REGULATION AND EMPLOYMENT: THE IMPACT OF SARBANES-OXLEY ACT ON DEMAND FOR ACCOUNTING AND AUDITING SERVICES

Vijay K. Vemuri, Quinnipiac University, CT, USA
vkvemuri@quinnipiac.edu

Nelson Alino, Quinnipiac University, CT, USA
nelson.alino@quinnipiac.edu

ABSTRACT

Prior studies have identified several interacting forces that are shaping the demand for accounting and auditing services. Chief among these forces are technology and regulation. One group of studies argue that technology driven by automation, artificial intelligence, and robotics has been a major force in the diminishing demand for humans in certain professional and service oriented jobs. Accounting and tax filing software are ubiquitous and appear to be replacing trained accountants and exerting downward pressure on the demand for accountants and tax preparers. The Sarbanes-Oxley (SOX) Act, especially section 404, requires increased disclosures and compliance by publicly and privately held companies. Several studies point to the increased hiring of accounting professionals as contributing to the high cost of compliance with SOX regulations. In light of this conflict in opinion, and relying on prior evidence of the demand reducing effect of technology, this study investigates if there is a structural change in demand for accounting and auditing services in the SOX regime proposing the year 2003 as a breakpoint. We use several breakpoint tests and forecast failure tests for this investigation. The most compelling evidence for upward shift in accounting and auditing employment due to SOX regime is provided by the Quandt-Andrews test. This test not only concluded that there is an upward structural shift during the SOX regime, but it also identified the year 2003 as the most likely breakpoint. We suggest several extensions of this study to include a test of the interacting effect of the two arguments.

Keywords: Sarbanes-Oxley Act, Section 404, demand for accounting services, structural changes, breakpoint tests, Chow test, Quandt-Andrews test, Forecast failure test.

INTRODUCTION

The demand for accounting services is not immune to technological progress. The forces that are transforming the workforce in the United States are exerting even stronger, and swifter influence, in reshaping the employment opportunities of the future. The rapid advances in computer hardware, software, networks, automation, artificial intelligence, and robotics are forever changing the labor market. In the late 20th century the effect of technological progress on employment was mainly on low-skilled office jobs and blue-collar workers in factories and other settings. Office automation, computers, and networks made it possible to replace low-skilled clerical staff, and factory automation and advanced manufacturing techniques displaced many blue-collar jobs. During the past two decades a major recommendation for displaced workers is to acquire more education and update their skills.

TECHNOLOGY AND DEMAND FOR ACCOUNTING SERVICES

In the past, unemployment created by technology is solved by the technology itself (Duernecker, 2014). Higher education and an upgrade of job skills enabled displaced employees to shift into new technology jobs. New fears of technology replacing human jobs have, however, once again taken the center stage. Brynjolfsson and MacAfee (2011) argue that despite increases in worker productivity in the U.S., employment has not increased. Until the year 2000, productivity and employment in the U.S. economy have increased in unison. Since then U.S. employment remained flat, but productivity remained on its upward trajectory. Brynjolfsson and McAfee (2011) interpret this disconnect as a new reality and project a gloomy future for U.S. employment. They offer advances in artificial intelligence, automation, and robotics as the main reason for their predictions and they expect stagnant earned incomes and growth in economic inequality. Their evidence includes Google's driverless cars, IBM's artificial intelligence machine Watson, and Rethink Robotics' industrial robot Baxter. Both office and factory jobs requiring tedious, repetitive, dangerous, and extraordinary physical or mental skills can be delegated to machines with artificial intelligence and robots. They predict that the decline in employment is not just limited to manufacturing jobs moving to China, but that even white-collar and professional and technical jobs are not immune to permanent job losses.

The recently published "Rise of the Robots and the Threat of a Jobless Future" by Martin Ford (2015) succinctly summarizes his conclusions in the title. The winner of several awards and a bestseller, the book has stark predictions for future employment prospects. Ford admits that past technological changes have greatly improved standards of living and increased employment, wages, and wealth almost universally. He argues that this time, with robots, it will be different. His dark predictions are based on 1) scientists' prediction that 47% of current jobs can be automated, 2) the current trends in labor market such as stagnant wages, increased wage disparity, falling labor share of national income, and rising unemployment are all due to increased automation, 3) falling prices of computers and increased processing power can make it more attractive to replace human workers with robots, and 4) the current technological progress in artificial intelligence as evidenced by Google's self-driving cars, IBM's Watson, cognitive computers, and flexible and adaptive Baxter robot. According to him, robotic technologies are different from previous technological innovations. The problem is that robots will be too intelligent, easily programmable, and can perform too many tasks and they will take all the jobs away from humans. Unlike the past, where technology is the solution, Ford suggests massive changes to the current economic system to cope with the job losses anticipated by the advancement of robotics and artificial intelligence. The current system of rewarding the returns of technological innovation exclusively to businesses and investors will result in a catastrophe. More education and skills upgrade will not solve problems faced by displaced workers. Ford sees that the only solution to this potential catastrophe is restructuring the economic system.

The fear that software will replace accountants has been a dominant theme for job market prognosticators for many years. The conventional wisdom is that tax preparation software will make human accountants preparing income tax filings a thing of the past. Caron (2011) in the *New York Times* suggests that accounting jobs will be replaced by software. A recent *Economist* article (Anonymous, 2015) lists the probability of job losses due to computerization in accounting and auditing occupations at 94%, a figure lower only to that of telemarketers. The statistics are in turn

based on the Frey and Osborne (2013) study listing this probability for the Bureau of Labor Statistics' occupation code 13-2011, the same occupation code analyzed in this study. They predict the probability of job losses for bookkeeping, accounting, and auditing clerks at 98%.

Despite these gloomy predictions, the latest study of enrollment and hiring by American Institute of Certified Public Accountants (2015) finds that hiring by public accounting firms increased by 7%, reaching record levels. Almost all respondents expect the trend to continue. Enrollments in accounting programs are also at record levels and most educational institutions are expecting a steady increase in undergraduate and master's programs.

How do we reconcile the gloomy predictions of future demand for the accounting profession and the current surveys that report a healthy demand and forecast for accounting services? A first explanation for the incongruency of these two predictions is that the prediction horizon is vastly different for these two forecasts. Brynjolfsson and McAfee (2011), Ford (2015), and Frye and Osbourne (2013) are making projections of labor markets several decades into the future, whereas the AICPA (2015) assessment of the current reality has a much shorter forecast horizon. The incongruency is resolved as both forecasts may be valid for their respective time horizons. Secondly, the bleak forecasts of employment probably commit the fallacy of composition arising from inferring about the whole (economy) based on what is observed for some part of the whole [one, or few business(s)]. This logical fallacy goes as follows: If I and everybody I know use tax software to file income taxes, everybody in the United States must also be using tax software to file their taxes. Hence no future need for human tax preparation. Finally, Van Reenen (1997) points out that ignoring the output expansion effect may lead to wrong predictions for future labor demand. That is, technology may reduce the labor inputs needed to generate a given level of output, but technological innovation is also expected to increase the level of output due to its effect on cost, quality, and customizability of products.

The recent work by Bessen (2015) offers hope that technology will not reduce employment, but rather will create opportunities for employment of new skills. In his view information technology is displacing workers not replacing them. Using U.S. Bureau of Labor statistics, he dispels the notion that technology replaces jobs. Despite a large growth in automatic teller machines (ATM), employment for bank tellers increased by 123,440 jobs during the years between 1999 to 2009. Contrary to conventional wisdom, an increase of 300,000 ATMs during that period did not reduce the demand for human tellers. In fact, there was an increase in the number of human tellers. Armchair theorizing would have suggested a drastic decline in employed bookkeepers and accounting and auditing clerks due to the widespread use of accounting and tax filing software. On the contrary, during the 11-year period between 1999 and 2009, the demand for these occupations increased by 138,000.

SARBANES-OXLEY ACT AND DEMAND FOR ACCOUNTING SERVICES

Financial scandals, corporate excesses, and executive greed led to the collapse of several multibillion-dollar companies in the early 2000s. The implosion of Enron, WoldCom, and Tyco during that time rattled investor confidence in the accounting and auditing profession. Without investor confidence in the financial reporting process, the capital markets may not function efficiently. The bankruptcy of Enron, once valued at U.S. $70 billion, had a major impact on the

credibility of the accounting profession. Criticism of U.S. disclosure practices and the competence and integrity of independent auditors intensified (Thomas, 2002).

Congress enacted the Sarbanes-Oxley (SOX) Act of 2002 in response to these corporate scandals and in order to rebuild the public's trust in corporations. President George W. Bush signed the SOX Act, officially named the Public Company Accounting Reform and Investor Protection Act of 2002, into law on July 30, 2002. SOX has had a far-reaching impact on the accounting profession. The SOX regulations require increased disclosures and compliance by publicly and privately held companies. Foreign companies that listed on U.S. stock exchanges must also comply with the regulations. Even not-for-profit organizations have to comply with two provisions that prohibit retaliation against whistleblowers and destruction, alteration or concealment of certain documents or the impediment of investigations.

Some of the important provisions of SOX are listed below. Coates (2007) provides more details.

- Establishes the Public Company Accounting Oversight Board.
- Prohibits auditing firms from performing specified non-audit services to audited companies.
- Requires senior management to certify the accuracy of annual and quarterly financial reports. Requires the SEC to review every public company's financial statements at least once every three years. Mandates "real time" disclosures of material changes in the financial condition or operations of an issuer.
- Requires disclosure of off-balance sheet transactions.
- Establishes protection for whistleblowers.
- Requires management to assess the effectiveness of internal controls over financial reporting and auditors to attest to management's representations.

The last provision, refereed to as Section 404 of SOX, has important impact on the demand for accounting services and accounting employment. Section 404 requires issuers financial statements to publish information in their annual reports about the scope and adequacy of the internal control structure and procedures for financial reporting. This statement should also assess the effectiveness of such internal controls and procedures. In addition, the audit firm, in the same report, should attest to and report on the assessment on the effectiveness of the internal control structure and procedures for financial reporting.

The Public Company Accounting Oversight Board (PCAOB), which was created by SOX act to oversee the auditing profession, has adopted standards requiring audit firms to disclose 1) internal control test methodology and results; 2) material weaknesses not disclosed by a firm's officers; and 3) whether a system is effectively providing the required reasonable assurances. Coates and Srinivasan (2015) conduct a meta-research of costs and benefits of SOX legislation. They review over 120 research studies and summarize that the quality of corporate financial reporting has improved. Although the costs of compliance due to SOX are substantial, on the positive side, they are declining. Coates and Srinivasan did not find convincing evidence for expected negative consequences of SOX legislation. In particular, their research did not find evidence of reduced initial public offerings, reduction of foreign listings, and reduction in risk-taking by American businesses.

Cost of complying with SOX. A very important provision of SOX is Section 404, which requires management to report on internal control structure and procedure and the auditor's to attest the report. The cost of compliance with SOX legislation is often its main criticism (Coates and Srinivasan, 2015). Section 404 compliance costs are grouped as 1) Section 404 audit costs; 2) outside vendor costs; 3) internal labor costs; and 4) non-labor costs (Krishnan, Rama, and Zhang, 2008). A 2009 SEC survey (SEC, 2009) reports the average SOX Section 404 annual compliance costs for the year 2007 as follows (rounded to the nearest '000s): 1) audit costs US$650,000; 2) outside vendor costs $311,000; 3) Internal labor costs $1,347,000; and 4) non-labor costs 138,000,; resulting in a total cost of U.S. $2,330,000. These costs are for section 404 compliance only and do not include non-section 404 audit fees. These numbers are averages and they depend on the size of the reporting firm. The total section 404 compliance costs for the companies with float less than $75 million, between $75 million to $700million, and over $700 million are $690,000, $1,011,000, and $3,986,000, respectively. Many other studies report costs similar to that of the SEC study. The Financial Executives International study (FEI (2005)) reports incremental annual audit fee for large companies at $1.3 million and annual internal and external labor costs of section 404 compliance at $ 3.1million. Other surveys report compliance costs similar to the figures provided here (Coates and Srinivasan, 2015).

The additional expenses and additional demand for accounting services are not limited to section 404 requirements. The annual budget of the PCAOB for the year 2014 is over $235 million and the broker-dealer auditor inspection program and other inspection-related activities account for a significant portion of the budget. Nearly 60% of the budget is for registration and inspections, and enforcement. A major component of PCAOB's activities requires accounting and auditing services. Nearly 80% of the PCAOB annual budget is for personnel costs (PCAOB, 2014). SOX also has had an impact on the SEC budget and the hiring of accounting professionals. The fiscal year 2003 appropriations were $278 million higher than for year 2002 (the year of the SOX act enactment).

The additional funding was used to hire 842 new staff to 1) review financial statements of each registrant once every three years; 2) provide enhanced enforcement programs; 3) review investment advices; and 4) conduct broker-dealer and branch-office examinations (Donaldson, 2003). Coates and Srinivasan (2015) provide details of the levels and trends of the PCAOB and SEC budgets as a consequence of SOX. SOX has generated additional demand for accounting and auditing services from many sources: domestic and foreign business enterprises trading in the U.S. capital markets and subject to SOX regulations; auditing firms with clients subject to SOX regulations; and regulators, including the PCAOB and SEC. Based on the cost estimates provided in this section, the impact on additional accounting and auditing services is significant.

RESEARCH QUESTIONS

Previous sections provided detailed arguments for new forces shaping the demand for accounting and auditing services. Technology driven by automation, artificial intelligence, and robotics diminish the need for humans providing these services. Prognosticators provide widespread use of tax filing software and accounting software, and the general agreement that accounting and auditing services are among the services most affected by the technology. As argued in the previous section, the SOX regulation is creating significant demand for SOX-related compliance work.

These two shifts – technology and regulation – are exerting opposing forces on accounting employment. What is the net effect? Will they be offsetting or which affect will prevail? There is little evidence, beyond enrollments in accounting programs and hiring by public accounting firms (AICPA, 2015), available to show how these forces are shaping the demand for accounting services. In this study we analyze data from the U.S. Bureau of Labor Statistics and U.S. Bureau of Economic Analysis to investigate whether SOX has a significant affect on the demand for accounting services. The focus of this research is the investigation of possible structural change in the SOX regime starting in the year 2003. A problem we need to resolve is what the effective date of implementation of SOX is. This simple question has very complicated answers. A very broad answer is that the SOX filings apply to the semi-annual or annual financial statements due after August 14, 2003. However, the first filing day is affected by many factors including 1) whether the filer is of domestic or foreign origin; 2) whether the filer is classified as an "accelerated filer;" 3) whether the filer is a registered investment company; 4) the market capitalization of the company; and 5) the disclosure requirements of Section 404 of the SOX act. For a certain large class of filers, the first SOX compliance begins at the fiscal year ending after August 14, 2003. Even more complications arise in determining the effective date because of the SEC's changes to the first compliance date of SOX filings. Iliev (2010) provides further details on the complexities of determining the dates of the first SOX compliance filings. In our study we consider years up to 2002 as the pre-SOX regime and 2003 and later as the post-SOX regime. There are several reasons for this choice. First, many companies filed SOX Section 404 complaint disclosures in 2003. Second, almost all companies started reacting to the disclosure requirements of Section 404 by revamping their internal control and accounting reporting systems in the year 2003. Another overwhelming evidence is that the SEC's budget appropriations increased by nearly 45% in the year 2003, mainly to handle increased investigation and enforcement actions due to SOX. To summarize, this study investigates if there is a structural change in the demand for accounting and auditing services in the SOX regime starting in the year 2003.

METHODOLOGY

To understand the effect of the SOX act on the demand for accounting services, we test for structural changes in the regression function explaining the employment of accountants and auditors in the pre- and post-SOX regimes. The effective date of SOX varies according to the the sections of the SOX act. Important provisions of SOX are Section 404(a), which require an internal control report by management discussing the effectiveness of the company's internal control structure and procedures for financial reporting, and Section 404(b), which requires that the auditor's report on the effectiveness of the company's internal controls. For large publicly held corporations, Section 404 is effective for the fiscal years ending in late 2003. Based on these effective dates, we consider years 2002 and before as the pre SOX regime and 2003 and after as the SOX regime.

The methodology of the study consists of building a model for annual accounting and auditing employment levels and testing if there is a structural change in the model due to the SOX regime. The date of the structural change is considered the breakpoint in accounting for the structural change. At a very abstract level the study investigates if there is a breakpoint in the year 2003 in the regression function estimating the demand for accounting and auditing services. This question can be investigated at varying levels of sophistication. A simplistic approach uses a dummy

variable regression to account for the structural break. A dummy variable allows for a shift in the levels in the response variable, but the effect of explanatory variables on response remains the same in both regimes. A more general approach allows for both levels (intercept) and the effect of explanatory variables (slopes) to vary across the regimes. In effect, two separate regressions are run for each regime. If there is no structural change in the regression function, both intercept and slope should be the same in both regimes. This comparison is implemented as a Chow test. The idea of the Chow test is simple. Run separate regressions for each regime and compare the combined sum of squared errors with the sum of squared errors of single regression for the entire period. If the two separate regime regressions considerably reduce the error sum of squares, appropriately adjusted for degrees of freedom, the assumption of structural change is supported. The Chow test statistic has a standard F distribution and we can easily test for structural change.

The first complication arises if the time periods in either regime are not sufficient for a separate regression models. In these circumstances Chow's predictive failure test will help. In this test, the sum of squared regression errors for a regression covering the entire sample period is compared with the squared regression errors for the model fit only for the longer subperiod. Comparing this ratio, after making the degrees of freedom adjustments, standard F statistic, provides the appropriate test for detecting parameter instability. If the longer regime happens to be more recent, the test uses the more recent data to "backcast" to earlier data.

Another significant enhancement to Chow's breakpoint test is the Quandt-Andrews breakpoint test, where the date of breakpoint is not assumed. Instead, every period in the substantial middle portion of the sample period is tested for a possible breakpoint and log likelihood and Wald statistics are computed. That is, every period during the sample period of the data is a potential breakpoint and Chow's F-statistic is computed for every one of the potential breakpoints. Unlike in the case of Chow test, now we have a proliferation of test statistics. Quandt-Andrews test combines all these test statistics three different ways: 1) maximum of the individual F-statistics (called Max-F, or sup Wald Statistic); 2) sum of exponential transformations of individual F-statistics; and 3) simple average of these statistics. These three summary statistics do not have standard F-distribution. However, select econometric software provides asymptotic distributions based on published results. An important strength of the Quandt-Andrews test is its ability to detect potential breakpoints, test them for significance, and identify the most likely breakpoint. These three test results within the Quandt-Andrews test, combined with identifying 2003 as the most likely break date should give the strongest evidence that SOX act has significantly altered the demand for accounting services and that there is a structural changes in the demand for accounting services.

DATA AND DATA SOURCES

The data for the study is obtained from two sources, 1) the U.S. Bureau of Labor Statistics and U.S. Bureau of Economic Analysis. Occupational Employment Statistics (OES, 2015) for accountants and auditors were obtained for the years 1997 to 2014. These detailed statistics are not available for years prior to 1997. Several aggregate statistics for the U.S. economy were obtained from BEA, 2015. The following table summarizes the data items we have analyzed and their sources. Due to the high degree of collinearity between the variables, not all data were utilized in the models analyzed.

Table 1. Data Sources

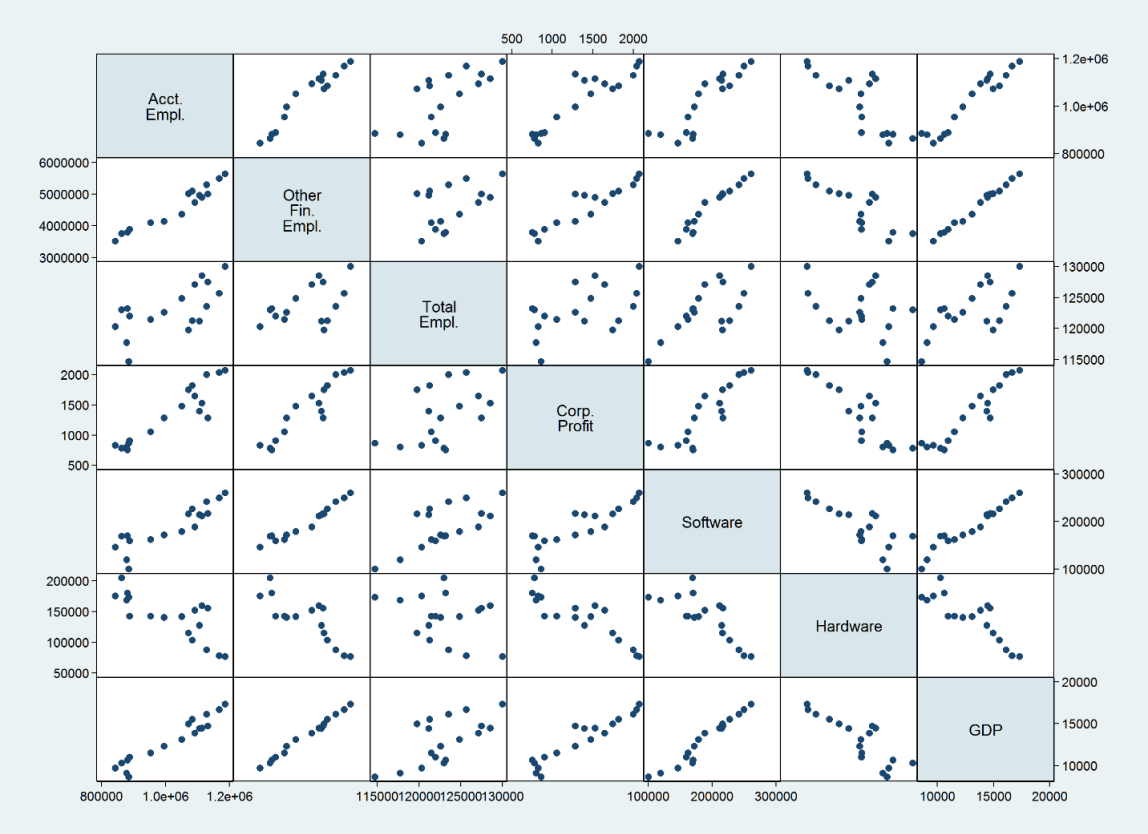
Variable	Description	Data Source
lacc	Log of employment accountants and auditors. Occupation code 13-2011	Bureau of Economic Statistics
loth	Log of employment of business and financial operations excluding accountants and auditors. Occupation code 13-000 less occupation code 13-2011	Bureau of Economic Statistics
ltot	Log of employment of all occupations. Occupation code 00-0000.	Bureau of Economic Statistics
lhard	Annual use of commodities. Input-output code 334. In millions of $	Input Output Tables. Bureau of Economic Analysis
lsoft	Annual use of commodities. Input-output code 5415. In millions of $	Input Output Tables. Bureau of Economic Analysis
lprofit	Table 6.16D. Corporate Profits by Industry: Annual corporate profits with inventory valuation and capital consumption adjustments in billions of dollars	Bureau of Economic Analysis
lcurGDP	Log of current annual GDP In billions of dollars. Table 1.1.5	National Economic Accounts, U.S. Department of Commerce, Bureau of Economic Analysis

Descriptive statistics are summarized in Table 2. Figure 1 shows a lattice graph of data analyzed in the study and provides justification for the exclusion of some variables in the static model we developed below.

Table 2. Descriptive Statistics

	Accounting and Auditing	Other Financial	Total Employment in Thousands	Corporate Profit in $Billions	Hardware Use in $Millions	Software Use in $ Billions	Current GDP in $ Billions
Mean	1018522	4604079	123020	1349.3	140383.2	189283.9	13013.4
Median	1061855	4816835	122797	1341.05	142818.5	183607.5	13474.8
Maximum	1187310	5641630	129971	2072	204613	261071	17348.1
Minimum	843160	3518820	114723	754	76593	100470	8608.5
Std. Dev.	118795.2	670404.5	3832.7	466.5	36390.0	44041.0	2722.0

Figure 1. Lattice Graph of Variables Analyzed



ANALYSIS AND RESULTS

Initial Models for Accounting Employment. First we construct two models, one static and one dynamic, to explain the levels of accounting and auditing employment. These models are not nested in that the explanatory variables of one model are not the subset of another model. If the clear choice of the preferred model is not obvious, Akaike Information Criteria (AIC) and MacKinnon's J test are used to select one model from these models. The selected model is further analyzed in the next section to test for structural shifts in the model.

The best fitting parsimonious static model is:

$$E(lacc|.) = \underset{(.985)}{.2384} + \underset{(.165)[0.0]}{1.1994} \times loth \; - \underset{(.139)[0.014]}{.3925} \times lsoft$$

Adjusted R^2 = .958 and AIC = -4.481, sample size = 19

The numbers below the coefficients in parentheses are standard errors of the coefficients and those in the square brackets are p-values. As expected software utilization has a significant negative effect on the employment for accounting and auditors. The elasticity of accounting and auditing employment is nearly 1.2; indicating that a 1% increase in other financial professional jobs is associated with a 1.2% increase in accounting and auditing jobs. The Ljung-Box Q statistic up to

10 lags shows no signs of residual autocorrelation. More details of this Q statistic and other tests we use throughout the paper are available in Davidson and MacKinnon (2003).

The best fitting dynamic model is:

$$E(lacc_t \mid .) = \underset{(.64)[.01]}{1.89} + \underset{(.20)[0.0]}{.91 \times lacc_{t-1}} - \underset{(.16)[0.0]}{.59 \times lacc_{t-2}} + \underset{(.12)[0.0]}{.50 \times loth}$$

Adjusted R^2 = .974 and AIC = -4.924, sample size = 19

In this dynamic model subscripts to *lacct* indicate that two lags of *lacct* are included as explanatory variable. The elasticity of nonfinancial employment has reduced, but still has significantly positive effect. Ljung-Box Q statistic for 10 lags shows no signs of residual autocorrelations and Durbin-Watson statistic of 1.83 confirms it.

The fit has improved over the static model and since these two models are non-nested, comparing the AICs indicates that the dynamic model is the preferred model. Davidson-MacKinnon (1981) J test confirms the selection of the dynamic model for further analysis. Augmenting the dynamic model with fitted response variables from the static model leads to p-value for testing the coefficient of fitted values of .12. The reverse procedure of testing for coefficient value of zero for dynamic fitted values in the static regression leads to a p-value of .021. The J-test also confirms that the dynamic model is superior.

Breakpoint Tests. Results of several breakpoint tests for structural changes are presented next.

Simple dummy variable regression. The first breakpoint test we perform is very simple dummy variable regression. We augment the model dynamic model chosen above with a simple dummy variable for the SOX regime. A significant coefficient of the dummy variable suggests that there is a shift in the employment level for accountants and auditors during the SOX regime. This test is rather simplistic, but often used in the literature to test consequences of regime shifts. This test is provided here to complement the following tests. The results of the model are given below.

$$E(lacc_t \mid .) = \underset{(.64)[.00]}{3.78} + \underset{(.14)[0.0]}{.69 \times lacc_{t-1}} - \underset{(.12)[0.0]}{.43 \times lacc_{t-2}} + \underset{(.08)[0.0]}{.42 \times loth} + \underset{(.01)[.00]}{.05 \times SOX}$$

As in the previous equations, the numbers in the parentheses are standard errors. The numbers in square brackets show the p-values of coefficients above them. The coefficient and p-value of SOX regime clearly suggest that there is an upward trend in accounting and auditing employment during the SOX regime.

Chow Test for known breakpoint. Table 3 shows the results of Chow's breakpoint test with the breakpoint in year 2003. All three tests reject the null hypothesis that there is no breakpoint in the year 2003. The last column shows that all three tests reject the null hypothesis at the conventional α value of .05.

Table 3: Chow Test

Statistic	Statistic Value	p-value
F-Statistic – F(4,8)	4.47	0.03
Log likelihood Ratio - $\chi^2(4)$	18.77	0.00
Wald Statistic - $\chi^2(4)$	17.86	0.00

Quandt-Andrews unknown breakpoint Test. The strongest confirmation of our result is this test pointing to the most likely breakpoint as the year 2003 – the first year of SOX act implementation. All three tests – maximum, exponential sum, and average of individual F-statistics – show the year 2003 as the most likely and significant breakpoint. It is common to allow for a 15% trimming of the data in this test. Because of the relatively small sample size, and trimming of data, the degrees of freedom are limited to test all coefficients together. We test the subsets of coefficients to the conserve degrees of freedom. The results of this test are summarized in Table 4.

Table 4: Quandt-Andrews Tests

Coefficients Tested	Statistic	Test Statistic	Year of Break Point	p-value
Const, $lact_{t-1}$	Max LR F-Stat	10.63	2003	0.00
Const, $lact_{t-1}$	Exp LR F-Stat	3.08		0.00
Const, $lact_{t-1}$	Average LR F-Stat	3.18		0.01
Const, loth	Max LR F-Stat	6.94	2003	0.018
Const, loth	Exp LR F-Stat	2.33		0.01
Const, loth	Average LR F-Stat	3.75		0.00
$lact_{t-1}$, loth	Max LR F-Stat	7.89	2003	0.00
$lact_{t-1}$, loth	Exp LR F-Stat	2.02		0.02
$lact_{t-1}$, loth	Average LR F-Stat	2.58		0.03

Along with the other tests, the Quandt-Andrews test provides the most compelling evidence of structural changes in the demand for accounting and auditing services. All three tests reject the null hypothesis of no breakpoint unequivocally at the conventional α level of .05. This test not only concluded that there is a structural shift during the SOX regime, but it also identified the year 2003 as the most likely breakpoint.

Chow's forecast failure test. Since the longer of the two regimes is the SOX regime consisting of the years 2003 to 2014, the dynamic model for these years is estimated and "backcasts" for the years 1997 to 2002 are predicted. Using Chow's predictive failure test we obtain a likelihood ratio test statistic of 24.534 with five degrees of freedom. The null hypothesis of no breakpoint is rejected with a p-value of .0002.

All the above tests unequivocally confirm that there is a structural shift in the demand for accounting services and that the break occurred in the year 2003, the beginning of SOX enforcement.

CONCLUSIONS

Considering evidence from prior research that the proliferation of technology and innovations in software development is likely to put downward pressure on the demand for accountants and auditors among other service jobs, we explored in this study the possible interaction of the structural positive change in demand for accountants realized as a result of changes in regulation, especially the effect of the SOX. SOX regulations require increased disclosures and compliance by publicly as well as privately held companies. Several studies also indicate that there has been an increase in the hiring of accounting professionals due to the need for compliance with SOX regulations.

We analyzed the demand for accounting and auditing services during the SOX regime starting in the year 2003. Several breakpoint tests and forecast failure tests are used in this investigation. We selected the dynamic model with two lags of employed accounting professionals and other (non-accounting) financial professions as explanatory variables. This model provided an excellent fit for the data. The Chow test with the known breakpoint in the year 2003 strongly suggested that demand for accounting has greatly increased in the SOX era. The most compelling evidence for structural change due to the SOX regime is provided by the Quandt-Andrews test. This test not only concluded that there is a structural shift during the SOX regime, but it also identified the year 2003 as the most likely breakpoint. The dummy variable test and Chow's predictive failure test also strongly confirm a structural break in the demand for accounting services in year 2003 – the first year of SOX enforcement. A limitation of our model is the availability of employment statistics by occupation for the years 1996 and before. A potential extension of the study is to find reliable occupational data for the years 1996 and before and replicate the study. Another extension of our study could involve exploring the likely interaction effect of the opposing forces of technology and regulatory changes on the demand and supply of accountants and auditors.

REFERENCES

AICPA (2015). Trends in the supply of accounting graduates and the demand for public accounting recruits. AICPA study. Retrieved from https://www.aicpa.org/InterestAreas/AccountingEducation/NewsAndPublications/DownloadableDocuments/2015-TrendsReport.pdf

Brynjolfsson, E., & McAfee, A. (2011). *Race against the machine: how the digital revolution is accelerating innovation, driving productivity, and irreversibly transforming employment and the economy*. Digital Frontier Press.

Bessen, J. (2015). Learning by Doing: *The real connection between innovation, wages, and wealth*. New Haven, CT: Yale University Press.

Caron, P. (2011, March 5). Software is replacing lawyers, accountants. *New York Times*.

Coates, J. C. (2007). The goals and promise of the Sarbanes–Oxley act. *Journal of Economic Perspectives*, *21*(1), 91–116.

Coates, J. C., & Srinivasan, S. (2015). SOX after ten years: a multidisciplinary review. Accounting Horizons, *28*(3), 627-671.

Donaldson, W. H. (2003). "Testimony concerning implementation of the Sarbanes-Oxley act of 2002." Testimony before the senate committee on banking, housing and urban affairs, September 9, 2003.

Davidson, R., & J. MacKinnon (1981). Several tests for model specification in the presence of alternative hypotheses. *Econometrica*, *49*(3), 781-793.

Davidson, R., & J. MacKinnon (2003). *Econometric theory and methods*. London, UK: Oxford University Press.

Duernecker, G. (2014, June). Technology adoption, turbulence, and the dynamics of unemployment. *Journal of the European Economic Association*, *12*(3), 724-754.

FEI. (2005). Sarbanes–Oxley compliance costs exceed estimates, financial executives international report. Retrieved from http://fei.mediaroom.com/

Ford, M. (2015). *Rise of the robots technology and the threat of a jobless future*. New York, NY: Basic Books.

Frey, C.A., & Osborne, M.A. (2013). The future of employment: how susceptible are jobs to computerisation. Unpublished working paper retrieved from http://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf

Iliev, P. (2010). The effect of SOX section 404: costs, earnings quality, and stock prices, *Journal of Finance 45*, 1163-1196.

Krishnan, J., Rama, D., & Zhang, Y. (2008). Costs to comply with SOX section 404. *Auditing: A Journal of Practice and Theory*. *27*(1), 169-186.

PCAOB (2014). Public Company Accounting Oversight Board – Annual report 2014. Retrieved from http://www.pcaob.org

SEC. (2009). Study of the Sarbanes-Oxley Act of 2002 section 404 internal control over financial reporting requirements. Retrieved from https://www.sec.gov/news/studies/2009/sox-404_study.pdf

Thomas, C. W. (2002). The rise and fall of Enron when a company looks too good to be true, it usually is. Journal of Accountancy, *193*(4), 41-47.

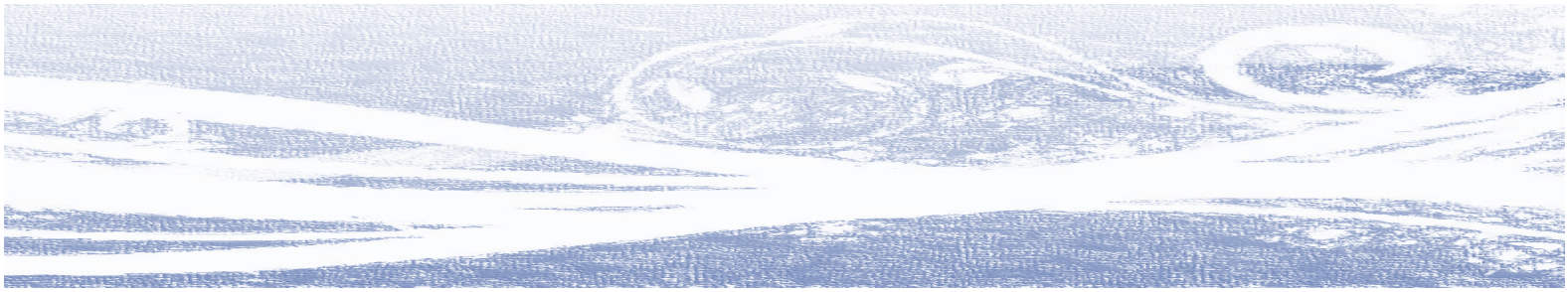
Van Reenen, J. (1997). Employment and technological innovation: evidence from U.K. manufacturing firms, *Journal of Labor Economics*, *15*(2), 255-284.

QRBD

QUARTERLY REVIEW OF BUSINESS DISCIPLINES

February 2016

Volume 2
Number 4



A JOURNAL OF INTERNATIONAL ACADEMY OF BUSINESS DISCIPLINES
SPONSORED BY UNIVERSITY OF NORTH FLORIDA
ISSN 2334-0169 (print)
ISSN 2329-5163 (online)