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MIDWESTERN BUSINESS AND ECONOMIC REVIEW

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ABSTRACTS

SELF-INSURANCE FOR WORKERS' COMPENSATION LOSSES AMONG COLLEGES AND UNIVERSITIES IN PENNSYLVANIA

This paper investigates the characteristics of institutions of higher education that have self-insured for workers' compensation (WC) losses. Using data on Pennsylvania colleges and universities, this research indicates that self-insurers employ 66 percent of the total workforce in the higher education sector, a sector characterized by a low risk of occupational injuries. The principal finding is that the use of self-insurance is positively and significantly related to the riskiness of institutions after controlling for the size and organizational factors. Institutions with a higher proportion of employees hired as other professionals and nonprofessionals prefer self-insurance to market insurance for WC risk.

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SELF-INSURANCE FOR WORKERS' COMPENSATION LOSSES AMONG COLLEGES AND UNIVERSITIES IN PENNSYLVANIA

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I. INTRODUCTION

Workers' compensation (WC) liability is one of the major operating risks that employers in the United States have to handle. Employers can finance their WC risk either by purchasing market insurance or using self-insurance as an alternative risk-financing mechanism.[1] That is, self-insurance serves as a substitute for market insurance (Ehrlich and Becker, 1992), allowing self-insurers to retain their WC risk by putting a self-insurance program in place. In 2011, self-insured employers paid $24 out of every $100 of WC benefits paid in the United States (Sengupta et al., 2013). Self-insurance is most prevalent in WC risk management—and it accounts for about three quarters of the total alternative risk transfer market (Holzheu et al., 2003). Thus, an investigation into the use of self-insurance for WC losses can shed light on how alternative risk transfer techniques help institutions manage risk.

Culp (2006) suggests that a self-insurance structure not only avoids the load associated with traditional insurance (e.g., insurer overhead, insurer profit, broker commission, and state premium taxes), but also brings immunity to any costs associated with asymmetric information (e.g., adverse pricing). For self-insurers, the financial responsibility for WC losses falls on themselves rather than on insurance companies. There is a cultural shift between employers who buy market insurance and those who self-insure for WC risk, and the latter can exercise better control over claims.[2] A firm's decision to self-insure can be influenced by factors at both the macro and micro levels. Previous studies based on state-level analysis have linked self-insurance for WC risk to a number of economic factors, such as high WC insurance costs, industry affiliation, high frequency and low severity of loss, and a cross-subsidy effect caused by the residual market (e.g., Butler and Worrall, 1993; Carroll, 1994; Chang and Weiss, 2011; Harrington and Danzon, 2000; Danzon and Harrington, 2001; Kwon and Grace, 1996). In addition, a few empirical studies have investigated the characteristics of self-insurers at the firm level. Chang (2008, 2013a) shows that self-insurance is widely used by certain healthcare providers—self-insured hospitals and nursing home facilities tend to be nonprofit entities. On the other hand, publicly owned manufacturers are more likely to self-insure than their privately owned counterparts, and self-insurance is particularly prevalent in some manufacturing subsectors such as nonmetallic mineral, petroleum and coal, and primary metal (Chang, 2013b). In order to provide a better understanding of how individual employers in other industries use self-insurance to mitigate WC losses, this study analyzes the characteristics of colleges and universities in Pennsylvania (PA) that have self-insured for WC risk.

This study examines the incentives institutions of higher education in PA choose to self-insure for WC. Colleges and Universities have been selected as the subject because their workplaces are, in general, subject to a very low level of occupational risk.[3] That is, employees in institutions of higher education experience fewer work-related injuries and illnesses than do most workers in other industries according to the Bureau of Labor Statistics. By contrast, some workplaces such as hospitals, nursing homes, and manufacturing companies are subject to a high risk of occupational injury, and self-insurance is instrumental in dealing with WC losses among these establishments, according to Chang (2008, 2013ab). College and universities are distinguished from healthcare and manufacturing employers by the services they offer and the WC loss exposures they face. As a result, the higher education sector offers a potential stepping stone for a better understanding of U.S. self-insurers in diverse industries because universities may suggest different incentives for self-insurance. That is, this study can not only provide insight into the motivation to self-insure among universities in the low-risk education sector. It can also generate a comparison between institutions of higher education and employers in healthcare and manufacturing sectors as the former and latter encounter different levels of occupational injury risk. As Butler and Worrall (1993) assert, understanding why firms choose to self-insure is important because this decision process offers an example of how firms make choices in the midst of uncertainty. That is why it is valuable to examine how individual institutions of higher education make insurance decisions in the face of WC liability.

This empirical analysis of self-insured universities uses data from the *2010 Pennsylvania Colleges and Universities Profiles*. The self-insurance status of each manufacturer was verified by the Self-Insurance Division of the PA Bureau of Workers' Compensation. The regression model used for the analysis has a binary dependent variable: one if a university is self-insured, zero otherwise. A logistic regression on cross-sectional data has been employed to empirically examine the characteristics of self-insured colleges and universities that have self-insured for WC losses. An institution's decision to self-insure is hypothesized to be related to some institution-level factors, such as size, riskiness, and organizational structure.

The results of the logistic regressions suggest that universities' decision to use self-insurance is related to three factors: the size of the institutions, their public attribute, and the institutional riskiness where the level of riskiness is proxied by the proportion of the employees who are employed as other professionals or nonprofessionals (i.e., those who are not classified as faculty

or executive, administrative and managerial staff.).[4] Large institutions are more likely to self-insure for WC losses since they have a large number of workers, making risk sharing more efficient. Compared with their private counterparts, public universities are more likely to self-insure. In particular, the use of self-insurance is linked to the institutions with a higher ratio of non-faculty and staff to total workforce. That is, self-insurance is more likely to be adopted by universities when other professionals and nonprofessionals account for a larger share of total employees in an institution. Other professionals and nonprofessionals are more vulnerable to work-related injuries and illnesses than faculty and staff. After controlling for the size of institutions and their organizational structure, this finding encourages one inference: the level of riskiness confronted by institutions of higher education plays a critical role in the selection of self-insurance.

This study contributes to the literature in two ways. First, this research offers a window into why certain institutions of higher education self-insured for WC liability. The results of this work complement previous research based on health care and manufacturing sectors. Second, this paper breaks new ground by showing how colleges and universities in the low-risk education sector manage their WC loss exposure by means of self-insurance. Despite the fact that the educational services sector is exposed to a very low risk of occupational injuries, numerous universities choose self-insurance over market insurance. Self-insured universities employ approximately 66 percent of the total workers in institutions of higher education in PA.

The remainder of this paper is organized as follows. Section two provides a brief overview of self-insurance for WC liability. Section three discusses the theoretical background of this research and develops hypotheses concerning institution-specific factors that may affect the decision to self-insure. Section four describes the methodology, data, and results of the study. This paper concludes with Section five, which summarizes its findings and suggests avenues for future research.

II. WORKERS' COMPENSATION AND SELF-INSURANCE

The objective of workers' compensation (WC) is to compensate for on-the-job injuries and illnesses suffered by employees. As a part of the American social insurance system embedded in each state's law, WC coverage is mandatory in all states but Texas and Oklahoma (Sengupta et al., 2013). Employers usually bear the full cost of WC coverage. They have two choices about how to finance their WC losses: they can buy insurance coverage from private carriers or state funds, or they can self-insure on an individual or group basis.

Self-insurance offers several potential benefits over market insurance. Chang and Weiss (2011) maintain that the primary driver for self-insurance is its capacity to lower costs and mitigate inefficiencies in the WC insurance market (e.g., the high transaction costs of dealing with the insurance industry related to adverse selection, moral hazard, and other imperfections). The fundamental rationale behind self-insurance is the belief that it will be less expensive in the long run (Vaughan, 1997, p. 323). Unlike market insurance, self-insurance allows an employer to retain financial responsibility for paying and administering the WC benefits due to its injured employees, rather than transferring that responsibility to an insurance carrier.[5]

III. THEORETICAL BACKGROUND AND HYPOTHESES

This research investigates several characteristics of colleges and universities that appear to affect their decision whether to self-insure: size, riskiness, and organizational structure. Butler and Worrall (1993, p. 132) suggest that the choice between self-insurance and market insurance hinges on which is cheaper for the firm, and some firms are able to implement self-insurance more efficiently than buying market insurance, in the sense that they give up relatively less income when protecting themselves against future losses. In view of low nonfatal WC injury incidence rates that may lead to low premiums for WC insurance, institutions of higher education seem to be more likely to purchase market insurant rather than self-insure. However, some may be economically stimulated to adopt a risk-financing alternative in hope of dealing with WC losses more effectively. Thus, an examination of institution-specific factors does much to explain why certain universities select self-insurance over market insurance.

Self-insurers tend to be large in size (Chang and Weiss, 2011; Chang, 2008, 2013ab; Thomason et al., 2001; Baranoff, 2000; Kwon and Grace, 1996; Carroll, 1994). Institutions with a large number of employees have the benefit of risk sharing. They should be in a better position to predict expected losses and pay incurred losses out of their funded reserves. Moreover, self-insurance is contingent on the approval of the state regulatory authority. Financial capacity, thus, substantially determines whether an employer will be permitted to self-insure. In addition, large firms are more likely to experience the cost-efficiency of administering a self-insurance program. Since the cost of maintaining self-insurance for WC losses in accordance with state requirements is a considerable investment, small companies may struggle to justify the expense. Hence, the first hypothesis is formulated as:

H_1: *The selection of self-insurance is positively associated with the size of institutions.*

The level of riskiness may also influence an institution's decision to self-insure. WC losses usually involve a high frequency of low-cost claims (Sengupta et al, 2012). This characteristic of WC can help large employers estimate and budget for their WC costs in their self-insurance programs. Chang and Weiss (2011) conclude that states with relatively high-frequency but low-severity WC losses are associated with a higher self-insurance share. Carroll (1994) also finds that higher injury rates are associated with greater usage of self-insurance in a state. In addition, the riskiness of firms can be reflected in the cost of insurance, given that employers with higher actual loss experience are charged higher premiums for WC coverage. Baranoff (2000) concludes that loss experience contributes positively to the selection of self-insurance. Thus,

the decision whether to self-insure may be heavily affected by the riskiness of institutions of higher education. This leads to the second hypothesis:

H_2: *The selection of self-insurance is positively associated with the riskiness of institutions.*

In addition, the self-insurance decision may be affected by the organizational structure of an institution. In the higher education sector, colleges can be either public or private. Public schools are those that are largely supported by state funds. Private schools, on the other hand, are mainly supported by tuition, endowment, and donations from alumni and friends. As a result, the decision process for risk financing techniques may distinguish public institutions from private ones. The last two hypotheses state:

H_{3a}: *The selection of self-insurance is positively associated with public institutions.*

H_{3b}: *The selection of self-insurance is positively associated with private institutions.*

IV. DATA, METHODOLOGY, AND RESULTS

Data and Sample

This empirical analysis of self-insured institutions of higher education employs the *2010 Pennsylvania Colleges and Universities Profiles,* compiled by the Pennsylvania Department of Education. The sample consists of 92 institutions. The original database contains the profiles of 178 individual institutions. Individual institutions belonging to the same system are consolidated to form one independent observation in the analysis. For example, the Pennsylvania State System of Higher Education comprises 14 individual campuses. The Pennsylvania State University System is composed of 24 campuses, while the University of Pittsburgh system consists of 5. This process results in 93 observations. The consolidated institutions are used rather than the individual ones because the former provide a more accurate picture of the characteristics of the total organization. As a result of missing values for one institution, 92 observations are eventually included in the analysis. The self-insurance status of each institution was verified by the Self-Insurance Division of the PA Bureau of Workers' Compensation.[6] The use of the college-level data in PA provides a snapshot of how institutions of higher education located in this jurisdiction manage their WC loss exposure.

Methodology

This study applies a logistic regression model to examine the characteristics of self-insurers for WC losses in the PA higher education sector. Self-insurance status is the binary dependent variable: it has a value of one if the institution self-insured in 2010, and zero otherwise. A logistic regression on cross-sectional data enables an empirical examination of the incentives for self-insurance. Three categories of independent variables are hypothesized to influence an institution's decision whether to self-insure: size, riskiness, and organizational structure. The logistic model is specified as follows:

$$[\text{Self-insured entity} = 1]_{i,2010} = \alpha_0 + \alpha_1 [\text{Size factor}]_{i,2009} + \alpha_2 [\text{Risk factor}]_{i,2009} + \alpha_3 [\text{Organizational factors}]_{i,2009} + \varepsilon_i$$

Incentives for Self-Insurance

Size factor

In order to be permitted for self-insurance by the state regulatory authority, an employer must demonstrate the financial resources to cover the expected WC losses. A self-insured employer retains WC risk by paying its own claims, as well as the expenses associated with the administration of its self-insurance program. Therefore, size is used to proxy for an institution's financial capacity to pay for losses incurred by injured workers. The measure is the natural logarithm of the number of workers an institution employs. According to hypothesis 1, the size variable should have a positive coefficient because bigger institutions have a greater number of employees available for risk pooling purposes, are more capable of estimating expected losses, and tend to handle WC losses via self-insurance.

Risk factor

The decision whether to self-insure may also be related to the riskiness of institutions. Risk management theory suggests that retention or self-insurance is favored when loss severity is low, regardless of the size of loss frequency. Nonetheless, a larger number of on-the-job injuries can help make claims more predictable, which would encourage institutions to use self-insurance. As far as the nonfatal incidence rate is concerned, educational services can be considered low-risk because their rates are much lower than the national average. That is, employees in institutions of higher education, in the aggregate, are exposed to lower levels of work-related injury risk than workers in other industries, such as manufacturing and health care, according to the Bureau of Labor Statistics. However, universities hire not only faculty and staff but also other professionals and nonprofessionals who perform classroom maintenance and institutional support such as logistical and transportation services.[7] The former are less likely to incur occupational injuries, but the latter are more likely to be injured on the job. Because data on the actual frequency and severity of losses at the institution level were not available, non-faculty and staff ratios were selected as the best available proxy for the levels of occupational injury risk. The ratio denotes the proportion of employees hired as other professionals or nonprofessionals in an institution (i.e., those who are not employed as faculty or executive, administrative, and managerial staff). According to hypothesis 2, a positive value is expected because higher ratios may drive up WC losses, motivating institutions to arrange an alternative risk-financing program as a measure to save WC costs.

Organizational factors

A choice between self-insurance and market insurance may be further affected by some features of organizational structure. Three variables are considered: whether the institution is public, whether it is affiliated with religions, and how long it has been in existence. The Public dummy equals one if an institution is public, and zero otherwise. According to hypotheses 3ab, there

Table 1
Descriptive Statistics

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Employees	92	42	29,877	1,659	4,138
Non faculty and staff ratio	92	0.22	0.71	0.44	0.11
Public dummy	92	0	1	0.05	0.23
Years	92	19	271	128	54
Religious dummy	92	0	1	0.57	0.50

Note: "Employees" represents the number of employees in an institution of higher education. "Non-faculty and staff ratio" denotes the proportion of employees who are employed as other professionals or nonprofessionals (i.e., those who are not classified as faculty or executive, administrative and managerial staff). The "Public dummy" takes the value 1 if an institution is public and 0 otherwise. "Years" is the number of years that an institution has been in operation since its inception until 2010. The "Religious dummy" is set to 1 if an institution is affiliated with religion. [a.] The University of Pennsylvania has the lengthiest history in the sample as it was founded in 1740.

Table 2
Self-Insurance versus Characteristics of Universities [a]

Variables	Frequency	Self-insured university ratio [b]	Employees	Self-insured employee proportion [b]
Colleges and universities	92	26%	152,664	66%
Size: [c]				
Employees (1–250)	59	7%	2,181	2%
Employees (251–500)	26	15%	10,423	17%
Employees (501–1,500)	39	31%	30,759	30%
Employees (1,501–2,500)	3	33%	6,230	38%
Employees (2,501 or more)	9	67%	103,071	84%
Classification: [d]				
Public				
(1) State university	1	100%	15,016	100%
(2) State-related commonwealth university	4	75%	53,201	99%
Subtotal: (1)+(2)	5	80%	68,217	99%
Private				
(3) Private state-aided university	6	33%	26,592	71%
(4) Private college and university	78	23%	57,580	24%
(5) Theological seminary	3	0%	275	0%
Subtotal: (3)+(4)+(5)	87	23%	84,447	39%
Affiliation:				
Religion	52	23%	32,747	30%
Non-religion	40	30%	119,917	76%
Years in existence: [e]				
1–50	6	17%	1,977	30%
51–100	28	11%	16,137	24%
101–150	25	24%	36,214	30%
151–200	26	38%	64,392	82%
201 or more	7	57%	33,944	95%

Note: [a.] These statistics are based on the full sample of 92 universities in PA in 2010. [b.] The self-insured manufacturer ratio represents the self-insured institutions of a given variable as a percentage of the total institutions of the same variable. The self-insured employee proportion equals the number of workers hired by self-insurers of a given variable as a percentage of the total number of workers hired by all institutions of the same variable. [c.] The numbers in parentheses indicate the number of workers in these institutions. [d.] The only state university is referred to as the Pennsylvania State System of Higher Education, including 14 individual campuses. The state-related commonwealth universities include the Pennsylvania State University system, University of Pittsburgh, Temple University, and Lincoln University. [e.] "Years" is the number of years that an institution has been in operation until 2010.

are no priors on the sign of this variable. Because public institutions are correlated with a larger number of employees, a variable interacting Public and Employees variables is alternatively included as a regressor in the model.

The Years variable is the natural logarithm of the number of years since an institution's inception. The coefficient for this variable should be positive because a greater number of years of WC claim data can provide better estimates of WC costs, thereby encouraging institutions to self-insure. The Religious dummy equals one if an institution is affiliated with any religion. No specific sign of this variable is expected.

Empirical Results

Descriptive statistics for 92 institutions of higher education in PA are contained in Table 1 in a preliminary, univariate setting. Table 2 exhibits the bivariate relationship between self-insurance and several characteristics of universities. Table 3 provides the results of the logistic regression using several attributes of institutions for the entire sample in a multivariate condition.

Table 2 indicates that 66 percent of the workforce hired by the 92 universities and colleges is covered by self-insurance programs. These institutions further break down into five size classes: 250 employees or less, 251 to 500 employees, 501 to 1,500 employees, 1,501 to 2,500 employees, and 2,501 employees or more. As size class increases, more workers in institutions of the same class are covered by self-insurance. More specifically, 84 percent of workers employed by institutions with more than 2,500 workers are covered by self-insurance. This finding lends support to the first hypothesis, that the use of self-insurance is positively linked to the size of an institution. Meanwhile, the prevalence of self-insurance among the institutions of the largest size class provides evidence that large universities prefer self-insurance to market insurance.

The preference for self-insurance for WC risk is particularly discernible among public institutions of higher education. As shown in Table 2, self-insurance is used among all state and state-related universities

but Lincoln University.[8] Nevertheless, only about a quarter of private institutions adopt self-insurance as an alternative technique for WC losses.[9] The proportion of workers covered by self-insurance is higher among public universities than among private universities—99 percent versus 39 percent. Self-insurance is not used by private institutions as commonly as by their public counterparts, everything else being equal. The acceptance of self-insurance as a risk-financing tool varies considerably between public and private institutions.

The results of logistic regressions are reported in Table 3. By and large, the size variable is an important determinant of self-insurance. Consistent with the first hypothesis, a positive and significant relationship exists between self-insurance and the number of employees, which is used to proxy for the size of an institution. Larger universities are more likely to have the financial capacity to meet self-insurance requirements and experience the benefit of risk retention in the form of self-insurance.

There exists a significant link between self-insurance and institutional riskiness, a finding consistent with the second hypothesis. That is, the coefficient for the non-faculty-and-staff ratio is positive and significant in all models. Higher non-faculty-and-staff ratios are associated with greater use of self-insurance. As the ratio of the number of other professionals and nonprofessionals to the total number of all employees increases, an institution is confronted with a higher level of work-related injury and illness and, thus, economically motivated to gain better control over claims by self-insuring for WC risk. In addition, the coefficient for this risk variable is much larger than that for the size variable. This suggests that the level of riskiness faced by institutions is more important in the decision to self-insure than the size of institutions. One plausible explanation is that the riskiness of institutions plays a pivotal role in the selection of self-insurance.

When it comes to organizational structure, public institutions are more inclined to self-insure than their private counterparts. That is, the Public dummy is positively and significantly linked to self-insurance in Table 3, a finding consistent with Hypothesis 3a. Public universities tend to be large in size, relying on state funds for operation.[10] By contrast, private universities tend to be smaller than public institutions. They may have to buy market insurance due to a risk aversion incentive. This may explain why market insurance is favored by most private institutions.

However, other organizational factors are not related to the decision to self-insure. Neither the Years variable nor the Religious dummy is significant in all models. A lengthy institution history does not motivate a firm to self-insure. Whether an institution is affiliated with religion is not a critical incentive toward self-insurance.

V. CONCLUSION

Self-insurance is an important risk-financing alternative to market insurance. However, the factors affecting an employer's decision to self-insure are not clear at the institution level. This research examines the incentives toward self-insurance among PA institutions of higher education. Factors expected to be related to self-insurance include size, riskiness, and organizational structure.

This research suggests that a university's decision to self-insure is positively associated with the size, public attribute, and riskiness of institutions where the level of riskiness is proxied by the ratio of the number of other professionals and nonprofessionals to the total number of workers in an institution. In general, self-insurers cover 66 percent of the total workers employed by PA institutions of higher education. Larger institutions are more likely to take advantage of self-insurance for WC risk. With the exception of Lincoln University, all public universities self-insure for WC losses. A reasonable inference to be drawn is

Table 3
Logistic Regression Results for Characteristics of Self-Insured Universities in PA

Variables	(1)	(2)	(3)
Intercept	−13.7110 ***	−9.8330 ***	−9.8600 ***
	.00	.00	.00
Size factor			
ln(Employees)	0.7670 ***		
	.01		
Risk factor			
Non faculty and staff ratio	7.7860 ***	.4710	1.7233
	.01	.46	.28
Organizational factors			
Public dummy		2.4660 **	
		.05	
Public dummy × ln(Employees)			0.3280 **
			.04
ln(Years)	.7610	1.0960	1.0720
	.28	.10	.11
Religious dummy	.4400	0.2150	0.2740
	.47	.71	.64
Predicted percentage correct	82.60	78.30	78.30
No. of observations	92	92	92

Note: The dependent variable takes the value one when the institution self-insures, and zero otherwise. "Employees" represents the number of employees in an institution of higher education. "Non-faculty and staff ratio" denotes the proportion of employees who are employed as other professionals or nonprofessionals (i.e., those who are not classified as faculty or executive, administrative and managerial staff). The "Public" dummy variable takes the value 1 if an institution is state or state-related and 0 otherwise. The "PA owner" dummy is set to 1 if the owner of the manufacture is located in PA. "Years" is the number of years that an institution has been in operation. Two variables, "Employees" and "Years" are in the natural logarithm. The asterisks (*), (**), and (***) denote statistical significance at the 10%, 5%, and 1% levels, respectively (2-tailed). P-values for two-sided tests are below coefficients.

that public institutions tend to be large in size. In addition, a significant relationship between self-insurance and riskiness implies that institutions with a larger proportion of employees classified as other professionals and nonprofessionals tend to select self-insurance over market insurance.

The results of this study may have some implications for future research on WC risk. In theory, universities are subject to a very low level of occupational injury risk, and their workers experience fewer work-related injuries and illnesses than do those of other sectors. Institutions should be rarely motivated to self-insure. In practice, risk retention in the form of self-insurance is particularly prevalent among large and/or public institutions of higher education. Particularly, the riskiness of institutions plays an instrumental factor in the self-insurance decision.

Future research using samples from other states could complement this study, which is solely based on the higher education sector in PA. Since the incentives for institutions to self-insure may differ from industry to industry and from state to state, more studies on self-insurance in different industries at the firm level could help explain how employers around the country make risk-financing decisions for WC liability.

END NOTES

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1. In the context of this paper, "market insurance" (or traditional insurance) means insurance purchased from private carriers or state insurance funds. The difference between self-insurance and market insurance has become blurred over the years because self-insurers buy excess insurance for risk beyond what they are prepared to retain and hence do not assume all the risk, and because large deductibles are available that in effect make employers self-insurers for the amount up to the deductible limit. Thus, there is no simple dichotomy between pure self-insurance and pure market insurance when it comes to risk retention. However, discrepancies still exist between self-insurance and market insurance. Each employer's self-insurance program must be approved by the state authorities. There is no need for such permission if an employer purchases market insurance for WC losses. The term "risk-financing" is used interchangeably with "risk transfer" throughout this work.

2. Vaughan (1997, p. 324) addresses the fact that self-insurers can exercise a greater degree of discretion regarding the claims that are paid and those that are contested.

3. The nonfatal incidence rates represent the number of injuries and illnesses per 100 full-time workers. Source: Bureau of Labor Statistics. Chang and Weiss (2011) provide a detailed risk map of incidence rates by industry in the U.S.

4. According to the Pennsylvania Department of Education, there are four categories of employees in an institution of higher education: (1) faculty, (2) executive, administrative and managerial staff, (3) other professional, and (4) nonprofessional. Other professionals are classified as the persons employed for the primary purpose of performing academic support, student service, and institutional support. Nonprofessionals are the individuals employed for the primary purpose of technical and paraprofessional clerical and secretarial occupations, skilled crafts and service/maintenance.

5. Self-insurers implement all the services an insurer typically performs, such as claims management, actuarial services, legal counsel, loss control, loss prevention, and administration of the program. Services can be carried out in-house or outsourced to third-party service providers.

6. The self-insurance status data on manufacturers were provided on June 16, 2010.

7. Kwon and Grace (1996) argue that employers in the construction, manufacturing, and transportation industries are those with high risks. They are operating in dangerous businesses and thus subject to high levels of WC risk.

8. According to the Pennsylvania Department of Education, there are four institutions defined as the state-related commonwealth universities: the Pennsylvania State University system, University of Pittsburgh, Temple University, and Lincoln University.

9. Most private universities do not receive state funds except the following: University of Pennsylvania, Drexel University, Thomas Jefferson University, University of the Arts, Lake Erie College of Osteopathic Medicine, and Salus University. These six institutions are classified as private state-aided universities.

10. As a result of a high correlation between the number of employees and the Public dummy, these two variables are not included simultaneously in the model to avoid multicollinearity problems.

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USING PUBLIC BENEFIT AND COST ESTIMATES TO ASSESS A PROSPECT'S LOCAL TAX ABATEMENT REQUEST

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EVOLVING TEXAS ECONOMIC DEVELOPMENT STATUTES

In 2003, then Governor Rick Perry and the 78th Texas Legislature established the Texas Enterprise Fund (TEF) to attract new jobs and business investment to the state. The fund has been re-appropriated by the Texas Legislature each biennium since its inception. As the largest "deal-closing" fund of its kind in the nation, its use continues to attract business to Texas. Intended as a "final step" state-sponsored incentive tool where a single Texas site is competing against a viable out-of-state option, it is used to help close deals with strong local support and which promise a positive rate of return on the invested public dollars. Recent criticisms about TEF results list multiple shortcomings. An October 24th, 2014, Houston Chronicle story by Lauren McGaughy, reports that pressure is growing in Austin to reform state-level incentives in the face of poor oversight, scant reporting, lax criteria and questionable returns on the public's investment.

Proposed TEF reforms, if they move beyond a politics-as-usual stasis, could include stricter controls and sterner abatement limits with, for the first time, a "rate of return" criterion impliedly in the "societal" arena, to be considered by economic development authorities. Interest centers on what the new assessment criteria may be and on the form for the rate of return measure. Attempts to determine a return on local social investment dollars would require a reasonably precise means to estimate "social" revenues and "social" costs on the local area. The nature and use of those measures are the focus of this paper.

Local economic development officers may offer other legislatively-approved local tax incentives to company prospects, in addition to the state's TEF support. As an example, statutory requirements enabling local school authorities to limit taxable value during construction and to identify possible tax credits are codified in Chapter 313 of the Texas Tax Code. Essentially, the prospect agrees to build facilities and create jobs in exchange for a multi-year suspension on property taxes for school district maintenance and operations. The community abates the ad valorem taxes while the project is under construction, up to a total of ten years, after which the ad valorem tax rate applies to the full taxable value.

Two other sales tax-related statutes, Type A and Type B, let local authorities financially support proposed locations and construction for vetted prospects. Any city located in a county with a population below 500,000 may impose the Type A sales tax, in addition to the 6.25 percent state sales tax rate, as long as the combined local sales tax rate addition does not exceed 2 percent. For the Type B Sales Tax, all cities are eligible, again, as long as the combined local sales tax rate addition does not exceed 2 percent. For both Type A and Type B taxes, the Development Corporation Act requires that cities establish a legal entity to administer their sales and use tax funds. Local officials have reasonably broad powers to vet and support qualified business applicants in their tax-base area. If a prospect's development proposal is consistent with the community's vision and conforms to statutory requirements, it may be eligible for support. Agreements signed with the prospect often contain "claw back" clauses, to be invoked if the prospect fails to meet stated goals. Current practice by local decision-makers focuses on the industry fit plus the impact on new private sector dollars and jobs, with an estimate for annual local tax revenues.

Economic impact models are designed to estimate the annual direct and indirect spending volume and job count to be generated by a company's private sector activity. Some impact model designs also derive revenue additions to city and ISD budgets from the prospect's activities, along with estimated cost burdens on public institutions. The economic impact model designed by John Caffrey and Herbert Isaacs (C&I Model) is one such recognized methodology. In their model, integrated linear equations estimate the size of the private sector influences, and public sector revenues with apportioned public sector costs, generated from a prospect's business activity. Major components of the public benefit and public cost dimensions, and how to use them, are discussed in the next section. The third section presents a case study conducted for a prospect seeking tax abatement in Galveston, Texas, and speaks to how public sector impact estimates can serve as useful screening criteria for tax abatement.

A BENEFIT-TO-COST PUBLIC SECTOR IMPACT TEST

The C&I Model derives estimates for public sector revenues, defined as prospect-related revenues received by the city and school district via its direct and indirect spending and jobs influence on the defined area. The public sector revenues are generated by activities related to the prospect, the prospect's employees and the prospect's suppliers, multiplied by a factor to capture local indirect effects. The model also estimates, by apportionment, the prospect's activity-related direct and indirect public sector costs allocable to local municipal services and public schools.

The relative magnitudes of these two public sector impact measures can aid local leadership screening of tax abatement requests. Making the estimates available to local decision makers through a third party analysis of the prospect's local area economic impact, also may help address local citizen concerns. See Table 1.

A first-level checkpoint using the C&I Model's public sector benefit and cost impact results is simple. If a prospect's annual public-revenue-to-public-cost ratio equals at least one, it implies that the community as a societal whole, is neither diminished nor enhanced, on balance, by the prospect's private sector activity. So a ratio value of 1 can be viewed as the minimum socially acceptable result. A value greater than one suggests a net positive social influence on the defined community. A value less than one, implies a social imbalance with public sector costs exceeding revenues. Using Table 1 data in the top row, compare the estimated figure for Public Revenues, including direct ad valorem tax payments paid directly by the prospect, ($10,607,393) to the apportioned Public Costs ($159,257). In ratio form, that is a large 66 public benefit dollars to each public cost dollar result.

To make the ratio for public benefits and public costs more economically discriminating, it is proper to subtract the ad valorem taxes paid directly by the prospect. That is so because it is that amount which is to be negotiated for reduction or suspension. Then check to see if the prospect's public sector benefit-to-cost ratio equals or exceeds one. From Table 1 data, the prospect's public sector results show that estimated annual public revenues, less the prospect's direct ad valorem tax payment, equals $1,007,393 which still exceeds the estimated annual public costs of $159,257, for a benefit-to-cost ratio result of 6.3. Call this the second-level net benefit ratio test. This prospect may be a viable candidate for a negotiated tax abatement.

When vetting a prospect for tax abatement the risk is that, once awarded, a legal tax abatement agreement is difficult to retract or modify, even if the actual net public revenue flows fall below the apportioned public sector costs. To bolster the likelihood of an acceptable long-term tax abatement award, it is beneficial to test the sensitivity of the second-level net benefit test results. That test involves altering chosen key public sector variable magnitudes, then again re-checking the benefit-to-cost ratio. Materially reducing the magnitude of a public sector revenue source or increasing a public sector cost source will work. Given the way local public schools are funded in Texas, the C&I Model's public cost variable with the greatest influence is the number of new school-aged children forecasted to enter the local school system, from the prospect's estimated employee count.

Call these results the third-level, sensitivity adjusted, net benefit ratio test. If, after the sensitivity estimates are derived and the public benefit to public cost ratio is still greater than one, then

Table 1 Annual Public Sector Benefit and Public Sector Cost Detail

Direct and Indirect Public Revenues/Yr. = **$10,607,393 =** *$9,600,000* + ***$1,007,393***	**Direct and Indirect Public Costs/Yr. =** ***$159,257*** = $40,029 + $119,228
Prospect-paid ad valorem tax to the City and ISD = $9,600,000 **+** **[**Employee-based & Supplier-based taxes of $625,919 **+** Sales tax revenue received by the City from prospect-related local purchases of $345,627 **+** State aid to the ISD allocable to the presence of the prospect of $35,847**] = *$1,007,393***	City services allocable to prospect-related activity = $40,029 **+** ISD services allocable to prospect-related activities = $119,228

Table 2 Pro Forma Public Sector Benefit/Cost Estimates, Ratios with Child Count Sensitivity

School-aged Children and Additions	Public Sector Revenue per Year	*Revenue Less Cost & Benefit/Cost Ratio*	Public Sector Cost per Year
16 School-aged Children	***$1,007,393***	*$848,136; (Benefit/Cost Ratio = **6.3**)*	***$159,257***
Add 4 more Children	+ $8,965		+ $29,807
20 School-aged Children	**$1,016,358**	*$827,294; (Benefit/Cost Ratio = **5.4**)*	**$189,064**
Add 10 more Children	+ $22,404		+ $74,518
30 School-aged Children	**$1,038,762**	*$775,180; (Benefit/Cost Ratio = **3.9**)*	**$263,582**

there is greater confidence about the abatement concessions to be approved by local authorities. It is useful to note that it is common for changes in an input variable to affect both public sector revenues and the costs, and by different proportions. Also, the choice of which C&I Model input parameter to vary on either the benefit or cost side should be discussed with the analyst conducting the economic impact study.

Case Study: A 2005 Proposed LNG Facility on Galveston Island

An October 5, 2014, *Houston Chronicle* story by Rhiannon Meyers, highlighted renewed interest for a liquid natural gas (LNG) facility to be located on Pelican Island in Galveston, Texas. The current LNG prospect's interest relates directly to a study undertaken by the authors in 2005, regarding a similar proposed facility by a major international oil and gas company. The authors conducted an economic impact study using the C&I Model, complete with public sector impact estimates. The client planned to seek local property tax abatement concessions from civic leaders.

On completion of the four-year construction cycle the LNG facility was forecast to be valued at $600 million and to employ sixty-four fulltime equivalent employees. Annual estimated ad valorem taxes to be paid directly by the prospect totaled $9.6 million annually. The private sector economic impact of the finished facility on Galveston Island was estimated to be $10.9 million annually.

The economic impact analysis presumed that the sixty-four employees and their children would live on Galveston Island. Table 2 data show the initially estimated public benefits and public costs with "sensitivity" analysis results from additional school-aged children attending local schools. Per the second-level criterion, the prospect's estimated direct tax payments have been removed from the public benefit numbers, since that is the value to be negotiated with local authorities. From the original school-aged children count of 16, four more were added, then an additional ten children were added. Table 2 results show that both Public Revenues and Public Costs rose, but that Public Costs rose more due to increases in the ISD budget to accommodate the additions of the school-aged children.

The difference between the estimated public sector revenues and public sector costs slowly diminishes, as the count of children rises from 16 to 20 then to 30. Yet the magnitude of the net public sector impact value remains large in total amount. Numerically, the public sector revenues divided by the public sector costs reflects a strongly positive 3.9 to 1 ratio, for the most stringent case presented. So the prospect passes the third-level, sensitivity tested, criterion.

The large, positive and robust difference of public revenues over public costs casts the prospect's net social economic impact in a favorable light. An informed and meaningful tax abatement dialogue with local public leaders can begin. While the outcome of the abatement deliberations cannot be predicted, the figures presented in Table 2 give local authorities a clear sense of the prospect's impact under several sets of reasonable and relevant assumptions. This analysis offers a straight-forward approach, part of a standard economic impact analysis, to assess local public sector influences from prospect-driven activity. Armed with this information, relevant statutory limitations, financial restrictions, community concerns and other criteria can be confidently weighed, prior to a final tax abatement award.

SUMMARY

Stricter state statutes affecting economic development local authority on monitoring and reporting of a corporate recipient's post-abatement performance, call for an objective and early means to assess public revenues and public costs to be generated by the prospect's planned local area activity. We describe an economic impact model-generated approach to assess any corporate prospect's eligibility for local tax abatement consideration in Texas, by comparing estimated public sector revenues with public sector costs.

The first-level criterion is to check that total estimated public sector benefits, including prospect tax payments, equal or exceed total public sector costs from the prospect's forecasted economic impact in the community. The second-level criterion is to have estimated public revenues—after removing the client's estimated ad valorem tax payments to the city and school district--equal or exceed the estimated public sector costs. The third-level criterion requires, after conducting sensitivity analyses which decrease public sector revenues and/or increase public sector costs still show that total public benefits exceed total public costs. If the findings support the third-level criterion, then local economic development leaders can potentially negotiate a lasting post-construction reduction in ad valorem taxes which can meet emerging state statute requirements and also help satisfy any local citizen-group concerns. The public sector variables used to conduct the analyses are by-products of standard economic impact models. An actual case study regarding a proposed 2005 LNG facility on Galveston Island, provided the reported data.

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AN UPDATED PROFILE OF THE REAL ESTATE APPRAISER: JOB SATISFACTION, EDUCATION AND COMMUNICATION ISSUES

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The primary job of real estate appraisers is to estimate the fair market value of real estate when it is sold, insured, mortgaged, or taxed (Cummings and Epley, 2013; Wolverton and Gallimore, 1998; Boykin, 1985). Real estate appraisers are as vital to the overall housing and financial markets as real estate agents, brokers, and financial institutions. Prior to the 1970s, the profession was not accorded much creditability. However, with the development of better market comparison techniques, the accuracy of appraisal estimates improved markedly (White, 1987). In addition, the status of appraisers has improved significantly owing to more accreditation programs, and the efforts to increase uniformity in accreditation and educational programs (Parli, 2007).

The number of persons working as appraisers seems to rise and fall in tandem with the movements in the economy. Real estate appraisers were particularly hard hit in the most recent disintegration of the housing and financial markets (Cummings and Epley, 2013). The number of people working as appraisers peaked in 2007 at 118,657 and subsequently declined to 111,233 by 2011 (Cummings and Epley, 2013). As the housing market declined, many appraisers may have found employment in other fields.

Research examining real estate appraisers began in the early 1980s (White, 1987; Diskin and Gatzlaff, 1994; Wolverton and Gallimore, 1998; Cummings and Epley, 2013). This research provided descriptive information as to who real estate appraisers were, and this knowledge was helpful to the profession in its formative years. However, few articles have explored important job-related factors which could impact appraisers' job satisfaction, and why many continued to work in the industry even as the industry conditions worsened. The purpose of this article is to provide an updated profile of the typical real estate appraiser, review additional issues related to job satisfaction, examine the appraisers' perception of the profession, and identify sources of industry information appraisers rely upon.

THE DATA

The data used in this study was obtained in 2013 from a survey of appraisers in Houston, Texas. Personal interviews were conducted with 158 practicing appraisers throughout the greater metropolitan area. A questionnaire was developed and pretested with a small pool of experienced appraisers. One of the study's author was a Texas certified real estate appraiser and spent over 30 years as a practicing appraiser. All interviewers were trained as to how to survey the respondents. All those interviewed, at the time of the study, were active practicing real estate appraisers.

A DEMOGRAPHIC PROFILE OF THE APPRAISAL PROFESSIONALS

As shown in Table 1, appraisers as a group are getting older. In our sample, the average age of a typical appraiser was 51. In 1998, Wolverton and Gallimore's national study of appraisers found that the average age was 49.1 years, and it was 41 years in the Diskin and Gatzlaff's study in 1994.

On average, appraisers are becoming more experienced because they are remaining on the job longer. In this study, the average number of years of experience as an appraiser was 22.6 years compared to 17.1 years in the earlier referenced 1998 study, and only 10 years in the 1994 survey. Twenty years after Diskin and Gatzlaff (1994) reported that appraisers were working an average of 48 hours per week, this study showed that the average number of working hours had not changed much. Appraisers reported working about 47.5 hours, and making slightly more income, as will be discussed later. The majority of respondents were married (77%), and 82% were male. Consistent with prior studies, relatively few women are involved in the profession. The overwhelming majority of the respondents (90%) were employed full time, and the vast majority were independent contractors (60%).

The 1994 Diskin and Gatzlaff study found the average appraiser's income was about $54,000. A CNN study in 2006 reported that the average appraiser in the US was making $66,000 annually. The average appraiser in our study appears to be making slightly more than $60,000 per year. However, it is important to remember that our sample is drawn from a single metro area, while the CNN data was from a nationwide study. Approximately 50.76% of the appraisers reported income between $41,000 and $80,000, while 23.13% made between

TABLE 1
Demographic Profile

Descriptor	Mean
Age	51.0 years
Experience	22.6 years
Average hours worked per week	47.5 hours
Average commute to work	22.58 minutes

$80,000 and $120,000, and 18.65 % reported income over $120,000 per year, as shown in Table 2.

SATISFACTION WITH JOB AND PERSONAL FACTORS

Real estate appraisers occupy a unique position because they are the people in the middle between the real estate agents/ clients and financial loan officers. Yet, they must be completely objective and committed to providing accurate and truthful evaluations, even under pressure from both sides. In this section, we examine appraisers' satisfaction with some major factors related to their jobs. Prior to this study, one of the researchers interviewed several appraisers to identify job related and personal factors that appear to be closely tied to the profession. Subsequently, each respondent was asked to evaluate his or her satisfaction with an array of factors on a scale from 1 to 10 with 10 being very satisfied and 1 being very unsatisfied. The factors were put into two groups: the job and personal. In evaluating the results, we used the following ratings: We defined scores between 9 and 10 as "very satisfied ", scores between 7 and 8 as "satisfied", 5-6 as "neutral" and 3-4 as "unsatisfied," and 1 to 2 as "very unsatisfied." As shown in Table 3, the appraisers were mostly satisfied, or neutral (not overly satisfied or unsatisfied) with all the factors except health coverage.

TABLE 2
Income of Appraisers

Less than $40K	7.46 %
$41-80K	50.76
$81-120K	23.13
$121- and above	18.65
	100.00 %

TABLE 3
Satisfaction with Job and Personal Factors Related to the Appraising Business

Job Related Factors	
Job in general	8.07
Commute time	8.00
Professional colleagues	7.90
Client relations	7.90
Business activity	7.60
Professional seminars	7.51
Quality of printed material	7.53
Income capacity	**7.34**
Hours worked	**7.27**
Working out of home	**7.13**
Income security	**6.77**
Trends in profession	**6.22**
Job stress	**6.12**
Health care coverage	**4.50**
Personal Factors	
Life in general	**8.63**
Living in (city)	**8.01**
Social life	**7.90**

Job Factors. The respondents were not very satisfied with any of the job related factors. The respondents appeared to be satisfied with the job in general, colleagues, client relations, business activity and professional seminars/quality of education material. Most of these variables received satisfaction ratings between 7 and 8. However, of all the job related variables, the job in general and commute time received the highest satisfaction levels, 8.07 and 8.0, respectively. Although appraisers are positioned between two demanding groups, job stress is not as big an issue as thought. Hurley (2012) reported that there is pressure on appraisers to meet implied loan targets because many residential loans are originated by third party companies. Therefore, we expected that appraisers would have reported dissatisfaction with the job stress. However, the study found that the average satisfaction with job stress was 6.12 which is defined as neutral. Since many appraisers are independent contractors or work in offices with a small number of employees, it is understandable why they may be dissatisfied with health care coverage (4.5 rating). They may have to pay higher premiums, or purchase a private health coverage plan if their office does not provide a plan. This is consistent with the findings in the Wolverton and Gallimore (1998) study, which reported fringe benefits as a major area of dissatisfaction. Appraisers are not terribly satisfied with the income associated with the appraisal profession. The mean satisfaction rating on the income capacity question was 7.34. They rated satisfaction with income security even lower at 6.77. Since income capacity is tied to economic conditions, this may influence appraisers' perceptions of income security because these conditions cannot be controlled or even predicted. A separate question which asked about the difficulty of earning a living resulted in 63.70 % of appraisers responding that it was getting harder to make a living as an appraiser, while 28.15 % felt it was about the same as it had been in the past.

Personal factors. Appraisers appear to be fairly satisfied with their lives. When asked about their satisfaction with "Life in General", they gave this as the highest satisfaction rating of all the factors (8.63 out of a possible 10.00 points). This is very close to very satisfied. They appear to be generally satisfied

Table 4
Type of Services Performed
(Number of appraisers responding)

Appraiser Service	Yes	NO
Residential	99	39
Commercial	68	70
Court Testimony	53	85
Rent Surveys	47	91
Counseling	46	96
Marketability studies	42	96
Property Tax Appeal	42	96
Brokerage	30	108

with their social life (7.90) and living in the city (8.01). This appears to support CNN Money Magazine's ranking of real estate appraisal in the Top Ten Best Jobs in America in 2006. Interestingly, a separate question asking respondents to select what they like best about being an appraiser found that the top factors were income (39%) and job satisfaction (29%).

An overwhelming number of appraisers (73%) would recommend the profession to others even though they estimated that the average starting salary of a beginning appraiser is less than $30,000 a year. Many felt it was getting harder to make a living as previously mentioned.

TYPES OF SERVICES PROVIDED BY APPRAISERS

As indicated in Table 4, the survey respondents performed a variety of services, but the predominant service was residential appraising. Appraisers are less likely to do counseling, marketability studies, property tax appeal or brokerage business. Consistent with the above findings, over 100 of the 158 respondents appraised residential property, and a significant number of respondents appraised multifamily property and office buildings, as shown in Table 5. The appraisers were less likely to appraise restaurants and other retail establishments.

PROMOTION AND COMMUNICATION EFFORTS

Most appraisers have websites (69%), but many have not yet utilized social media. According to the study, only 26 % of appraisers use Facebook and less than 10 % use Twitter. This could be due to the nature of the job—need for personal contact. Most appraisers generate business through referrals and other informal sources. When asked how they generated new clients, 63% said from word of mouth communications, 6% from sales calls, and 43% from other sources. Other forms of social media such as LinkedIn which has become a very popular choice of many business professionals was not included in this study.

Table 5
Type of Property Appraised
(number of appraisers responding)

Property Appraised	Yes	No
Office	55	83
Residential	106	32
Multi-Family	64	74
Industrial	42	96
Retail	48	90
Drug Stores	25	113
Restaurants	33	105
Car Dealers	30	108

Table 6
Promotion and Communication

Web based Promotion	Yes	No
Website	95 (69 %)	43
Facebook	36 (26 %)	102
Twitter	10 (7%)	128

EDUCATION AND CERTIFICATION OF APPRAISERS

Most appraisers are college graduates. Approximately, 73% of our sample had either a bachelor's degree or college plus other education, and many have certificates related to the field. A review of Table 7 finds that the most popular certificates were MAI and State. However, respondents have a variety of other certifications related to the profession. The survey found that only 23 % of the respondents were undergraduate business majors, and only 54% had taken a real estate class in college. Therefore, appraisers have a variety of educational backgrounds, and appear to depend heavily on certificate programs to increase their knowledge of the industry.

Table 7
Education and Certification

Education	
High School	2.20%
Some College	24.83%
College	64.23%
College Plus	8.76%
Certificate (actual number)	
MAI certificate	28
State	27
Certified Appraise	11
License	7
Tax Certificate	6
SRA	5
REA	5
CRA	3
TALCB,MRA	2
CIA,CRAT,CREA,FHA,GRA ROW,RPA,TALCU,SIRA	1

Table 8
Sources of Information on Industry
(actual number of respondents)

Reading Source	YES	NO
Appraisal Journal	101	37
ASA Journal	18	120
Real Estate Review	52	86
Real Estate Issues	37	101
Journal of Property Management	15	123
Journal of Real Estate Research	32	106
CCIM Journal	23	115
Real Estate Economics	21	117
Others	48	90

INDUSTRY INFORMATION SOURCES

Real estate appraisers read a variety of journals as indicated in Table 8. However, the most popular source of information is the Appraisal Journal. Of the respondents who answered this section, the survey found that 73% read the Appraisal Journal, 38% read the Real Estate Review, 27% read Real Estate Issues, and 23% read the Journal of Real Estate Research. The popularity of the Appraisal Journal may be due to the fact that it addresses more basic practitioner issues.

RETIREMENT PLANS

Our study indicated that 54% of the appraisers plan to retire at some point, but a surprisingly large percent (46%) do not plan to ever retire. The reason that the average age of the appraiser is rising is that many of the current appraisers plan to work past the typical retirement age. Appraisers appear to have confidence in the real estate field. Many appraisers are saving for retirement by investing in real estate (74%). However, a larger number are also investing in mutual funds (94%) for retirement. A plausible explanation for the current retirement situation is that many appraisers do not have company sponsored retirement plans, and are completely responsible for their personal retirement savings.

CONCLUSIONS

This study used a sample of real estate appraisers in the Houston, Texas metropolitan area to explore some of the issues surrounding the real estate appraisers' profile, job satisfaction, educational and communication issues. The study is unique in that it explores different job satisfaction issues related to real estate appraisers, education levels, and retirement plans. The study confirms other research findings that the average age of appraisers is increasing, as well as average years of experience in the business. The profession is still dominated by males. Overall, appraisers are mostly satisfied with their profession. The income level is one of the primary reasons for choosing the profession even though appraisers were only moderately satisfied with income. Job satisfaction could be related to the fact that their income is affected directly by economic variables like interest rates and unemployment rates, which cannot be controlled by the respondents. These economic variables have a strong influence on the US housing market. The vast majority of the appraisers in this study were involved more in residential than commercial appraising. Given their level of involvement in the residential market, it is not surprising that many are tying retirement to investment in residential real estate, and the stock market. The appraisers depend heavily on referrals for new business and are not typically involved with social media. However, most appraisers recognize the need for a website which can be created to promote the skills and experience of the individual appraiser or his/her firm. In this study, most of the appraisers have general appraisal designations and many have certificates. Therefore, they realize the value of education and training in the profession. They depend heavily on industry certification programs for training.

This study provides valuable insights on the real estate appraisers. However, given the study was done using a group of appraisers in a major Southwestern city, the findings may not be entirely generalizable to other areas of the country. Therefore, the next step would be for this study to be replicated on a national level. Additional, information needs to be gather to understand fully the appraisers' use of social media such as LinkedIn which is extremely useful for most professionals. Additional research is needed to identify other job satisfaction factors.

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THE DETERMINANTS OF VALUE FOR SINGLE-DWELLING HOMES IN LAWTON AND WICHITA FALLS

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INTRODUCTION

Conventional wisdom states that the value of a real estate property is determined by location, location, and location. It is not the intent of this paper to dispute the conventional wisdom, but to find the specific determinants of value of a single-dwelling property. This study investigates housing variables that significantly affect the value of a home in Lawton, Oklahoma, and Wichita Falls, Texas. These two cities were chosen for their similarity in size, demography, proximity to each other, and economic characteristics.

BRIEF DESCRIPTIONS OF LAWTON AND WICHITA FALLS

Lawton, Oklahoma

Lawton was established on August 8, 1901, and was named after a Civil War general, Major General Henry Ware Lawton. According to the 2010 Census, its population was about 96,867. Lawton is the county seat of Comanche County, Oklahoma. The city is located 87 miles southwest of Oklahoma City. The city is considered to be a part of Great Plains with Wichita Mountain bearing north of the city. Wichita Mountain Wildlife Refuge attracts many visitors each year. Fort Sill, the home of U.S. Army Field Artillery School, is the main economic force for Lawton. The base has about 56, 000 people that include military and civilian personnel and their families. The base contributes an estimated $1.9 billion to Lawton's economy. Other notable employers include Cameron University, Good Year Tire and Rubber Company, Comanche County Memorial Hospital, and other companies in various industries.

Wichita Falls, Texas

Wichita Falls is located about 53 miles south of Lawton. Lawton and Wichita Falls make up the bulk of the so-called "Texoma" area. It is a slightly larger city than Lawton with the population of about 104,553 (2010 Census). The city is the county seat of Wichita County, Texas. The main economic driving force in the city is The Sheppard Air Force Base with daily population of about 15,000. Sheppard was established on October 17, 1941, and is the U.S. Air Force's largest technical training wing and the world's only internationally manned and managed flying training program. The base contributes about $ 503 million in economic impact to Wichita Falls. Other major employers in the city are Midwestern State University, United Regional Healthcare System, Cryovac, and other companies in various industries.

LITERATURE REVIEW

Bond et al. (2002) analyze the impact of lakefront view on the home value. They check the correlation between different house features. Their results show that features like numbers of bedrooms, numbers of bathrooms, numbers of fireplaces and square footage have no significant relationship with each other. In other words, they are independent of one another. Further analysis, in which they use square footage to represent the four variables mentioned above, reveals that square footage is positively related to home prices and desirable lakefront view adds value to a home.

Baffoe-Bonnie (1998) examines the influence of macroeconomic variables such as inflation, taxation, interest rates and employment on the value of houses sold from 1973 to 1994. The results suggest that macroeconomic variables affect housing prices. They argue that regional economic conditions influence home values and numbers of homes sold. Their results indicate that home prices are positively affected by increase in employment growth rate and income.

Sirmans et al. (2005) review 125 empirical studies to determine how different characteristics of a house influence its price. Their findings are mixed. They find that most studies show the number of bedrooms to have a positive relationship to home value while some papers show a negative correlation. Other studies indicate an insignificant relation between home prices and number of bedrooms.

Conroy and Milosch (2011) look at the premium associated with houses near coastal areas. They analyze the home-sale data for San Diego County during 2006. Their results show that there is a premium associated with homes near coastal regions, and this premium decreases as the distance from the coast increases. They use age, the number of bedrooms, number of bathrooms, and square footage as housing variables.

Our research follows Conroy and Milosch in using age, the number of bedrooms, the number of bathrooms, and square footage as housing variables. Winson-Geideman et al. (2011) study the effects of age on the value of historic homes in designated historic districts. They find that age has a positive impact on houses that are more than 119 years old. Asabere and Huffman (2013) examine the effect of relative size of homes on their values for a given neighborhood. They analyze the data from San Antonio, Texas, for the years 2001 and 2002. They find that, in the same area, prices of relatively large houses are negatively affected by their size. In our study, we

use the same variables as used by Bond et al. (2002), Sirmans et al. (2005), Winson-Geideman et al. (2011), and Conroy and Milosch (2011). In addition, we compare the two cities' macroeconomics indicators, the cost-of-living index (COL) and unemployment rates, and find no differences between Lawton and Wichita Falls.

DATA

The data consists of homes sold in 2013 from May to September for Wichita Falls, Texas, and Lawton, Oklahoma. The data is obtained from Zillow.com website and entered manually into a spreadsheet. CES data provides monthly employment data for both Wichita Falls and Lawton. The final set of data consists of 363 observations for Lawton and 62 observations for Wichita Falls. Some observations are excluded due to missing sales price, which result in fewer observations for Wichita Falls than for Lawton.

HOUSING VARIABLES

We use housing variables that are reported to have a significant relationship with home value as suggested in Sirmans et al. (2005) and Conroy and Milosch (2011). Sirmans et al. (2005) review 125 empirical studies to find that square footage, number of bedrooms, number of bathrooms, Pool, garage, and fireplace are most used variable in the literature. They believe that these variables show a significant relation to the home prices. Conroy and Milosch (2011) also use the variables as mentioned above in their analysis of coastal premium.

METHODOLOGY

OLS is used at sales price as the dependent variable. Regressors comprise of the number of bedrooms (Bedroom), number of bathrooms (Bathroom), existence of fireplace (Fireplace), swimming pool (Pool), and number of square footage (Square

Table 1: Summary Statistics:

This table displays information about homes sold in the cities of Lawton, Oklahoma, and Wichita Falls, Texas, for the year 2013 for the months of May, June, July, August, and September.

Variables	Lawton			Wichita Falls		
	No.	Mean	Std. Dev.	No.	Mean	Std. Dev.
Sale Price	363	97626.41	76416.51	62	113905.50	83726.77
Bedrooms	363	3.06	0.67	157	3.10	0.78
Bathrooms	349	1.81	0.68	155	1.86	0.66
Square Footage	363	1567.47	732.62	158	1725.67	704.57
age	363	43.44	22.30	158	42.83	24.06

Table 2: Unemployment data:

This table presents the data for employment for both Wichita Falls and Lawton.

Date	Wichita Falls			Lawton		
	Employed	Change	%age Change	Employed	Change	%age Change
Apr-13	57,600	300		44,200	200	
May-13	57,400	-200	-0.35%	44,000	-200	-0.45%
Jun-13	57,500	100	0.17%	43,700	-300	-0.68%
Jul-13	57,600	100	0.17%	43,800	100	0.23%
Aug-13	57,700	100	0.17%	44,000	200	0.46%
Sep-13	57,900	200	0.35%	44,000	0	0.00%
Oct-13	57,600	-300	-0.52%	44,300	300	0.68%
Nov-13	57,400	-200	-0.35%	44,400	100	0.23%
		H_A : Diff < 0		H_A : Diff $= 0$		H_A : Diff > 0
Cost of living index (COL) (100=national)*	76	Pr(T < t) = 0.3643	Pr(|T| > |t|) = 0.7287	77		Pr(T > t) = 0.6357

**Source: www.areavibes.com*

Footage), the presence of garage (Garage), age of the house (age), and designated states (State). The model is:

$$\text{Sale price} = b_0 + b_1\text{Bedroom} + b_2\text{Bathroom} + b_3\text{Fireplace} + b_4\text{Pool} + b_5\text{Square Footage} + b_6\text{Garage} + b_7\text{Age} + b_8\text{State} + e, \text{ where}$$

b_n = coefficients and e = error term.

Sales price is the negotiated price on which the house was sold, Bedroom is the number of bedrooms in the house. Bathroom is the number of bathrooms in the house. Square footage is the covered area of the house excluding garage. Age is the number of years since the house was originally built. Pool, fireplace, garage and State are represented by dummy variables. State dummy variable is included to ascertain a location premium associated with a home being located in a different state. The 1% significance level is used throughout the paper.

RESULTS AND DISCUSSIONS

Table 1 shows the summary statistics for the data. Average sale price for homes in Wichita Falls is higher than the average value of homes in Lawton. Mean values for housing variables are very similar. For example, mean values of the number of bedrooms, bathrooms, square footage, and age display very little differences, which suggest that houses in both cities are similar. Baffoe-Bonnie (1998) has suggested that certain macroeconomic indicators, such as inflation and unemployment, influence home prices. Monthly unemployment rates and the cost-of-living index (COL) for both cities show no significant differences during the period under investigation. Since these two macroeconomic variables are essentially the same for the two cities, their impact on home prices would also be of similar degree and direction. For this reason, COL and unemployment rates were not included as explanatory variables.

To study the impact of housing variables on prices, we run the regression of the model above. The results are shown in Table 3. Regression results for Lawton and Wichita Falls are shown separately in column 1 and column 2, respectively. Column 3 provides the regression results for the combined cities. In Column 1, the number of bathrooms and square footage show significant positive relationship with prices while age is negatively significant for Lawton. In column 2, the results indicate square footage and age as having significant positive and adverse impact on home price for Wichita Falls. In Column 3, the dummy variable for state is significantly positive indicating a premium effect associated with the location in Texas as compared to Oklahoma. A premium relating to buying homes in Texas exists during the Investigated period. This state

Table 3: Regression all Cities:

This table presents the results of our model.

Sale price = Bedroom + Bathroom + Fireplace + Pool + Square Footage +Garage + Age +State

Bedroom is number of bedrooms in a house; bathroom is number of bathrooms in the house. Square footage is covered area of the house excluding garage. Age is number of years since the house was originally built. Pool, fireplace, garage and State are dummy variables. State is 1 for Wichita Falls and 0 for Lawton.

	Lawton	Wichita Falls	Combined
Constant	66731.59	54561.34	80642.56
Bedroom	-590.36	9366.87	-3288.41
Bathroom	31196.91**	-16759.13	23160.23**
Fireplace	4731.30	-10012.82	2284.67
Pool	38022.68**	-6119.25	35830.46**
Squarefootage	20.51**	76.32**	30.06**
Garage	3087.81	-5849.64	883.31
age	-1461.19**	-1287.05**	-1529.62**
State			21578.70**
N	349	62	411
R-square	0.61	0.74	0.60
Adj R-Square	0.60	0.71	0.59

** Significant at 1% level

premium cannot be discounted by COL and unemployment rate differences since these two indicators are virtually the same for both cities. This premium may be attributed to the higher level of income and absence of state tax in Texas. Future research is needed to look into the location premium issue.

CONCLUSION

The study provides some insights as to specific determinants of home value for Lawton and Wichita Falls. Number of bathrooms and square footage variables contribute positively to home prices while age is negatively related to house prices for Lawton. As for Wichita Falls, the results show square footage and age as having positive and negative impact on home prices, respectively. There is also a location premium associated with Texas relative to Oklahoma. Future studies should include larger cities, such as Dallas and Oklahoma City, with more housing variables for a longer period.

END NOTE

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WORLD WAR II: A CASE STUDY OF CROSS ELASTICITY OF SUPPLY

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INTRODUCTION

The concept of cross elasticity of supply was introduced to the body of economic theory by Fritz Machlup in his 1952 work, *The Economics of Sellers' Competition.*[1] It is a concept which is not necessarily widely known today in the economics profession for it is rarely discussed in economic textbooks and in the economics literature generally.[2] The concept essentially views possible relationships among goods through the perspective of suppliers of goods. More will be said of this subsequently. I contend herein that cross elasticity of supply can be used in conjunction with its counterpart, the cross elasticity of demand, to help define relevant product markets. In fact, federal courts at various levels of the judicial process have been using these two cross elasticities to do just that for a number of years as noted in an earlier work.[3] The main thrust of this article, however, is to illustrate cross elasticity of supply through a myriad of examples provided by American industry in the period immediately preceding World War II through the war's conclusion in 1945.

Over this timespan, there was essentially a massive conversion from peacetime to wartime production undertaken by American industry. I regard this supply substitutability conversion as illustrative of the responsiveness, power, and efficiency of the free market system of the American economy. Although I acknowledge that the economics profession has clearly ceded this point, I am surprised that said profession has not formally recognized the treasure-trove of working examples of the cross elasticity of supply embodied in the wartime conversion of American industry in the years preceding America's entry into World War II and even more so after the bombing of Pearl Harbor.

THE ORIGINS OF THE CONCEPT OF CROSS ELASTICITY OF SUPPLY

The designation "cross elasticity of supply" was actually initiated price to Machlup in a 1951 article by Alan S. Manne.[4] However, his perception of said elasticity differs from that of Machlup who apparently arrived at his version independently. Manne's formulation was actually an adaptation of the Hicks-Allen cross elasticity of substitution of the 1930s which examined the percentage change in the ratio of inputs used in a production process to a one percent change in the ratio of the prices of the inputs.[5] It was a concept associated with the optimum combination of inputs in a given production process. Manne essentially applied this concept to the optimum combination of goods that a firm should produce in a production process in which two or more distinct goods were emerging together.[6] His cross elasticity of supply formulation examined the percentage change in the ratio of outputs produced in a production process to a percentage change in the ratio of the prices of those outputs. His formulation may be expressed as Formula 1:

$$\frac{\Delta\left(\frac{qx}{qy}\right)}{\Delta\left(\frac{px}{py}\right)} \quad \frac{\frac{px}{py}}{\frac{qx}{qy}}$$

Where x and y are the two outputs produced

Manne was interested in the appropriate product mix to be produced by the firm in dealing with a joint-cost problem. Has cross elasticity of supply was essentially concerned solely with the internal dynamics of a firm's production.

Machlup, on the other hand, had a broader perspective in that he was trying to formulate a devise helpful to the identification of the borders of given industries, i.e. he was attempting to assist in identifying the participants in a given industry. His coefficient of cross elasticity of supply can be expressed as Formula 2:

$$\frac{\Delta Q_x^S}{\Delta P_y} \times \frac{P_y}{Q_x^S}$$

This formulation examines the percentage charge in quantity supplied of a good (x) to a percentage change in the price of another good (y), if all other things are held constant, including the price of good x. As such, it is clear that Machlup's formulation deals with absolute prices and quantities, rather than the ratios of the Manne formulation. The sign of Machlup's formulation is examined to determine if two goods are substitutes, and arguably in the same industry; or whether the two goods are complementarity to one another. Machlup was, again, addressing the concept of "the industry" in economic analysis, noting that any discussion of entry into an industry presupposed definite borderlines between one industry and another. Noting that there are often no such borderlines, Machlup questioned the grounds upon which a group of firms could be construed as a separate industry, that is, he pondered what degree of substitutability among the products of different firms would justify the designation of the same industry or separate industries.[7]

While pointing out the inevitable interdependence of everything in the economy, Machlup asserted that the concept of the industry was an expedient abstraction for disregarding

negligible or all too uncertain interdependence. He explained that interdependence could be aptly expressed by cross elasticities of demand and of supply.[8] Bain had also introduced the cross elasticity of demand vehicle in 1952 in his discussion of the interrelations of industry demand.[9] However, Bain did not devote any discussion to the cross elasticity of supply as a criterion for the delineation of specific industries. Students of economics are well familiar with the cross elasticity of demand, which focuses on the relationship between two goods from the consumer's point of view. They are taught that the coefficient of cross elasticity of demand measures the response of the quantity demanded of one good to a change in the price of a different good. Specifically, this coefficient is equal to the percentage change in the quantity demanded of one good (x) divided by the percentage change in the price of another good (y) and may be expressed as Formula 3:

$$\varepsilon_d = \frac{\frac{\Delta Q_x^d}{Q_x^d}}{\frac{\Delta Py}{Py}}$$

It is assumed that are all other things remain constant, including the price of good x. This sign of this coefficient, which may be either positive or negative, suggests a given type of relationship between the two goods. Whereas a positive sign of the coefficient suggests that the two goods are substitutes and, hence, are interchangeable for one another; a negative sign of the coefficient suggest that the two goods are complementary and, hence, are used together. The establishment of a substitute relationship through the calculation of the coefficient of cross elasticity of demand can prove helpful in the identification of firms that are competitive sellers within a given market. That is, such a calculation can provide at least a first approximation of a given product market as viewed from the eyes of consumers.

On the other hand, as noted above, cross elasticity of supply measures substitutability or complementary among two different goods through the eyes of producers or suppliers. For the coefficient of cross elasticity of supply measures the response of the quantity supplied of a good (x) to a change in the price of a different good (y). Similar to the coefficient of cross elasticity of demand, the coefficient of cross elasticity supply is equal to the percentage change in the quantity supplied of good (x) divided by the percentage change in the price of good (y) and can be expressed as seen earlier as Formula 2:

$$\varepsilon_s = \frac{\frac{\Delta Q_x^s}{Q_x^s}}{\frac{\Delta P_y}{P_y}}$$

Remember that all other things, including the prices of good x, remain constant. Here again, this coefficient may be either negative (suggesting that the two goods are substitutes) or positive (suggesting that the two goods are complementary. The reader will note that opposite interpretations than those explained above for the coefficient of cross elasticity of demand apply to the signs of the coefficient of cross elasticity of supply. To illustrate, if the quantity supplied of right-handed baseball gloves declines in response to an increase in the price received by suppliers of left-handed baseball gloves, this suggest that suppliers are responding to the increase in price of the left-handed baseball glove by producing more of these and less of the right-handed baseball gloves. Hence, the negative signs of the coefficient of cross elasticity of supply between right and left-handed baseball gloves suggests these goods are substitutes for one another as viewed through the eyes of suppliers of baseball gloves. Suppliers can easily switch production from one type of glove to the other in response to a change in the relative prices of the two types of gloves. Alternatively, consider the relationship between baseball gloves and baseballs. If there is an increase in the price received by suppliers for baseball gloves of either or both aforementioned varieties, there will likely be an increase in the quantity supplied of baseballs. The increase in the price of the baseball glove and in that of the quantity supplied of baseballs results in a positive coefficient of cross elasticity of supply suggestive of a complementary relationship between baseballs and baseball gloves. While Bain defines cross elasticity of demand via an appropriate algebraic formula and provides a numerical example, Machlup describes both the cross elasticity of demand and that of supply, but does not specifically express these in algebraic form or provide any numerical examples. Neither Bain nor Machlup discusses relationships among specific goods such as provided above that illustrate either or both of the cross elasticity concepts.

After describing the two cross elasticity concepts, Machlup characterizes them as showing the effect of product B's price bids and offers upon product A's sales and purchases. Using both cross elasticity concepts, be goes on to provide a somewhat all-encompassing definition of an industry as follows: "Firms related through cross-elasticities of the demands for their products or of the supplies of their factors may be said to constitute an 'industry' if these cross-elasticities are either so important or so definite that they could not be neglected without impairing the considerations of the firms or the analyses of the economist."[10] He then asserts that the simultaneous attention to both types of cross elasticities uncomfortably expands the number of variables and, hence, the definition of the "industry" at hand. Rather than intertangle the two cross elasticity concepts, he decides that it is best to focus on either one or the other. For purposes practical to the immediate discussion in his text, he opts to confine himself to demand conditions and, consequently focuses there from on the cross elasticity of demand concept.[11] Perhaps this at least partially accounts for the widespread neglect of the cross elasticity of supply concept in Economics textbooks noted elsewhere. Out of 51 intermediate microeconomic and industrial organization textbooks examined by the author, only 7 discussed the concept of cross elasticity of supply.[12]

COMMENTARY ON THE CROSS ELASTICITY OF SUPPLY

Needham discussed the cross elasticity of demand and supply concepts at some length. While noting that they, respectively, deal with the response of potential buyers and that of sellers of good X to changes in price of another good Y, he emphasized that neither of the concepts necessarily reflected the change

in the quantity of good X that was actually bought and sold. Rather, these quantities depend primarily on the price of good X itself presumably held constant in the calculation of cross-elasticities, as well as possible nonprice responses by the producers of good X, such as the level of advertising undertaken by firms in response to a price change initiated by the producer of another product. The prominent influence of the price of X upon the quantity of good X actually bought and sold is echoed by Clarkson and Miller.[13]

Further, both the Needham and Clarkson and Miller texts raise the question of where to draw the line between cross elasticity values in determining which products belong in the same industry. That is, what is a sufficiently large enough value of cross elasticity of either demand or supply to justify classifying goods as being in the same industry? Both texts also note that though all firms are affected by the actions of other firms, a particular firm will focus solely on those few firms whose actions it regards as having a significant impact on its own policies. The cross elasticity measures shed light on these few firms likely to influence the policies of other firms. This reasoning is well-aligned with the definition of an industry of Malchup noted previously.[14]

In his discussion of cross elasticity of supply, Shepherd provides an appropriate algebraic formula and admits that certain conditions of supply can be relevant in defining markets. However, he is skeptical of analysts who have assigned supply conditions the major role in the delineation of product markets, being critical of the inclusion in said market definitions of outside firms or "uncommitted entrants" as if they were already in such markets. He argues that it is confusing to mix these possible entrants with the definition of the industry. He prefers to define an industry in terms of demand conditions of consumer choice. He notes the now well-established practice of the use of cross elasticity of supply considerations by antitrust defendants' attempts to enlarge the size of the relevant product market. He does admit that it is sometimes possible to shift production facilities from the production of one product to that of another product quickly and efficiently. However, he asserts that claims relative to the degree of transferability of capacity are often exaggerated. Further, he points out that producers may be so profitably engaged in the production of one product that no transferability will occur even in the wake of sizable price changes of other products. Based on these considerations, Shepherd concludes that it is correct and, indeed, wise to ignore the "uncommitted entrants" in defining existing markets.[15] The foregoing is illustrative of the relatively limited discussion afforded to the cross elasticity of supply.

As noted above, the trailblazers of the cross elasticity concepts, Machlup and Bain, did not provide any examples of pairs of goods illustrative of either concept. Some early examples were, however, provided by Irston R. Barnes. He pointed out that interior and exterior paints may be substitutes on the supply side of the market. He reassured logically that if it were feasible, given their production facilities, for paint manufactures to alter the proportion of their output of the two types of paint in response to changing consumer demand that the appropriate supply side market could well include both types of paint. The same would be true of shoe manufacturers easily able to alter their production of men's and women's shoes in response to changes in demand for each type of shoes. Similar reasoning would apply wherein a steel manufacturer integrates forward by acquiring a maker of structural shapes and, hence, has the capability of altering its production of basic steel and structural shapes in response to changing conditions of demand.[16] Needham did give the example of the production of left-handed golf clubs, being substituted for the production of right-handed golf clubs in response to a rise in the price of the former.[17] While Clarkson and Miller's brief discussion of the cross elasticity of supply of supply did not provide any concrete examples, Shepherd did give the examples of the interchangeability of men's and women's shirts, as well as that of quilts and sleeping bags.[18] It is interesting to the author that neither Malchup nor Bain offered any examples of the cross elasticity of supply concept. Further, it is curious, as noted above, that Bain did not identify the concept at all. In fact, it seems rather curious that this concept was not discussed by these authors or by anyone else until 1952, nearly seven years after the conclusion of World War II.

WORLD WAR II: A CASE STUDY OF CROSS ELASTICITY OF SUPPLY

Clearly World War II provided more than any other prior war, a plethora of examples of American Industries which converted their production facilities from peacetime to wartime production.

No doubt many industries and their respective employees felt it their patriotic duty to serve the war effort in support of the efforts of American and Allied Armed Forces. However, this massive conversion to wartime production was underway prior to America's entry into the war. This was due to the implementation of the Lend-Lease program in early 1941. This was initially an attempt to overcome the crisis Britain was facing in war purchases.[19] Hence, to a large extent, it had to have been prompted by the profit motive. It was a reflection of a generosity of selfishness, merely mirroring once again the self-interest noted long before by Adam Smith in his *Wealth of Nations*.[20] That is, when the demand for and, therefore, the prices of war implements and materials began to rise, American industry supplied the same through massive conversion of their existing production facilities, as well as, through the construction of new war-oriented facilities.

However, in pursuit of their self-interest, American manufactures were initially reluctant to accept government defense contracts. They feared that a rearmament program might be commandeered by President Roosevelt whom they believed was generally anti-business. Nevertheless, this and other concerns relative to their profitability and risk were greatly soothed by a number of moves by the government. First, the government stopped awarding contracts by formal competitive bidding in favor of a system of Cost-Plus-Fixed Fee Contracts. Though this fee was limited to 7 percent of the estimated cost, the government contracts were not binding. Appropriate fee increases could be made to account for significant changes in the contractor's circumstances in the scope of the contract. Further,

manufactures often experienced lower than projected costs due to the realization of economies of learning (or experience), a situation which permitted them to earn more than a 7 percent margin over actual costs. In addition, manufactures benefitted from advance and progress payments made by the government during the course of the contract.[21]

In addition, a law was passed in 1940 which allowed manufactures to accelerate depreciation of certified emergency facilities from the usual 20 years down to five years or less. This statue also released manufactures from the yoke of some existing project limitations. Even though this law did raise corporate income taxes, as well as imposing an excess profits tax, it did provide for sufficient loopholes to allow escape from much of the burden imposed by these new taxes. Further, most of the corporate investment that was deemed eligible for the accelerated depreciation provided under the Act was in facilities that could easily be converted into peacetime production after the war. For example, there was three times more investment in steel and chemical plants than in those for ammunition, guns, and wartime vehicles and vessels.[22]

The federal government also invested heavily in the provisions of wartime plants and equipment. In fact, the government funded 66.6 percent of the investment in such from July 1940 to June 1945 ($17.17 of $25.79 billion invested). The Defense Plant Corporation (DPC) was created in August 1940 as a subsidiary of the Reconstruction Finance Corporation. Its primary function was to expand wartime capacity while minimizing the risk of private industry. By the end of the war, the DPC had invested over $7 billion in wartime plant and equipment. These plants constructed were called "GOCO plants" (Government-Owned, Contractor-Operated). By June 1944, 26 of the nation's largest firms, such as, GM, U.S. Steel, Ford, Chrysler, Dow Chemical, et al. operated half of the value of the government-financed GOCO facilities leased to private contractors. The top 168 companies using these factories accounted for 83 percent of their value. Many of these facilities were subsequently sold to private corporations. Hence, it is evident that the government worked closely with private industry in conducting the war effort, doing a number of things, such as the above, to lessen the risk and enhance the profitability of firms participating in that effort.[23]

Of course, Washington's control over the economy was expanded in the coordination and the direction of the war effort. However, its control was focused primarily on the consumption of civilian goods inclusive of selected rationing of things as meat, gasoline, and coffee, rather than in the production efforts of American industry.[24] Wiliam Knudsen director of war production for the War Department, who, though a civilian, was granted the rank of lieutenant general. Although he served as Director of Industrial Production of the Natural Defense Advising Commission (NDAC) with extensive powers, he and the Army could not order any company to produce any specific goods. On the contrary, production was purely voluntary. It is true that the War Production Board used its authority to order companies not to produce such things as new cars, and refrigerators and other heavy durable goods. However, the Board never endeavored to tell anyone what to make. American firms had this left to their own discretion. That is, firms were free to choose to enter into contracts with the government to produce implements of war. This was in keeping with Knudsen's plan to elicit war-time production by those who envisioned some advantage to themselves for doing so.[25]

To encourage and facilitate the production conversion process, Business Week began featuring stories on how companies might obtain defense contracts by converting to wartime production. Advice was provided on how to procure government loans to assist in the conversion, as well as, on materials that could be substituted for those that were in short supply.[26] Further, the Research Institute of America published *Your Business Goes to War* which also dealt with defense contract procurement and how to obtain crucial materials. In addition, this publication counseled firms on how to deal with the government's war-time priority system and offered an extensive list of war-time products a company could offer to produce. For example, a vacuum cleaner manufacturer might produce gas-mask parts and a lawn mower manufacturer might convert to the production of shrapnel.[27] Before long, it was noted that war-time production was being undertaken with 25,000 contractors and 120,000 subcontractors, with more on the horizon, making products that they never previously dreamed of making.[28]

Major wartime conversion took place in the U.S. automobile industry which ultimately produced 20 percent of U.S. munitions in the war.[29] Peacetime production was officially halted in the industry on February 10, 1942. Although GM delayed conversion to wartime production, it ultimately contributed 10 percent of U.S. war production. It actually began war production only 29 days after ceasing its civilian-line production.[30] The company quickly converted nearly 90 percent of its 41 operating divisions to the production of munitions and experienced an increase in war-related sales from $40 million in 1941 to 3.5 billion in 1943, an increase of over 762 percent.[31] The Chrysler Corporation was chosen as the primary producer of American tanks in 1940. Other manufacturers similarly engaged were the Pullman-Standard Car Manufacturing Company, the Pressed Steel Tank Company, The Lima Locomotive Works, and The Baldwin Locomotive Works, with engines manufactured by Continental Motors Corporation. Chrysler's initial production was of M3 Giant tanks. Then in March 1942, the company was contracted to construct the new M4 tanks which came to be called "Shermans."[32] Subsequently, Chrysler manufactured nose sections, landing edges and center wing flags for the mammoth B-29. Though the production of 40-mm Bofors guns had been in place for some time at Plymouth, total conversion to war work evolved in the early summer of 1941. Thereafter, assembly-line production of the Bofors took place in several Plymouth, Dodge and Chryslers plants.[33]

After ceasing civilian car production in February 1942, Ford's vehicular production focused on staff cars for Army officers, Navy service trucks, bomb service trucks, and the jeep. The Willis-Overland company won the initial government contract to build the small, four-wheeled, rough-terrain personnel carrier which came to be called the jeep. Ford was subsequently asked to produce jeeps based on the Willis-Overland design because the Army wanted a second supply source for said

vehicle.[34] Ford made a relatively small proportion (14.7 percent) of tanks and other vehicles produced during the war compared to Chrysler, G-M and Studebaker. However, Ford was noted for its aircraft and tank engines. The company would also make aircraft parts, aircraft engine synchronizers, gun mounts, machine tools, etc. at its renowned tool and die plant. When the Army approached Ford to produce gliders for its airborne forces, Ford used a sawmill and woodworking plant for a mass production of the gliders. Its production of all CG-4A gliders increased from less than one percent in 1942 to 36.6 percent in 1943 and to 50 percent in 1944.[35] Ford also focused on producing hard-to-make vehicles, such as Navy cargo trucks and bomb service trucks. In addition, Ford also worked on producing B-24s.[36] Other examples of war-time conversion such as, Hudson Motors producing fuselage waste sections and tail gun turrets for the B29, can be identified. Impressively, American automakers would produce 50 percent of all aircraft engines, 35 percent of aircraft propellers, 47 percent of machine guns, 87 percent of aerial bombs, 80 percent of tanks and tank parts, 50 percent of diesel engines for submarines and other naval craft and 100 percent of army trucks, half tracks, and other vehicles.[37]

The following passenger car figures for the industry in Table 1 add emphasis to its war-time conversion. The data relative to war weaponry, though not restricted to that produced by auto manufactures, emphasize the shift in production caused by the war.

The data show a dramatic conversion from passenger car production after 1941. After gaining government contracts to produce various war implements, such as those discussed above, the auto manufacturers used their production facilities to provide these war-related goods, moving away from the production of passenger cars. Hence, as the price of war goods (y) in Formula 2 rose, the quantity supplied of passenger cars (x) fell. Once the big automotive producers had committed to war-time production, a myriad of subcontractors followed in keeping with the argument advanced by Bill Knudsen that the latent power of subcontractors would be unleased to propel war-time production. For example, Houdaille Hershey, a parts supplier which specialized in shock absorbers, was implementing increased efficiency in the production of the .30 caliber machine guns.[38]

G-E was another huge contributor to the war-production effort. The company gained its first military contract in late 1939 to produce mule-pack howitzers for the Army. It would produce a variety of war-time goods, such as, propulsion plants for warships, turbo-superchargers for airplanes, searchlights and military radios, radar sets, and ramp-operating motors for LSTs and Higgins boats. It also devised 300 new types of electric lamps, produced 400,000 electrically heated flying suits, while designing a new Navy torpedo. Further, G-E produced turbines for several heavy carriers, cruisers, and destroyers. It even filled an Army order for 5,000 bulldozers in an amazingly quick manner.[39]

Extensive war-time conversion was obviously needed and accomplished in the aircraft industry. Douglas introduced its new improved SBD-4 Dauntless dive-bomber. Consolidated Aircraft applied modified mass-production techniques to

Table I

Yearly Production of Passenger Cars by US Auto Manufacturers*

and Production of Various Implements of War**

Year	Tanks and Self Propelled guns	Military Trucks and Lorries	Fighter Planes	Submarines
1939	0	32,604	0	0
1940	331	183,614	1,162	0
1941	4,052	619,735	4,416	2
1942	24,997	621,502	10,769	34
1943	29,497	596,963	23,988	55
1944	17,565	Unavailable	38,873	81

* Source: Francis Walton, Miracle of World War II, Macmillan, N.Y. 1956, p. 240
** ww2-weapons.com

produce B-24 bombers and PBY flying boats.[40] North American was producing thousands of two-engine Mitchell bombers, as well as, the new single engine P-51 Mustang fighter which featured Rolls-Royce Merlin engines produced by Packard.[41] The construction of the massive B-29 busied several different firms. For example, Martin Aircraft phased out production of B-26 Marauders to shift to the B-29. Mention has already been made of the B-29 components supplied by Chrysler. Goodyear supplied bomb-bay fuselage sections. Mention has also been made of Hudson Motors' contribution to the B-29. The J.I. Case tractor company supplied outer wing panels, wing tips, and ailerons, while Bendix Corporation produced the dorsal and belly turrets. Further, Curtiss-Wright and bevy of subcontractors worked on the design of the B-29 engine.[42]

In the additional crucial area of shipbuilding, much conversion activity, of course, took place. Todd Shipbuilding produced Liberty ships in Houston. The Manitowoc Shipbuilding Company of Wisconsin which produced small cargo vessels for Great Lakes trade collaborated with the Electric Boat Company in mid-1942 to make submarines.[43] The Higgins Boat Company of New Orleans had developed a boat (the Eureka) to haul logs out of shallow waters around strands of timber. All the company needed to do to provide an ideal mechanism for loading and unloading U.S. Marines on beaches was to cut a ramp out of the front of its Higgins boat. After the attack on Pearl Harbor, the Navy suddenly needed large quantities of Eurekas, as well as crafts to transport medium tanks onto the beach and PT (patriot torpedoe) boats. Higgins provided ramp-equipped LCUPs, LCMs and PT boats. In addition, hundreds of Land Ship Tanks were built by Missouri Valley Bridge and Iron and by Chicago B&I.[44]

A myriad of other examples of war-time conversion could be presented. For example, Frigidaire manufactured .30-caliber machine guns.[45] Roch-Ola, a Chicago manufacturer of jukeboxes, contracted to produce M1 carbines, as did the Underwood Typewriter Company, National Postal Meter, Quality Hardware and IBM.[46] General Industries of Ohio was engaged in the assembly of M48 artillery fuses; and Franks Ix's mill of Charlottesville, Virginia made extensive amounts of parachute cloth for the airborne division of the Army.[47] It has been noted that by the beginning of 1944, 70 percent of American manufacturers was engaged in wartime production.[48] Some of this massive effort is reflected in the annual production of selected war implements provided above in Table 1. Such conversion to wartime production was unprecedented historically. Suffice it to say, therefore, that World War II, more so than any previous war, provided countless examples of the supply substitutability embedded in the concept of cross elasticity of supply, only some of which have been presented herein. It is , to reiterate, therefore, rather amazing that the economics profession did not discover said concept until nearly seven years after the conclusion of World War II and that neither those who perceived the concept, nor those addressing it in their wake, ever alluded to the countless illustrations of the concept presented by the war.

SUMMARY

The cross elasticity of supply is the counterpart of the cross elasticity of demand. Whereas the latter measures the response of the quantity demanded of a good to a change in the price of another good, the former relates the response of the quantity supplied of one good to a change in the price of another good, assuming that all other things are held constant. These two cross elasticities can be helpful in defining relevant product markets. Over time, however, more emphasis has been placed on the demand side in defining products of markets. Hence, more attention has been devoted to cross elasticity of demand than to cross elasticity of supply. It is maintained, however, that the cross elasticity of supply is still an interesting and relevant concept. Examples of this concept have been presented in this article. Mostly, examples are provided that occurred in American industry during World War II, examples that speak for themselves and have long awaited recognition by the economics profession. Although it is acknowledged that some of the conversion from peacetime to wartime production on the part of American industry was motivated by patriotic intentions, it is certain that much of it is attributable to the desire to earn lucrative government contracts to supply the various implements crucial to the war effort. This conversion process, which occurred in several individual industries illustrates so well the responsiveness and power of the market system. As students of economics well know, elasticity equates to responsiveness.

NOTES

1. Machlup, *The Economics of Sellers' Competition,* 213
2. Greco, "Cross Elasticity of Supply: Seldom Heard of and Seldom Taught."
3. Greco, "The Treatment of Supply Substitutability in U.S. District Court and FTC Decisions, 6-16.
4. Manne, "Oil Refining: Cross-Elasticities of Supply."
5. Hicks, *Theory of Wages,* 1932 and R.G.D. Allen, *Mathematical Analysis for Economics,* 1938.
6. Manne, "Oil Refining: Cross Elasticities of Supply", 214.
7. Machlup, *The Economics of Sellers' Competition,* 213.
8. *Ibid.*,214.
9. Bain, *Price Theory,* 50-51
10. Machlup, *The Economics of Sellers' Competition,* 214
11. Machlup, *The Economics of Sellers' Competition,* 215
12. Greco "Cross Elasticity of Supply: Seldom Heard of and Seldom Taught"

13. Clarkson and Miller, *Industrial Organization,* 57-58; Needham, *Economic Analysis and Industrial Structure,* 20-21

14. Clarkson and Miller, *Industrial Organization,* 58; Needham, *Economic Analysis and Industrial Structure,* 21

15. Shepherd, *The Economics of Industrial Organization,* 68

16. Barnes, "Markets, Competition, and Monopolistic Tendencies in Merger Cases", 145.

17. Needham, *Economic Analysis and Industrial Structure,* 19

18. Shepherd,*The Economics of Industrial Organization,* 68

19. Walton, *Miracle of World War II,* 111-112.

20. Adam Smith, *The Wealth of Nations,*

21. Higgs, *Depression, War, and Cold War,* 36-40.

22. Higgs, *Depression, War, and Cold War,* 41-44.

23. Higgs, *Depression, War, and Cold War,* 44-51.

24. Herman, *Freedom's Forge,* 254

25. Ibid.,254.

26. Herman, p.255; *Business Week,* March 15, 1941, pp.38-42

27. Herman, pp.255-256, Cherne, *Your Business Goes to War,* pp.50-53

28. Herman, *Freedom's Forge,* 167. Walton, *Miracle of World War II,* 551.

29. Herman, *Freedom's Forge,* 215

30. Herman, *Freedom's Forge,* 216, Davis, *Detroit's Wartime Industry*, 45.

31. Herman, *Freedom's Forge,* 248-249, General Motors Annual Report, 1945, 9.

32. Herman, *Freedom's Forge,* 200.

33. Walton, *Miracle of World War II,* 232.

34. Walton, *Miracle of World War II,* 239.

35. Herman, *Freedom's Forge,* 218, Nevins, Ford: *Decline and Rebirth,* 207.

36. Herman, *Freedom's Forge,* 218-219

37. Herman, *Freedom's Forge,* 217; Walton, *Miracle of World War II,* 237, Clive, *State of War,* 22.

38. Herman, *Freedom's Forge,* 216; Janeway, *Struggle for Survival,* 195.

39. Herman, *Freedom's Forge,* 248, Walton, *Miracle of World War II,* 401-403.

40. Herman, *Freedom's Forge,* 202-203; Bill Yenne, *The American Aircraft Factory in World War II,* 80,86.

41. Herman, *Freedom's Forge,* 203; Yenne, *The American Aircraft Factory in World War II,* 86.

42. Herman, *Freedom's Forge,* 312; Vander Meulen, *Building the B-29,* 29,31.

43. Herman, *Freedom's Forge,* 252-53. Roger Franklin, *The Defender: The Story of General Dynamics,* 92-93.

44. Herman, *Freedom's Forge,* 252; Barbara Forgy Schock, "The Prairie Shipyard" *www.thezephyr.com*.

45. Herman, *Freedom's Forge,* 252.

46. Ibid.

47. Herman, *Freedom's Forge,* 252; Walton, *Miracle of World War II,* 469.

48. Herman, *Freedom's Forge,* 283.

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