code (from our example, we would

now be looking at wood products manufacturing in general as opposed to just plywood manufacturing). Once we have dropped codes that are not present in both data sets and codes that indicate exempt industries, we again adjust the wage bill data for within-district industry. After the adjustment, we calculate our tax ratio for each of the remaining 2-digit NAICS codes as shown below.

Figure D: The figure below shows both tax ratios and magnitudes of under/overpayments based on the aggregation to the 2-digit NAICS level of both the wage bill and tax revenue data sets (2005 tax year).



As one can see, the majority of these very general industries are paying at approximately the benchmark. Mining and the management of companies are the lowest. As we can see from the percent underpaid of total tax revenue, the management of companies represents a much larger portion of revenues than does mining. Though both may warrant further attention, we have included an appendix to this report further detailing the management of companies. Note

that we have not fully eliminated the misclassification errors by aggregating to the 2-digit level; there are still instances of whole industries paying above the benchmark.

Next, we calculate the five industry level characteristic statistics outlined earlier in preparation of measuring their effects on the tax ratio. Specifically, we do so at the more disaggregated 6-digit NAICS level in order to maximize the number of individual observations. In determining the relative amounts of churning that occurs within contributing industries, we begin with the LTD tax revenue data for each of our sample years. We start by totaling the number of years that each individual tax payer is present in the data. Next, we use these totals to calculate an average number of years that firms in a specific industry are present in the data. Finally, we divide this average by the total number of years represented (five) to determine our final churning index. For average firm size, we use the average number of employees for each NAICS code as provided in the paper by Jones. For the volatility of tax payments, we first determine the summary statistics of mean tax payment amount and associated standard deviation for each industry. Next, we calculate the quotient of twice the value of each standard deviation divided by its respective mean. This gives us our final volatility index for each industry. The number of firms in each industry is determined by simply adding each individual tax payer classified under a single NAICS code. Mean payment amount is calculated by adding the total tax paid in each industry by quarter and dividing that sum by the total number of quarters represented for each industry.

Now that we have quantified characteristics and tax ratios for contributing industries, we use ordinary least squares (OLS) regression analysis to determine the strength of the relationship between the two. Specifically, we regress the independent variables of churning, volatility,

average firm size, number of firms, and mean payment amount on the dependent variable of the tax ratio as seen below.

Regression Analysis: The following regression analysis printout shows the effects of changes in each of the industry characteristics on the tax ratio. The independent variables are listed as *num_firms* (the number of firms within an industry), *meanpayment* (the mean tax payment amount of an industry), *volatility* (the calculated volatility index of an industry), *churning* (the calculated churning index of an industry), and *numemployees* (the average firm size of an industry).

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reg taxratio num_firms meanpayment volatility churning numemployees
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Source	SS	df	MS	Number of obs =	430
Model	2.8335632	5	.566712639	F(5, 424) =	6.06
Residual	39.6322287	424	.093472237	Prob > F	= 0.0000
Total	42.4657919	429	.09898786	R-squared	= 0.0667
				Adj R-squared	= 0.0557
				Root MSE	= .30573

taxratio	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
num_firms	.0009076	.0003009	3.02	0.003	.0003162 .0014989
meanpayment	1.26e-06	3.56e-07	3.55	0.000	5.63e-07 1.96e-06
volatility	.0023152	.0232616	0.10	0.921	-.0434072 .0480376
churning	-.0564475	.0863251	-0.65	0.514	-.226126 .1132309
numemployees	.0004236	.0004965	0.85	0.394	-.0005523 .0013994
_cons	.0161123	.0603082	0.27	0.789	-.1024279 .1346525

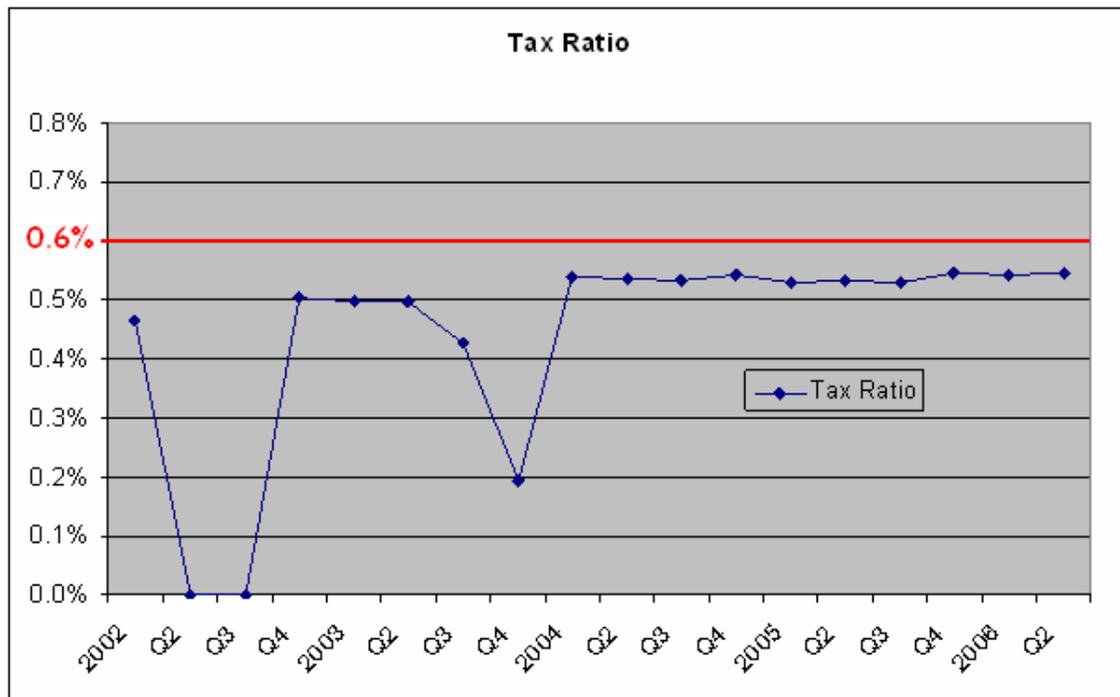
The two highlighted independent variables of *num_firms* and *meanpayment* are the only independent variables for which there is evidence of a statistically significant effect on the tax ratio. Specifically, the effect is positive (the sign of the figure labeled *coef.*) Thus, when we witness an increase in either the number of companies in an industry or the mean tax payment amount of an industry, we would expect on average to see an increase in the tax ratio. This positive effect is consistent with theory explained in our hypotheses.

Though our theory for the other three independent variables has shown to be incorrect for LTD's tax base, this still represents a significant finding: When dealing with the 6-digit NAICS

industries of LTD's tax base, changes in the amounts of volatility, churning, or average firm size do not explain changes in the industries tax ratio.

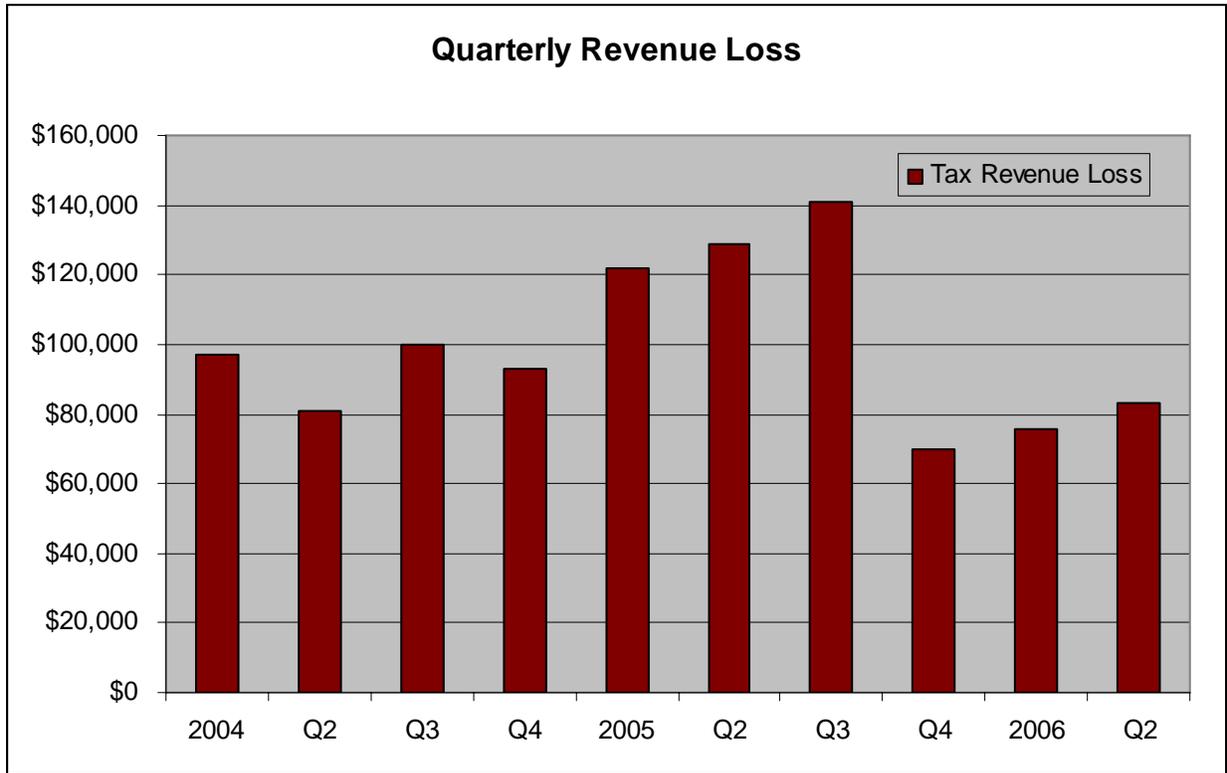
As the final step in our analysis, we look at the trends of the overall tax ratio paid by LTD's tax base across our full years of data (2002-05). We determine these tax ratios in much the same way as we did previously for the 6 and 2-digit aggregation levels, but this time aggregating to the total tax base level. In addition, we use this overall tax ratio combined with figures of LTD's total payroll tax revenue to make estimations of how much revenue is being lost. We then return to Figure D (2-digit NAICS tax ratio) to show the industry breakdown of the loss prediction.

Figure E: This figure shows the trend of the overall tax ratio paid by LTD's tax base across our sample quarters. The sharp declines/inclines from 2002 to 2004 are likely the result of partially incomplete LTD payroll tax revenue data for quarters 2 and 3 of 2002 and quarter 4 of 2003. However, the trend beginning in the first quarter of 2004 and continuing throughout the rest of the data represents an accurate estimation of the overall tax ratio paid.



As one can see in this figure, the tax ratio since the beginning of 2004 has had slight fluctuations around 0.53-0.54%. From this trend we can see that underpaying in the tax base as a whole has remained relatively steady across the years for which we have complete data.

Figure F: This figure shows the estimated revenue loss associated with the overall tax ratios shown in Figure E. As a result of the partially incomplete data prior to 2004, we make estimations only since the first quarter of that year.



In this figure we see that each quarter since the beginning of 2004 has had a substantial amount of revenue loss. In addition, it is also apparent that those small fluctuations visible in Figure E are actually quite considerable (ranging from a loss of \$65,000 per quarter to a loss of \$140,000 per quarter). Note that the total loss of revenue for 2005 based on our calculations is \$461,895.

Figure D: The figure below shows both tax ratios and magnitudes of under/overpayments based on the aggregation to the 2-digit NAICS level of both the wage bill and tax revenue data sets (2005 tax year).

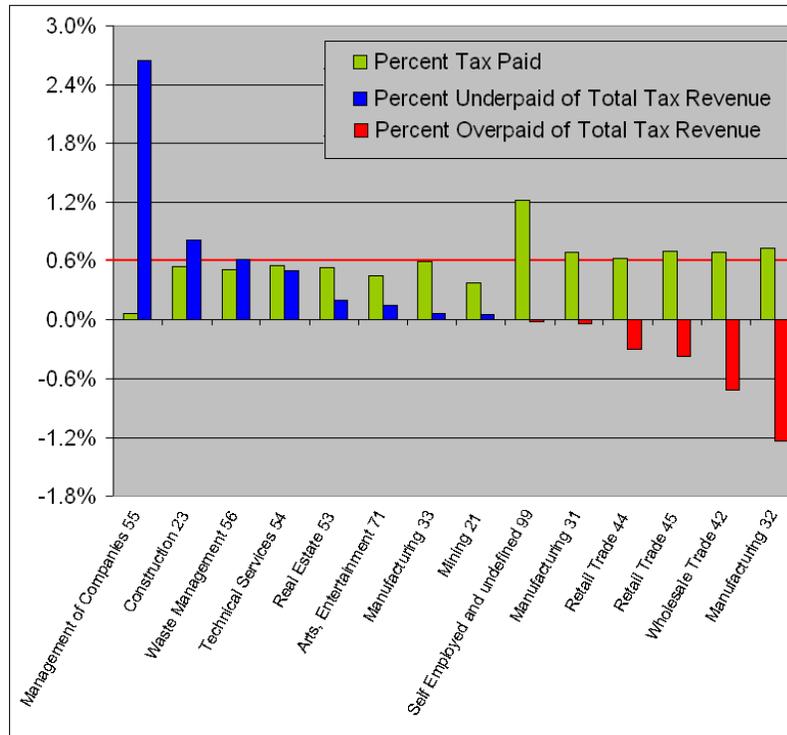


Table 1: The following table shows the predicted underpayment/overpayment amounts of each of the industries listed in Figure D (tax-year 2005).

Management of Companies 55	\$ 531,063
Construction 23	\$ 162,480
Waste Management 56	\$ 121,978
Technical Services 54	\$ 99,332
Real Estate 53	\$ 38,913
Arts, Entertainment 71	\$ 29,308
Manufacturing 33	\$ 11,522
Mining 21	\$ 9,977
Self Employed and undefined 99	\$ (4,441)
Manufacturing 31	\$ (10,058)
Retail Trade 44	\$ (62,073)
Retail Trade 45	\$ (74,695)
Wholesale Trade 42	\$ (144,172)
Manufacturing 32	\$ (247,548)

From the table we are able to see the relative industry-level magnitudes of revenue loss. Since we are still dealing with considerable misclassification error (as demonstrated by the overpayment in Figure D), we will total not only the instances of underpaying, but also the instances of overpaying, lending to a more accurate (and consistent with Figure F) calculation of revenue loss for 2005 of \$461,895.

Conclusion:

As we can see in the results section of this report, our calculations indicate a considerable amount of underpayment across each quarter and year of the data. As calculated in Figure F and Table 1, the amount is approximately \$460,000 for 2005 alone. Although we have shown that there is indeed underpaying going on, we must be cautious of stating specific figures or labeling specific industries. The main reason for this is the recurrence of misclassification errors throughout our analysis. Although we have identified the management of companies (NAICS 55) as a likely underpayer, we must be aware of the possibility that this very generally named industry is being misclassified both by the Department of Revenue in the data they provide to LTD and by the Bureau of Labor Statistics in the data they provide for Lane County wage bills. However, a deeper analysis into the tax paying behavior of NAICS 55 is likely a good place to continue research.

When we conducted a regression analysis of the five industry level characteristics on the tax ratio, we found three major characteristics that appeared to insignificant. A major cause of this insignificance could be the fact that we have incomplete LTD tax revenue data for quarters 2 and 3 of 2002 and quarter 4 of 2003. If the effect of these incomplete quarters is strong enough to skew our calculations, then it is difficult to say whether or not these characteristics are truly insignificant in explaining the tax ratio. If further research were conducted into what variables

affected the tax paying behavior of firms within LTD's tax base, then the inclusion of more years of data would undoubtedly help to reduce the effects of whatever skew these missing quarters may be causing. In addition, as seen in the paper by Hanlon, Mills, and Slemrod, the inclusion of firm level characteristics (i.e. being publically traded or privately owned, multinationality, form of executive compensation, and governance characteristics) as independent variables would add another dimension to a regression analysis conducted for LTD's tax base. This would of course involve the disaggregation of the BLS wage bill data to firm level observations as well as the disclosure of firm names in the LTD revenue data.

Finally, as mentioned in the footnote on page 14, the analysis of the effects of the relative health of the economy on the tax paying behavior of the firms that comprise LTD's tax base would represent another valuable research endeavor.

Appendix: Since the management of companies (2-digit NAICS 55) is a particularly low payer and is responsible for the largest portion of our estimated tax revenue loss, we have included a list of the 29 individual firms that comprise this industry. From the table below, one can see that only 6 of the firms paid over \$1000 in LTD payroll tax in 2005.

Firm	NAICS	Tax Amount
A	551114	\$0.00
B	551114	\$0.00
C	551112	\$0.80
D	551112	\$2.88
E	551114	\$9.97
F	551114	\$21.37
G	551112	\$28.20
H	551114	\$73.43
I	551112	\$85.65
J	551114	\$179.95
K	551114	\$189.00
L	551114	\$202.17
M	551114	\$305.18
N	551114	\$378.00
O	551114	\$378.58
P	551112	\$387.62
Q	551114	\$403.66
R	551112	\$501.55
S	551114	\$552.51
T	551114	\$787.44
U	551114	\$828.00
V	551112	\$911.96
W	551114	\$991.83
X	551112	\$1,305.40
Y	551114	\$1,811.76
Z	551114	\$2,454.99
A1	551114	\$2,767.64
B1	551114	\$12,142.36
C1	551114	\$33,651.64

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