THE
JOURNAL OF
BUSINESS INQUIRY

Report of the Editor of *The Journal of Business Inquiry*
For the Year 2013, Volume 12

The Year 2013 was another good year for *The Journal of Business Inquiry (JBI)*. Volume 12 published seven articles. We received many high-quality papers with 24.13 percent of acceptance rate. The articles were written by authors, whose primary affiliations include 30 institutions from 11 countries, including Australia, Bahrain, Bangladesh, India, Iran, Kuwait, Puerto Rico, Qatar, Saudi Arabia, Tunisia and the US. Turnaround time took, with almost 27.58 percent of the editorial decisions, less than or 30 days, 48.27 percent between 31 and 180 days, 24.13 percent, between 181 and 272 days.

On behalf of *The Journal of Business Inquiry*, I would to thank Professor Diane Tardif of the University of Ottawa for copy editing the articles in this issue and Ann Mecham for her excellent administrative assistance and for formatting the articles.

The Journal of Business Inquiry would also like to thank the following individuals, who served as referees over the past year. Some of these individuals refereed more than one paper. Without their help, *JBI* could not fulfill its mission.

Dr. Adel Al-Shayea: King Saud University
Dr. Maria Arbatskaya: Economics Department, Emory University
Dr. Vaughn Armstrong: Finance and Economics Department, Utah Valley University
Dr. Muhammad Atmeh: German Jordanian University
Dr. Sanjoy Bose: Abu Dhabi University
Dr. Ahmed El-Galfy: Gulf University for Science and Technology
Dr. Karim Eslamloueyan: Department of Economics, Shiraz University
Dr. Mamoon Hammad: Department of Civil Engineering, Abu Dhabi University
Dr. James Matthew Hampton: Economics Department, Emory University
Dr. Stan Jenne: Accounting Department, Accounting Department, Utah Valley University
Dr. Michael Jetter: Economics and Finance Department, Universidad EAFIT in Medellin
Dr. Susan Madison: Management Department, Utah Valley University
Dr. Milton Mayfield: Texas A&M International University
Dr. Guy McClain: School of Accountancy, Auburn University
Dr. Gary Mercado: Finance and Economics Department, Utah Valley University
Dr. Kaz Miyagiwa: Florida International University
Dr. Kaushik Mukhopadhaya: Economics Department, Emory University
Dr. Rashid Nikzad: Economics Department, Ottawa University
Dr. Haitham Nobanee: College of Business Administration, Abu Dhabi University
Dr. Andre Oliveira: Finance and Economics Department, Utah Valley University
Dr. Geoffrey Poitras: Faculty of Business Administration, Simon Fraser University
Dr. Manuel Salas Velasco: Department of Applied Economics Campus, University of Granada
Dr. Abdus Samad: Finance and Economics Department, Utah Valley University
Dr. Scott E Seavey: University of Nebraska-Lincoln
Dr. Sheldon Smith: Accounting Department, Utah Valley University

Dr. Maritza Sotomayor: Finance and Economics Department, Utah Valley University
Dr. Ramendra Thakur: University of Louisiana at Lafayette
Dr. Hamid Yeganeh: Winona State University
Dr. Chris Westley: Jacksonville State University

Amir Kia

Editorial Board

The Impact of Product Differentiation on the Collapse of Arthur Andersen

By GUY MCCLAIN*

This study investigates industry specialization during the demise of Arthur Andersen after the Enron scandal. While the literature on industry specialization has centered mainly on the auditing firm's ability to generate fee premiums and increase audit quality, this paper argues that industry specialization is a method of product differentiation that allows firms to be less imitable and therefore, replaceable. Using multinomial logistic regression from a sample of Fortune 500 firms, I find that Arthur Andersen was not fully differentiated with respect to industry specialization when compared with two of their competitors: Deloitte & Touche and KPMG.

Keywords: Audit Markets, Auditor Replacement, Product Differentiation

JEL Classification: M420

I. Introduction

The demise of Arthur Andersen was an event that rocked the global financial accounting community. So significant was the impact of Andersen's decline that legislation was enacted through the Sarbanes-Oxley Act of 2002 to restore public confidence in the U.S. financial markets. Most notably, the Sarbanes-Oxley Act restricts the types of services (referred to as management advisory services or non-audit fees) auditors can provide to their public audit clients. It has been argued that auditor dependence on fees (both audit fees and fees from management advisory services) clouds the auditor's independence and ultimately the judgment auditors use when applying generally accepted accounting principles (Frankel *et al.,* 2002). Because Andersen was so dependent on the fees received from Enron, the fear of losing those fees led them to make suspect judgments or to acquiesce to client demands. While this finding has been debated (Ashbaugh *et al.,* 2003), what remains true is that Andersen is no longer performing audits, and its former competitors have filled the vacancy.

Product differentiation is an important key to having a successful business. Within the context of public accounting, differentiation can be hard to operationalize given the homogenous nature of financial statement audits. Therefore, auditing firms specialize by industry (both nation-wide and city-specific) in order to demand fee premiums (Francis *et al.,* 2005; Ferguson *et al.,* 2006). Product differentiation also acts as protection against competitors as the firm's product becomes less imitable (Matraves and Rondi, 2007). The reasons can explain why Andersen's clients dropped the auditing firm prior to the obstruction of justice indictment. For example, Federal Express, Delta Airlines, and Freddie Mac all dropped Andersen prior to the indictment (Day, 2002)

which signaled serious problems for the firm. As such, improved knowledge about Andersen's specialization within the audit market provides new insights into the surprising and seemingly overnight disappearance of the firm. This paper investigates whether Andersen properly differentiated itself from its competitors by comparing its client characteristics to the client characteristics of its Big 5 competitors: Deloitte and Touche, Ernst and Young, KPMG, and Pricewaterhouse Coopers.

II. Prior Literature

A. The Homogenous Audit Market

Managers of public firms demand audit services in order to provide credibility to their financial statements. This demand is called audit quality, which refers to the likelihood that auditors detect and report financial statement errors or omissions (DeAngelo, 1981). Higher audit quality protects shareholders and managers by decreasing the chance that errors or omissions will exist in the audited financial statements. Previous research has defined audit quality by firm size— Big 5 versus non Big 5 accounting firms (for example, Simunic and Stein, 1987; Francis and Wilson, 1988; Firth and Smith, 1992). Selection of a Big 5 auditor, therefore, is viewed as a signal of financial statement quality. Thus, audit clients are faced with a dilemma: if the clients want a quality audit, must they choose a Big 5 firm? If so, which Big 5 firm should the clients choose?

First, audit clients demand higher audit quality because of agency frictions in the relationship between shareholders and managers. These frictions are the costs incurred to structure, to implement and to monitor contracts related to the performance of managers. As clients become larger (Francis and Wilson, 1988; DeFond, 1992) and more complex (Dopuch and Simunic, 1982), agency costs increase resulting in a need for a higher quality audit. Auditing provides credibility to financial statements and reliability in their role as a monitoring device; thus, auditing helps to mitigate agency costs (Jensen and Meckling, 1976).

Next, audit clients are keenly aware of the risks equity investors incur when investing in the stock of their company: business risk and information risk. Business risk is a measure of general business success or failure. Investors can mitigate this risk by investing in a diversified portfolio of firms. However, diversification can be impaired since it depends on the reliability and adequacy of the financial statement information available to the investor. This risk is known as information risk, the risk or the probability that the financial statements used by the investor are inadequate and unreliable (DeJong and Smith, 1984).

In addition, auditors can be seen as a "deep pocket" (think insurance policy) for any potential lawsuits arising from the performance of the audit and the client's possible financial failure. Audit firms have three mechanisms to mitigate their litigation: audit design, audit pricing and client selection. Audit design refers to creating and executing a sufficient audit that accurately detects and reports the financial statements. Audit pricing refers to pricing the audit higher than normal to compensate for the increased risk. Simunic and Stein (1987) find that firms do not increase price; they increase the amount of audit work. Client selection refers to selecting clients with as little business risk (potential for failure) as possible.

Audit firms competing within the Big 5 have clients with a similar profile regarding the aforementioned characteristics. In fact, Francis *et al.,* (2013) report the Big 4 (the firms remaining after Andersen's failure) have a global market share for publicly listed firms of 55 percent and 61

percent for firms in the United States. This demand for auditing allows multiple types of audit quality to exist and leads to product differentiation within the Big 5.

B. Industry Specialization

One method used in differentiation is industry specialization. KPMG led the advancement to an industry based audit strategy with its restructuring along industry service lines in 1993 (Hogan and Jeter, 1999). Professional audit standards also stress the importance of understanding a client's business. Both U.S. standards (the Public Company Accounting Oversight Board's Audit Standard No. 9, *Audit Planning)* and the International Standard on Auditing 315, *Identifying and Assessing Risks of Material Misstatement through Understanding the Entity and its Environment* require the auditor to have a thorough understanding of matters affecting the industry in which the client operates.

Prior research has attempted to identify the reasons why auditors specialize. Early work by Eichenseher and Danos (1981) and Danos and Eichenseher (1986) argues that auditors specialize in industries where the auditor can use economies of scale to reduce the cost of production. They argue these specializations are more common in regulated industries where auditors have to make large investments in industry-specific knowledge. For example, certain types of transactions such as interest rate swaps, long-term leases, and joint ventures are more common in some industries. Other industries such as banking and healthcare have specialized accounting procedures, reporting requirements and internal control systems. In this regard, the auditor's investments necessary to achieve specialization are similar to those regarding quality in repeat purchase settings (DeAngelo, 1981; Klein and Leffler, 1981).

More recent evidence suggests that auditor specialization has increased in non-regulated industries. Hogan and Jeter (1999) find that auditor specialization in unregulated industries has increased over time during their sample period from 1976-1993. Extending the discussion beyond regulated versus non-regulated industries, Cairney and Young (2006) find auditor specialization in industries where firms have similar operational cost structures. Similarly, Cahan *et al.,* (2008) find that a homogenous investment opportunity set within an industry is positively related to auditor specialization. They refer to this as concentration, not dominance, as firms within a homogenous industry would be reluctant to share an auditor because of concerns regarding the transfer of proprietary information.

O'Keefe *et al.,* (1994) suggest that the provision of audit services to a client includes general, industry-specific, and client-specific knowledge. General knowledge (e.g., knowledge of GAAP and GAAS) and client-specific knowledge are not dimensions of industry specialization. The former is required of all auditors and the latter is acquired as part of a particular engagement and is not transferrable. Gaining industry-specific knowledge and expertise requires considerable investment on the part of auditing firms. Kend (2008) documents Big 5 audit partners' responses by indicating specialist's knowledge requires an understanding of the client's operating environment, key accounting policy issues, business practices, key performance indicators, history, current issues and future direction. This investment, however, allows firms to maximize economies of scales through reductions in costs for technologies, personnel and training (Craswell *et al.,* 1995) as the costs are spread over a larger number of clients.

Industry specialization also produces a higher quality audit which allows industry specialist auditors to charge a fee premium. The evidence on the benefits of auditor specialization is straight forward. First, specialist auditors detect more errors (Owhoso *et al.,* 2002) and make better

assessments of risk (Low, 2004). Second, firms employing a specialist auditor are associated with better cash flow predictability (Gramling *et al.,* 1999), higher earnings response coefficients (Balsam *et al.,* 2003), higher analyst evaluations of disclosure quality (Dunn and Mayhew, 2004) and lower instances of financial fraud (Carcello and Nagy, 2004).

The evidence regarding fee premiums, however, is mixed. Early work by Craswell *et al.,* (1995) suggests a fee premium for industry specialists when measured at the national level. Their results, however, are sensitive to the cut-off percentage used to define specialization. In contrast, Ferguson and Stokes (2002) also using Australian data, find no evidence of a premium at the national level. Using city-level industry specialization only adds to the inconsistency. Ferguson *et al.,* (2003) find evidence of a fee premium for auditors identified as specialists at both the city and national level. Thus concluding, both levels of specialization are required to achieve a premium. Francis *et al.,* (2005) find evidence of a city-level fee premium, but the relationship fails in two of their robustness tests. The authors conclude their results are mixed and inconclusive.

Additional work has tested the association between industry specialization and fees in the context of Porter's (1985) competitive strategy framework. Here, specialization is viewed as a form of differentiation which leads to greater efficiencies and therefore lower production costs. Once again, the empirical results are mixed. Mayhew and Wilkins (2003) find that auditors who are successful in differentiating themselves from their competitors can charge a fee premium. When they are not successful at differentiation they must offer discounts to attract clients. Casterella *et al.,* (2004) using Porter's (1985) framework find that smaller clients are charged a premium, while larger clients with bargaining power are not charged. Their findings are in contrast with earlier work by Craswell *et al.,* (1995) who find a fee premium for larger clients but not for small companies. They attribute this to large clients having greater agency costs and hence more need for a specialist auditor.

Auditor Switching

While auditing is believed to be a means of reducing agency costs, there is no unifying theory on how companies select a new auditor or weigh the cost/benefit of switching auditors. Prior research suggests three potential costs involved in changing auditors[1]: switching costs, agency costs and implicit insurance costs (Schwartz and Menon, 1985; Francis and Wilson, 1988; DeFond, 1992; Shu, 2000). I hold the latter constant by only comparing Andersen to other Big 5 auditors. This assumption is consistent with Menon and Williams (1994) who find that the implicit insurance provided by Big N audit firms is relatively equal.

Thus, a client must weigh the cost/benefit of switching costs and agency costs when deciding on changing auditors. Switching costs are the costs incurred by the client for a new audit engagement. These costs typically include the following: cost incurred by the client to educate the auditor about the company's operations, systems, financial reporting practices and accounting issues, the costs incurred selecting a new auditor and increased risk of audit failure (Blouin *et al.,* 2007).

Consistent with Jensen and Meckling (1976) agency costs are the costs associated with monitoring by the principal, bonding with the agent, and a loss in welfare experienced by the principal because the agent does not always act in the principal's best interest. Agency problems

---

[1] This is different from audit mergers that brought the auditing profession from the Big 8 to the Big 5. Those mergers were done to increase the ability of the two new firms to compete for large clients (Sullivan, 2002) in an increasingly competitive market along industry lines (Wootton *et al.,* 2003).

arise when managers have incentives to misallocate or expropriate investor's funds. An independent audit can weaken these incentives by assuring investors that management is properly reporting in accordance with generally accepted accounting principles (Dopuch and Simunic, 1982; Watts and Zimmerman, 1983). The infrequency of auditor switching (the special case of Andersen withstanding) suggests that the marginal agency benefit gained is significantly less than the cost of switching.

Agency costs typically manifest themselves as changes in client characteristics, which are outside the auditor's control (Johnson and Lys, 1990; Krishnan and Krishnan, 1997; Hackenbrack and Hogan, 2002). On the other hand, switching costs, relate to the industry and client specific knowledge of the auditor. Prior research on auditor specialization has typically identified industry specialist auditors by using a market share-based approach where a significant share of the industry's audit fees (or the auditor's share of total assets or total revenues in an industry) is used to designate a specialist auditor (Hay *et al.,* 2006). This measure can be problematic since an auditor can become an industry specialist in two different ways. That is, the auditor can audit a few large clients within an industry or, alternatively, audit many relatively small clients. Thus, the current market share-based definition embraces two strategies.

Based on Porter (1985) there are two basic competitive strategies: product differentiation and cost minimization. To have the largest firms in an industry as clients, an auditor must develop a high level of technical expertise to deal with the scope and complexity of accounting issues that arise in those types of clients. These auditors differentiate themselves as product specialists. On the other hand, auditors who gain market share by auditing a large number of small clients are more likely to be low-cost specialists. Using companies in the *Fortune 500* eliminates the cost minimization strategy to focus on product differentiation.

Industry specialization provides a differentiated service by providing a greater value proposition to the auditor's clients. The audit should be viewed not as a standardized report, but rather as a process. This process requires efforts by both the auditor and the client. An industry specialist auditor should reduce the client's effort by reducing the time the client spends explaining industry-specific practices, procedures and trends. Behn *et al.,* (1997) find that industry specialization is a key component of client satisfaction. Furthermore, research provides evidence that the audit process does not simply produce an audit opinion; it produces audited financial statements to which auditors have substantial impact (Kinney and Martin, 1994; Nelson *et al.,* 2002).

Thus, if auditors are specialists, their clients can incur significant costs to change auditors. In the context of Andersen's decline, previous research investigated the costs associated with changing auditors; specifically, the trade-off between switching costs and agency costs. Chaney and Philipich (2002) find negative market returns for Andersen clients in the three days after Andersen's admission that documents had been shredded. This result implies that investors had downgraded the quality of an Andersen audit thereby negatively impacting the client's agency costs. In a direct test of switching versus agency costs, Blouin *et al.,* (2007) find that clients followed their former Andersen team to a new auditing firm when Andersen was an industry specialist, thus reducing switching costs. On the other hand, they also find that clients with greater agency costs were more likely to sever ties with Andersen. Their results are helpful in understanding the costs and benefits weighed by clients when switching auditors. In a similar study, Barton (2005) investigates the timing of client defections from Andersen. Barton (2005) finds that clients defected prior to Andersen's indictment for criminal misconduct if they were more visible in the capital markets. Measures of agency conflict were not associated with early defections.

To summarize the literature on auditor switching relative to Andersen's criminal indictment implies that once reputational concerns for Andersen arose, the credibility of the financial statements was in doubt. Clients defected because the agency costs simply became too great and switching costs were no longer relevant. Defections prior to the indictment, however, have a different implication. In those situations, clients weighed the agency costs against switching costs and concluded the agency benefit outweighed the switching costs. Perhaps, Andersen had not differentiated its product from its competitors; consequently, there was another auditing firm with comparable technical industry expertise.

This paper's hypothesis tests the differentiation (industry specialization) of Big 5 auditors prior to the bankruptcy of Andersen. Since Big 4 auditors operate almost exclusively in the market for large publically traded firms (Francis *et al.,* 2013), this theory implies that differentiation takes place on a variable other than client size, risk, or complexity. Rather, differentiation occurs through industry specialization. As it relates to Andersen, lack of industry differentiation from their competitors allowed many of their clients to switch auditors prior to any legal indictment. These notions form the basis for H1:

H1: Andersen is not differentiated by industry from its Big 5 competitors.

III. Sample and Research Design

To explore the issue of auditor differentiation, a sample of 183 firms from the April 15, 2002 *Fortune* magazine Fortune 500 list are used. The sample firms were selected from *Fortune's* listing of selected industries. The industries were judgmentally selected to ensure diversity in services and/or products offered. Within each industry, the largest companies (based on revenues) were selected. Financial and auditor data was collected from Research Insight, and the sample was restricted to a December 31, 2001 year-end, the last year-end in which Andersen performed financial statement audits.

When using a multinomial regression model, one firm must be the reference firm (i.e., the firm with value 0). All other firms are then compared to this base firm. In this study the reference firm is Andersen because Andersen is the firm that went bankrupt and is no longer providing audit services. In addition, the model was also run with Pricewaterhouse Coopers (PWC) as the base firm. PWC was randomly chosen as an opposite to Andersen (i.e., a firm with no regulatory or legal troubles). I compared the Andersen model with the PWC model by comparing the frequencies of actual and predicted outcomes. The Andersen model correctly predicted the same percentage of outcomes as the PWC model, (70 out of 183 or 38.25 percent)

Based on the discussion above, the paper tests whether Andersen is differentiated with respect to its Big 5 competitors using the following multinomial logistic regression model. Multinomial logistic regression is used to predict a dependent variable on the basis of continuous and categorical independent variables. The model is as follows:

$$\text{AUDITOR} = \alpha_0 + \alpha_1\text{ASSET} + \alpha_2\text{REV} + \alpha_3\text{DE} + \alpha_4\text{OPIN} + \alpha_5\text{FSUB} + \alpha_6\text{DSUB} + \alpha_7\text{D1} +$$
$$\alpha_8\text{D2} + \alpha_9\text{D3} + \alpha_{10}\text{D4} + \alpha_{11}\text{D5} + \alpha_{12}\text{D6} + \varepsilon,$$

where:

1.   AUDITOR= a multinomial variable used to identify each of the Big 5 firms
2.   ASSET= the natural log of total assets reported for the year-ended Dec. 31, 2001
3.   REV= the natural log of total revenues reported for the year ended Dec. 31, 2001

4.   DE= the debt-to-equity ratio as reported on Dec. 31, 2001
5.   OPIN= a dummy variable for the type of opinion received on the Dec. 31, 2001 financial statements. A 0 is used for an unqualified opinion, a 1 for all other opinion types
6.   FSUB= the number of foreign subsidiaries that are consolidated into the financial statements as of Dec. 31, 2001
7.   DSUB = the number of domestic subsidiaries that are consolidated into the financial statements as of Dec. 31, 2001
8.   D1-D6 = a series of dummy variables used to represent the industry sector in which a company operates. The dummy variables are as follows: D1- the aerospace/defense industry; D2- equipment manufacturing; D3- chemical and petroleum; D4- health care and health related; D5- energy; and D6- telecommunications

IV. Results and Discussion

A. Univariate Results

Table 1 presents the variable means for the sample by industry. Table 2, panel A presents the variable means by auditor. Panel B presents t-tests for mean differences between Andersen and the other Big 5 auditors for the entire sample. Panel B shows that KPMG clients are significantly larger than Andersen clients (p-value 0.004); all other results are not significant. These results suggest that Andersen is not significantly different from its competitors on variables that measure size, agency costs and complexity. Therefore, it is expected that Andersen would differentiate itself through industry specialization which is the purpose of the multinomial logistic regression.

B. Multivariate Results

Table 3 contains the results of the multinomial logistic regression. The model has a chi-square of 28.732 (significance 0.032) suggesting that the final model (with independent variables) is significantly different from the intercept-only model. The McFadden pseudo R^2 of 0.230 measures the amount of explained variance in the outcome variable. A McFadden value from 0.2 to 0.4 is considered highly satisfactory (Hensher and Johnson, 1981). The table presents each firm's results as compared to Andersen. When comparing PWC to Andersen, it is noted that D5 and D6 are significant, p-values .0234 and .0553, respectively. The coefficients on these variables are negative. Thus, one concludes the following: in comparison to Andersen, the probability of PWC auditing a company in the energy or telecommunications industries is less likely than Andersen. Additionally, since the financial services variable is coded 0, it is represented in the constant term. The constant term is negative and significant (p-value .0175). Thus, PWC is less likely to have a financial services client than Andersen. The REV variable is also positive and significant (p-value of .0216). From that p-value, one concludes that PWC clients are more profitable than Andersen's, but this is more a function of industry specialization than a systematic auditor-client characteristic.

Table 1: Descriptive Statistics of Variables by Industry (n=183)

Industry	Mean (standard deviation)				
	Assets (in millions $)	Revenue (in millions $)	Debt to Equity	Foreign subsidiaries	Domestic subsidiaries
Financial Services	56,914.50 (99,653.49)	10,319.74 (10,068.40)	128.03 (121.28)	13 (45)	81 (143)
Aerospace	19,011.64 (11,370.57)	17,261.50 (12,797.83)	57.24 (28.86)	31 (37)	95 (96)
Manufacturing	28,798.01 (75,182.99)	20,660.68 (42,623.73)	76.48 (38.50)	107 (98)	153 (140)
Chemical	17,370.38 (30,321.34)	23,055.75 (41,279.55)	46.11 (16.37)	70 (101)	115 (143)
Health Care	15,978.08 (20,500.44)	14,517.18 (10,980.19)	52.92 (106.20)	44 (84)	223 (430)
Energy	18,516.03 (17,814.16)	24,510.40 (22,361.37)	68.97 (21.88)	24 (54)	85 (130)
Telecommunications	54,567.66 (51,970.93)	20,364.63 (21,097.22)	63.55 (23.76)	26 (54)	113 (129)

When comparing Andersen to Ernst & Young (EY), the results indicate that D1, D2, and D3 are all positive and significant (p-values of .0275, .0079, and .0430) suggesting that EY is more likely to have clients in the aerospace, equipment manufacturing, and petroleum industries. The ASSET variable is also positive and significant (p-value .0266). This difference may be the result of larger firm sizes for EY specializations than Andersen specializations. Additionally, the FSUB variable is negative and significant (p-value of .0128). It seems counterintuitive that the industries that EY has specialized in, especially petroleum and equipment manufacturing would have fewer foreign subsidiaries than other industries. Thus, this result may be the sign of an auditor characteristic in firm selection.

Table 2: Descriptive Statistics of Variables by Auditor (n=183)

Panel A	Mean (standard deviation)				
Auditor	*Assets*	*Revenues*	*Debt to Equity*	*Foreign Subsidiaries*	*Domestic Subsidiaries*
Arthur Andersen	$20,538.52 (24,356.57)	$11,661.67 (10,308.37)	82.44 (90.24)	45.47 (81.56)	110.31 (121.69)
Ernst & Young	29,675.60 (36,632.39)	11,875.87 (12,548.51)	79.45 (77.34)	21.00 (41.58)	134.11 (364.25)
Deloitte & Touche	32,476.67 (53,686.49)	19,231.77 (30,341.34)	89.01 (74.69)	34.69 (86.46)	88.85 (132.24)
KPMG	71,516.29 (102,114.44)	12,511.07 (10,476.09)	131.11 (179.46)	42.14 (96.51)	121.71 (159.02)
Pricewaterhouse Coopers	41,836.96 (101,590.04)	24,758.48 (37,409.33)	63.18 (45.28)	57.64 (76.88)	120.94 (155.05)
Panel B	t-test of Differences (p-value)				
Andersen–EY	-1.325 (.189)	-.084 (.933)	.158 (.874)	1.646 (.104)	-.399 (.691)
Andersen-Deloitte	-1.302 (.196)	-1.526 (.131)	-.355 (.723)	.578 (.565)	.761 (.449)
Andersen-KPMG	-3.046 (.004)	-.273 (.786)	-1.355 (.181)	.126 (.900)	-.281 (.780)
Andersen-PWC	-1.325 (.189)	-2.196 (.031)	1.293 (.199)	.565 (.468)	-.358 (.721)

Consistent with my predictions are the non-significant differences when comparing Andersen to Deloitte & Touche (DT) and KPMG. Thus, when the legal troubles ensued for Andersen, their clients and the market, in general, likely viewed them as easily imitable and thus replaceable. The assumption is that Andersen did not adequately protect its product from its competitors. This result and prediction are consistent with the data in Hoitash *et al.,* (2007) and Barton (2005). Hoitash *et al.,* (2007) indicate that as of February 2007, 280 of the 540 (51.8 percent) Andersen clients who had switched firms had switched to either DT or KPMG, while Barton (2005) indicates 12.3 percent of former Andersen clients chose a non-Big 5 auditor.

Table 3. Multinomial Logistic Regression Results (n=183) Coefficient (p-value)

Variables	PWC	EY	DT	KPMG
Constant	-6.8299 (.0175)*	-4.0617 (.2054)	2.6398 (.3000)	-.6844 (.8845)
ASSET	.0299 (.8799)	.8275 (.0266)*	.1925 (.4281)	-.4200 (.8648)
REV	.8424 (.0216)*	-.5052 (.3142)	.5009 (.1905)	-.6246 (.9086)
DE	-.0065 (.2084)	-.0013 (.6830)	.0004 (.9052)	.0036 (.1791)
OPIN	.0644 (.9275)	.2866 (.7117)	.0836 (.9075)	1.3394 (.1120)
FSUB	-.3363 (.2926)	-.0163 (.0128)*	-.0051 (.1976)	.0005 (.9096)
DSUB	-.0007 (.7453)	.0011 (.4565)	-.0005 (.8369)	.0011 (.5581)
D1	.1523 (.9062)	3.0256 (.0275)*	.5599 (.6806)	.6857 (.6666)
D2	.1327 (.8707)	2.9219 (.0079)*	.5988 (.5050)	-.7496 (.5964)
D3	.2486 (.7817)	2.3162 (.0430)*	.5237 (.5928)	.5990 (.6107)
D4	-.4163 (.6056)	1.54440 (.1447)	-.9465 (.3500)	-.2578 (.8158)
D5	-2.8244 (.0234)*	-28.0608 (1.0000)	-.4028 (.8670)	-1.0543 (.4213)
D6	-1.9558 (.0553)*	-.0744 (.9366)	-.8829 (.3304)	-.70892 (.5815)

McFadden R^2 = .230
Chi-square = 28.732 (p-value of 0.032)
*significant at the .05 level

V. CONCLUSION

In this study, a sample of *Fortune 500* companies is examined regarding the differentiation of Andersen relative to its Big 5 competitors prior to their indictment for obstruction of justice. Results indicate little difference between Andersen and its competitors when comparing along measures of size, agency cost and complexity. Differences are discovered when testing along industry specialization. Specifically, Andersen is more likely than PWC to audit a firm in the

energy and telecommunications industry, while EY is more likely than Andersen to audit a firm in the aerospace, equipment manufacturing and petroleum industries. There were no differences between Andersen and either DT or KPMG. This result is consistent with the auditor switching results of Hoitash *et al.,* (2007) who find that over half of Andersen's former clients switched to DT and KPMG and Barton (2005) who finds that 12.3 percent of former Andersen clients switched to a non-Big 5 firm.

Audit firms have incentives to perform audit services for clients that are not easily replicated (Porter, 1985). The results from this study provide modest evidence to suggest that industry specialization (or lack thereof in Andersen's case) allowed competitors to easily court Andersen's clients prior to Andersen's obstruction of justice conviction, as reported by Day (2002) in which FedEx, Delta Airlines and many other larger clients switched firms. Generalizing these results to the audit market as a whole is problematic since the data came from the largest publicly traded companies in the U.S., where the Big 5 (now Big 4) overwhelmingly dominate the market. Perhaps industry specialization at the lower end of the size continuum will yield different results given the impact size plays on audit efficiency and effectiveness.

The results from the present study warrant the following conclusion: in the large audit market, Arthur Andersen did not sufficiently differentiate itself from its competitors. This is consistent with the theory that product differentiation acts a protection against competitors.

References

Ashbaugh, Hollis, Ryan LaFond, and Brian W. Mayhew. 2003. "Do Nonaudit Services Compromise Auditor Independence? Further Evidence." *The Accounting Review,* 78(3): 611-39.

Balsam, Steven, Jagan Krishnan, and Joon S. Yang. 2003. "Auditor Industry Specialization and Earnings Quality." *Auditing: A Journal of Practice and Theory,* 22(2): 71-97.

Barton, Jan. 2005. "Who Cares about Auditor Reputation?" *Contemporary Accounting Research,* 22(3): 549-86.

Behn, Bruce, Joseph Carcello, Dana Hermanson, and Roger Hermanson. 1997. "The Determinants of Audit Client Satisfaction among Clients of Big 6 Firms." *Accounting Horizons,* 11(1): 7-24.

Blouin, Jennifer, Barbara Murray Grein, and Brian R. Rountree. 2007. "An Analysis of Forced Auditor Change: The Case of Former Arthur Andersen Clients." *The Accounting Review,* 82(3): 621-50.

Cahan, Steven, Jayne Godfrey, Jane Hamilton, and Debra C. Jeter. 2008. "Auditor Specialization, Auditor Dominance, and Audit Fees: The Role of Investment Opportunities." *The Accounting Review,* 83(6): 1393-1423.

Cairney, Timothy D., and George R. Young. 2006. "Homogenous Industries and Auditor Specialization: An Indication of Production Economies." *Auditing: A Journal of Practice and Theory,* 25(1): 49-67.

Carcello, Joseph V., and Albert L. Nagy. 2004. "Client Size, Auditor Specialization and Fraudulent Financial Reporting." *Managerial Auditing Journal,* 19(5): 651-68.

Casterella, Jeffrey R., Jere R. Francis, Barry L. Lewis, and Paul L. Walker. 2004. "Auditor Industry Specialization, Client Bargaining Power and Audit Pricing." *Auditing: A Journal of Practice and Theory,* 23(1): 49-66.

Chaney, Paul K., and Kirk L. Philipich. 2002. "Shredded Reputation: The Cost of Audit Failure." *Journal of Accounting Research,* 40(4): 1221-245.

Craswell, Allen T., Jere R. Francis, and Stephen L. Taylor. 1995. "Auditor Brand Name Reputation and Industry Specializations." *Journal of Accounting and Economics,* 20(3): 297- 322.

Danos, Paul, and John W. Eichenseher. 1986. "Long-term Trends toward Seller Concentration in the U.S. Audit Market." *The Accounting Review,* 61(4): 633-50.

Day, Kathleen. 2002. "Riggs National, FedEx Drop Andersen as Auditor." *The Washington Post*, March 12.

DeAngelo, Linda Elizabeth. 1981. "Auditor Independence, 'Low Balling', and Disclosure Regulation." *Journal of Accounting and Economics,* 3(2): 113-27.

DeFond, Mark L. 1992. "The Association between Changes in Client Firm Agency Costs and Auditor Switching." *Auditing: A Journal of Practice and Theory,* 11(1): 16-31.

DeJong, Douglas V., and John H. Smith. 1984. "The Determination of Audit Responsibilities: an Application of Agency Theory." *Auditing: A Journal of Practice and Theory,* 4(1): 20- 34.

Dopuch, Nicholas, and Dan A. Simunic. 1982. "Competition in Auditing: An Assessment." In *Fourth Symposium on Auditing Research,* 401- 50. University of Illinois.

Dunn, Kimberly A., and Brian W. Mayhew. 2004. "Audit Firm Industry Specialization and Client Disclosure Quality." *Review of Accounting Studies,* 9(1): 35-58.

Eichenseher, John W., and Paul Danos. 1981. "The Analysis of Industry-Specific Auditor Concentration: towards an Explanatory Model." *The Accounting Review,* 56(3): 479-92.

Ferguson, Andrew, and Donald Stokes. 2002. "Brand Name Audit Pricing, Industry Specialization and Leadership Premiums Post-Big 8 and Big 6 Mergers." *Contemporary Accounting Research,* 19(1): 77-110.

Ferguson, Andrew, Jere R. Francis, and Donald J. Stokes. 2003. "The Effects of Firm-Wide and Office-Level Industry Expertise on Audit Pricing." *The Accounting Review,* 78(2): 429-48.

Ferguson, Andrew, Jere R. Francis, and Donald J. Stokes. 2006. "What Matters in Audit Pricing: Industry Specialization or Overall Market Leadership?" *Accounting and Finance,* 46(1): 97-106.

Firth, Michael, and Andrew Smith. 1992. "Selection of Auditor Firms by Companies in the New Issue Market." *Applied Economics,* 24(2): 247- 55.

Francis, Jere R., and Earl R. Wilson. 1988. "Auditor Changes: A Joint Test of Theories Relating to Agency Costs and Auditor Differentiation." *The Accounting Review,* 63(4): 663-83.

Francis, Jere R., Paul N. Michas, and Scott E. Seavey. 2013. "Does Audit Market Concentration Harm the Quality of Audited Earnings? Evidence from Audit Markets in 42 Countries." *Contemporary Accounting Research,* 30(1): 325-55.

Francis, Jere R., Kenneth Reichelt, and Dechun Wang. 2005. "The Pricing of National and City-Specific Reputations for Industry Expertise in the U.S. Audit Market." *The Accounting Review,* 80(1): 113-36.

Frankel, Richard M., Marilyn F. Johnson, and Karen K. Nelson. 2002. "The Relation between Auditors' Fees for Nonaudit Services and Earnings Management." *The Accounting Review,* 77(S-1): 71-105.

Gramling, Audrey A., Van E., Johnson, and Inder K. Khurana. 1999. "The Association between Audit Firm Industry Experience and Financial Reporting Quality." Georgia State University Working Paper.

Hackenbrack, Karl E., and Chris E. Hogan. 2002. "Market Response to Earnings Surprises Conditional on Reasons for an Auditor Change." *Contemporary Accounting Research.* 19(2): 195-223.

Hay, David C., W. Robert Knechel, and Norman Wong. 2006. "Audit Fees: A Meta-Analysis of Supply and Demand Attributes." *Contemporary Accounting Research,* 23(1): 141-91.

Hensher, David, and Lester Johnson. 1981. *Applied Discrete Modeling.* London: Croom Helm.

Hogan, Chris E., and Debra C. Jeter. 1999. "Industry Specialization by Auditors." *Auditing: A Journal of Practice and Theory,* 18(1): 1-17.

Hoitash, Rani, Ariel Markelevich, and Charles A. Barragato. 2007. "Auditor Fees and Audit Quality." *Managerial Auditing Journal,* 22(8): 761-86.

Jensen, Michael C., and William H. Meckling. 1976. "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure." *Journal of Financial Economics,* 3(4): 305-60.

Johnson, W. Bruce, and Thomas Lys. 1990. "The Market for Audit Services: Evidence from Voluntary Auditor Changes." *Journal of Accounting and Economics,* 12(1-3): 281-308.

Kend, Michael. 2008. "Client Industry Audit Expertise: Towards a Better Understanding. *Pacific Accounting Review,* 20(1): 49-62.

Kinney, William R., and Roger D. Martin. 1994. "Does Auditing Reduce Bias in Financial Reporting? A Review of Audit-Related Adjustment Studies." *Auditing: A Journal of Theory and Practice,* 13(1): 149-56.

Klein, Benjamin, and Keith B. Leffler. 1981. "The Role of Market Forces in Assuring Contractual Performance." *Journal of Political Economy,* 89(4): 615-41.

Krishnan, Jagan, and Jayanthi Krishnan. 1997. "Litigation Risk and Auditor Resignations." *The Accounting Review,* 72(4): 539-60.

Low, Kin-Yew. 2004. "The Effects of Industry Specialization on Audit Risk Assessments and Audit-Planning Decisions." *The Accounting Review,* 79(1): 201-19.

Matraves. Catherine, and Laura Rondi. 2007. "Product Differentiation, Industry Concentration and Market Share Turbulence." *International Journal of the Economics of Business,* 14(1): 37-57.

Mayhew, Brian W., and Michael S. Wilkins. 2003. "Audit Firm Industry Specialization as a Differentiation Strategy: Evidence From Fees Charged to Firms Going Public." *Auditing: A Journal of Practice and Theory,* 22(2): 33-52.

Menon, Krishnagopal, and David Daou Williams. 1994. "The Insurance Hypothesis and Market Prices." *The Accounting Review,* 69(2): 327-42.

Nelson, Mark N., John A. Elliott, and Robin L. Tarpley. 2002. "Evidence from Auditors about Managers' and Auditors' Earnings Management Decisions." *The Accounting Review,* 77(S-1): 175-202.

O'Keefe, Terrence B., Dan A. Simunic, and Michael T. Stein. 1994. "The Production of Audit Services: Evidence from a Major Public Accounting Firm." *Journal of Accounting Research,* 32(2): 241-61.

Owhoso, Vincent E., William F. Messier Jr., and John G. Lynch Jr. 2002. "Error Detection by Industry Specialized-Teams During Sequential Audit Review." *Journal of Accounting Research,* 40(3): 883-900.

Porter, Michael E. 1985. *Competitive Advantage: Creating and Sustaining Superior Performance.* New York: Free Press.

Schwartz, Kenneth B., and Krishnagopal Menon. 1985. "Auditor Switches by Failing Firms." *The Accounting Review,* 60(2): 248-61.

Shu, Susan Zhan. 2000. "Auditor Resignations: Clientele Effects and Legal Liability. *Journal of Accounting and Economics*, 29(2): 173-205.

Simunic, Dan A., and Michael Stein. 1987. "On the Economics of Product Differentiation in Auditing." In *Proceedings of the 1986 Touche Ross/University of Kansas Symposium on Auditing Problems*: 69-99, University of Kansas.

Sullivan, Mary W. 2002. "The Effect of the Big Eight Accounting Firm Mergers on the Market for Audit Services." *Journal of Law and Economics,* 45(2): 375-99.

Watts, Ross L., and Jerold L. Zimmerman. 1983. "Agency Problems, Auditing and the Theory of the Firm: Some Evidence." *Journal of Law and Economics,* 26(3): 613-33.

Wootton, Charles W., Carel M. Wolk, and Carol Normand. 2003. "An Historical Perspective on Mergers and Acquisitions by Major U.S. Accounting Firms." *Accounting History,* 8(1): 25-60.

Measuring Energy Efficiency in GCC Countries
Using Data Envelopment Analysis

By Mohammed A. Alsahlawi[*]

Energy efficiency is a key issue in determining the direction of global concern about preserving the environment. The Gulf Cooperation Council (GCC) is an emerging economic block of six countries with abundant oil reserves and high energy consumption. However, satisfying high levels of energy efficiency in GCC countries might hinder their fast growing economies. Therefore, it is important to measure energy efficiency of GCC countries in order to set the appropriate policies without adverse effects on their economic development strategies. This paper is the first attempt to measure energy efficiency in GCC countries using two models of Data Envelopment Analysis (DEA). As a complementary step, energy intensity for GCC countries and causality of the relationship between energy consumption and economic growth have been tested. The results indicate several policy implications with regard to energy conservation and efficient use of energy.

Keywords: GCC, Energy Efficiency, Energy Intensity

JEL Classification: C54, C81, Q48

I. Introduction

International concern over environmental issues such as global warming and climate change has put severe political and economic pressures on governments of both developed and less developed countries. Energy efficiency is one of the relevant targets to be met by international environmental standards. Therefore, improvement of energy efficiency is one of the most important objectives for any energy policy, especially for countries with high dependency on imported energy. It also exerts political pressures to deal with the climate change challenge (Al-Mansour, 2011). The objective of improving energy efficiency is not only for environmental benefits, such as reducing CO_2 emissions, but also for attaining commercial, industrial competitiveness and energy security. However, the issue in measuring energy efficiency performance is to define the term "energy efficiency" (Patterson, 1996). Different definitions of energy efficiency would lead to different indicators being used to monitor changes in energy efficiency. In this paper we employ two models of DEA to measure and compare energy efficiency in GCC countries.

The problem of increasing energy efficiency in GCC countries by reducing energy consumption might slow down their economic growth where most GCC countries depend on fossil fuels, in particular oil. Thus, analyzing the relationship between the economic growth as presented by gross domestic product (GDP) and energy consumption is very important in setting energy policies.

---
[*]Professor of Energy Economics, Department of Finance and Economics, College of Industrial Management, King Fahd University of Petroleum and Minerals, P.O. Box 1617, Dhahran 31261, Saudi Arabia. E-mail: msahlawi@kfupm.edu.sa. Phone: 966-3-860-2668, Fax: 966-3-860-2772.

The relationship between GDP and energy consumption has been of interest to many researchers in energy economics (Hannesson, 2009). This interest has been stimulated by the unprecedented oil price increase of the early 1970s, which substantially increased the energy bill in oil-importing countries (Al-Iriani, 2006). Different studies have focused on different countries over different time periods to examine the relationships between energy and other macroeconomic variables (Haji and Said, 2011). To assess the effect of energy conservation policies on economic growth, the direction of the causality relationship between the GDP and energy consumption is usually tested (Sa'ad, 1010). In this paper, we will test the causality between these two variables for GCC countries to draw some policy implications.

As far as energy efficiency is concerned, this paper attempts to measure the energy efficiency in GCC countries using two different models of DEA and utilizes the results of the causality test between GDP and the energy consumption for each GCC country and for the GCC as a panel.

II. General Review of GCC Economies

GCC countries share several homogeneous aspects. They have the same language, culture, history and similar economic challenges which emphasize the need for economic integration and diversification. The GDP for the total GCC has increased from US$245 billion in 1980 to US$1,384 billion in 2011 as presented in Table 1.

Table 1: Major Development in GCC Countries, Economic Indicators (Billion US dollar)

Economic Indicator	UAE		Bahrain		Saudi Arabia		Oman		Qatar		Kuwait	
	2008	*2011*	*2008*	*2011*	*2008*	*2011*	*2008*	*2011*	*2008*	*2011*	*2008*	*2011*
Nominal GDP	254.4	366.2	21.9	25.8	472.3	592.5	60.3	67.9	100.4	173.5	148.2	158.0
Real GDP growth %	7.4	3.5	6.3	2.2	4.2	7.1	12.8	5.0	13.4	14.1	8.5	4.8
Interest rates on US Dollar (3 months)	2.2	0.3	2.4	0.3	2.2	0.3	2.9	0.7	2.2	0.3	2.9	0.7
Inflation rate	12.3	0.9	3.5	-0.4	9.9	5.0	11.8	4.0	15.1	1.9	10.6	4.7
Money supply*	29.1	1.6	20.8	5.3	17.6	13.3	23.1	12.2	21.9	27.5	15.9	8.5
Imports (FOB)	176.3	198.5	14.2	12.1	100.6	119.1	20.7	21.3	25.1	22.2	22.9	20.7
Exports (FOB)	239.2	295.5	17.3	19.9	313.4	364.6	37.7	47.1	54.9	111.4	78.0	95.1
Current account	22.3	52.3	2.3	3.3	132.3	158.5	5.5	9.6	14.2	51.4	64.8	62.7
Ratio of current account balance in GDP**	8.8	14.3	10.3	12.6	27.9	26.8	9.1	14.2	14.1	29.6	43.7	39.7
Government balance (% of GDP)**	136.0	7.4	7.5	-2.3	32.6	13.1	6.0	3.7	10.5	7.1	28.5	33.6
Population (million)	5.6	4.8	1.1	1.4	24.8	28.1	2.9	2.8	1.4	1.8	3.4	2.8

*M2 in Oman represents broad money supply, while M3 represents broad money supply in the remaining GCC countries.
**Ratio of surplus/deficit to GDP (at current prices)
Source: Saudi Arabian Monetary Agency, 2010 and 2012.

GCC countries excluding Bahrain are major producers and exporters of oil. They depend on oil revenue for their economic development as shown in Table 2.

Table 2: World Oil and Gas Reserves, Year End 2010

Region	Oil Reserves		Gas Reserves	
	Thousand Million bbls	%	Trillion CM	%
Americas	313.8	22.7	17.3	9.2
Europe and Eurasia	139.7	10.1	63.1	33.7
Middle East–of which:	752.5	54.4	75.8	40.5
(Gulf Region)	**749.2**	**54.2**	**74.8**	**40.0**
Africa	132.1	9.6	14.7	7.9
Asia Pacific	45.2	3.3	16.2	8.7
Total World	**1383.2**	**100**	**187.1**	**100**

Source: British Petroleum (BP) Statistical Review, 2011.

Recently, GCC countries have embarked on plans for developing their non-energy sectors such as manufacturing and developing renewable energy sources. Such a policy has been driven by the international search for energy alternatives to oil. A fast demographic change is another factor that puts pressure on GCC countries to diversify their economies from oil as the main source for economic development to meet employment aspirations.

The industrial development in the GCC is concentrating on industries, such as basic petrochemicals, fertilizers, and steel, as well as aluminum and non-durable consumer goods. Most of these industrial products are for export and are primarily energy intensive. However, to reach an effective diversification, GCC countries need to integrate economically and politically.

Table 2 shows that GCC countries collectively account for 54.2 percent of world proven oil reserves, and produce more than 21 percent of world crude oil production. As shown in Table 2, GCC countries have around 40 percent of world natural gas reserves and 9.1 percent of the world natural gas production. The GCC countries enjoy relatively cheap extraction costs of oil and gas, which puts them in an advantageous position relative to other oil and gas producers. The wealth generated by the GCC countries from oil and gas exports allows their economies to reach unprecedented development, with higher standards of living and modern physical infrastructure. However, subsidized domestic oil prices in GCC countries are contributing to high consumption of oil which will lead to high CO_2 emissions and reduce their energy efficiency. Therefore, GCC countries have to adopt an energy policy in line with the diversification and integration strategy which improves energy efficiency and economic growth.

III. Energy Efficiency

Energy efficiency generally refers to using less energy to produce maximum output. Patterson (1996) has introduced four types of indicators which can be used in measuring energy efficiency: thermodynamic, physical-thermodynamic, economic-thermodynamic and economic indicators. Each indicator differs in terms of the measurement unit of input and output. In this paper, we used the economic-thermodynamic indicators to compare the level of efficiency of each GCC country relative to one another. The most commonly used indicator to measure aggregate of a nation's energy efficiency is the energy GDP ratio, or usually called "energy intensity". Other methods exclude the extraneous factors, such as changes in energy input mix, energy for labor

substitution, and changes in structure of economy, from the energy GDP ratio, in order to isolate the underlying technical energy efficiency.

Zhou and Ang (2008) use production framework to measure energy efficiency performance. By utilizing DEA, energy consumption is treated as one of the inputs within the production framework with labor and capital as other established economic inputs. Different energy sources are treated as different inputs so that changes in energy mix could be accounted for in evaluating energy efficiency. The undesirable output of energy input which is CO_2 emission is also included to measure the efficiency performance of 21 Organization for Economic Co-operation and Development (OECD) countries.

On the other hand, energy intensity as one of the indicators is used to measure energy efficiency. High energy intensities indicate a high cost of converting energy into GDP. Figures 1 and 2 show the trend of energy efficiency in GCC countries based on their energy intensity as one bloc and as individual countries, respectively.

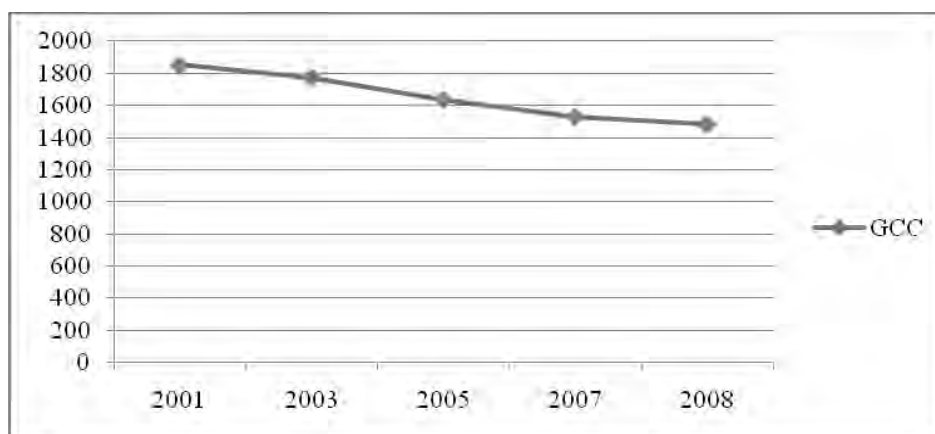**Figure 1: Energy Intensity of GCC: As a Ratio of Energy/GDP**

Figure 2: Energy Intensity of Individual GCC Countries: As a Ratio of Energy/GDP
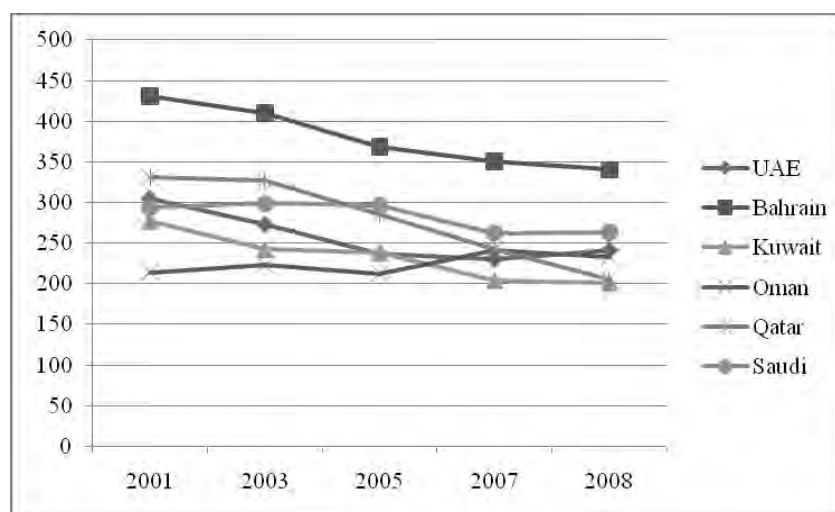
Figure 2 depicts Bahrain as the most inefficient GCC country in terms of energy intensity as a ratio of energy divided by GDP. Oman was the most efficient in 2001, 2003 and 2005, and it indicated some performance decreases in this efficiency level since its energy intensity was increased.

In 2007 and 2008, Kuwait became the most efficient GCC country with the lowest energy intensity. The UAE and Kuwait had shown good improvements in their energy efficiency in the last 8 years. Qatar had shown the highest level of improvement compared to other GCC countries and reached the most efficient country, Kuwait, in 2008. For Saudi Arabia, there was a moderate level of improvement in the energy efficiency over these time periods.

Many factors influence an economy's overall energy intensity. Such factors are the requirements for general standards of living and weather conditions. It is not typical for particularly cold or hot climates to require greater energy consumption in homes and workplaces for heating or cooling purposes, given the differences in standard of living.

Testing the causality between GDP and energy consumption is very essential for determining energy intensity. Empirical results in oil importing countries have been mixed (Chontanawat *et al.*, 2006 and Hertog and Luciani, 2009). This led to some confusion about the effects that energy conservation policies have on economic growth in both developed and developing countries. The disparity in results has most likely been a product of methodological and data differences.

Al-Iriani (2006) investigated the causality relationship between GDP and energy consumption in the GCC. He utilized the recently developed panel cointegration and causality techniques to test the direction of energy-GDP causality in the GCC. Results indicated a unidirectional causality running from GDP to energy consumption. Evidence shows no support for the hypothesis that energy consumption is the source of GDP growth in the GCC countries. Such results suggest that energy conservation policies have been adopted without much concern about their adverse effects on the economic growth of GCC countries.

Mehrara (2007) examined the causality issue between energy consumption and economic growth for three typical oil-exporting countries: Iran, Kuwait and Saudi Arabia. By using two different test methods, a unidirectional long-run causality from economic growth to energy consumption for Iran and Kuwait and a unidirectional strong causality from energy consumption to economic growth for Saudi Arabia were consistently shown.

Chontanawat *et al.* (2008) tested causality between energy to GDP for over 100 countries. He found that causality from energy to GDP more prevalent in the developed OECD countries, compared to the developing non-OECD countries. Its implication on policy is that reducing energy consumption aimed at reducing emissions is likely to have greater impact on the GDP of the developed rather than developing world.

IV. Measuring Energy Efficiency

In order to measure energy efficiency, we used two different models. The first model emphasizes more energy intensity, and the second model incorporates other economic factors in the measurement.

A. Model I

The objective is to maximize the DEA efficiency rating for each country as the relative efficiency of unit j using only energy consumption as input is given by

$$\frac{relative\ output\ value}{relative\ input\ value} = \frac{wyj}{vxj} \tag{1}$$

We define the variables as follows:

       w = relative output weight applied to country's GDP
       y = amount of output (GDP) from unit j
       v = relative input weight applied to country's energy consumption
       x = amount of input (energy consumption)
       j = unit/ country being measured

Looking at the model, we can see that it is a non-linear function in the decision variables. However, since all quantities are relative to some value, we shall choose to make the denominator equal to 1. So vxj=1 will be a constraint in the model. Given this, the objective function is modified to $Max\ output = w\ yj$.

The second constraint is that all DEA efficiency ratings must not exceed 1 for all countries, $w\ yj \leq v\ xj$. All weights must be non-negative, shown as resulting in w,v $\geq$ 0.

Then Model I:

$$Max\ output = wyj \tag{2}$$
$$Subject\ to\ vxj = 1$$
$$wyl - vxl \leq 0 \qquad l=1,2,\ldots..9$$
$$w,v \geq\ 0$$

l = units (countries) included in the measurement

B. Model II

The objective is to maximize the DEA efficiency rating for each country. The relative efficiency of unit j using only economic factors as input is given as

$$The\ relative\ efficiency\ of\ unit\ j = \frac{wyj}{v1x1j + v2x2j + v3x3j}, \tag{3}$$

where

       w   = relative output weight applied to country's GDP
       y   = amount of output (GDP) from unit j
       v1 = relative input weight applied to country's labor
       x1j = amount of input 1 (labor) from unit j
       v2 = relative input weight applied to country's energy consumption
       x2j = amount of input 2 (energy consumption) from unit j
       v3 = relative input weight applied to country's capital
       x3j = amount of input 3 (capital) from unit j

Following the same steps we did for Model I in establishing the constraints, we came up with Equation (4) in Model II:

$$\text{Max output} = wyj \qquad\qquad\qquad\qquad\qquad (4)$$

$$Subject\ to \sum_{i}^{2} vt\,xtj = 1$$

$$wyl - \sum_{i}^{3} vi\,xil \le 0 \qquad\qquad i = 1,2,\ \ .....9$$

2,v1,v2,v3 ≥ 0
1=units (countries) included in the measurement

In measuring energy efficiency, we used total energy consumption for each GCC country without differentiating energy source types because all of these countries depend on fossil fuels, mainly oil. Based on World Bank data (2012), all GCC countries derive 100 percent of their energy consumption from fossil fuels, United Arab Emirates, Saudi Arabia and Bahrain use less than 1 percent of alternative sources of energy.

V. Data and Methodology

A. The Data

The data sources which are used in the modeling are secondary. In performing the unit root, cointegration and causality tests between the GDP and energy consumption, we used time series data from 1980 to 2009. The GDP data obtained from the IMF (2011) and energy consumption data was obtained from the World Bank (2012).

In performing the DEA to measure the energy efficiency, the data of 2001, 2003, 2005, 2007 and 2008 is used for three inputs (capital, labor force, and energy consumption) and one output (GDP). For all input, World Bank (2012) data was used and IMF (2011) data was used for the output. The description of data is presented in tables 3, 4, and 5.

Table 3: Data Used for Causality Test

Variables	*Descriptions*
Energy consumption	Energy use in (tons of oil equivalent), World Bank (2012)
GDP	Gross domestic product based on local constant price (in billions of national currency units), IMF (2011) World Economic Outlook

Table 4: Data Used for DEA Measurement

Variables	*Descriptions*
Energy consumption	Energy use (ton of oil equivalent), World Bank (2012)
Capital	Gross capital formation (current US$), World Bank (2012)
Labor force	total labor force, World Bank data
GDP	Gross domestic product based on purchasing-power-parity (PPP) valuation of country GDP (billions in current international dollar), IMF (2011) World Economic Outlook

Table 5: Summary of Inputs and Output Variables for Six GCC Countries and Three Developed Countries, 1980-2009

Variables	*2001*	*2003*	*2005*	*2007*	*2008*
Mean Input 1- Capital (billions in current US$)	27.8	35.7	51.8	72.8	89.7
Stdev Input 1- Capital (billions in current US$)	28.1	36.5	55.1	69.1	88.4
Mean Input 2- Energy consumption in (tons of oil equivalent)	38984.6	42166.6	46966.8	49625.1	52784.4
Stdev Input 2- Energy consumption in (tons of oil equivalent)	37385.6	41295.2	47192.8	46920.5	49539.7
Mean Input 3- Labor (in thousands)	3059.8	3251.0	3491.5	3823.9	4004.7
Stdev Input 3- Labor (in thousands)	3119.9	3312.0	3507.8	3687.4	3766.6
Mean Output-GDP (billions in current US$)	179.8	199.8	232.9	269.4	286.3
Stdev Output-GDP (billions in current US$)	169.5	187.6	212.8	237.8	248.4

B. The Methodology

The Augmented Dickey Fuller (ADF) (1979) and Phillips-Perron (1988) tests were implemented to assess the unit root. While performing the ADF test, the Schwarz (1987) Information Criterion was used for the lag length including the trend and intercept in the equation. The Phillips-Perron test was performed using automatic bandwidth selection of Newey-West (1987). This was implemented by including trend and intercept as well. For the cointegration test, the Johansen maximum likelihood cointegration test was employed (Masih and Masih, 1996).

After conducting the unit root and cointegration tests, we continued by testing the causality between energy consumption of the GDP by using Granger Causality Test (Granger, 1969). In order to test the causality from energy consumption to GDP, the following log-linear equation is estimated for GCC countries over the period from 1990-2009:

$$Lny_t = \underline{\lambda}_0 + \underline{\lambda}_1\, 7Lny_{t-1} + \underline{\lambda}_3\, Lnx_{t-1} + \mu, \qquad\qquad\qquad (5)$$

where

y_t	= real per capita GDP in period t
y_{t-1}	= real per capita GDP in period t-1
y_{t-1}	= layed value for per capita energy consumption in period 5-1
μ	= error term

The presence of Granger-causality depends on the significance of X_{x-I} term in Equation (5); energy consumption causes GDP if the current value of GDP is predicted better by including lagged value of energy consumption.

In measuring the performance of energy efficiency among GCC countries, DEA methodology was used. Various indices have been used in comparing performances of countries across the world, e.g., the human development index and the global competitiveness index, by considering some relevant attributes in developing them (Savic and Martic, 2001 and Thore, 2008). We can classify them as fixed weight schemes since they combine performances in terms of various attributes using pre-fixed weights, which may be subjectively chosen. The advantage of DEA vs. fixed weight schemes is that the weights are not subjective but determined using linear programming (Ramanathan, 2006). The DEA approach computes these weights that maximize the efficiency score of a country subject to the efficiencies of other countries (calculated using the same set of weights) falling between 0 and 1.

Despotis (2005) considers DEA as a mathematical programming methodology based on the Frontier approach. It has been successfully employed to study the comparative performance of units that consume similar inputs and produce similar outputs. The units are generally referred to as Decision Making Units (DMUs). When we are assessing the performance of nations, DEA combines performances of countries in terms of several desirable and undesirable attributes into a single scalar measure, called the efficiency score. Countries that have unit efficiency scores of 1 are considered efficient, with the highest value of desirable attributes and the lowest values of undesirable attributes. Countries with efficiency scores of less than one are considered to operate sub-optimally for a given set of variables.

There are two possible assumptions that could be made while computing efficiency scores using DEA, namely constant returns to scale (CRS) and variable returns to scale (VRS). The assumption of CRS occurs when an increase in all inputs (i.e., increase in terms of undesirable attributes) by 1 percent leads to an increase in all outputs (i.e., increase in terms of desirable attributes) by 1 percent, while the assumption of VRS is for situations when the CRS assumption is not satisfied. The VRS efficiency of a DMU measures only technical efficiency, while CRS efficiency accounts for both technical efficiency and efficiency loss, when the DMU does not operate in its most productive scale size. The scale efficiency is the ratio of CRS to VRS scores. The scale efficiency of 1 would be for DMU which operates in its most productive size (Savic, 2001).

Taqi and Shah (2006) considered DEA as a non-parametric linear programming based methodology originally introduced by Charnes *et al.* (1978). Choosing the DMUs as the entities responsible for converting inputs into outputs is the key element in DEA. It compares each DMU based on its input and output factors with all other similar DMUs taken into consideration. Consequently, choosing outputs and inputs is a very important activity in the DEA process.

DEA can be used to obtain an overall measure of efficiency for each DMU, given the choices and the observed values of the inputs used and the outputs produced by each DMU. By using mathematical models, we obtained efficiency results depending on the performance attained by all of the DMUs. Thus, we can say that the efficiency measures through DEA are obtained by comparing them relatively with other DMUs. For example, one DMU, designated as DMU1, is being evaluated relative to some other DMUs which produced the same amount of output as DMU1 but used smaller levels of input. Then, DMU1 would be rated as inefficient relative to the other DMUs, where differences in their inputs would represent sources and amounts of inefficiency in DMU (Nordin, 2007).

VI. Results and Analysis

A. Causality Test

For policy purposes, the causality relationship between economic growth and energy consumption will be tested using a unit root test to find whether or not there is a unit root effect in the series. The result is presented in Table 6.

Table 6: Unit Root Test Results

Series	Augmented Dickey Fuller Test			Phillips-Perron Test	
	Level	1st difference	2nd difference	Level	1st difference
Saudi Arabia-Energy consumption	non stationary	stationary		non stationary	stationary
Saudi Arabia GDP	non stationary	stationary		non stationary	stationary
Bahrain-Energy consumption	non stationary	non stationary	stationary	non stationary	stationary
Bahrain-GDP	non stationary	stationary	stationary	non stationary	stationary
Kuwait- Energy consumption	non stationary	stationary		non stationary	stationary
Kuwait-GDP	non stationary	stationary		non stationary	stationary
Qatar- Energy consumption	non stationary	non stationary	stationary	non stationary	stationary
Qatar-GDP	non stationary	non stationary	stationary	non stationary	stationary (at 10%)
Oman- Energy consumption	non stationary	stationary		non stationary	stationary (at 10%)
Oman-GDP	non stationary	stationary		non stationary	stationary
UAE- Energy consumption	non stationary	stationary		non stationary	stationary
UAE-GDP	non stationary	stationary		non stationary	stationary
Panel- Energy consumption	non stationary	stationary		non stationary	stationary
Panel-GDP	non stationary	stationary		non stationary	stationary

Based on the unit root test, all the series are non-stationary at the level, since they contain trends. Taking the first difference for all of them, they become stationary at first difference. Since the stationarity of the series at the same level is a necessary condition in order to get valid result of causality test, then the causality test can be continued.

However, the co-integration test between the GDP and energy consumption for each country is shown in Table 7.

Table 7: Co-integration Test Results

Countries	*Cointegration between energy and GDP*
UAE	Not cointegrated
SAUDI ARABIA	Cointegrated
QATAR	Cointegrated
OMAN	Cointegrated
KUWAIT	Not cointegrated
BAHRAIN	Cointegrated
PANEL	Cointegrated

Although the results for the UAE and Kuwait showed that energy consumption and GDP are not cointegrated at a 5 percent confidence level, further testing of the causality between the two series (energy consumption and GDP) is not a necessary condition for the causality test. However, correlation does not necessarily imply causation.

Based on Granger (1988), whether x causes y in Equation (5) depends on how much of the current y can be explained by past values of y and then to see whether adding lagged values of x can improve the explanation. It is said that y is Granger-caused by x if x helps in the prediction of y, or equivalently if the coefficients on the lagged x's are statistically significant. The result of applying the Granger Causality test on the relationship between GDP and energy consumption is presented in Table 8. The results are confirmed by doing F-tests for the coefficients of the independent results including error terms at a 5 percent significance level, while R-squares range from 80 percent to 95 percent.

Table 8: Granger Causality Test Results

Granger Causality	*Saudi Arabia*	*Bahrain*	*Kuwait*	*Qatar*	*Oman*	*UAE*	*Panel*
GDP cause energy consumption	no	yes	yes	no	no	no	yes
Energy consumption cause GDP	yes	no	no	yes	yes	yes	no

It is noted that there is a strong causality from energy consumption to GDP for Saudi Arabia. Results for Oman are similar to Saudi Arabia, while Qatar and the UAE show a moderate causality from energy consumption to GDP. The result for Bahrain shows the opposite direction that GDP

causes energy consumption, while Kuwait somehow tends to have stronger causality running from GDP to energy consumption. For the panel of GCC, causality runs from GDP to energy consumption, which is consistent with previous research by Al-Iriani (2006) and Mehrara (2007).

Bahrain and Kuwait tend to be in line with developing countries when causality runs from GDP to energy consumption, while the other countries showed that they are close to what was found in the developed countries by Chontanawat *et al.* (2006).

B. Energy Efficiency

After performing the causality tests, the measurement of energy efficiency is performed using the input oriented DEA with CRS envelopment analysis.

In order to have benchmark for comparison, three other OECD countries were added in the measurement. We selected efficient countries based on the results of measurements conducted by Zhou and Ang (2008) for 21 OECD countries. The result of energy efficiency measurement using Model I is presented in Table 9.

Table 9: Energy Efficiency Measure Using Model I

No.	*DMU Name*	*2001*	*2003*	*2005*	*2007*	*2008*
1	UAE	0.41	0.45	0.48	0.40	0.35
2	SAUDI ARABIA	0.49	0.46	0.43	0.42	0.32
3	QATAR	0.55	0.53	0.64	0.65	0.41
4	OMAN	0.54	0.48	0.46	0.45	0.46
5	KUWAIT	0.45	0.55	0.51	0.45	0.52
6	BAHRAIN	0.47	0.46	0.46	0.44	0.45
7	AUSTRALIA	0.60	0.59	0.57	0.54	0.54
8	NORWAY	0.79	0.78	0.80	0.76	0.72
9	SWITZERLAND	1.00	1.00	1.00	1.00	1.00

Saudi Arabia and Bahrain did not show significant improvement and were still in the inefficient rankings compared to others countries as measured in Table 9. Qatar showed significant improvement, while the UAE's improvement was slightly slow. Oman's performance has declined since 2007, and Kuwait exhibited significant improvement to become the most efficient country in the GCC surpassing Oman.

By comparing the energy efficiency of GCC countries with energy efficiency in developed countries, it seems that the GCC is still far behind but has high potential for energy preservation. Comparing the results of the energy efficiency measurement in Model I with the efficiency findings using the energy intensity in Figure 2, the results are consistent.

The advantage of using the energy intensity of Figure 2, is that improvement in country efficiency can be shown for recorded years while Model I, gives efficiency improvement of GCC countries relative to other depicted countries at one time period.

In Model II, instead of using only energy consumption as the only input, labor and capital as other economic features were added in order to measure energy efficiency within an economic perspective.

Measurement results using Model II are shown in Table 10. Even classified as inefficient in terms of energy consumption, Saudi Arabia appears in the efficient frontier in economy-wide performance since 2005. Qatar and Kuwait have maintained their efficient economy-wide relative to others as in Model I, while Oman has been inefficient since 2007. The UAE and Bahrain have shown more room for improvement to attain economic efficiency.

Table 10: Energy Efficiency Measure Using Model II

No.	DMU Name	2001	2003	2005	2007	2008
1	UAE	0.45	0.85	0.86	0.77	0.75
2	SAUDI ARABIA	0.42	0.84	1.00	1.00	1.00
3	QATAR	0.51	1.00	1.00	1.00	1.00
4	OMAN	0.56	0.99	1.00	0.86	0.82
5	KUWAIT	0.42	1.00	1.00	1.00	1.00
6	BAHRAIN	0.45	0.71	0.74	0.81	0.70
7	AUSTRALIA	0.54	0.90	0.87	0.86	0.84
8	NORWAY	0.72	1.00	1.00	1.00	1.00
9	SWITZERLAND	1.00	1.00	1.00	1.00	1.00

In comparison with efficient developed countries, Model II also shows that GCC countries have to improve their economic energy efficiency. It is noted that results from Model I and Model II differ substantially. This is due to the structural difference between Model I and Model II, where the latter explains economic efficiency more than energy efficiency. Including labor, and capital as a factor of production in Model II, has also changed the model specifications and, ultimately, the results. Furthermore, the structural and policy differences among GCC countries are clearer in Model II which affected its results and caused some discrepancies between the results from Model I and Model II.

VII. Conclusion and Policy Implications

With increased pressure on scarce water resources and high energy consumption, the GCC will be adversely affected by climate change and rising air pollution vulnerabilities. Therefore, GCC countries have directed their energy policy to energy efficiency policies. Recently, research on alternative energy has been encouraged with more strategic movement toward energy conservations. Table 11, shows the policy implications of the results.

Table 11: Energy Efficiency—Results and Policy Implications

Countries	Model II	Model I	Causality	Policy Implication
Saudi Arabia	Efficient	Inefficient	Energy consumption to GDP	It seems that Saudi Arabia depends significantly on oil consumption in its economy. Their economy is efficient, but their energy consumption is not efficient compared to other GCC countries. Energy consumption in Saudi Arabia is very high since they have very cheap energy. Increasing oil prices (reduce subsidy) to reduce the oil consumption will obviously reduce CO_2 emissions. Since the causality strongly runs from EC to GDP for Saudi Arabia, then it needs to complement the strategy by providing alternative power environment-friendly sources of energy like solar to substitute oil, so that the effect on the GDP is controlled.
Bahrain	Inefficient	Inefficient	GDP to energy consumption	Bahrain's economy is inefficient due to its inefficient use of energy. Thus, energy conservation policy would be appropriate for Bahrain, since the causality runs from GDP to energy consumption. In fact, the more efficient their energy use, the more efficient the economy will be.
Kuwait	Efficient	Efficient	GDP to energy consumption	For Kuwait, it is efficient for both energy and economic efficiency compared to other GCC countries. Since the strong causality runs from GDP to energy consumption in this country, it is suggested for the government to implement energy conservation policy to become more energy efficient which eventually will become more efficient in the economy as well as toward that of more developed countries that were used as benchmark.
Qatar	Efficient	Inefficient	Energy consumption to GDP	The economy of Qatar is efficient compared to other GCC countries, and the trend for its energy efficiency is improving. Based on their causality test, they have weak causality which runs from EC to GDP that will not have a great negative effect on their economy if they implement energy conservation policy.
Oman	Inefficient	Inefficient	Energy consumption to GDP	Unlike in other GCC countries, the trend of energy efficiency is decreasing for Oman. It started to become inefficient in using energy and the economy has tended to become inefficient, as well since 2007. By implementing energy conservation policy, Oman needs to also adopt an alternative energy policy to replace the oil dependency in its economy, since we found strong causality running from energy consumption to GDP.
UAE	Inefficient	Inefficient	Energy consumption to GDP	Both the economy and energy use of the UAE is classified as inefficient compared to those of other GCC countries. They can improve their efficiency by implementing energy conservation policy since they have only weak causality running from energy consumption to GDP.

Increasing international concerns over global warming and climate change have brought a significant dilemma for some countries, especially developing countries. It becomes important for GCC policy makers to realize the importance of energy efficiency. Some indicators were developed to measure energy efficiency, such as energy intensity and economic-thermodynamics to assist in quantifying such measures. In this paper, we applied linear programming techniques to measure and compare energy efficiency of the GCC countries.

In order to complement the results, the causality test between energy consumption and GDP for each GCC country and for all GCC countries as a panel has been conducted. This type of test will be useful for determining the appropriate policy to adopt to achieve energy efficiency without crippling economic growth.

For further research, a sectoral energy analysis related to the GDP of GCC countries should be performed to develop sound policies for each sector without harming the economic growth of the country.

References

Al-Iriani, Mahmoud A. 2006. "Energy-GDP Relationship Revisited: An Example from GCC Countries Using Panel Causality." *Energy Policy*, 34(17): 3342-50.

Al-Mansour, Fouad 2011. "Energy Efficiency Trends and Policy in Slovenia." *Energy*, 36(4): 1868-77.

British Petroleum (BP). 2011 Statistical Review of World Energy Report. British Petroleum. http://www.bp.com/sectiongenericarticle800.do?categoryId=9037161&contentId=7068605 (accessed May 14, 2012).

Charnes, A., W. W. Cooper, and E. Rhodes. 1978. "Measuring the Efficiency of Decision Making Units." *European Journal of Operational Research*, 2(6): 429-44.

Chontanawat, Jaruwan, Lester Charles Hunt, and Richard G. Pierse. 2006. "Evidence from 30 OECD and 78 non-OECD Countries." Surrey Energy Economics Discussion Paper, (SEEDS) 113. Surrey Energy Economics Centre (SEEC), University of Surrey, www.seec.surrey.ac.uklResearchlSEEDS.htm.

Chontanawat, Jaruwan, Lester Charles Hunt, and Richard G. Pierse. 2008. "Does Energy Consumption Cause Economic Growth? Evidence from Systematic Study of over 100 Countries." *Journal of Policy Modeling,* 30(2): 209-20.

Despotis, D. K. 2005. "Measuring Human Development via Data Envelopment Analysis: The Case of Asia and the Pacific." *The International Journal of Management Science*, 33(5): 385-90.

Dickey, David A., and Wayne A. Fuller. 1979. "Distribution of the Estimators for Autoregressive Time Series with a Unit Root." *Journal of the American Statistical Association*, 74(366): 427-31.

Granger, C. W. J. 1969. "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods." *Journal of Econometrics*, 36: 424-38.

Granger, C. W. J. 1988. "Some recent developments in a Concept of Causality." *Journal of Econometrics*, 39(1-2): 199-211.

Haji, Mohamad Nordin, and Fatimah Binti Said. 2011. "Comparing Macroeconomics Performance of OIC Member Countries." *International Journal of Economics and Management Sciences*, 1(3): 90-104.

Hannesson, Rögnvaldur. 2009. "Energy and GDP Growth." *International Journal of Energy Sector*, 3(2): 157-70.

Hertog, Steffen, and Giacomo Luciani. 2009. *Energy and Sustainability Policies in the GCC.* Kuwait: The Center for the Study of Global Governance.

International Monetary Fund. 2011. "World Economic Outlook Database." September.

Masih, Abdul M. M., and Rumi Masih. 1996. "Energy Consumption, Real Income and Temporal Causality: Results from a Multi-Country Study Based on Cointegration and Error-Correction Modelling Techniques." *Energy Economics*, 18(3): 165-83.

Mehrara, Mohsen. 2007. "Energy-GDP Relationship for Oil-Exporting Countries: Iran, Kuwait and Saudi Arabia." *OPEC Review*, 31(1): 1-16.

Newey, Whitney K., and Kenneth D. West. 1987. "A Simple, Positive Semi-Definite Hetroskedasticity and Autocorrelation Consistent Covariance Matrix." *Econometrica*, 55(3): 703-08.

Nordin, Mohamad. 2007. "A Linear Programming Formulation of Macroeconomic Performance: the Case of Asia Pacific." *Matematika*, 23(1): 29-40.

Patterson, Murray G. 1996. "What is Energy Efficiency? Concepts, Indicators and Methodological Issues." *Energy Policy*, 25(1): 377-90.

Phillips, Peter C. B., and Pierre Perron. 1988. "Testing for a Unit Root in Time Series Regression." *Biometrica*, 75(2): 335-46.

Ramanathan, Ramakrishnan. 2006. "Evaluating the Comparative Performance of Countries of the Middle East and North America: A DEA application." *Socio-Economic Planning Sciences*, 40(2): 156-67.

Sa'ad, Suleiman. 2010. "Energy Consumption and Economic Growth: Causality Relationship for Nigeria." *OPEC Energy Review,* 34(1): 15-24.

Saudi Arabian Monetary Agency. 2010. *Forty-Sixth Annual Report.* Riyadh: SAMA, 18.

Saudi Arabian Monetary Agency. 2012. *Forty-Eighth Annual Report.* Riyadh: SAMA.

Savić, Gordana, and Milan Martić. 2001. "An Application of DEA for Comparative Analysis and Ranking of Regions in Serbia with Regards to Social-Economic Development." *European Journal of Operational Research,* 132(2): 343-56.

Schwarz, Gideon. 1987. "Estimating the Dimension of a Model." *The Annual of Statistics,* 6(2): 461-64.

Taqi, N. A., and M. S. Shah. 2006. "Productivity Assessment of The GCC Countries By Means of Data Envelopment Analysis." *International Journal of Business Research*, 122-26.

Thore, Sten, and Ruzanna Tarverdyan. 2008. "Using Data Envelopment Analysis to Screen the Possibility of a Fair Globalization." *Portuguese Journal of Management Studies*, 13(1): 129-51.

World Bank. 2012. "World Development Indicators."

Zhou Peng, and Beng Wah Ang. 2008. "Linear Programming Models for Measuring Economy-Wide Energy Efficiency Performance." *Energy Policy*, 36(8): 2911-16

An Examination of Great by Choice: Redux

By Eric Olsen and James Sena[*]

Given the works by Collins, and later Collins with Hansen, we examined the performance and practices of the fourteen companies in Great by Choice [GBC]. We looked at the financial performance for the 11 years ending the GBC comparison period (1991-2001) and the 11 years of our research period (2002-2012). We used financial analysis to develop and examine research propositions as to whether the companies continued, discontinued, or started employing the GBC practices. Overall, we concluded that GBC has good advice for companies.

I. Introduction

In a series of books, starting with *Built to Last* (Collins, 2001), Jim Collins and a team of researchers sought to discover the underlying principles of greatness. Their approach was to identify companies that differentiated themselves through outstanding marketplace performance, comparing them to other, equally promising companies that were less successful. These comparisons covered a specific period where the firms had equal potential for success. It is to a recent edition of the Collins series that we address this paper – *Great by Choice* (Collins and Hansen, 2011).

Collins and Hansen sought to identify principles and practices that were unique to successful companies across sample sets. This approach appears to be scientifically rigorous. We decided to test their conclusions beyond their sample sets' *dynastic period*. The principles and practices apply to companies within the period of analysis, but what about beyond? There are certainly examples of once great companies that have fallen off the pedestal in Collins' own body of work (Collins, 2009). Collins made the argument that those that *fall* from greatness did not invalidate his conclusions because during the dynastic period the companies were engaging in those practices identified as being *great*. His assumption was that the companies are no longer *great* because they are no longer modeling the practices. In this paper, we test to see if continued great performance is explained by the application of GBC practices or if a reduction in performance is explained by companies discontinuing the use of the practices that ostensibly made them great. Similarly, we look to see if the comparison companies identified in GBC improve their financial performance if they adopt GBC practices. We begin with a review of Collins' previous works to determine how their conclusions and practices were derived (Table 1).

_____

[*]James Sena: Orfalea College of Business, California Polytechnic State University. E-mail: jsena@calpoly.edu. Eric Olsen: Orfalea College of Business, California Polytechnic State University. E-mail: eolsen@calpoly.edu.

Table 1: Quick Reference to Collins and Team Series of Books

<u>Title</u>	<u>Reference</u>	<u>Objective</u>
Built to Last	Collins and Porras (1994 and 2001)	Identify practices that enable the transformation from a mediocre (good) company to a great company.
Good to Great	Collins (2001)	Identify practices of great companies.
Good to Great and the Social Sectors	Collins (2011)	Identify practices of great companies in the social sector.
How the Mighty Fall	Collins (2009)	Identify mechanisms that cause once great companies to fail.
Great by Choice	Collins and Hansen (2011)	Uncertainty, chaos luck—why some thrive despite them all.

In *Good to Great* Collins showed how great companies triumph over time and how long-term sustained performance could be engineered into the enterprise. He identified a set of elite companies that made the transition from mediocre to extraordinary results and sustained those results for at least fifteen years. After the transition, the good to great companies generated cumulative stock returns that beat the general stock market by an average of seven times in fifteen years, better than twice the results delivered by a composite index of the world's greatest companies. They noted that the transformation was a process of build-up, followed by breakthroughs, broken into three broad stages, with a few key differentiators in each as described in Figure 1.
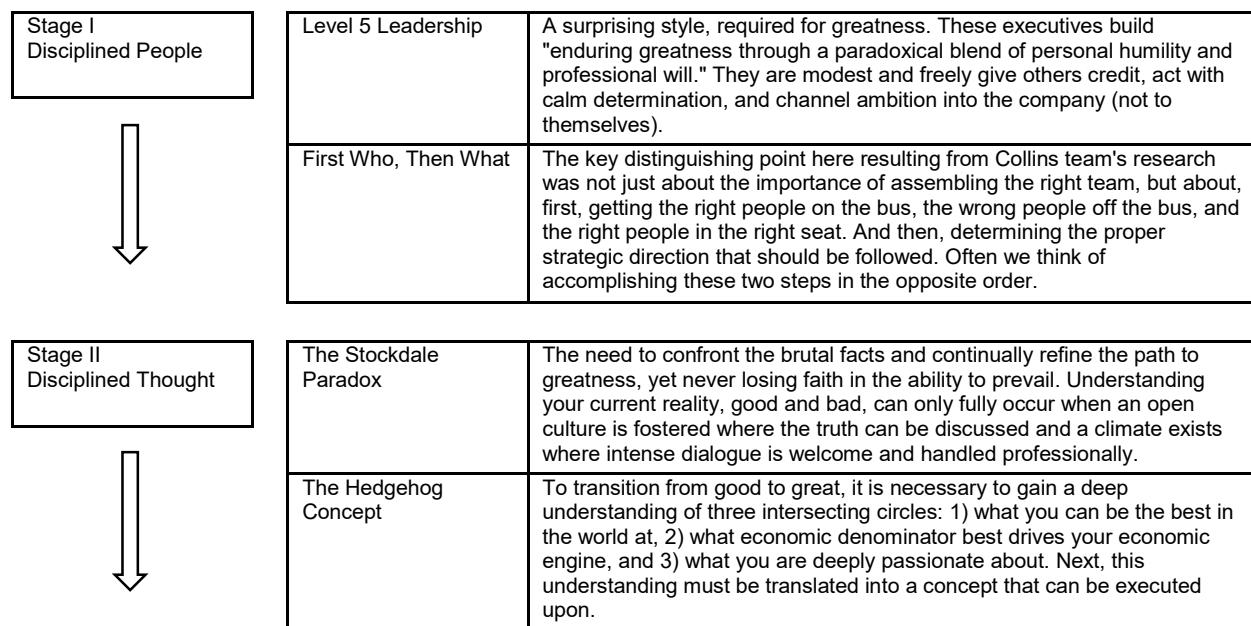
Figure 1: *Good to Great* Stages and Key Differentiators

Stage I Disciplined People	Level 5 Leadership	A surprising style, required for greatness. These executives build "enduring greatness through a paradoxical blend of personal humility and professional will." They are modest and freely give others credit, act with calm determination, and channel ambition into the company (not to themselves).
	First Who, Then What	The key distinguishing point here resulting from Collins team's research was not just about the importance of assembling the right team, but about, first, getting the right people on the bus, the wrong people off the bus, and the right people in the right seat. And then, determining the proper strategic direction that should be followed. Often we think of accomplishing these two steps in the opposite order.

Stage II Disciplined Thought	The Stockdale Paradox	The need to confront the brutal facts and continually refine the path to greatness, yet never losing faith in the ability to prevail. Understanding your current reality, good and bad, can only fully occur when an open culture is fostered where the truth can be discussed and a climate exists where intense dialogue is welcome and handled professionally.
	The Hedgehog Concept	To transition from good to great, it is necessary to gain a deep understanding of three intersecting circles: 1) what you can be the best in the world at, 2) what economic denominator best drives your economic engine, and 3) what you are deeply passionate about. Next, this understanding must be translated into a concept that can be executed upon.

Figure 1: *Good to Great* Stages and Key Differentiators: Continues

Stage III Disciplined Action	The Culture of Disciipline	The good-to-great companies built a consistent system with clear constraints, but they also gave people freedom and responsibility within the framework of that system.
	Technology Accelerators	Good-to-great companies think differently about technology. They do not use technology to transform from good to great, but to accelerate their progress, staying focused on their Hedgehog. Collins asserts that technology by itself is never a primary cause of either greatness or decline.
	The Flywheel and the Doom Loop	Why those who do radical restructuring fail to make the leap to greatness, while those that consistently accumulate momentum (turn upon turn, step by step) can transform themselves. Patience, persistence and discipline are critical to achieving desired results.

Collins and Hansen (2011), subsequent to *Good to Great,* extended this research work in GBC to companies that they refer to as "10x" cases. During the study period, these companies outperformed other companies in their industry by 10 times or more. The final organizations that met their criteria, after considering over 20,000 companies, were Amgen, Biomet, Intel, Microsoft, Progressive Insurance, Southwest Airlines, and Stryker.
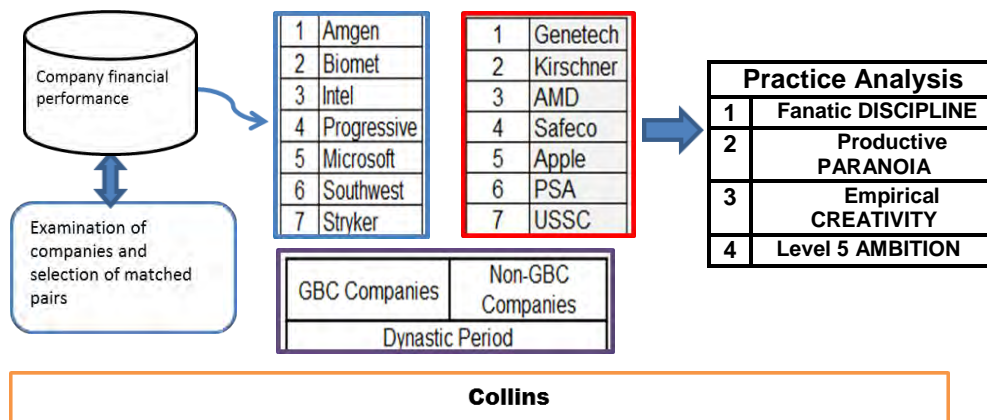
These companies started from a position of vulnerability, rose to become *great by choice* with spectacular performances, and did so in unstable environments characterized by big forces that were out of their control, fast moving, uncertain, and potentially harmful. Simultaneously, they compared these companies to matched pairs that failed to become great in the same extreme environments. They used the contrast between winners and the "also-ran" comparison companies to uncover the distinguishing practices that allow some to thrive in uncertainty. Table 2 presents the GBC practice concepts.

Table 2: *Great by Choice* Practice Concepts

| **Practice**	**Analogy**	**Description**
Fanatic Discipline	The 20 Mile March	Consistent execution without overreaching in good times or underachieving in bad times.
Productive Paranoia	Leading above the Death Line	Learning how to effectively manage risk so that the risks your organization takes never put it in mortal danger.
	Return on Luck	"The critical question is not whether you'll have luck, but what you do with the luck that you get."
Empirical Creativity	Firing Bullets, Then Cannonballs	Testing concepts in small ways and then making adjustments rather than placing big, unproven bets. But then placing big bets when you have figured out exactly where to aim.
Level 5 Ambition		Ambition for the success of the organization rather than self.

Given these works by Collins, and later Collins with Hansen, we set out to examine the performance and practices of the fourteen companies in GBC since the study was completed. We used a convention of looking at the financial performance for a specific time periods, namely the 11 years ending the GBC comparison period (1991-2001) and the 11 years of our research period (2002-2012). This approach is depicted in Diagram 1 and Diagram 2.

Diagram 1: Collins Approach During Dynastic Period

Company financial performance		1 Amgen		1 Genetech		Practice Analysis	
		2 Biomet		2 Kirschner		1	Fanatic DISCIPLINE
		3 Intel		3 AMD		2	Productive PARANOIA
		4 Progressive		4 Safeco		3	Empirical CREATIVITY
		5 Microsoft		5 Apple		4	Level 5 AMBITION

Examination of companies and selection of matched pairs

GBC Companies	Non-GBC Companies
Dynastic Period	

Collins

We think this is a valid and comparable financial performance indicator that meets the intent of Collins and Hansen to compare matched pair companies under identical economic conditions. Basically in this paper we replicate the methodology presented in Collins and Hansen's GBC over the end of their period of examination (1991–2001) and extend it into a second period (2002–2012). Our objective is to determine if the practices identified in GBC, and related performance, continued (or increased) or discontinued (or decreased) based on financial and practice analysis comparable to that used in GBC. We used our financial analysis to develop research questions and propositions as to whether the eleven remaining companies in the GBC sample were or were not employing the GBC practices. We used propositions rather than hypotheses because we viewed the practice analysis to be of a qualitative nature. We then tested these propositions by seeing if the companies indeed were or were not using the practices based on a review of the relevant literature. The sections that follow describe our financial analysis, the development of our propositions, our practice analysis, and conclusions as to the validity of Collins and Hansen's assertion that GBC practices lead to great performance.

Diagram 2: Our Research Approach 2002-2012
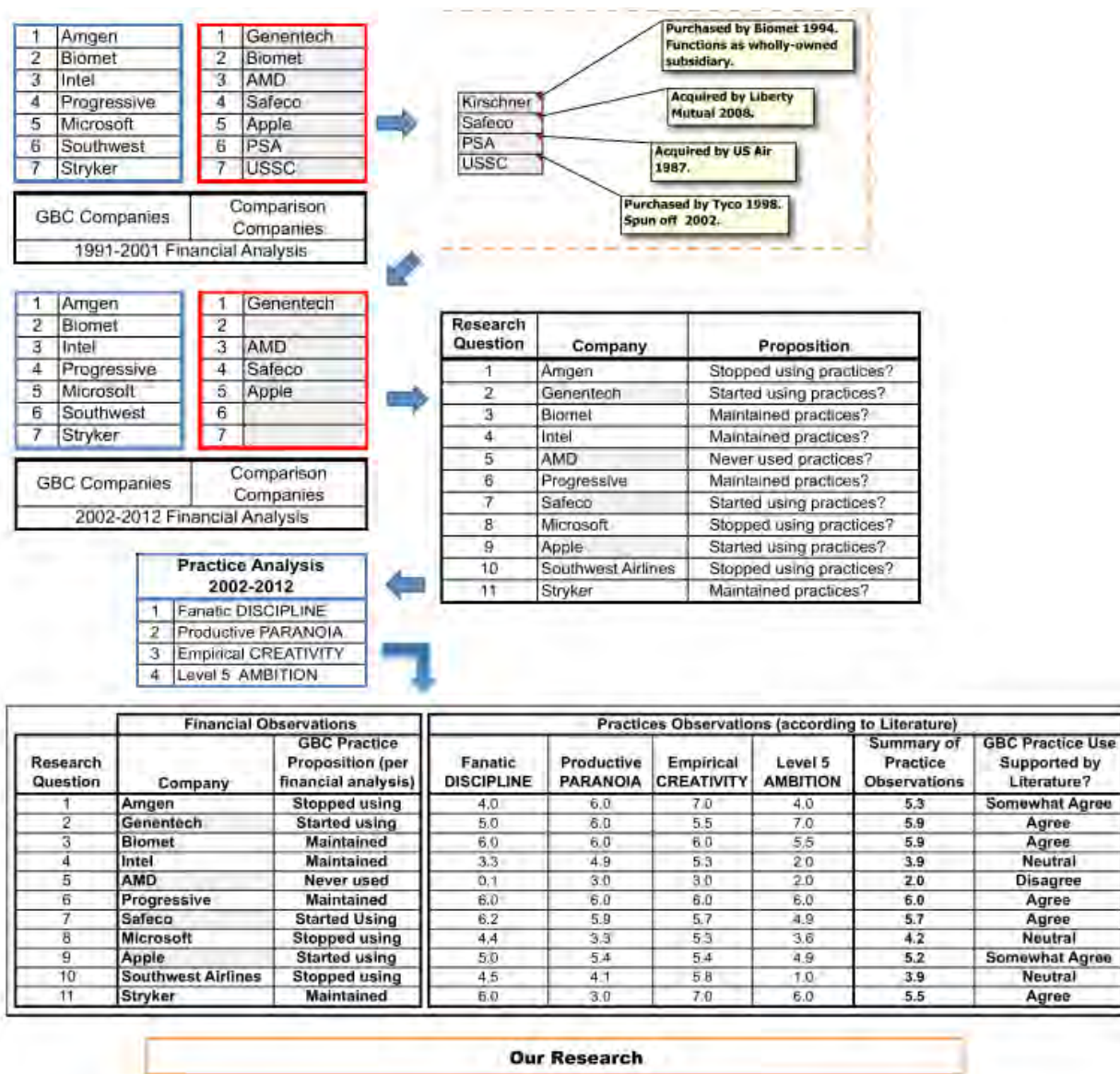
II. Financial Performance Analysis

A. GBC Procedure

Collins and Hansen selected and compared companies based on total price return performance from 1972 to 1992. If the company was not publicly traded in 1972 its performance was held at the "general stock market rate of return." This convention actually created some interesting anomalies in the "10x'ers" claim. Some companies benefited considerably from riding the general market trend until its initial public offering. For example, the GBC return for $10,000 purchased December 31, 1972, and assumed to be held at the general stock market rate until Amgen went public in 1980, and then held until 2002, would yield $4.5 million. This equates to 24x the market. However, $10,000 invested in 1980 and sold at the end of 2002 would yield only 4420 percent or $442,000.

The S&P 500 Total Price Return was 226.6 percent for the same period. Therefore, Amgen outperformed the market by 19.5x since 1980. During the last 10 years of the GBC period from 1992 to 2002, Amgen only outperformed the S&P 500 by 2.1x. While this performance may still be considered "great," it points to an inherent problem in allowing the results to be influenced by variable public offering dates.

B. Our Process

Table 3 shows the Total Price Return percentage and "times better" of the eleven remaining GBC and comparison companies for the two periods: 1991–2001 and 2002–2012. Table 3a provides data when full 11-year periods were available. Table 3b provides data when less than full periods of date were available.

The first check we performed was to see if the relative financial performance identified by Collins and Hansen was maintained in the last eleven years of their study. To do this, we examined how the GBC companies performed in comparison to the Standard and Poor's 500 and to their comparison companies. All the GBC companies we examined performed 2.1 to 7.1 times better than the S&P 500. Two of the three comparison companies examined did worse than the S&P 500: Safeco and Apple. We looked at the five remaining comparison pairs in the sample: Amgen-Genentech, Progressive-Safeco, Intel-AMD, Microsoft-Apple, and Stryker-USSC. The Stryker and USSC comparison was only done for 1991-1998 because USSC was purchased by Tyco in 1998. All these pairs showed that the GBC Company outperformed their comparison company by 3.3 to 29.4 times. Although not consistently "10x," these observations generally support the selection of GBC and comparison companies by Collins and Hansen and for continued use in our research.

Table 3a: Total Price Return Percentage Comparison for Full Periods

	GBC (1991-2001)			Update (2002-2012)		
	Percentage Change Total Return	Times better (times worse) than S&P 500	Times better (times worse) than Comparison Company	Percentage Change Total Return	Times better (times worse) than S&P 500	Times better (times worse) than Comparison Company
S&P 500 Index	**346**			**54**		
Amgen	2076	4.9	3.9	57	1.0	
Genentech *(1)*	460	1.3		See Table 3b		
Biomet	938	2.3				
Kirschner *(2)*						
Intel	2574	6.0	4.1	-17	(1.9)	5.5
AMD	551	1.5		-85	(10.2)	
Progressive	821	2.1	3.3	118	1.4	
Safeco *(1)*	180	(1.6)		See Table 3b		
Microsoft	3069	7.1	29.4	7	(1.4)	(46.0)
Apple	8	(4.1)		4801	31.9	
Southwest Airlines	1534	3.7		-44	(2.7)	
PSA *(2)*						
Stryker	1428	3.4		102	1.3	
USSC *(3)*	See Table 3b					

Notes: continued on next page
Notes: from Table 3a.

1. Updates for Genentech and Safeco are included in Table 3b due to change or discontinuation of business during 2002-2012.
2. PSA dropped from analysis due to acquisition early in the GBC period.
3. USSC GBC partial period included in Table 3b due to acquisition after 1998.

Table 3b: Total Price Return Percentage Comparison for Partial Periods

Company	Comparison Period	S&P 500 Basis Percentage Change	Percentage Change	Times better (times worse) than S&P 500	Times better (times worse) than Comparison Company
Great by Choice Partial Period					
Stryker	1991 – Nov. 1998	335	449	1.3	4.9
USSC			13	(3.9)	
Update Partial Period					
Amgen	2002 – Apr. 2009	-13	-14	(1.2)	(4.1)
Genentech			250	3.5	
Biomet	2002 – Oct. 2007	49	53	1.5	
Progressive	2002 – Oct. 2008	-5	28	1.3	(2.0)
Safeco			152	2.5	

C. GBC-Redux

We looked at the 11-year update period 2002-2012. Most of the companies did worse due to the 2008 recession, except for Apple, which went from being 4.4 times worse than the general market to being 31.9 times better. To test Collins and Hansen's implied hypothesis that GBC practices lead to great performance and the lack of these same practices leads to worse performance, we applied the same performance comparisons to the S&P 500 and the remaining comparison companies to develop indicators of great and mediocre financial performance.

Overall, the GBC companies did not fair very well in the update period. In comparison to the S&P 500, only Progressive (1.4x) and Stryker (1.3x) were doing slightly better than the market. Amgen and Biomet performed only as well as the general market (1.0x). The other three GBC companies were doing worse than the general market: Intel (1.9x worse), Microsoft (1.4x worse), and Southwest Airlines (2.7x worse). With respect to the comparison companies, Genentech, Safeco and Apple now outperform the S&P 500 by 4.x, 2.7x, and 31.9x respectively. AMD and USSC are the only remaining comparison companies that continue to do worse than the general market.

Collins and Hansen had seven matched pairs of companies for comparison. In the update period, we had enough data to make comparisons for four remaining matched pairs. For three of the matched pairs, the GBC Company was now performing worse than the comparison company: Amgen-Genentech, Progressive-Safeco, and Microsoft-Apple. Collins and Hansen observe that the true test of a company's ability to handle a turbulent business environment is best accomplished by comparing like companies operating in the same environment. For the four remaining comparisons that we looked at, only Intel is still doing better than its comparison company, AMD. The relationship for the other three comparisons has reversed, with the comparison companies Genentech, Safeco, and Apple doing better than the previous "great" companies in the update period 2002-2012. From a survival analysis perspective, the fact that more agile firms absorbed Kirschner, PSA, and USSC provides support for the GBC hypothesis. In addition, the two other companies absorbed—Genentech and Safeco—improved their performance during our research period and became targets for acquisition. Biomet actually acquired Kirschner and went private during our period of study.

Based on our financial analyses we proposed a set of eleven research questions and propositions related to the GBC practices. These research questions, shown in Table 4, depict our expectations for GBC practice or lack of practice given on our financial analysis of the update period. Next, we looked for evidence of practice use during the update period 2002-2012 and summarized our observations in the table. Our supporting analyses and literature examination is discussed in the sections that follow.

Table 4: GBC Practice Usage During Update Period 2002-2012 Propositions

	Financial Observations		Practices Observations (according to Literature)					
Research Question	Company	GBC Practice Proposition (per financial analysis)	Fanatic DISCIPLINE	Productive PARANOIA	Empirical CREATIVITY	Level 5 AMBITION	Summary of Practice Observations	GBC Practice Use Supported by Literature?
1	Amgen	Stopped using	4.0	6.0	7.0	4.0	5.3	Somewhat Agree
2	Genentech	Started using	5.0	6.0	5.5	7.0	5.9	Agree
3	Biomet	Maintained	6.0	6.0	6.0	5.5	5.9	Agree
4	Intel	Maintained	3.3	4.9	5.3	2.0	3.9	Neutral
5	AMD	Never used	0.1	3.0	3.0	2.0	2.0	Disagree
6	Progressive	Maintained	6.0	6.0	6.0	6.0	6.0	Agree
7	Safeco	Started Using	6.2	5.9	5.7	4.9	5.7	Agree
8	Microsoft	Stopped using	4.4	3.3	5.3	3.6	4.2	Neutral
9	Apple	Started using	5.0	5.4	5.4	4.9	5.2	Somewhat Agree
10	Southwest Airlines	Stopped using	4.5	4.1	5.8	1.0	3.9	Neutral
11	Stryker	Maintained	6.0	3.0	7.0	6.0	5.5	Agree

III. Practice Comments

In GBC 10x leaders were both "disciplined" and "creative," "prudent" and "bold"—they went fast when they must, but slow when they could—they were consistent, but open to change. According to Collins and Hansen, successful companies were not as innovative as the control companies; they were in some cases less innovative. Rather, they managed to "scale innovation," introducing changes gradually, then moving quickly to capitalize on those that showed promise. The successful companies were not necessarily the most likely to adopt internal changes as a response to a changing environment. "The 10x companies changed less in reaction to their changing world than the comparison cases" (Murray, 2011).

Collins and Hansen began the process of identifying and further explicating the unique factors and variables that differentiate GBC companies. One of the most significant differences is the quality and nature of leadership. They found that many of those classified in this group displayed an unusual mix of intense determination and profound humility, often having a long-term, personal sense of investment in the company and its success, cultivated through a career-spanning climb through the company's ranks. Personal ego and individual financial gain are not as important as the long-term benefits to the team and the company. Designated as "Level 5 Ambition," this is the centerpiece and grounding practice of leaders that support the other three GBC practices—"Fanatic Discipline," "Productive Paranoia," and "Empirical Creativity."

"Fanatic Discipline:" In GBC the authors introduced the "20-Mile March" analogy to illustrate the practice of fanatic discipline. It is about having concrete, clear, intelligent, and rigorous performance mechanisms with two types of self-imposed control: (1) the discomfort of unwavering commitment to high performance in difficult conditions, and (2) the discomfort of holding back in good conditions. GBC leaders and companies demonstrate the discipline to make well-reasoned, measured commitments and stick to them.

"Productive Paranoia:" In practicing productive paranoia, GBC leaders and companies are positioned better than their comparison companies to take advantage should the worst (or best)

happen. GBC leaders continuously scan the environment in what Collins and Hansen call "zoom out" mode and then "zoom in" to put specific plans and resources in place to cover even lower probability eventualities if the effect is potentially devastating enough. Another analogy that Collins and Hansen make in support of this practice is "return on luck." Both GBC and comparison companies have the same good and bad luck opportunities. However, GBC companies are better positioned to take advantage of extraordinary events or situations.

"Empirical Creativity:" A key practice of GBC companies is their unique ability to collect and analyze their own data. GBC companies are data driven. They are not "me, too, companies" that mindlessly follow the crowd. The analogy that Collins and Hansen use to describe a typical application of this practice is "first bullets, and then cannon balls." GBC companies do many small experiments and tests of the market place, before committing to a huge investment of time and resources.

We used these practice descriptions, and those in GBC, to identify practice usage by the sample companies. To better understand the context and business environment of the update period we also considered a number of additional factors that complemented and might be considered correlated to the GBC practices. These included counts by year of acquisitions and divestitures, joint ventures, infrastructure incidents, significant personnel actions, philanthropic activity, litigation, financial announcements, and recognitions/presentations. These factors were particularly helpful in analyzing and assigning ratings in situations where there was extensive activity. Examples are litigation dealing with the drug companies; the joint ventures of AMD in their attempt to compete with Intel; the acquisition activity of Microsoft; and the personnel changes and leadership ratings of Southwest and Amgen and Stryker.

We performed a detailed practice analysis of the eleven companies depicted in Table 4. To verify our propositions we examined an extensive set of sources and references. Of note, there was neither uniform nor consistent availability of the company data. For example, Wikipedia was somewhat useful for providing a ready supply of current links and sources. For some organizations, such as Intel and Microsoft, company websites overwhelmed us with data while others (e.g. Stryker) had minimal content. We visited all of the company websites and examined their financial declarations for the eleven years of our study. There was much variability among the companies in the form and content of reporting. For a number of the companies, media and press releases were quite useful—in most cases, this involved sifting through two to three hundred references for each of the eleven years. Two other sources we used were *Brint.com*, a specialized business search engine and *Motley Fool*, a specialized stock portfolio analysis tool. The Brint.com source allowed us to view academic journals, business magazines and newspapers, as well as industry specific publications, while deploying various search filters.

Overall, we rated each company as shown in Table 5 on the four practices: "Fanatic Discipline," "Productive Paranoia," "Empirical Creativity" and "Level 5 Ambition" and noted whether the data supports or does not support our proposition. We scored articles and incidents using GBC discussions and descriptions. The scores were converted into a 7-point scale from "strongly disagree that the practice is being used" (1) to "strongly agree the practice is being used" (7). If the practice rating supports our propositions on practice usage based on financial performance (Table 5), then our analysis supports Collins and Hansen's work in GBC. For example, in the case of Genentech we proposed that they had started using GBC practices based on their better-than-comparison and market financial performance. An overall practices rating of 5.9 (agree) indicates that this was indeed the case. Collins and Hansen's work is supported. In another instance, Amgen had worse-than-comparison and industry financial performance. We

proposed that they had stopped using GBC practices. However, an overall practices score of 5.3 (somewhat agree) indicates that the GBC practices were still in place. In this case, Collins and Hansen's work is not supported.

Of the eleven companies we examined from 2002 to 2012, only one case clearly did not support the proposition that GBC practices lead to better financial performance. Amgen seems to have continued to use the GBC practices, but had worse financial performance. Seven of the cases clearly supported the use of GBC practices either by confirming great financial performance or by confirming poor performance through the lack of practice usage. Three of the cases lacked decisive evidence for practice usage either way (neutral).

In the remainder of this paper, we provide a case-by-case description of our analysis and conclusions with respect to GBC practice usage by the study companies in the period from 2002 to 2012. At the conclusion of the paper, we summarize our findings and conclude with some observations about the nature, replication and extension of Collins and Hansen's work.

A. Proposition 1: Amgen Stopped Using GBC Practices

During our study period, 2002 to 2012, Amgen started applying the scientific method and experimentation to the sales process. Typically, pharmaceutical salespersons represent several products. However, selling new medications entails educating physicians and medical staff making the sales effort very labor intensive. Based on experiments suggested by an Amgen research scientist, salespersons were made specialists in individual products. This has proven to be beneficial in some industries; however, for Amgen it became a distraction and a deviation from the GBC practices of "Fanatic Discipline" and "Productive Paranoia."

As part of our research on Amgen, we examined and categorized 138 news releases over our study period (Amgen News Releases). Table 5 presents a summary of these categorizations.

Table 5: Amgen News Releases 2002-2012

Acquisitions	Jt Ventures	Personnel	Philanthropy	Litigation	Financial	Recognition
13	13	29	18	10	18	37

A. 1. Fanatic Discipline [Neutral]

During the period of our study, Amgen had a stable of drugs under patent protection generating cash flows. It also had several high potential drugs in its R&D pipeline. Amgen is the largest independent biotechnology firm in the world. The market for biotechnology products is expanding significantly, and the market will continue this expansion. Amgen had a record of accomplishment of delivering solid growth earnings, causing it to be selected by Collins and Hansen as a GBC company. However, in 2009, 2008 and 2007, Amgen incurred restructuring charges of $70 million, $148 million and $739 million respectively, related primarily to staff separation costs, asset impairment charges and accelerated depreciation and loss accruals (Flinn, 2012). These developments had an adverse impact on sales and operations. However, Amgen continued its disciplined focus on solving compelling medical problems using good science (Bashe, 2008).

A. 2. Productive Paranoia [Agree]

Amgen's patents protected them from competition. This is an example of adherence to "Productive Paranoia." However, manufacturing difficulties, disruptions or delays have limited the supply of their products and consequently their product sales. Current economic conditions have magnified certain risks that affect their business (U.S. Security and Exchange Commission, 2010). Another measure for productive paranoia, as used by Collins and Hansen, is to examine the relative current ratio and debt to equity ratios for each firm. The data for all firms are included in Table 6. This data is comparable to the data provided in GBC, which stated that the great companies have current ratios better than comparisons 72 percent of the time and better total debt-to-equity ratios 64 percent of the time. Essentially, great companies have more cash and less debt to guard against uncertainties in the environment. Our analysis concurs with Collins and Hansen in that three of the four great companies had better average performance than the comparison companies in the last eleven years of the GBC period. Amgen was the exception. Amgen also had only a slight improvement in current ratio performance (7 percent) and a decrease in debt to equity ratio performance of 162 percent in the update period.

Table 6: Average Current Ratio and Debt-to-Equity Ratio

	GBC (1991-2001)				Update (2002-2012)					
	Average Current Ratio	Percent Better than Comparison Company	Average Debt/Equity Ratio	Percent Better than Comparison Company	Average Current Ratio	Percent Better than Comparison Company	Percent Better than GBC period (1991-2001)	Average Debt/Equity Ratio	Percent Better than Comparison Company	Percent Better than GBC period (1991-2001)
Amgen *(1)*	2.56	-63%	0.13	-31%	2.74	-4%	7%	0.34	-56%	-162%
Genentech *(1)*	4.16		0.09		2.85		-31%	0.15		-67%
Biomet	5.18		0.03		3.19		-38%	0.31		-933%
Kirschner *(3)*										
Intel	2.50	28%	0.08	288%	2.70	37%	8%	0.08	2700%	0%
AMD	1.80		0.31		1.70		-6%	2.24		-623%
Progressive	na		0.39	18%	na			0.34	-15%	13%
Safeco	na		0.46		na			0.29		37%
Microsoft	3.57	32%	0.00	much better number	2.74	13%	-23%	0.06	-83%	slightly worse number
Apple	2.42		0.30		2.39		-1%	0.01		97%
Southwest Airlines	0.91		0.50		1.10		21%	0.44		12%
PSA *(3)*										
Stryker	2.46		0.64		3.12		27%	0.09		86%
USSC *(3)*										

Notes:
1. Amgen-Genentech update comparison period is 2002-2008.
2. Biomet update period 2002-2007.
3. Company dropped from analysis due to acquisition or discontinued business early in the update period.

Our conclusion is that Amgen is not consistently applying this practice.

A. 3. Empirical Creativity [Strongly Agree]

Amgen expected to encounter increasing competition from bio-similar products and anticipated this impact on their profitability. Regardless they did not hesitate to stop late-stage studies (Berkrot, 2012). At Amgen, research is very creative. In some ways, chaos runs rampant. The most persistent, aggressive, and gifted people make it to the top. Their research function consisted of constantly shifting networks of projects and allegiances that formed, prospered, and

faded with little direction from above. A project that looked promising would attract scientists. The mechanism of shepherding researchers was mostly informal. In general, about twenty percent of a scientist's time was free to spend on their own projects (Berkley, 1992). This creates a hail of "bullets" which then are followed by cannon balls as critical mass is reached through the attraction of scientists to successful projects.

A. 4. Level 5 Ambition [Neutral]

Over the period of our study, it appeared that Amgen believed they could make change happen simply by force of personality, position, or intellect. Under CEO Sharer's leadership, Amgen overhauled its management team, altered its culture, and fired a couple of cannon balls (George, 2007). The CEO was considered an interventionist when it came to acquisitions and mergers by not allowing the process to follow naturally. There were several situations where Amgen restructured or stepped back from planned expansions (Fubini, 2006). In 2008, Sharer ranked second for CEOs with the highest disapproval ratings and was at risk of being ousted (54 percent disapproved) (Glassdoor Team, 2008). Sharer retired in 2011.

In Research Question 1, we proposed that Amgen stopped using GBC practices based on our financial analysis. However, our examination of the four practices found that Amgen did indeed continue the practices. This finding rejects our proposition and does not support the findings in GBC.

B. Proposition 2: Genentech Started Using GBC Practices

Genentech's greatest strength lies in its research team and in its capacity to innovate specialized, highly effective drugs. However, a number of other extraneous, and possibly unnecessary, investments had drained Genentech's resources. This included the development of unspecialized drugs for health problems such as asthma. In addition, one division consists of highly educated and specialized marketing experts that sell drugs to specialists.

In 2009, Roche acquired control of Genentech, making it a wholly owned subsidiary. Consequently, our research on Genentech has focused on the public period from 2002 to 2008 before their acquisition.

As part of our research on Genentech, we examined and categorized 125 media releases over the eight years of available data. Table 7 presents a summary of the categorizations.

Table 7: Genentech Media Releases

Acquisitions	Jt Ventures	Personnel	Philanthropy	Litigation	Financial	Recognition
6	18	26	7	11	13	19

B. 1. Fanatic Discipline [Somewhat Agree]

Genentech had an extensive internal pipeline of potential blockbuster drugs. They are noted for their investment in research and development of products while maintaining a talented workforce in research labs and marketing divisions. The company's defining success lays in the field of oncology, producing the most effective and advanced cancer drugs on the market.

Most large companies in the pharmaceutical industry purchase small companies to acquire new product pipelines. Genentech preferred to spend its resources strengthening its own pipelines instead. This strategy allowed Genentech to support small companies with promising drugs or technology that were still in an early stage of development licensing. They had only six acquisitions over the ten years of our analysis, excluding their own acquisition by Roche. Overall, they entered into 18 alliances or joint ventures over the period of 2002 to 2008 (Hall, 2012). In addition, Genentech had a strong reputation in the buying and licensing of compounds and technology platforms at all stages of development.

B. 2. Productive Paranoia [Agree]

Genentech had a sense of mission and a role in efforts to improve the lives of patients. Employees regard Genentech to be a great place to work. Each year, the IT part of the organization spends two days off-campus at the "Full Spectrum IT" event, where the group meets face-to-face with patients who have benefitted from the medications developed for people with difficult-to-treat diseases (King, 2010). Sensitivity to employees and customers is a special way that Genentech demonstrated the practice of productive paranoia. They obsess about getting this right and reap the benefits. On the other hand, from a fiscal standpoint, Genentech's current ratio and debt-to-equity ratio slipped in comparison to the GBC period (Table 6).

B. 3. Empirical Creativity [Somewhat Agree]

Genentech was conscious of the pharmaceutical industry changes over that time, becoming more regulated and more cost-conscious. According to their Marketing VP, "For many years Genentech was immune to some of these things—they were insulated, because they were delivering on the innovation, on breakthrough drugs, and technology—many salespeople took things for granted—that this was a job that was stable, where they could earn a great living and be able to provide for their families. And then all of a sudden that gets shattered" (Looney, 2011). Similarly a senior scientist noted that Genentech was "regarded as the number one company in innovation, and employees felt blessed and pleased to work with Genentech and Roche;" and "They come up with these incredible brands, patient services and communications that just scream innovation" (Iskowitz, 2011). These observations support the proposition that Genentech has become good at systematically investing in, and benefitting from, their creativity.

B. 4. Level 5 Ambition [Strongly Agree]

The past 18 months at Roche have involved rapid change and reorganization. Genentech was fully integrated along with the seamless design of a research and early development organization. A Genentech employee that was part of this process noted that change was not to be feared, but instead to be embraced—change can be exciting and often leads to new and interesting opportunities (Anonymous, 2010). In our study of Genentech, we noted a consistent pattern of recognition internally and externally that resulted in Genentech's being considered a model employer (King, 2012). In 2008, Genentech's Art Levinson came in as the number one rated CEO with a 92 percent approval rating (Glassdoor Team, 2008).

In Research Question 2, we proposed that Genentech started using GBC practices based on our financial analysis. In addition, our examination found that Genentech did adopt the GBC

practices. This could explain their improved performance relative to their comparison company and industry.

C. Proposition 3: Biomet Maintained the Use of GBC Practices

Established in 1977, Biomet, Inc. and its subsidiaries design, manufacture and market products used primarily by musculoskeletal medical specialists in both surgical and non-surgical therapy. At the end of 2006, our last year of analysis, Biomet as a family of companies enjoyed steady growth at levels exceeding market expansion. Biomet's performance demonstrates a responsive, customer-oriented approach to the healthcare market. Biomet thrives by strengthening its commitment to innovation and partnership.

Biomet recorded its twenty-eighth consecutive year of record year-over-year sales and earnings growth. 2006 was a milestone year for the company, attaining net sales exceeding $2 billion, an increase of 8 percent over last year's sales, which approached $1.9 billion. In September 2007 the company was acquired by a consortium of private equity firms and ceased trading on NASDAQ.

C. 1. Fanatic Discipline [Agree]

From its beginning (25 years as of our study), Biomet had become the recognized leader in the musculoskeletal products market with one of the top four positions in eleven segments of the U.S. musculoskeletal products market, as well as the #4 position in the European market. Biomet has successfully built itself primarily through internal growth, augmented by strategic acquisitions. Additionally, they expanded their sales forces to sustain excellent customer service to clinicians worldwide. Biomet's 1,850 person worldwide sales force is one of the largest and most responsive selling organizations in the orthopedic industry.

As a direct result of investing in research and development programs and new product technologies, in addition to selective small-to medium-sized acquisitions, Biomet possesses one of the broadest product portfolios addressing the fastest growing market segments of the musculoskeletal products industry. Consequently, the company is balanced and poised to capitalize on the continued growth anticipated in these market segments in the years to come.

C. 2. Productive Paranoia [Agree]

Over the period of our study, Biomet's research and development expenses have increased at a rate of 9 percent each year. This increase reflects the company's continued emphasis on new product development; enhancements and additions to existing product lines and technologies; and clinical outcomes of research related to the safety, efficacy and clinical performance of the company's products.

From a fiscal standpoint, current ratio and debt-to-equity ratio slipped appreciably in comparison to the GBC period (Table 6).

C. 3. Empirical Creativity [Agree]

Biomet strived to view their work through the eyes of one surgeon and one patient. They treated every solution they provided as if it was meant for a family member. Their approach to innovation created real solutions that assist surgeons in the delivery of durable personalized care

to each patient, whether that solution required a minimally-invasive surgical technique, advanced biomaterials, or a custom, patient-matched implant. Biomet prides itself on its unconventional profile: the responsiveness and innovation of a small company with the resources and market presence of a large company. The solid growth experienced by the company in both domestic and international markets was attributable to the company's emphasis on technological advances through line extensions and new product introductions.

C. 4. Level 5 Ambition [Agree]

At the end of our period of study of Biomet 72 percent of their revenues were generated in the United States. They continued to expand their market share in the estimated $14 billion worldwide musculoskeletal products market. In less than five years of operations, Biomet-Merck had become the fourth largest musculoskeletal market participant in Europe. In addition, Biomet Orthopedics International division capitalized on numerous growth opportunities in attractive markets outside the United States and Europe. In particular, the company continued to focus its efforts on the further development of its newly created direct distribution channel in Japan.

During the period of our study, Biomet introduced more than 500 new products to the market. Biomet believed one of their strengths and key differentiating factors centered on management's drive to provide an environment conducive for the introduction of innovative products and technological advances. Biomet's annual report theme in 2005 stated that "innovation starts here." This is a tribute to the company's long-term commitment to product development and engineering excellence.

Following Dane Miller's retirement in 2005 the company began the process of implementing numerous management and infrastructural changes designed to enhance Biomet's operational execution in the coming years. The company intended to become more centralized in key areas such as accounting, information technology, human resources, clinical and regulatory affairs, and certain research and development activities.

In Research Question 3, we proposed that Biomet continued using the GBC practices based on our financial analysis. Our practice analysis confirms that Biomet was still using the GBC practices.

D. Proposition 4 Intel Maintained the Use of GBC Practices

Intel Corporation is the world's largest and highest valued semiconductor chipmaker, based on revenue (Wikipedia, 2012; Intel, 2012). Intel also makes motherboard chipsets, network interface controllers and integrated circuits, flash memory, graphic chips, embedded processors and other devices related to communications and computing. Intel combines advanced chip design capability with a leading-edge manufacturing capability (Valich, 2007).

During the 1990s, Intel invested heavily in new microprocessor designs fostering the rapid growth of the computer industry. During this period, Intel became the dominant supplier of microprocessors for PCs, and was known to use aggressive and sometimes illegal tactics in defense of its market position, particularly against AMD.

D. 1. Fanatic Discipline [Somewhat Disagree]

According to Intel CEO Paul Otellini (Stengel, 2011), it is possible to move too fast in some situations; however, sometimes slowing down early on helps you accelerate to a higher speed later. Proper planning had to be done, or the organization could not be fully engaged and prepared to execute the plan.

Intel has an extensive history of acquisitions and investments in related businesses. In 2011 and the early part of 2012, we noted 12 major acquisitions and 10 investments. Not all of their acquisitions have been that fruitful. One 2009 article commented that Intel had been in need of a "savior" for "several years" (*PC Perspective*, 2009). It conjectured that the technology industry's most lucrative partnership—the long-running alliance between Microsoft and Intel—was coming to a day of reckoning. Tablets, smartphones, and televisions using rival technologies were taking off, pushing the two companies to go their separate ways (Wingfield, 2011). Further, Intel had formed an alliance with Google for Android-based smartphones and tablets to be optimized for Intel's chips, highlighting the fracturing of the US chipmaker's decades-long relationship with Microsoft (Nuttall, 2011). Overall, the fractious state of Intel's alliance and acquisition strategy leads us to conclude that they have lost their "20-mile march" discipline, which was devoted to introducing core processors for PCs and laptops.

D. 2. Productive Paranoia [Somewhat Agree]

Systematic introduction of new products had been a means by which Intel created value for its customers. New products were being introduced with increasing frequencies. Transitions to these new products began while existing products were still selling in the market, giving rise to the challenge of simultaneously managing product life cycles for multiple product generations (Stanford Graduate School Case, 2005).

Intel is gearing up to provide more computing solutions for consumer electronics, smart phones, and products such as advanced refrigerators and cars that increasingly run on powerful CPUs. Intel is honing its strategy while seeking to maintain its dominance in computer chips where it has an 80 percent global market share.

Intel has invested over $4 billion in a specialized chip-equipment in an effort to shave two years from the time needed to adopt new production techniques. They have also expanded their factory network to meet an increasing demand for chips. In 2011, they spent over $9 billion on plants and equipment compared with $5 billion in 2010 (King, 2011). Intel is pursuing "Productive Paranoia" by improving its product introduction capability and adding capacity. Both moves buffer against uncertainty. This is supported by their steady performance with respect to current and debt-to-equity ratios (Table 6).

D. 3. Empirical Creativity [Somewhat Agree]

A Senate report stated, "In the semiconductor industry, innovation is indispensable; research breakthroughs are essential to the life and health of the industry. Research and innovation in the design of semiconductor chips is threatened by the inadequacies of existing legal protection against piracy and unauthorized copying" (Senate Report, 1984).

While Intel had been having spectacular success as portrayed in the GBC study, they were beginning to lose market share by 2006 and more importantly, their leadership in technology was

challenged by AMD. In response, Intel's CEO initiated a second restructuring and cost-cutting program to improve their competitiveness. Shortly thereafter, they entered into a costly acquisition of ATI Technology to gain market share in the manufacturing of graphics chips (King, 2011).

Overall, we concluded that, although industry trends are taking Intel outside its traditional markets, Intel continues the GBC practice of doing many small experiments (firing bullets) following the successful ones with large investments (cannon balls).

D. 4. Level 5 Ambition [Disagree]

In 2005, Intel, following a change in leadership, entered into a major reorganization. The existing organizational structure had divided the company into broad industry categories—client, server, etc. The reorganization focused on the uses by which customers could put technology to work. This divided operations into five groups—digital enterprise, digital home, mobility, digital health, and channel platforms (Yoffie, 2005).

More recently, the leadership at Intel noted that these new business initiatives required a level of integration with the strategic leadership team, which had not yet been accomplished. Instead of working outside of the system, Intel needs to work closer with the business unit leaders from the earliest stages (Shih, 2010). Overall, we conclude that there is a lack of the type of integrative, selfless leadership that typically characterizes the GBC practice of "Level 5 Ambition."

In Research Question 4, we proposed that Intel maintained the use of GBC practices based on our financial analysis. However, our examination of the four practices did not provide enough evidence to confirm or refute this proposition (neutral).

E. Research Question 5: AMD Never Used GBC Practices

Advanced Micro Devices (AMD) is a multinational semiconductor company that develops computer processors and related technologies for commercial and consumer markets. Its main products include microprocessors, motherboard chipsets, embedded processors and graphics processors for servers, workstations and personal computers, and embedded systems applications (IDG News Service, 2010). AMD is the second-largest global supplier of microprocessors and one of the largest suppliers of graphics processing units. AMD is the only significant rival—and sometimes partner—to Intel in the central processor (CPU) market for personal computers (Stokes, 2010; Myslewski, 2011). AMD has a long history of litigation with Intel as well (amd_Intel_Litigation_History.pdf, 1995).

As part of our research on AMD, we examined 432 press releases over the ten-year period (AMD Press Releases, 2012). Table 8 presents a summary of the categorizations.

Table 8: AMD Classifications

Acquisitions (Divestitures)	Jt Ventures	Infrastructure	Personnel	Philanthropy	Litigation	Financial	Recognition/ Presentations
7 and (2)	130	22	67	34	13	55	102

E. 1. Fanatic Discipline [Strongly Disagree]

AMD has been a reactor to market demands. They have been rather erratic. They have ventured into most of the computer arenas such as graphics, security, clouds, and 3D imagery. They have not been active in acquisitions with only seven over the period of study and two divestitures. AMD utilizes strategic industry partnerships to further its business interests as well as to tackle Intel's dominance and resources. During the ten-year period of our study, AMD entered into over 130 such arrangements—our impression being that they were rather scattered—a shotgun effect (Hryska, 2010).

E. 2. Productive Paranoia [Disagree]

In our categorization of AMD activities over the period of study, we added, and modified categories to explain their actions. We added infrastructure and modified recognitions to include presentations. AMD has demonstrated a significant ability to bring unique and high-quality products to market, yet their profitability was not forthcoming. They had two significant re-organizations (Vance, 2008), several layoffs (Linuxgram Newsletter for Open Source Community, 2011), and slowdowns (Burt, 2011). Of note is the large number of infrastructure changes—22 over the first nine years of the study period. Their consistently poor current ratio and debt-to-equity ratio performance (Table 6) confirms a lack of paranoia that changes may not go their way.

E. 3. Empirical Creativity [Somewhat Disagree]

AMD, as mentioned earlier, is reactive, not proactive—whatever the next technological wave is, they become a player—first in graphics, then processors for every form of workstation, PC, tablet, and other devices, and now even cloud computing. In a sense, they spread themselves too thin, compromising their profitability. Over the period of study, they have been recognized and honored for their high quality product offerings with 102 such recognitions. They have consistently been able to bring high quality products to market, yet are not able to increase their market share. It seems as though they are firing many cannon balls without aiming.

E. 4. Level 5 Ambition [Disagree]

Their personnel changes, appointments at the senior level across the spectrum and at the board level demonstrated a lack of sustained leadership. The overall image of AMD is that it is an admired company and one that takes care of its employees. In their Corporate Responsibility Report, it was noted, among other aspects, a wide interest in philanthropy and the encouragement of employee participation in community activities (AMD Inv, 2012)**.** Overall, AMD has a significant array of philanthropic activities as exhibited by 34 different programs and offerings. Their major litigation activities centered about Intel, mainly in the 2005 period; other than that, their leadership has managed to avoid conflicts given the myriad of activities and product offerings in which they are engaged.

In Research Question 5, we proposed that AMD never used the GBC practices based on our financial analysis. In addition, our examination of the four practices confirmed the proposition.

F. Research Question 6: Progressive Maintained Use of GBC Practices

Beginning 85 years ago, Progressive has built a strong proposition in auto insurance through competitive pricing and by continuously improving their products and services. They pride themselves on offering competitive rates and 24-hour, in-person and online services to all drivers in the United States. Progressive customers can purchase auto insurance online, by phone, or from independent agents. Prices vary based on how they choose to buy (Progressive Insurance, 2012).

Progressive had an unequivocal commitment to maintaining a profitable combined ratio no matter what conditions it faced, how its competitors behaved, or what seductive growth opportunities beckoned. According to GBC, Progressive had a near-perfect record. However, they obsessed over what they needed to do to stay on track.

F. 1. Fanatic Discipline [Agree]

Progressive is one of a small number of companies whose business and online presence are virtually seamless. Progressive's technology operation has been ahead of the curve. Most of the insurance industry plays catch-up. Some of the innovative technologies and strategies that Progressive regularly introduces have become commonplace. Progressive's current CIO, Voelker, notes that "invent" continues to be important, but now so does "adopt and adapt" (Conz, 2009). The way that Progressive systematically introduces innovations while sticking to its core business is our justification for agreeing that they practice fanatic discipline.

F. 2. Productive Paranoia [Agree]

Ironically, over the past several years, Progressive has seen their bottom line shrink from $1.1B to $1.0B despite an increase in revenues from $14.8B to $15.4B. An increase in the percentage of sales devoted to cost of goods sold from 89.26 percent to 90.15 percent is one of the key components in the falling bottom line in the face of rising revenues (*Bloomberg BusinessWeek*, 2012). Progressive invests in new technologies and ways of conducting business to stay ahead of the competition. For example, they recently unveiled several new and enhanced mobile services—an upgrade in their mobile website that includes the ability to buy policies; a VIN capture feature by iPhone and Android apps allowing customers to get quotes based on a picture of a VIN; and severe weather text alerts based on Weather Central. These practices actually create a kind of "stock pile" or buffer against changes in the environment or actions by competitors. Progressive's debt-to-equity ratio was also rock steady over the entire 22 year period covered in this research (Table 6).

F. 3. Empirical Creativity [Agree]

Progressive provides a welcoming atmosphere for its employees. They enjoy a casual dress code and a unique work environment where all are required to risk, learn, grow and perform (Progressive Insurance Newsroom, 2012). Progressive's larger locations collectively house one of the USA's largest and most eclectic contemporary art collections. Their core values communicate a clear picture of what they try to achieve, how they interact with customers, and what guides their behavior. This permits all people associated with Progressive to understand what is expected, yet be inventive in how they meet business goals.

F. 4. Level 5 Ambition [Agree]

Progressive's Core Values serve as the foundation for its culture of innovation, empowerment and transparency. "At Progressive, fair dealing and transparency are synonymous with our way of conducting business," said Progressive's Chief Executive Officer, Glenn Renwick. "We have a culture that embraces innovation, risk taking, excellence and doing the right thing for our customers, agents, employees and investors. We revere honesty and transparency, and reinforce it in everything we do. That's crucial to be the company we strive to be."

One of the most tangible examples of Progressive's commitment to transparency is its financial reporting schedule. Every publicly traded company is required to report financial results on a quarterly basis. But, in 2003, Progressive became the first, and still only, public company to report full monthly financials to ensure frequent communication with investors and analysts (Progressive Insurance Newsroom, 2012). Many news releases mention the dominance of Progressive as a company in the insurance industry, but few discuss leadership. This can be attributed to leadership placing the company first.

In Research Question 6, we proposed that Progressive continued using the GBC practices based on our financial analysis. Our practice analysis confirms that Progressive is still using the GBC practices.

G. Proposition 7: Safeco Started Using the GBC Practices

Safeco was founded in Seattle, Washington in 1923 as the General Insurance Company of America, a property and casualty insurer. Safeco competed not only for business and individual customers, employers and other group customers, but also for agents and other distributors of investment and insurance products.

In 2001, new management was brought in to restructure the company. Commercial credit operations were sold to General Electric in 2001, and on March 15, 2004, the company announced the sale of its most profitable division, the life insurance and investments business, to a group of private investors. The same day, it was announced that Hub International Ltd. was buying Safeco's insurance brokerage operations. Less than a month later, it was announced that Mellon Financial Corporation would buy Safeco Trust Company, whose business is providing financial and estate planning services to individuals with over $1 million in assets. Shortly thereafter, the closure of Safeco Asset Management, the mutual-fund business, was announced.

On April 23, 2008, Safeco announced an agreement to be acquired by Liberty Mutual for $68.25 per share. Safeco continues to offer personal lines insurance (including auto, home, motorcycle, recreational vehicle, watercraft and more) through independent agents (Young, 2008).

Most of this turbulent activity during our period of study does not provide a representative picture of Safeco's practices. Of note though, is the selling off of non-core businesses which will be addressed in the practices discussion. Being Seattle-based an extensive amount of data was captured and chronicled in the University of Washington education library. We were able to view complete annual financial reports for the years 2002 to 2006. In addition, Motley Fool had over 900 articles and press releases about Safeco. Using these two sources we generated Table 9.

Table 9: Summary of Safeco GBC Practices from 2002 to 2006

Year	Fanatic DISCIPLINE	Productive PARANOIA	Empirical CREATIVITY	Level 5 AMBITION	Summary PRACTICES
2002	80%	90%	80%	90%	85%
2003	90%	90%	90%	90%	90%
2004	90%	90%	60%	60%	75%
2005	90%	60%	90%	50%	73%
2006	90%	90%	90%	60%	83%
	88%	84%	82%	70%	81%

G. 1. Fanatic Discipline [Agree]

Safeco over the period of study has focused on re-igniting sales by increasing the number of auto and small business policies; re-underwriting existing book of business and increasing life and investment revenues. In 2003 they announced a strategic redirection manifested in their sale of non-core businesses, staying with their property and casualty (P&C) business and selling off their L&L operations. This resulted in staff reductions with the aim of lowering their cost structure and facing increasing competition. However, Safeco believed that this focus could better provide a unified sales and service platform (called *Safeco New*) that would also lower their partners' costs. In addition they made efforts to get their expenses in line, strengthen their claim operations, and automate their underwriting.

During the period from 2002 to 2005 the insurance industry encountered a series of catastrophes. Despite addressing these, Safeco turned in back-to-back record net income. Faced with extensive payouts and increased competition, they maintained underwriting discipline and generated profits on every major line of their business.

G. 2. Productive Paranoia [Agree]

Over our period of study Safeco introduced a zero-defect service. They launched a multiyear initiative to drive out errors from processes involving customers. They also initiated six major projects to eliminate mistakes that degrade service and waste money. Safeco developed a business model focusing on the P&C business. This model was intended to drive greater efficiencies. Lower costs provide customers with competitively priced products and services, and create a sustainable market advantage. Their 37 percent improvement in debt-to-equity performance (Table 6) supports a shift to productive paranoia.

G. 3. Empirical Creativity [Agree]

While being committed to selling through independent agents, Safeco also recognized the need to mirror the diversity of consumers and their buying preferences. More and more people want to comparison shop—by phone, through affinity groups and especially via the internet. They took steps to insure that these preferences were accommodated. They brought together their major auto, property, specialty and small-to-midsized commercial products onto their online Safeco Now sales-and-service platform. The agent workplace was web-based and featured a single point of entry for all of the 17 Safeco commercial and personal products. In addition they rolled out new products that made it easier to customize insurance coverage such as the *Safeco Optimum Package*

for auto and home. As a safeguard their R&D sought and obtained patent protection for these new lines.

G. 4. Level 5 Ambition [Agree]

Safeco has made a commitment to invest in its people. They changed their compensation plan to reward achievement and introduced stock option grants. They stepped up training company-wide. Explicit consideration was given to increase diversity, especially in management. Safeco also had a strong independent Board of Directors. Management demonstrated that it would make painful decisions to give up market share when products were inadequately priced.

In Research Question 7, we proposed that Safeco started using the GBC practices given the results of our financial analysis. Our practice analysis confirms that Safeco started to use the GBC practices. Overall, they made progress in becoming a low-cost carrier, deployed capital to provide meaningful returns to their shareholders, and built an infrastructure and technical capability that meets a best-in-class standard. Thus, in effect, they became a desired take-over target resulting in their 2008 acqusition.

H. Proposition 8: Microsoft Stopped Using GBC Practices

Microsoft is the leading software producer worldwide (van Kotten, 2011). As of 2012, they dominate both the PC operating systems and Office Suite markets. The company also produces a wide range of other software for desktops and servers and is active in areas including internet search (with Bing); the video game industry (with the Xbox and Xbox 360 consoles); the digital services market (through MSN); and mobile phones (via the Windows Phone OS). In June 2012, Microsoft announced that it would be entering the PC vendor market for the first time with the launch of the Microsoft Surface tablet computer**.**

The GBC study ended in 2002; in that period Microsoft met the "great" criteria. Table 10 presents our compilation of the four practices for the ten-year period along with other considerations that mitigate the practices ending 2012. This compilation better clarifies by presenting both chronologically and in summary, introducing more granularity overall. Not all practices have a score for each year when there were no significant events.

Table 10: Microsoft Four Practices and Considerations

Year	Acquisitions	Infrastructure	Personnel	Philantrophy	Litigation	Financial	Recognition/ Presentations	Fanatic DISCIPLINE	Productive PARANOIA	Empirical CREATIVITY	Level 5 AMBITION
2002	4				4			10.00	7.33		
2003	2	1	0	0	3	0	0	7.50		7.00	
2004	2	0	0	0	5	0	0	7.00	7.00		
2005	7	1	0	0	3	0	0	5.33	6.00	8.00	8.00
2006	11	2	2	0	3	0	0		5.33	8.50	10.00
2007	8	1	3	1	3	3	3		5.00		
2008	16	1	0	0	0	1	0		5	9	5
2009	6	1	0	0	0	1	0	7.00	7.00	8.00	5.00
2010	3	2	1	0	0	0	1	8.00	5.50		
2011	3	0	1	1	0	3	2	4.67	7.60	10.00	5.00
2012	2	1	0	1	0	1	0	6.33	6.33		5.00
	64	10	7	3	21	9	6	74%	62%	84%	63%

H. 1. Fanatic Discipline [Neutral]

To serve the needs of customers around the world and to improve the quality and usability of products in international markets, Microsoft localized many of their products to reflect local languages and conventions. Localizing a product may require modifying the user interface, altering dialog boxes, and translating text. Localization, although an attractive international strategy, can be a deterrent to consistency.

Microsoft has been very active in acquisitions throughout its history. Over the past ten years, they have acquired 64 companies. Table 10 showed the distribution over the ten years of our study. Many of these acquisitions signify entries into new or developing marketing areas. They are rarely a first mover. Microsoft often enters during the shakeout stage of the product life cycle. This is evidenced by their recent entry of a tablet into the very crowded iPad/Samsung foray. Another example is their entry into the *cloud computing* market for Windows (Fried, 2008) and their intent to open a chain of Microsoft-branded retail stores (Fried, 2009). Over the past 20 years, Microsoft has exhibited discipline and endurance in its "not first mover" strategy.

H. 2. Productive Paranoia [Somewhat disagree]

Microsoft contracts most of their manufacturing activities to third parties. These include Xbox 360 and related games; Kinect for Xbox 360; various retail packaged software products and Microsoft hardware. Their products include some components that are available from only one or limited sources. The Xbox 360 console and Kinect for Xbox 360 contain key components supplied by a single source. The integrated central processing unit/graphics processing unit is purchased from IBM, and the supporting embedded dynamic random access memory chips are purchased from Taiwan Semiconductor Manufacturing Company. However, they generally have multiple sources for raw materials, supplies, and components, and are often able to acquire component parts and materials on a volume discount basis (U.S. Securities Exchange Commission, 2011).

As the smartphone industry boomed beginning in 2007, Microsoft struggled to keep up with its rivals Apple and Google in providing a modern smartphone operating system. As a result, in 2010, Microsoft revamped their aging flagship mobile operating system [OS], Windows Mobile, replacing it with the new Windows Phone OS. This constituted a change in strategy in the smartphone industry. Microsoft is now working more closely with smartphone manufacturers, such as Nokia, to provide a consistent user experience. In May 2012, Microsoft released the next generation Windows 8 software designed to power devices ranging from tablets to desktop computers (AFP Relax, 2012).

A relaxation in paranoia is also evident in the reduction in current ratio and increase in debt in comparison to the GBC period and in comparison to Apple (Table 6).

H. 3. Empirical Creativity [Somewhat Agree]

Microsoft (Kate, 2005) has long been known as a company that tightly controls all aspects of its marketing and communications with customers, business partners, analysts, and the media. In the middle of our study, Microsoft made efforts to change its image and develop a more open marketing culture. The fact that they reached out to the media and analyst community to discuss the change was news in itself. Internally they changed the way engineering and marketing work together to create a more cohesive and seamless product development process.

Most of Microsoft's software products and services are developed internally. Internal development allows them to maintain competitive advantages that come from closer technical control over their products and services (U.S. Securities Exchange Commission, 2011). This also gives them the freedom to decide which modifications and enhancements are most important and when they should be implemented. They strive to obtain information as early as possible about changing usage patterns and hardware advances that may affect software design. Before releasing new software platforms, they provide application vendors with a range of resources and guidelines for development, training, and testing.

H. 4. Level 5 Ambition [Neutral]

When Bill Gates, Chairman of Microsoft, announced his intention to step down in July 2008 (BBC News, 2006), he stressed that he was not retiring but simply making a transition. Even though he no longer would be the chair in two years' time, he intended to maintain a key role in advising the firm. In 2000, he had assumed the title of chief software architect and stayed on as company chairman; Steve Ballmer took over as chief executive (U.S. Securities Exchange Commission, 2011).

In the 1990s, critics began to contend that Microsoft used monopolistic business practices and anti-competitive strategies. This put unreasonable restrictions on the use of its software. Both the U.S. Department of Justice and European Commission found the company in violation of antitrust laws. Many forms of litigation continued throughout the period of our study. There were eighteen separate incidents from the time period of 2002 to 2006. One of Microsoft's business tactics, described by an executive as "embrace, extend and extinguish," initially embraces a competing standard or product; extends it to produce their own version which is incompatible with the standard; and, in time, extinguishes competition that does not or cannot use Microsoft's new version (Rodgers, 2008). Various companies and governments sue Microsoft over this set of tactics, resulting in billions of dollars in rulings against the company. Microsoft claims that the original strategy is not anti-competitive, but rather an exercise of its discretion to implement features it believes customers want.

In Research Question 8, we proposed that Microsoft stopped the use of GBC practices based on our financial analysis. However, our examination of the four practices did not provide enough evidence to confirm the proposition.

I. Proposition 9: Apple Started Using GBC Practices

With respect to Apple in the period from 2002 to 2012, we noted a steady progression of improvement in "Fanatic Discipline" and "Productive Paranoia," and a relatively stable set of "Empirical Creativity" activities. However, in "Level 5 Ambition" there was mixed evidence due to questions about Steve Jobs' performance, as well as the introduction of products such as the iPad. Table 11 depicts the four practices and the associated set of activities.

Table 11: Apple Practices over the Period of Study

Year	Acquisitions	Infrastructure	Personnel	Philanthropy	Litigation	Financial	Recognition/ Presentations	Fanatic DISCIPLINE	Productive PARANOIA	Empirical CREATIVITY	Level 5 AMBITION
2002	2	4	2	1	1	6	4	6.67	7.68	8.93	
2003	0	2	2	2	0	5	3	8.50	8.40	8.70	8.00
2004	0	3	2	0	0	4	2	6.30	7.10	7.60	7.00
2005	0	2	1	1	0	5	1	8.40	7.30	7.80	6.00
2006	0	3	2	0	1	4	1	8.80	8.10	8.50	
2007	0	2	2	0	0	4	1	6.60	7.80	7.80	9.50
2008	0	5	2	0	0	4	2	8.20	8.8	7.7	
2009	0	0	3	0	0	5	1		8.80	9.20	
2010	0	5	2	0	1	4	2	10.00	9.40	9.60	10.00
2011	0	0	3	0	1	5	3	10.00	9.80	8.80	5.00
2012	0	1	2	0	1	3	2	10.00	9.80	9.70	
	2	27	23	4	5	49	22	83%	85%	86%	76%

I. 1. Fanatic Discipline [Somewhat Agree]

Apple's leadership has been pervasive (Mirchandani, 2012). Traditional supply chain disciplines like managing an extended network of contract manufacturers and component suppliers are fully in force, but beyond those areas, Apple has led in at least two vital ways. The first is in its huge advantage of the digital supply chain. By fostering the development of a secondary market in applications for its iPhone, the company has shown again (as with iTunes) that consumer product revenue growth with zero inventories is not only possible, but also repeatable. The other area in which Apple's supply chain leadership is increasingly important is in the retail experience. As one of a handful of deeply vertically integrated brands, Apple's retail chain achieves almost unimaginable success in its stores.

I. 2. Productive Paranoia [Somewhat Agree]

Apple has built a retail store chain that is the envy of even long-time retailers (Mirchandani, 2012). It has built Apple's elaborate global network of suppliers and contract manufacturers that has confused the traditional accounting that economists use to measure global trade. In addition to the elaborate physical supply chain, it has had to integrate the digital supply chain as iPhones are activated via iTunes both at customer homes and via carriers. As it rolls out its iCloud, it has built one of the biggest data centers in the world. It has built an ecosystem of apps and games around its products at a scale never seen before. Admirably, it built its supply chain in a much more volatile industry than that of consumer products or chemicals. It balanced the risk of overproducing, or increasing buffer inventory and taking write-offs, as opposed to producing and losing customers to the next competitive product just a few weeks away. Apple took that risk time and again, and made the rest of the industry do the same. Their improvement in current ratio and debt-to-equity performance (Table 6) allowed them to take risks while maintaining financial stability.

I. 3. Empirical Productivity [Somewhat Agree]

One example of Apple's creativity was the introduction of the Apple store. Apple is the most successful retailer in history, with an astonishing $50,000 in sales per square foot in their best stores (there is no close second) and roughly $13 billion in revenue in ten years. For the Apple

stores to succeed, they had to express the Apple ideal of creative exploration and self-expression. That meant that stores had to look beyond simply moving product to changing customers' lives by actively helping them express their creativity. The stores were envisioned as places where consumers could test-drive Apple products and learn the "digital arts" of using those products; where they could join Apple retail employees and other consumers in a real-life, brick-and-mortar, non-virtual community. Steve Jobs saw the stores as places that could best succeed—really, could only succeed—if they strove to inspire greatness in everyone who walked through the door.

Leaders who excel despite an uncertain environment tend to turn first to "empirical evidence, empirical experience, and empirical data rather than immediately seeking what experts or others advise them to do," Collins says. This hands-on approach "often leads 10x'ers to very creative outcomes, since the outcomes are based on empirical validation" (Grams, 2011). Collins points to Apple founder Steve Jobs, who bet much of his company's success on the iPod. "You'd think it was this big creative thing that came out of nowhere," says Collins. "It wasn't. ... The MP3 was already out in the world, and [Apple employees had] made an iPod for themselves. The company fired 'bullets,' or small empirical steps, to validate the concept, and then they went big with it."

I. 4. Level 5 Ambition [Somewhat Agree]

Steve Jobs famously refused to release a new Apple product, or even a product enclosure, until it was as close to perfection as possible. Yet, no one allowed perfectionism to paralyze Apple's creative processes. Depending on the form it takes, perfectionism is not necessarily a block to creativity. A growing body of research in psychology has revealed that there are two forms of perfectionism: healthy and unhealthy. Characteristics of what psychologists view as healthy perfectionism include striving for excellence and holding others to similar standards, planning, and strong organizational skills. Healthy perfectionism is internally driven in the sense that it is motivated by strong personal values for things like quality and excellence (Steve Jobs). Conversely, unhealthy perfectionism is externally driven. External concerns show up over perceived parental pressures, need for approval, a tendency to ruminate over past performances, or an intense worry about making mistakes (not Steve Jobs). Healthy perfectionists exhibit a low concern for these outside factors.

In Research Question 9, we proposed that Apple started using the GBC practices based on our financial analysis. Our examination of Apple's use of the four practices confirmed the proposition.

J. Research Question 10: Southwest Airlines Stopped Using GBC Practices

According to GBC (Grams, 2011) Southwest demanded of itself a profit every year, even when the entire industry lost money. From 1990 through 2003, the U.S. airline industry as a whole turned a profit in just six of 14 years. In the early 1990's it lost $13 billion and furloughed more than 100,000 employees; nevertheless, Southwest remained profitable and furloughed not a single person. Despite an almost chronic epidemic of airline troubles, including high-profile bankruptcies of some major carriers, Southwest has generated a profit every year for 30 consecutive years.

J. 1. Fanatic Discipline [Neutral]

Southwest has espoused a high level of customer service as a key component of their mission. The value placed on customer service is virtually unquestioned by the company's employees. Southwest Airlines is dedicated to the highest quality of customer service, delivered with a sense of warmth, friendliness, individual pride, and "company spirit" (Southwest Airlines, 2012). Interestingly, though, the foundation of Southwest's corporate message is not that customers are number one; rather, employees always come first with the company, with customers a respected second. Southwest, in turn, expects its staff to extend to customers the same level of warmth, respect, and responsiveness that they receive. This approach stands in stark contrast to the "customers first" approach taken by most service-oriented organizations. Equally important, Southwest had the discipline to hold back in good times so as not to extend beyond its ability to preserve profitability and the Southwest culture.

Southwest's decision in 2010 to buy AirTran Holdings, Inc. marked its first foray into a second jet type and its first boost in seating capacity since the end of 2008. They also faced off with bigger Delta Air Lines at its primary hub of Atlanta, the world's busiest airport and the only major U.S. city Southwest did not serve. Southwest also started flying at Washington's Reagan National, adding its first international flights, and meshed 8,000 employees into their workforce (Hughes, 2010). This is a strategic turning point for Southwest. They became a widespread, far-flung airline. Their emerging strategy is no longer just serving cities that met their simple requirements. With the acquisition of Air Tran Holdings, Southwest complicated their simple low-cost strategy by no longer flying just one fleet type (Boeing 737s). They could no longer hold down maintenance and training costs; make short hops between cities at high frequencies; and own most of their jets.

In 2008, Southwest Airlines (CNN, 2008) initiated inspection of 44 planes after an "ambiguity related to required testing" was found during a review of records, the airline said. At the same time, they placed three employees on administrative leave and began conducting an internal investigation into allegations that they flew planes without proper inspections.

J. 2. Productive Paranoia [Neutral]

Southwest had successfully navigated the turbulent aviation industry, making money as competitors bled by being conservative about everything, including technology. Southwest actually had reusable, plastic boarding passes that were collected as passengers boarded. In fact, the airline made a virtue of being low tech. New security after 9/11 forced the airline, kicking and screaming, to rethink ticketing and other automation. That was fortuitous because it allowed Southwest to align with a trend that started to accelerate around that time: the increasingly tech-savvy customer (Mirchandani, 2012).

Southwest improved its current ratio 21 percent and debt-to-equity ratio 12 percent from the period 1991-2001 to 2002-2012.

J. 3. Empirical Creativity [Agree]

Over the years, Southwest's practical and down-to earth culture allowed them to be very creative and they were easily able to identify many of their own problems and solutions. Keeping things simple has allowed Southwest to take advantage of speed and flexibility in contrast to their

competition. Outside resources are regarded to be helpful in certain situations. They do not want to pay consultants for their ideas, given that they have generated many ideas internally. However, they do need focus, tried-and-true methodology, and resources to help streamline or simplify the internal ideas into the most desired solutions. Sometimes they need unique skills in facilitation, methodology, and technology to put their ideas together into a project plan, and to mobilize the completion of the task at hand. In a discussion (Sartain, 1998), Southwest Airlines explained under what circumstances it uses management consultants. Of note, consultants are evaluated on these criteria: 1) cost efficiency; 2) track record and reputation; 3) ability to listen to corporate goals; 4) people; 5) culture fit; 6) honesty and integrity; and 7) customer service. These criteria can also be used to describe some of the aspects of "Empirical Creativity." Consultants are, by Southwest definition, very expensive animals. They prefer to invest in their own people rather than in temporary consultants. They do not want the training and development expertise lost on consultants. Employees are considered to be more loyal and dedicated to doing what is best.

J. 4. Level 5 Ambition [Strongly Disagree]

Southwest has prided themselves with their focus on efficiency and high utilization of assets. Aircraft and ground equipment were employed in an effective manner; believing that an aircraft is not making any money when it is on the ground, their scheduling allowed for quick turnaround times of their planes, and better utilization of ground equipment. Southwest has level activity throughout the day, resulting in not having to hire a large of a staff to cover "rush hours." Lower per unit costs can lead to higher profit margins (Jenkins, 2010).

Ironically, in the year Kelleher stepped down as CEO, Southwest posted a profit while still offering bargain fares (Pae, 2008). Southwest in the latter part of the study exhibited poor leadership. The President and CEO of Southwest Airlines is Gary C. Kelly. Kelly replaced former CEO Jim Parker on July 15, 2004 and assumed the title of President on July 15, 2008, replacing former President Colleen Barrett. Southwest Airlines' CFO is Laura Wright. In July 2007, Herb Kelleher resigned his position as Chairman. Colleen Barrett left her post on the Board of Directors and as Corporate Secretary in May 2008 and President in July 2008 (Southwest Airlines, 2012). This type of leadership churning is not indicative of Level 5 Ambition.

In Research Question 10 we proposed that Southwest stopped using the GBC practices based on our financial analysis. Our practice analysis confirmed that Southwest significantly reduced the use of GBC practices.

K. Proposition 11: Stryker Maintained GBC Practices

When John Brown became CEO of Stryker in 1977, he deliberately set a performance benchmark to drive consistent progress: Stryker would achieve 20 percent net income growth every year. This was more than a mere target, or a wish, or a hope, or a dream, or a vision. It was to use Brown's own words, "the law." He ingrained "the law" into the company's culture.

K. 1. Fanatic Discipline [Agree]

Stryker since its inception has followed the path of sticking with its core areas. They have engaged in numerous acquisitions and joint ventures. In 2011 alone, they had two acquisitions and seven joint ventures. In 2011, Stryker's CEO noted: "Our acquisitions have all been grown out of

existing relationships we have with our customers. It is not diversification for diversification's sake, but diversification because we see opportunities for growth."

K. 2. Productive Paranoia [Somewhat Disagree]

Stryker has mixed marks with respect to productive performance indices. On one side, it has maintained consistent growth that strictly adheres to the Collins model; on the other side, Stryker has, in the past five years, experienced unwanted attention from the FDA and has been involved in several litigation incidents regarding product failures and quality. Since early 2007, the company has received three warning letters from the Federal Drug Administration citing issues in compliancy.

There have also been some ethical issues. In 2007, Stryker, along with other companies, was involved in civil ligation with the U.S. Department of Health and Human Services, Office of Inspector General. The office maintained that Stryker engaged in unlawful kickbacks to physicians who urged hospitals to purchase their respective products. Stryker, however, having cooperated early in the investigation, was not fined.

As of February 2008, a dispute exists between Stryker Corp. and the U.S. Department of Justice concerning a subpoena linking the company to aforementioned misconduct in sales of products. Since governmental filing of the injunction, Stryker notes that it has produced in excess of 300,000 pages of documentation in compliance with the mandate. U.S. Government counters, however, that the documentation was not proper as required.

In spite of these negatives, Stryker showed a marked improvement in current ratio and debt-to-equity ratio performance in the update period.

K. 3. Empirical Creativity [Strongly Agree]

Stryker has consistently maintained a culture of creativeness and innovation. They continue to focus on early-stage medical technology opportunities as well as emerging economies with complex healthcare needs. They have assembled a team with deep knowledge, expertise, and skill in global execution—combinations that will help deliver above-market growth. For example, their recently created Performance Solutions division developed and piloted new offerings. They are working to engage their customers on a deep level by delivering services and systems that enable healthcare providers to achieve clinical, operational and financial performance goals. These services and systems include performance management and other data-driven capabilities from one of their newly acquired businesses. At the same time, their plan to produce and execute with excellence in an ever-evolving healthcare landscape has become even more of an imperative as cost pressures continue to rise. Amid global economic challenges, they have continued to advance their quality discipline. The character of their employees and ability to adapt to an increasing rate of change defines Stryker as a medical technology leader for the long haul.

K. 4. Level 5 Ambition [Agree]

In 2011 at a company meeting, Stryker's CEO noted that the company has proven its mettle in tough times, allowing it to continue to perform, despite struggles in the orthopedic industry. For many years in med tech, the rising tide lifted Stryker, and he sees the company as a team that continues to deliver and is poised to win in any environment, despite mounting pressures from tough economic conditions that have been a drain on the entire orthopedic industry. Stryker

officials predicted 11 to 13 percent sales growth despite these conditions. The CEO said his confidence was rooted in the fact that the company is not dependent on just one market for success. In fact, no single franchise in the Stryker family makes up more than 18 percent of the company's total revenues.

In 2003, Stephen P. MacMillan joined Stryker as President and CEO. In 2005, annual sales reached $4.9 billion and John W. Brown transitioned to the single role of Chairman of the Board while Steve MacMillan became President & CEO. Steve MacMillan resigned from the post of CEO in 2012. Curt Hartman, the chief financial officer will serve as interim CEO while Stryker searches for a permanent successor to MacMillan. By 2007, Stryker had sold its Physiotherapy Associates division to private equity firm Water Street Healthcare Partners for $150 million. There were some changes in management at the latter part of our ten-year study; to wit, the resignation of the Chairman, President and CEO. Yet Stryker has continued to be regarded as one of the most innovative companies.

In Research Question 11, we proposed that Stryker continued using the GBC practices based on our financial analysis. Our practice analysis confirms that Stryker is still using the GBC practices.

IV. Conclusions

Overall, we conclude that GBC has sound advice for companies. Given the life cycles of organizations, products and industries there is an ebb and flow that is evident in the financial bottom line. However in GBC, Collins and Hansen attempted to explain what some of these ingredients might be in the form of practices. Our approach to the study replication and extension was rigorous and requires extensive subjective analysis. Figure 2 shows the placement of the companies in our study based on the GBC Performance and our practice analysis.

Figure 2: Summary of GBC Performance vs GBC Practices
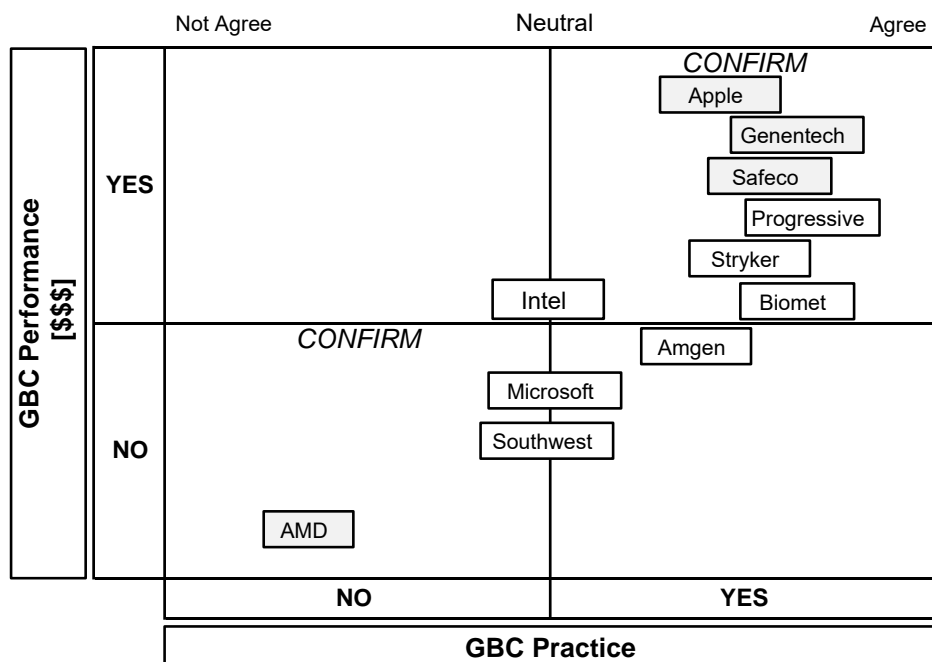
For companies that started using the practices (i.e. Apple, Genentech, and Safeco), their performance improved. The adoption of GBC practices for an organization is best depicted by the resurgence of Apple. Isaacson (Isaacson, 2011) narrates the ebb and flow of Steve Jobs from his formation of Apple, the release and success of the Macintosh, the deviation from fanatic discipline, the learning at Pixar, and the return and re-vitalization in the four-product business plan.

For companies that continued to use the GBC practices (i.e. Biomet, Progressive, and Stryker), their financial performance remained good. The only company we found that never used the GBC practices (disagree) is AMD. They never embraced the GBC practices and their financial performance was not as good as industry or their comparison company (Intel). For AMD the lack of "Productive Paranoia" was evidenced by its scattering and scrambling from product line to product line and the vast array of disjoint ventures and partnering.

For companies that reduced their use of GBC practices (i.e. Microsoft, Intel, and Southwest), two of the three had their financial performance suffer and one (Intel) maintained their financial performance. The decline of Microsoft may be based on moving away from GBC practices. For example, the change in leadership or perhaps the proliferation of products, many of which were cannon balls being shot after the battle was almost over (e.g. the entry of Bing into the search engine wars dominated by Google) cost Microsoft over $2 billion in losses.

The only instance we found that contradicts the confirmation of GBC was Amgen. In the study period, Amgen's financial performance did not reflect the use of the GBC practices we found still in place. A possible explanation is leadership. For Southwest and Amgen, many of their problems have been related to "Level 5 Ambition" or the lack thereof. Both firms continue to be very successful in their industries, but do not meet the criteria of great financial performance.

One observation we can make is that some of the GBC comparisons may become less relevant over time. Apple's rivalry with Microsoft still flickers occasionally, but strategically they almost ignore each other. Apple has won in music. Its position in phones and tablets has pushed Microsoft to playing catch-up, yet Microsoft can still rely on the sheer heft of 1.5 billion PC installations to ensure a stream of replacements and new sales for Office. Apple's reputation has been transformed from a put-upon, also-ran PC maker to world-spanning design brand.

There is a tendency among academicians to criticize popular business press books as not meeting the rigorous standards required for academic journals. Collin's works demonstrate the value of doing in depth case-based research on matched pairs that combines both financial and practice analyses. In our paper, we applied Collins and Hansen's techniques to see if the practices they identified apply beyond the dynastic period of identification and to companies who adopt the practices. Does the momentum continue, or as in the case of Apple versus Microsoft, does performance and practice change over time? One final caveat: eleven years is a long time in the technology industry. Collins did examine the companies in his study on a year-by-year basis, but summarized/coalesced his findings in a binary fashion. Our practitioner analysis attempted to duplicate this process wherein we showed a stream of significant events that tempered our determinations.

References

AFP Relax. 2012, May 21. *Microsoft launches social network So.cl, claims not to compete with Facebook*. Retrieved from Yahoo OMG: http://ph.omg.yahoo.com/news/microsoft-launches-social-network-cl-claims-not-compete-110708921.html.
AMD Inv. 2012. *Corporate Social Responsibility.*

AMD Press Releases. 2012, September 3. *Press Releases*. Retrieved from About AMD: http://www.amd.com/US/ABOUTAMD/NEWSROOM/PRESSRELEASES/Pages/index.aspx.

amd_Intel_Litigation_History.pdf. 1995. *AMD-INTEL LITIGATION HISTORY.* amd archve reports.

Amgen News Releases. 2002-2012. Retrieved from Amgen: http://www.amgen.com/media

Anonymous. 2010. "The New Breed of Leadership." *Pharmaceutical Executive*.

BBC News. 2006, June 15. *Bill Gates: A Timeline*. Retrieved from new.BBC.co.uk: http://news.bbc.co.uk/2/hi/business/5085630.stm

Berkley, James. 1992. *Amgen, Inc.: Planning the Unplannable.* Harvard Business School Publishing.

Berkrot, Bill. 2012, July 26. "Amgen Profit Beats Estimates; Raises 2012 Forecast." *Reuters*.

Binder, Gordon, and Philip Bashe. 2008. *Science Lessons: What Biotech Taught Me About Management.* Boston: Harvard Business Press.

Bloomberg BusinessWeek. 2012, September 4. *Bloomberg BusinessWeek Financials*. Retrieved from Bloomberg BusinessWeek: http://investing.businessweek.com/research/stocks/financials/financials.asp?ticker=PGR

Burt, Jeffrey. 2011, September 28. *AMD Cuts Q3 Forecast Due to Chip Manufacturing Problems*. Retrieved from eWeek.com: http://www.eweek.com/c/a/Desktops-and-Notebooks/AMD-Cuts-Q3-Forecast-Due-to-Chip-Manufacturing-Problems-581901/

CNN. 2008, March 12. *Southwest Grounds Planes, Places Three on Leave*. Retrieved from CNN.com.

Collins, Jim. 2001. *Good to Great: Why Some Companies Make the Leap...And Others Don't.* New York: HarperCollins.

Collins, Jim. 2009. *How The Mighty Fall: And Why Some Companies Never Give In.* New York: HarperCollins.

Collins, Jim. 2011. *Good To Great And The Social Sectors: A Monograph to Accompany Good to Great.* New York: HarperCollins.

Collins, Jim, and Mortenson Hansen. 2011. *Great by Choice: Uncertainty, Chaos, and Luck—Why Some Thrive Despite Them All.* New York: HarperCollins.

Collins, Jim, and Jerry I. Porras. 2001. *Built to Last: Successful Habits of Visionary Companies.* New York: HarperCollins (HarperBusiness for the 1994 edition).

Conz, Nathan. 2009, November 18. *Progressive Details Twitter Strategy*. Retrieved from Insurance Technology: http://www.insurancetech.com/management-strategies/221900146

Flinn, R. 2012. "Amgen Rises as Profit Tops Estimates on Drug Sales." *Bloomberg Business Week*. July 27.

Fried, Ina. 2009, February 12. *Microsoft Follows Apple into the Retail Business*. Retrieved from CNET CBS Interactive.

Fried, Ina. 2008, October 27. *Microsoft Launches Windows Azure*. Retrieved from CNET CBS Interactive.

Fubini, David, Collin Price, and Maurizio Zollo. 2006. *Mergers: Leadership, Performance and Corporate Health.* New York: Insead Business Press.

George, Bill. 2007. *True North: Discover Your Authentic Leadership.* San Francisco: John Wiley & Sons.

Glassdoor Team. 2008, December 18. *Which CEOs Have Been Naughty or Nice According to Their Employees?* Retrieved from Glassdoor Blog: Glassdoor.com

Grams, Chris. 2011, October 10. *A review of the new Jim Collins book Great By Choice.* Retrieved from Dark Matter Matters: http://darkmattermatters.com/2011/10/26/a-review-of-the-new-jim-collins-book-great-by-choice/

Hall, Melanie. 2012. *Genetech Inc: Hoover Company Profile.* Hoovers.

Hau, L. Lee, Feryal Erhun, Jay Hopman, Mary Murphy-Hoye, and Paresh Rajwat. 2005. *Intel Corporation Product Transitions and Demand Generation.* Stanford Graduate School of Business. Case no. GS43.

Hryska, Joel. 2010, July 17. *AMD Flip-Flops: Llano Later, Bobcat Bounding Forward*. Retrieved from hothardware.com: http://hothardware.com/News/AMD-FlipFlops-Llano-Later-Bobcat-Bounding-Forward/

Hughes, John A. 2010. *Southwest CEO Risks Keep-it-Simple Strategy to Reignite Growth*. Retrieved from anywhere: http://www.webcitation.org/5vh7wuxod.

IDG News Service. 2010, January 7. *AMD launches DirectX 11 graphics chips for laptops*. Retrieved from TechWorld: http://news.techworld.com/mobile-wireless/3209713/amd-launches-directx-11-graphics-chips-for-laptops/

Intel. 2012. *Intel Financial Report 2011.*

Iskowitz, Marc. 2011. Harrison & Star. *Medical Marketing and Media*.

Isaacson, Walter. 2011. *Steve Jobs*. Simon and Schuster.

Jenkins, D. 2010. *Chapter 7: Flight Arrival Flow*. Retrieved from Southwest Airlines: An In-Depth Review: http://web.archive.org/web/20070222232106/http://www.erau.edu/research/BA590/index.htm

Kate, Maddox. 2005. "Microsoft Opens the Lines of Communication." *B to B*. October 10.

King, Ian. 2011, February 18. *Intel Plans To Build $5 Billion Chip Plant In Arizona*. Retrieved from Bloomberg: http://www.bloomberg.com/news/2011-02-18/intel-plans-to-build-5-billion-chip-plant-in-arizona-hire-4-000-workers.html

King, Julia. 2012. "18th Annual Report: 100 Best Places to Work in IT." *Computerworld*.

King, Julia. 2010. "These CIOs Go Way Beyond IT-Business Alignment." *Computerworld*. May 24.

Linuxgram, The Newsletter for the Open Source Community. 2011, November 4. "AMD To Fire 1,400."

Looney, William. 2011. "Emerging Pharma Leaders 2011: Managing In the Era Of Lean." *Pharmaceutical Executive*. June 1.

Mirchandani, Vinnie. 2012. *The New Technology Elite: How Great Companies Optimize Both Technology Consumption and Production.* Hoboken, New Jersey: John Wiley and Sons.

Murray, Allan. 2011. "Turbulent Times, Steady Success." *Wall Street Journal*. October 11.

Myslewski, Rik. 2011, June 14. *Intel, AMD in HP Notebook Smackdown*. Retrieved from ChannelRegister.com: http://www.channelregister.co.uk/2011/06/14/amd_hp_notebooks/

Nuttall, Chris. 2011. Intel and Google form Android Chip Alliance. Retrieved from Tech Hub: http://www.ft.com/intlcms/s/2/544c33a8-de3b-11e0-9fb7-00144feabdc0.html#axzz1YRA3N2Dr.

Pae, Peter. 2008. "Hege on Fuel Prices Pays Off." *Los Angeles Times*. May 30.

PC Perspective. 2009, October 14. "Intel Needs a Savior."

Progressive Insurance Newsroom. 2012, March 16. *Ethisphere Institute Names Progressive to List of World's Most Ethical Companies*. Retrieved from Progressive Insurance: http://www.progressive.com/newsroom/2012/March/ethical-company.aspx

Progressive Insurance. 2012. *Progressive Insurance Company Introduction*. Retrieved from progressive.com: http://www.progressive.com/progressive-insurance/companyintroduction.aspx

Rodgers, Will. 2008. "Intel Exec: MS Wanted to 'Extend, Embrace and Extinguish' Competition." *ZDNet.* November 9.

Sartain, Libby. 1998. "Why and How Southwest Airlines Uses Consultants." *Journal of Management Consulting*, 10(2): 12-17.

Senate Report. 1984. *Senate Report Bill No. 425.* Washington, DC: 98th Congress Senate Report.

Shih, Willy. 2010. *Intel NBI: Intel Corporation's New Business Initiatives.* Harvard Business School.

Southwest Airlines. 2012. *Mission of Southwest*. Retrieved from Southwest Airlines: http://www.southwest.com/html/about-southwest/index.html?int=GFOOTER-ABOUT-ABOUT

Stengel, Jim. 2011. *Grow: How Ideals Power Growth and Profit at the World's Greatest Companies.* New York: Random House.

Stokes, Jon. 2010, February 8. *AMD Reveals Fusion CPU+GPU, to Challenge Intel in Laptops*. Retrieved from arstechnica.com: http://arstechnica.com/business/2010/02/amd-reveals-fusion-cpugpu-to-challege-intel-in-laptops/

US Securities Exchange Commission. 2011. *Microsoft 10-K Report.* Washington, DC: U.S. Government.

Valich, Theo. 2007, September 19. *Secret of Intel's name revealed*. Retrieved from The Inquirer: http://www.theinquirer.net/inquirer/news/1031210/secret-intel-revealed

van Kotten, Michael. 2011, August 23. *Global Software Top 100 Edition 2011: Highlights*. Retrieved from SoftwareTop100.org: http://www.softwaretop100.org/global-software-top-100-edition-2011

Vance, Ashlee. 2008. A.M.D. to Split Into Two Operations. *New York Times.* October 6.

Wikipedia. 2012. *Intel*. Retrieved from Wikipedia.org: http://en.wikipedia.org/wiki/Intel.

Wingfield, Nick, and Don Clark. 2011. "Microsoft Alliance With Intel Shows Age." *Wall Street Journal*. January 4.

Yoffie, David B. 2005. Intel Corp. 2005. *Harvard Business Review* .

Young, B. 2008. "Liberty Mutual Group Completes Safeco Acquisition." *Insurance Journal*. September 24.

Empirically Revisiting the Learning-by-Exporting Theory Using Data on Chilean Manufacturing Plants

By RUOHAN WU*

This paper empirically studies the learning-by-exporting hypothesis based on data of Chilean manufacturing plants from 2001 to 2007. I examine plants' exporting behavior from two aspects: export ratio and exporting experience. Intensive exporting behavior, in terms of higher export ratio or longer exporting experience, consistently and significantly raises the manufacturers' productivity only among those plants with asset innovation investment over 100 million pesos. Otherwise, the plants' exporting behavior cannot effectively improve their productivity; learning-by-exporting hypothesis does not hold under a low-innovation circumstance.

I. Introduction

The positive relationship between exports and productivity growth has been well documented over the years. According to learning-by-exporting theory (Marin, 1992; Ben-David, 1993), firms can grow faster by making substantial exports. Compared to their non-exporting cohorts, exporting firms have access to more advanced skills via *ex post* benefits, especially when these skills are unavailable domestically. Alternatively, exporting firms can have access to more comprehensive market information, both globally and domestically. In other words, firms learn from their foreign business partners in the course of undertaking exporting activities. Theoretically speaking, such a learning process greatly enhances a firm's production efficiency. For example, tips on new manufacturing techniques, or news about an upcoming technological breakthrough, can help a firm make successful transitions vis-à-vis production and sales. As a result, it can grow more quickly than less resourceful domestic firms.

This study examines the reasons as to why the learning-by-exporting effect may not exist under certain circumstances. To undertake an empirical study that garners valid and reliable results, I use data captured through the ENIA (Encuesta Nacional Industrial Anual) survey, an annual industrial survey of Chilean manufacturing plants. I consider the learning-by-exporting hypothesis from two perspectives: the export ratio, which is the ratio between a plant's export value and its total production value, and exporting experience, or how many years a plant has

continuously operated as an exporter. I then study whether exporting behavior significantly improves productivity.

Based on all the exporting manufacturers observed within the dataset, I find that while a plant's export ratio helps it significantly increase its productivity, exporting experience does not. I then study how innovation influences the learning-by-exporting effect. I use plants' aggregate innovation input on their capital assets (land, buildings, vehicles, and machines). A grouped test based on the plants' innovation investment reveals new findings: the learning-by-exporting effect is consistently significant only among the Chilean manufacturers that make sufficiently large asset innovation investments (i.e., exceeding 100 million Chilean pesos). Thus, a firm's exports can improve its productivity, but only when that firm makes substantial innovation efforts.

This study contributes to the literature by explaining why mixed evidence exists vis-à-vis the learning-by-exporting hypothesis; it does so by studying the latest plant-level survey data from Chilean manufacturers. It examines the learning-by-exporting hypothesis through two types of exporting behavior, and yet it reaches a consistent conclusion: high innovation investment practically guarantees a manufacturing plant's productivity growth, by way of its exports. If a firm wishes to effectively improve its productivity through intensive exports, it must concurrently pay sufficient attention to its research and development (R&D) investment.

To date, empirical tests based on various samples have found both positive and negative evidence for the learning-by-exporting hypothesis, indicating that this theory is very case-sensitive. This conclusion is addressed by Wagner (2007) in his review of the empirical literature on the positive correlation between exports and productivity growth. On one hand, Clerides *et al.* (1998) use plant-level data from Mexico, Colombia, and Morocco and find no evidence that firms' production costs are affected by their previous exporting behaviors. Using data from the Swedish manufacturing industry, Greenaway *et al.* (2005) find no evidence of differences between pre and post-export-market entry in terms of firm-level productivity. On the other hand, studies based on data from Indonesia (Amiti and Konings, 2007; Blalock and Gertler, 2004), Canada (Baldwin and Gu, 2004), the United Kingdom (Girma *et al.* 2003 and 2004), Slovenia (De Loecker 2007 and 2013), Spain (Manjón *et al.* 2013), and Chile (Alvarez and Lopez, 2005) all reach approximately the same finding: manufacturing firms become significantly more productive than their domestic counterparts upon entering the exporting market.

Recently, extensive empirical studies have explained this mixed evidence of the veracity of the learning-by-exporting theory. Among these studies, the role of innovation investment has been put under the spotlight with increased frequency. In their theoretical and empirical works, Hallward-Driemeier *et al.* (2002), Bustos (2011), Aw *et al.* (2008), and Costantini and Melitz (2007) each concludes that firms' exports are related to their R&D investments or their adoption of new technology. The key insights drawn from these studies are that innovation and exportation correlate, and that they both influence a firm's growth.

This paper is organized as follows. Section II describes the data. Section III presents the empirical results and analysis. Section IV provides a discussion, and section V concludes the paper.

II. Data Description

The plant-level data used in this study come from ENIA (Encuesta Nacional Industrial Anual), the Annual National Industrial Survey conducted by the National Statistics Institute of Chile (Instituto Nacional de Estadisticas Chile; INE). The original dataset features comprehensive plant-level information from 1995 to 2007. The survey contains the universe of manufacturing

plants in Chile that employ more than 10 workers. More than 5,000 plants are reported per year, so the data contain more than 65,000 plant observations. Through the survey, the INE also captured data on the plants that began operating during the current year, and excluded those that stopped operating for any reason. Each plant is assigned with a specific identification number that allows me to track its activities over time. Note that although a plant is not necessarily a "firm"—since a firm may have several plants concurrently—according to Pavcnik (2002), more than 90 percent of the manufacturing firms of Chile have only one plant. Thus, this plant-level survey data can also be used to address firm-level issues, and the terms are often used interchangeably.

A. Descriptive Statistics of the Observed Plants

The data from before 2001 contain no information on the plants' capital input. Since estimations of productivity require the plants' detailed production information, and because ENIA captured fixed capital input data through the survey only after 2001, I select the manufacturers from 2001 to 2007 and combine them as balanced panel data. These data comprise continuously operating plants, and so I can observe their long-term exporting experience. There are 2,264 plants per year and 15,848 observations in total. Table 1 reports the descriptive statistics of the panel data. Among all the observations, 3,782 (24 percent) plants were exporters during this timeframe, and 12,066 (76 percent) were non-exporters. Nonetheless, exporting behavior among Chilean plants is relatively rare.

Besides exports, I use two other variables that measure plants' business dealings with foreign countries. One is the proportion of the plant's capital that is foreign-owned, and the other is the proportion of the plant's techniques that come from abroad. In panel B, the foreign capital proportion is the ratio of the plant's foreign capital to its total capital input. In comparing exporting and domestic plants, it is clear that high proportions of foreign capital (>50 percent) occur more frequently among the exporters. In all, 10 percent of the exporters are endowed with 100 percent foreign capital; on the other hand, almost all non-exporter capital (97 percent) is completely domestic.

Foreign technical assistance is the value of technical assistance that a plant receives from abroad; in panel C, the "Foreign Tech Assistance Ratio" is the ratio of a firm's foreign technical assistance to its total production revenue. A firm with no foreign capital also receives no foreign technical assistance, and relatively fewer non-exporters receive as much foreign technical support as do exporters.

Panel D indicates the plants' sizes—in other words, the number of workers. The proportion of small (<50 workers) non-exporters is twice as large as that of small exporters. Compared to non-exporters, a much higher proportion of exporters comprise large plants with more than 150 workers each.

Furthermore, the ENIA dataset shows the innovation behavior of plants vis-à-vis their capital assets (i.e., buildings, vehicles, machines, and land). Manufacturing innovation information is not directly reported within the data via their original R&D expenditures; rather, it is indicated indirectly, through the value-added of assets—that is, based on its innovation-related activities, how much value-added has been created with respect to a plant's current capital assets. If a plant shows no signs of increased asset value, then I consider there to be no actual innovation. The more capital value-added the plant has acquired, the greater its innovation-related effort has been, and it is evidenced in real effects. Hereafter, I use the capital value-added as derived from the plants'

innovative activities to measure innovation effort. For simplicity, I name this variable "innovation investment."

Panel E, "ASSET INNOVATIONS," reports how many exporters or non-exporters have made innovation investments on a variety of asset types. Under each asset category, the proportion of innovating exporters is almost twice that of innovating non-exporters. Nonetheless, most of the plants—among either the exporters (88 percent) or the non-exporters (95 percent)—do not innovate.

Table 1: Descriptive Statistics of Exporting and Non-Exporting Plants, 2001 to 2007

	Exporters		Non-Exporters	
	Number	Percentage	Number	Percentage
A. TOTAL NUMBER OF PLANTS	3,782	100.00	12,066	100.00
B. CAPITAL PROPORTION				
Foreign Capital Proportion = 0	3,057	80.83	11,770	97.55
Foreign Capital Proportion $\in$ (0, 50%)	113	2.99	104	0.86
Foreign Capital Proportion $\in$ (50%, 100%)	223	5.90	99	0.82
Foreign Capital Proportion = 100%	389	10.29	93	0.77
C. TECHNICAL ASSISTANCE				
Foreign Tech Assistance Ratio = 0	3,057	80.83	11,770	97.55
Foreign Tech Assistance Ratio $\in$ (0, 5.0e^{-6})	373	9.86	105	0.87
Foreign Tech Assistance Ratio $\in$ (5.0e^{-6}, 1.0e^{-5})	121	3.20	30	0.25
Foreign Tech Assistance Ratio > 1.0e^{-5}	231	6.11	161	1.33
D. SIZES				
Small (10-49 Workers)	1,647	44.26	10,715	88.80
Medium (50-149 Workers)	2,034	53.78	1,306	10.82
Large ($\geq$150 Workers)	99	2.62	41	0.34
E. ASSET INNOVATIONS				
Innovators on Buildings > 0	265	7.01	386	3.20
Innovators on Vehicles > 0	33	0.87	55	0.46
Innovators on Machines > 0	251	6.64	294	2.44
Innovators on Land > 0	16	0.42	29	0.24
No Innovation	3,343	88.39	11,448	94.88

Source: ENIA (Annual National Industry Survey) Dataset, National Institute of Statistics of Chile.

B. Exporting Experience vs. Non-Exporting Experience

Table 2 reports the plants' exporting and non-exporting experience. The "exporting experience" of an exporter is the number of years that it has continuously exported goods. For example, if an exporter in 2007 has four years of exporting experience, then it did not export in 2003, but had positive exports from the beginning of 2004 to the end of 2007. If an exporter in 2007 has five years of exporting experience, then it did not export in 2002, but exported from the beginning of 2003 to the end of 2007.

Meanwhile, "non-exporting experience" is an exporter's number of continuous years with zero exports, prior to the current year. For example, if an exporting plant in 2007 has four years of non-exporting experience, then it did not export from 2003 to 2006, but did export in 2002; similarly, for an exporting plant in 2007 with five years of non-exporting experience, it had no exports from 2002 to 2006, but did export in 2001.

Table 2: Exporters' Exporting and Non-Exporting Experience from 2001 to 2007

Number of Years	Exporting Experience		Non-Exporting Experience	
	Number	Percentage	Number	Percentage
7	359	15.86	-	-
6	20	0.88	22	0.97
5	27	1.19	0	0.00
4	30	1.33	1	0.04
3	32	5.79	3	0.13
2	30	1.41	5	0.22
1	42	1.86	11	0.49
0	-	-	359	15.86
Never-Exporting Plants	1,522	67.23		
Total	2,264			

Source: ENIA (Annual National Industry Survey), National Institute of Statistics of Chile.

To study the continuous behavior of the observed plants, I reassemble the balanced panel data into a time-series longitudinal dataset. To preclude redundancy, I consider only those plants in 2007 and their past experience. In total, 2,264 plants continuously operated from 2001 to 2007. From Table 2, one can see that most of the plants (67 percent) never exported goods. Even in today's mature state of globalized business and expanding international trade and cooperation, exporting behavior is still not commonly observed among Chilean plants.

The exporters that exported from 2001 and all the way through 2007 constitute the second-largest group (16 percent). Additionally, most of the current exporters already had previous exporting experience, and very few of them started to export after sustaining a long period of not exporting. Thus, plants are highly likely to have a consistent exporting or non-exporting status;

frequently jumping in and out of the export market is quite rare. Once a plant exports or stops exporting, it tends to retain this status for a considerable time.

C. Distribution of Productivity

Based on a traditional Cobb–Douglas production function[1], I estimate the plants' levels of productivity, based on their outputs, capital inputs, labor inputs, and material costs. Specifically, I use the Olley–Pakes methodology (Olley and Pakes, 1996), which makes use of a semi-parametric algorithm; it effectively removes endogeneity and simultaneity during the estimation of the production coefficients—especially the coefficient of the capital input.

Table 3 reports the productivity distribution among all the observed exporters and non-exporters in the panel data. A_{it} is the estimated total factor of productivity; hereafter, for simplicity, I use $a_{it} = \log A_{it}$ as productivity. As shown in the table, the productivity score of most of the exporters (67 percent) ranges from 1 to 3, while that of most of the non-exporters (59 percent) is between 0.25 and 1. The median of the exporters' productivity (0.96) is much higher than that of the non-exporters (0.37). Additionally, the productivity distribution of the non-exporters is more left-skewed than that of the exporters; an exporter thus faces a greater chance of having a high level of productivity than a non-exporter.

Table 3: Distributions of Productivity

$a_{it} = \log A_{it}$				
	Exporters		Non-Exporters	
	Number	Percentage	Number	Percentage
$a_{it} < 0$	23	0.61	524	4.34
$a_{it} \in (0\ 0.25)$	36	0.95	1,161	9.62
$a_{it} \in (0.25\ 0.5)$	127	3.36	2,239	18.56
$a_{it} \in (0.5\ 1)$	985	26.04	4,964	41.14
$a_{it} \in (1\ 1.5)$	1,327	35.09	2,188	18.13
$a_{it} \in (1.5\ 3)$	1,232	32.58	939	7.78
$a_{it} > 3$	52	1.37	51	0.42
Total	3,782	100.00	12,066	100.00

---

[1]A traditional Cobb-Douglas production function looks like:

$$Y_{it} = A_{it} L_{it}^{\beta_l} K_{it}^{\beta_k} M_{it}^{\beta_m}$$

where for firm i at time t, Y_{it} is the total production, A_{it} is the manufacturing productivity, L_{it} is labor input, M_{it} is material cost, and K_{it} is capital input. β_l, β_k, and β_m are the coefficients of L_{it}, M_{it}, and K_{it}, respectively. The estimation of productivity A_{it} is based on the estimates of β_l, β_k, and β_m.

III. Empirical Tests

In this study, the learning-by-exporting effect is examined from two perspectives: first, whether an exporter's relatively high export volume improves its productivity, and second, whether a longer consecutive period of exporting experience leads to higher productivity. Let us explore each of these in greater detail.

A. Export Ratio and the Learning-by-Exporting Hypothesis

The first hypothesis is that to observe a significant learning-by-exporting effect, a larger export volume would need to help bring about a higher level of productivity. To test this theory, I will start with a linear regression of productivity against export ratio, as one of the main explanatory variables. This regression is specified as:

$$a_{it} = \alpha_0 + \alpha_1 \text{Export Ratio}_{it-1} + \alpha'_2 X_{it-1} + \alpha'_3 \text{Plant}_{it-1} + \varepsilon_{it}, \qquad (1)$$

where "Export Ratio$_{it}$" is the ratio between plant i's export value and its total production revenue in year t. X_{it} is a vector of the exporting-related activities of plant i in year t. Plant$_{it}$ constitutes the business characteristics of the plant. Note that all the explanatory variables on the right-hand side are lagged by one period; this is to preclude potential simultaneity during estimation.

Aggregate innovation is based on the plant's innovations with respect to four asset types: buildings, machines, vehicles, and land. If a plant exhibits no type of innovation, then its total innovation is 0. If the plant has invested in any type of innovation, its innovation effort is measured as the aggregate of different types of innovation—specifically,

$$\text{Total Innovation}_i = \sum_j^4 \text{Innovation}_{ij}, \qquad (2)$$

where $j \in$ {Buildings, Machines, Vehicles, Land}. Total Innovation is the sum of each type of innovation.

To test whether the learning-by-exporting hypothesis holds and how it is influenced by exporting experience and innovation investment, I will focus on α_1. Specifically, α_1 illustrates the effect of export ratio on productivity, and therefore shows whether the learning effect exists with significance. I therefore refer to α_1 as the "learning coefficient." The results are reported in Table 4. Besides foreign capital proportion and technical assistance, I also use other exporting-related explanatory variables (e.g., the plant's expenditure in promoting exports and subsidies received due to exports). The export revenue ratio is the ratio of the plant's export revenue to its total production revenue. Two business characteristics are also included: the value-added ratio, which is the ratio of the plant's value-added to its production value, and the capital depreciation ratio, which is the ratio of the plant's depreciated capital to its total fixed capital.

In column (i) of Table 4, if we do not consider the potential influence of innovation investment, there is significant evidence that the export ratio promotes productivity. A 1 percent increase in export ratio significantly increases productivity (i.e., by 1.1 percent); all the exporting activities and business characteristics also significantly influence productivity. Increased foreign capital, foreign technical support, and export subsidies and expenditures all effectively increase productivity. Greater value-added and capital depreciation also indicate higher productivity. Interestingly, however, higher export revenue decreases productivity; this finding suggests that if a plant were earning more money from exports, it would actually be a less-productive

manufacturer. A 1 percent increase in export revenue ratio significantly reduces productivity by 1.25 percent.

Table 4: Correlation Between Productivity and Exports Among Exporters

Dependent Variable: $a_{it} = \log A_{it}$	With Aggregate Innovation in Chilean Pesos (CLP)				Without Innovation
	All Exporters	$> 1.0e^{+8}$	$\in (1.5e^{+7}, 1.0e^{+8})$	$\in (0, 1.5e^{+7})$	
	(i)	(ii)	(iii)	(iv)	(v)
Export Ratio	1.14***	5.03**	3.65	0.07	0.39
	(0.32)	(2.18)	(2.22)	(2.25)	(0.32)
Foreign Capital Proportion (%)	0.27***	1.42	0.42***	0.03	0.26***
	(0.03)	(0.11)	(0.12)	(0.11)	(0.03)
Foreign Technical Assistance	0.91***	0.51	3.40	9.83**	0.77***
	(0.19)	(0.83)	(3.32)	(4.37)	(0.19)
Export Subsidy	0.12***	0.27***	0.62***	2.94	0.12***
	(0.02)	(0.08)	(0.20)	(2.14)	(0.02)
Export Promotion Expenditure	1.33***	1.22	5.86**	0.08	1.50***
	(0.17)	(0.89)	(2.77)	(3.36)	(0.17)
Export Revenue Ratio	-1.25***	-5.29**	-4.06*	-0.38	-0.54*
	(0.31)	(2.08)	(2.11)	(2.17)	(0.30)
Value Added Ratio	0.39***	0.95***	0.57**	0.11	0.74***
	(0.05)	(0.27)	(0.28)	(0.20)	(0.05)
Capital Depreciation Ratio	0.14***	1.20*	1.33	-0.18	0.23***
	(0.05)	(0.72)	(0.87)	(0.49)	(0.05)
Region FE	Yes	Yes	Yes	Yes	Yes
Size FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.370	0.449	0.302	0.556	0.412
No. of observations	3,242	121	127	130	2,864

Notes: Standard errors are in parentheses. Foreign technical assistance, export subsidy and export promotion are measured in 10^{10} pesos. ***: Significant at or less than 1%; **: Significant at or less than 5%; *: Significant at or less than 10%.

Columns (ii)–(iv) report test results based on the plants that exhibit asset innovation; column (v) reports on plants lacking any innovation. Most of the sampled plants exhibit no innovation effort. Only 378 of 3,242 (11.7 percent) exporters have made innovation efforts vis-à-vis their capital assets; among them, the learning effect is significant only among the plants with the highest levels of innovation. For a plant with an aggregate innovation investment exceeding CLP100 million, a 1 percent increase in export ratio significantly increases its productivity (i.e.,

by 5 percent). A higher export ratio can significantly improve a plant's productivity; in such cases, the learning effect substantially holds. Besides the export ratio, each of higher export subsidy, value-added, and the capital depreciation rate can increase productivity. Rising export revenue still lowers productivity.

For the plants in column (iii) with innovation investments of CLP15–100 million, the learning coefficient is lower, and no longer significant. Nonetheless, other exporting-related activities (i.e., higher foreign capital ratio, higher value-added ratio, and higher export subsidies and expenditures) all enhance productivity in a very significant manner. The export revenue ratio continues to affect productivity negatively. For the plants in column (iv) with aggregate innovation investments lower than CLP15 million, the learning-by-exporting hypothesis does not hold, either; the learning coefficient is insignificant, but even smaller. Except foreign technical assistance, none of the exporting activities and business characteristics influences productivity anymore.

Meanwhile, for the non-innovating exporters in column (v), the learning coefficient is still small and insignificant. This remains as evidence that runs counter to the learning-by-exporting hypothesis. The learning effect cannot be detected among the non-innovating exporters; however, their exporting activities and business characteristics all regain significance. Higher foreign capital and technical assistance effectively increase productivity; so do export subsidies and expenditures. As previously found in columns (i)–(iii), the export revenue ratio is still found to reduce productivity.

In summary, the learning-by-exporting effect exists only when plants exhibit sufficient innovation effort. On one hand, for manufacturing plants with innovation investments exceeding CLP15 million, more exports can effectively increase their productivity; this finding is consistent with that positive evidence for the learning-by-exporting theory. For example, based on micro-level data from Indonesia (Amiti and Konings, 2007), Canada (Baldwin and Gu, 2004), the United Kingdom (Girma *et al.* 2003 and 2004), and Slovenia (De Loecker, 2007 and 2013), it has been found that firms experience significant productivity growth upon participating in the export market.

On the other hand, a higher export ratio cannot significantly improve the productivity of a plant whose innovation investment is lower than CLP15 million. This finding is consistent with evidence that runs counter to the learning-by-exporting theory. For example, Clerides *et al.* (1998) and Greenaway *et al.* (2005) each found there to be no production difference among firms' export-market entrants. Therefore, we cannot simply argue that the learning-by-exporting theory itself is right or wrong; there are explanations as to why divergent results exist. Thus far, the current study has already shown that innovation investment is an effective way of reconciling evidence that supports the theory with that which disputes it.

B. Exporting Experience and the Learning-by-Exporting Hypothesis

Next, I examine the learning-by-exporting effect from the second perspective: exporting experience. Let us see how exporters' levels of productivity differ, given their divergent lengths of exporting experience period.

I follow the definition of "exporting experience" described in Section II.B. For example, an exporter in 2007 that has four years of exporting experience had positive exports from 2004 to 2007, but did not export in 2003; a firm with three years of exporting experience had positive exports from 2005 to 2007, but did not export in 2004. Having five to seven years of exporting experience means that the plant has been continuously exporting for at least five years. Figure 1

shows how exporting experience corresponds to the plants' expected productivity, which is based on estimations of their average productivity levels. I examine the plants in 2007, and study their expected productivity levels year by year. The vertical axis refers to the estimated expected productivity, while the horizontal axis refers to the time. I call those plants that have never exported "zero-year exporters."

Figure 1: Exporting Experience and Expected Productivity: Plants in 2007
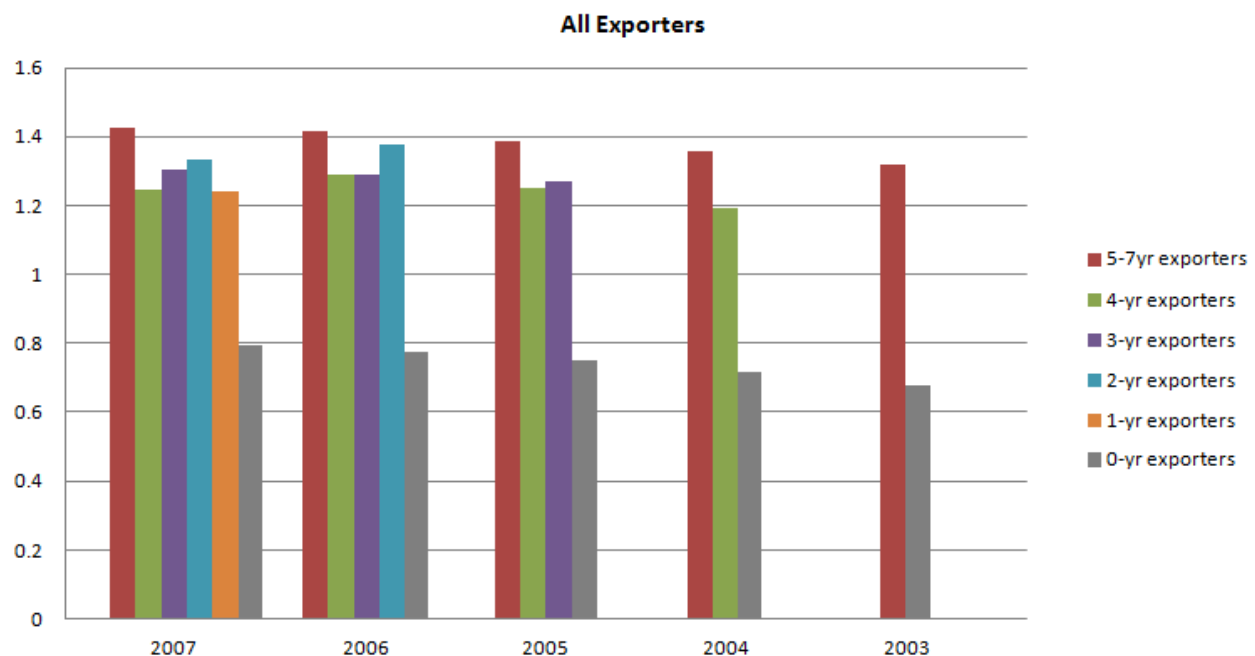
Each bar in Figure 1 represents the expected productivity of plants that have attained a certain length of exporting experience. For example, red bars represent the expected productivity of exporters with five to seven years of consecutive exporting experience; that labeled "2007" is the expected productivity in 2007. The red bar labeled "2006" is the expected productivity of these exporters in the previous year (2006), and that labeled "2005" is their expected productivity two years previous (2005). The green bars represent the expected productivity of exporters with four years of exporting experience, across various years; the purple bars represent exporters with three years of experience; and blue and yellow bars are exporters with two and one year of experience, respectively. The gray bars indicate the expected productivity of those plants that never exported (i.e., "zero-year exporters") between 2001 and 2007.

First, let us compare expected levels of productivity across exporters that have the same length of exporting experience, but in different years. Except for the exporters with four and two years of experience, all plants—even those with no exports between 2001 and 2007—saw increases in expected productivity year by year. Thus, exporting behavior alone cannot explain productivity growth; exports may improve productivity to a certain extent, but they do not fully decide growth trends vis-à-vis productivity.

Let us then compare exporters within the same year, but with different consecutive levels of exporting experience: as the exporting experience increases, the expected productivity does not always increase. As expected, the plants that exported every year between 2001 and 2007 show

the highest productivity levels. Unsurprisingly, the plants that never exported always show the lowest productivity levels. However, in 2007 and 2006, the plants with two years of exporting experience witnessed the second-highest level of productivity—even higher than that of plants with three and four years of experience. Among all the observed exporters in 2007, the strength of correlation between expected productivity and exporting experience is very ambiguous.

B.1. Exporting Experience, Learning-by-Exporting Effect, and Innovation

Based on the plants' asset innovation investment, I divide the plants observed in 2007 into four groups, in terms of their level of innovation investment: group 1 had the highest investment level (>CLP100 million), group 2 had medium investment (CLP15–100 million), and group 3 had the lowest investment level (<CLP15 million). Group 4 includes all the non-innovating exporters. In each of these groups, let us look again at the relationship between the plants' exporting experience and their expected productivity.

Figures 2 and 3 show how exporting experience influences productivity within each of the various innovation groups. First, let us look at Figure 2. In the high innovation investment group (group 1; >CLP100 million), if we compare vertically within each group across different periods, we find that expected productivity always increases year after year. If we compare horizontally within each year, the plants with five-to-seven years of exporting experience have the highest expected productivity; those with four years of experience have the second-highest expected productivity; those with three years of experience have the third-highest productivity, and so on. The less experience an exporter has, the lower its expected productivity will be; as such, the plants that have never exported have the lowest expected productivity. Therefore, among plants showing the highest level of innovation investment, the learning-by-exporting hypothesis is found to hold significantly. In other words, a longer period of exporting experience leads to higher expected productivity. Higher productivity levels can be rightfully expected among more experienced exporters that each invest more than CLP100 million in asset innovation.

Figure 2: Exporting Experience and Expected Productivity in Different Innovation Groups – Plants in 2007
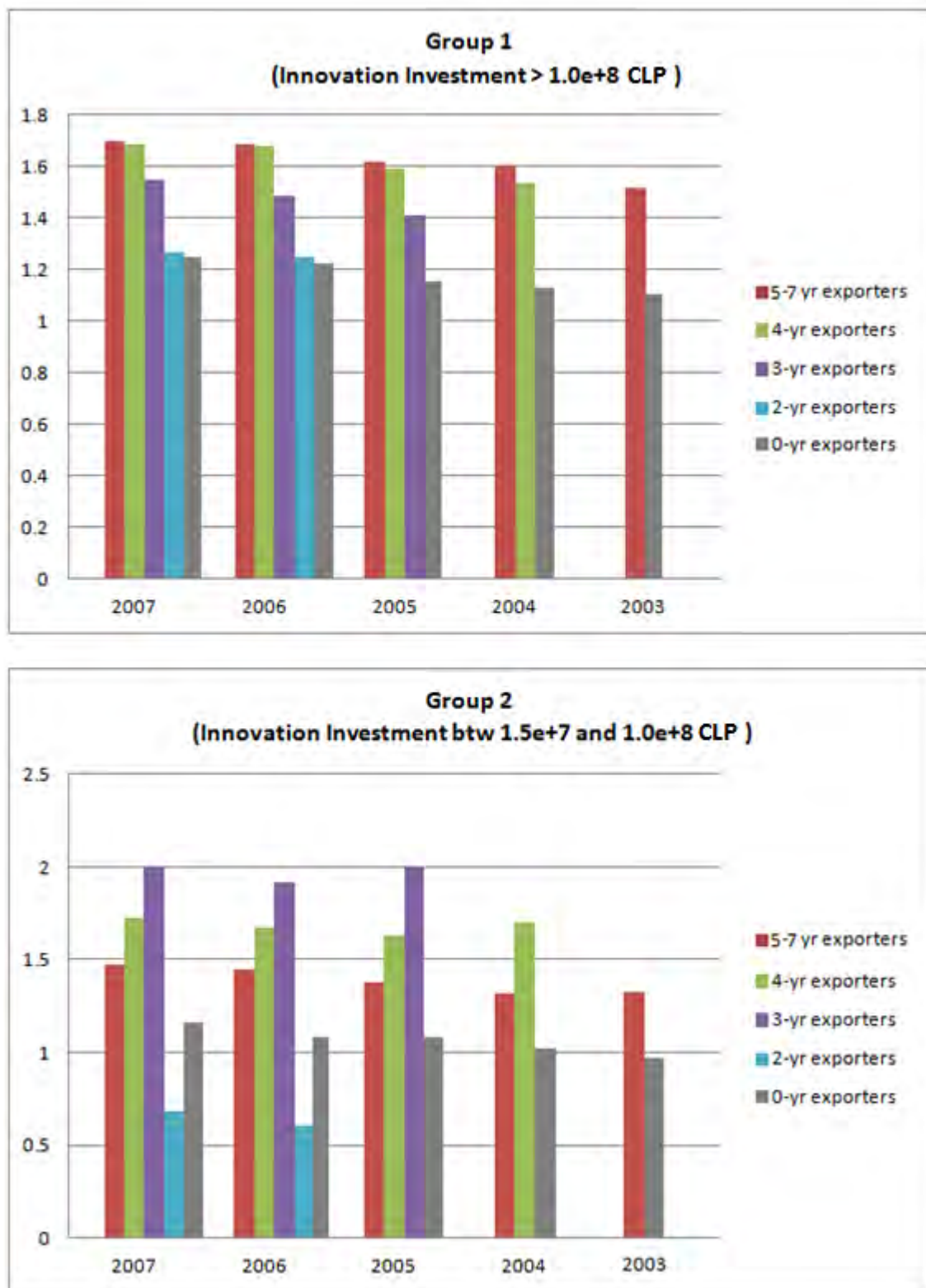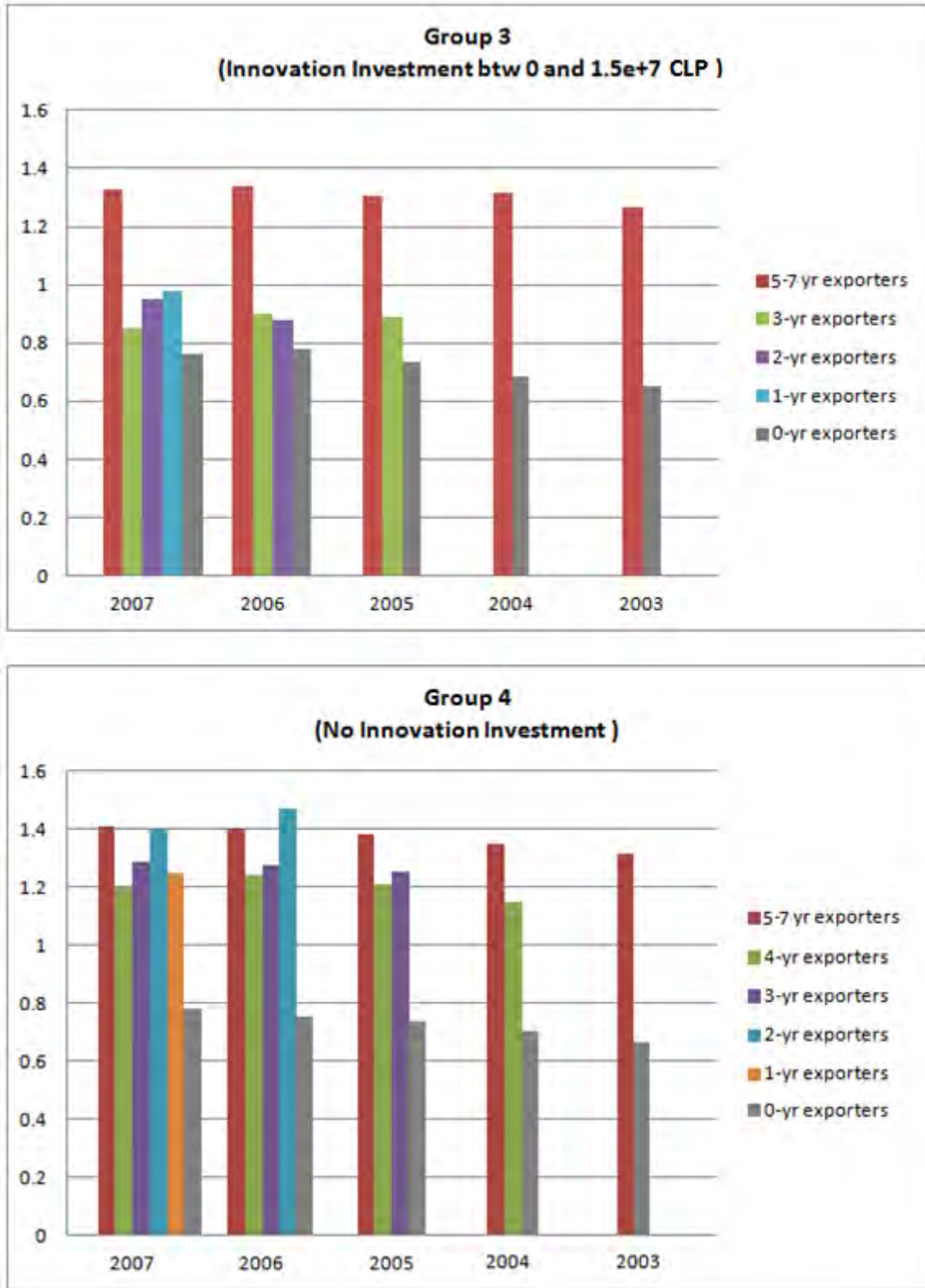
**Figure 3: Exporting Experience and Expected Productivity in Different Innovation Groups
– Plants in 2007: Continues**

However, in group 2, this positive correlation between exporting experience and productivity is dramatically violated: a longer period of exporting experience no longer equates with higher productivity. For example, in 2007, exporters with only two years of exporting experience have the lowest expected productivity—much lower, even, than that of non-exporters with seven years of non-exporting experience. Additionally, exporters with three years of exporting experience have the highest expected productivity. Thus, the learning effect does not exist for the exporters that make a lower innovation investment (CLP15–100 million). Clearly, more exporting experience does not necessarily translate into a higher productivity level.

Figure 3 shows the results of the exporters with the lowest (<CLP15 million) investment levels and of those with no innovation investment. In group 3, the learning-by-exporting hypothesis is strongly violated in 2007. Although the plants with five to seven years of exporting experience have the highest expected productivity, and those that have never exported have the lowest, the second-highest expected productivity is observed among exporters with only one year of exporting experience. The expected productivity of non-exporters with seven years of experience remains the lowest for each year. As for group 4—which comprises plants that showed no asset innovation effort—the strength of the correlation between exporting experience and expected productivity is again ambiguous. In 2007 and 2006, the plants with only two years of experience have the highest productivity—higher even than that of those with the longest period of exporting experience. Thus, the learning effect does not exist for groups 3 and 4, which comprise plants that each spent less than CLP15 million in asset innovation.

IV. Discussion

Although this paper addresses the learning-by-exporting effect by using two different methods—namely, one that uses the export ratio, and another that uses exporting experience—the conclusion is consistent. If I do not consider the potential influence of manufacturing plants' levels of asset innovation investment, but rather target all the observed Chilean exporting plants from 2001 to 2007, the learning effect is found to give rise to inconsistent results. The export ratio significantly increases the plants' productivity, but a longer period of exporting experience does not necessarily result in higher expected productivity.

However, once I divide the plants into groups according to their total innovation investment, interesting and consistent findings are revealed. A significant learning-by-exporting effect can be detected only among plants that invest a sufficiently high amount in asset innovation. Specifically, among Chilean manufacturing plants that each spend more than CLP100 million in asset innovation investment, more exports and a longer period of exporting experience can be expected to effectively increase productivity—otherwise, a plant with lower innovation investment cannot improve its productivity through intensive exporting behavior. My conclusion aligns with the findings of Hallward-Driemeier *et al.* (2002), Bustos (2011), Aw *et al.* (2008), and Costantini and Melitz (2007). Innovation investment is indeed an important decision for plants to make in an open economy, especially when they are deciding to augment productivity by undertaking more intensive exporting activities.

Naturally, the current study has limitations and bias. For example, the sample includes only the manufacturing plants that continuously operated from 2001 to 2007; the use of this inclusion criterion stems from my need to estimate the plants' productivity levels and study their continuous exporting behavior. The selected sample, furthermore, does not represent the entire Chilean economy,

and I have little to say about the learning-by-exporting effect on plants that operate sporadically or inconsistently.

V. Conclusion

This study examined the learning-by-exporting hypothesis and whether it holds among Chilean manufacturing plants. It interprets the learning effect from two perspectives. First, with respect to the export ratio, it examined the effect of a plant's exports on its total production. Second, it examined exporting experience—namely, the number of years that a plant maintains an exporter status. I used data captured through the ENIA, an annual industrial survey on Chilean manufacturing plants from 2001 to 2007.

I studied how innovation alters the learning effect. I found that a Chilean plant's exporting behavior can significantly and consistently improve its productivity, but only if it is spending more than CLP100 million in asset innovation. There is a solid, economics-based rationale behind this conclusion: the more an exporting plant innovates, the more its effort will be repaid in terms of improved technology or increased efficiency. As a plant improves its production efficiency, it becomes better able to effectively learn from exporting—and, as a result, its production will increase more quickly than that of exporters with low innovation investment.

This study reconciles both negative and positive evidence of the learning-by-exporting hypothesis, and ultimately concludes that differential investment in innovation gives rise to these mixed findings. Therefore, while it remains a controversial topic, the learning-by-exporting hypothesis is neither absolutely right, nor absolutely wrong. In the real world, we need to consider other specific, micro-level details—for example, innovation behavior—before we can decide the likelihood of the existence of the learning effect.

References

Alvarez, Roberto, and Ricardo A. López. 2005. "Exporting and Performance: Evidence from Chilean Plants." *Canadian Journal of Economics*, 38(4): 1384-1400.

Amiti, Mary, and Jozef Konings. 2007. "Trade Liberalization, Intermediate Inputs, and Productivity: Evidence from Indonesia." *American Economic Review*, 97(5): 1611-38.

Aw, Bee Yan, Mark J. R.oberts, and Daniel Yi Xu. 2008. "R&D Investments, Exporting, and the Evolution of Firm Productivity." *American Economic Review*, 98(2): 451-56.

Baldwin, John, and Wulong Gu. 2004. "Export-Market Participation and Productivity Performance in Canadian Manufacturing." *Canadian Journal of Economics*, 36(3): 634-57.

Ben-David, Dan. 1993. "Equalizing Exchange: Trade Liberalization and Income Convergence." *The Quarterly Journal of Economics*, 108(3), 653-79.

Blalock, Garrick, and Paul Gertler. 2004. "Learning from Exporting Revisited in a Less Developed Setting." *Journal of Development Economics*, 75(2): 397-416.

Bustos, Paula. 2011. "Trade Liberalization, Exports, and Technology Upgrading: Evidence on the Impact of MERCOSUR on Argentinean Firms." *American Economic Review*, 101(1): 304-40.

Clerides, Sofronis K., Saul Lach, and James R. Tybout. 1998. "Is Learning by Exporting Important? Micro-Dynamic Evidence from Colombia, Mexico, and Morocco." *The Quarterly Journal of Economics*, 113(3): 903-47.

Costantini, James A., and Marc Melitz. 2007. "The Dynamics of Firm-Level Adjustment to Trade Liberalization." In *The Organization of Firms in a Global Economy*, ed. Elhanan Helpman, Dalia Marin, and Thierry Verdier, 107-41. Cambridge, MA: Harvard University Press.

De Loecker, Jan. 2007. "Do Exports Generate Higher Productivity? Evidence from Slovenia." *Journal of International Economics*, 73(1): 69-98.

De Loecker, Jan. 2013. "Detecting Learning by Exporting." *American Economic Journal: Microeconomics*, 5(3): 1-21.

Girma, Sourafel, David Greenaway, and Richard Kneller. 2003. "Export Market Exit and Performance Dynamics: A Causality Analysis of Matched Firms." *Economics Letters*, 80(2): 181-87.

Girma, Sourafel, David Greenaway, and Richard Kneller. 2004. "Does Exporting Increase Productivity? A Microeconometric Analysis of Matched Firms." *Review of International Economics*, 12(5): 855-66.

Greenaway, David, Joakim Gullstrand, and Richard Kneller. 2005. "Exporting May Not Always Boost Firm Productivity." *Review of World Economics*, 141(4): 561-82.

Hallward-Driemeier, Mary, Giuseppe Iarossi, and Kenneth Sokoloff. 2002. "Exports and Manufacturing Productivity in East Asia: A Comparative Analysis with Firm-Level Data." National Bureau of Economic Research Working Paper No. w8894.

Manjón, Miguel, Juan Máñez, María Rochina-Barrachina, and Juan Sanchis-Llopis. 2013. "Reconsidering Learning by Exporting." *Review of World Economics*, 149(1): 5-22.

Marin, Dalia. 1992. "Is the Export-Led Growth Hypothesis Valid for Industrialized Countries?" *The Review of Economics and Statistics*, 74(4): 678-88.

Olley, G. Steven, and Ariel Pakes. 1996. "The Dynamics of Productivity in the Telecommunications Equipment Industry." *Econometrica*, 64(6): 1263-97.

Pavcnik, Nina. 2002. "Trade Liberalization, Exit, and Productivity Improvements: Evidence from Chilean Plants." *The Review of Economic Studies*, 69(1): 245-76.

Wagner, Joachim. 2007. "Exports and Productivity: a Survey of the Evidence from Firm-Level Data." *The World Economy*, 30(1): 60-82.

Banking and Monetary Crises: Impacts on Exports of MENA Countries

By Mohamed Ben Abdallah and Zouheir Bouchaddakh[*]

In this paper we try to contribute to the limited literature treating the impact of financial crises on exports. In addition to exports of goods we emphasize on exports of services. We quantify both the level and duration of exports collapse due to monetary and banking crises. Estimating a gravitational model of unilateral trade for the MENA countries over the period 1970-2011, we find that after currency and banking crises in the partner countries, exports of MENA countries decreased significantly. However, exports of services of MENA countries are not as adversely affected by financial crises.

Keywords: Trade, Gravity Models, Monetary Crisis, Banking Crisis, MENA Region

JEL Classification: F10, G01

I. Introduction

Away from the empirical debate on the direction of causality in the relationship between finance and growth, it is widely acknowledged that a good performance of the financial system is favorable for economic development. Indeed, a developed financial system allows for an improvement in the effectiveness of the capital allocation within the economy, which consequently improves investment, growth and economic development. The financial crises indirectly confirm the utility of the financial system since their occurrence produces a disorganization in the financial systems, which often leads to strong recessions, economic crises and social conflicts.

With globalization, the perverse effects of the financial crises have exacerbated. Because of financial globalization, crises propagate more quickly. In addition, the increasing openness of the economies has contributed to the amplification of the real effects of the financial crises. Thus, most financial crises turned into real recessions with a deceleration of economic growth and higher unemployment rates. However, the most outstanding fact is that the financial crises were accompanied by a collapse of exports. For example, in the 2008 financial crisis, real world exports dropped by 17 percent while GDP fell by 5 percent (Amiti and Weinstein, 2011).Thus, exports fell sharply and out of proportion with the fall in demand. The latter is insufficient to explain the decline in exports. Eaton *et al.* (2011) find that for China and Japan, which account for 15 percent of world exports, demand shocks only explained 8 to 23 percent of the remarkable declines in their export to GDP ratios.

The reason is that, beyond the fall in demand, financial crises are associated with the intensification of financing difficulties and shortages of liquidity. Recent literature about financial

---

[*]Zouheir Bouchaddakh: FSEG Nabeul, University of Carthage. E-mail: z.bouchaddakh@fsegt.rnu.tn. Phone: (00216) 98208768. Fax: (00216) 72232318. Mohamed Ben Abdallah: FSEG Tunis, University of El Manar. E-mail: mohamed.benabdallah@fsegt.rnu.tn. Phone: (00216) 96878332.

crises shows that negative export performance can be attributed to financial constraints. For example, Amiti and Weinstein (2011) believe that one-third of the 1993 Japanese export collapse is attributed to financial constraints.

In this paper we look at the impacts of financial crises on the exports of goods and the exports of services in the case of MENA countries.[1] We try to quantify both the level and duration of exports collapse due to monetary and banking crises. By doing this, we hope to contribute to the limited literature on the subject. According to the authors' knowledge, this paper is the first to explore this issue with regards to MENA countries and aspires to distinguish between trade of goods and trade of services in that respect.

The rest of the paper is organized as follows. Section II focuses on the role of financing constraints in the relation between trade and financial crises. Section III studies the impact of banking, monetary and twin crises on exports. Section IV presents some stylized facts concerning the frequency of financial crises and the nature of exports in the MENA region. Section V provides the empirical analysis of the impact of financial crises on exports of goods and services in MENA countries. Section VI concludes.

II. Financial Crises and Trade: The Role of Financing Constraints

The link between trade and finance is obvious. First, most of financial crises were marked by the sharp drop in international trade. Second, global imbalances, and particularly commercial imbalances, are believed to be the origin of most financial crises (Obstfeld and Rogoff, 2009; Portes, 2009). Even if this point fails to gain unanimous support, it is widely accepted that international trade is one of the channels through which financial crises have a "contagious effect". Thus, several authors show that intensified trade relations contribute to the explanation of the propagation of financial crises (Eichengreen and Rose, 1999; Glick and Rose, 1999; Kaminsky and Reinhart, 2000; Forbes, 2001; Forbes and Rigobon, 2002; Caramazza *et al.*, 2004; Frankel and Cavallo, 2004).

While the focus of several preceding studies was on whether trade linkages play a role in transmitting crises across countries, few studies were interested in the inverse relationship that concerns the effect of the financial crises on the international trade. The first studies on this subject emphasized the role of financial constraints in the export behavior of firms. Some authors believe that by signaling[2] and diversification[3] effects, exporting companies should have a comparative advantage in overcoming financial constraints. This conclusion was disputed by a large number of authors (Amiti and Weinstein, 2011; Bellone *et al.*, 2011; Bernard and Jensen, 1999 and 2004; Chaney, 2005; Manova, 2008). It is clear from their work on the relationship between exports and financial constraints that the direction of causality could be reversed from what is expected under the signaling and diversification effects. Indeed, exporting firms are more sensitive to financial constraints. The conquest of exterior markets implies specific fixed costs and some firms are limited in their capacity to finance these costs. Thus, "in the presence of fixed costs associated with exporting and liquidity constraints, some firms could profitably export, but they are prevented from doing so

---

[1]Algeria, Bahrain, Djibouti, Egypt, Iran, Irak, Israel, Jordan, Kuwait, Lebanon, Libya, Malta, Mauritania, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, United Arab Emirates, Yemen.

[2]In the presence of asymmetry of information, the fact of exporting could be interpreted by the investors as a signal of company's efficiency. Thus, firms that come to export can profit from a better notation and a lower cost of borrowing. (Ganesh-Kumar *et al.*, 2001).

[3]Exporting to different markets decreases dependency on demand resulting from domestic market. By selling their products to markets whose business cycles are not very correlated, companies will be less exposed to demand shocks (Campa and Shaver, 2002).

because they cannot gather sufficient liquidity. Only those firms that are not liquidity constrained are able to export."[4] Amiti and Weinstein (2011) argue that due to longer transportation delays (especially maritime), exporting firms are more sensitive to financial constraints. More lengthened deadlines for payments and a higher risk of defect increase the requirements in working capital and, thus, the dependence of the exporting firms with respect to the bank-based financing.

Sensitivity to financial constraints makes exporting firms more vulnerable to financial shocks. Thus, it is the tightening of financial constraints following the financial crisis that explains the sharp and disproportionate[5] drop of exports. This tightening of financial constraints is more supported in the case of a financial crisis taking the form of a banking crisis.

III. Impact of Different Types of Crises on Exports

For some economists, a financial crisis takes real importance only when it shakes the payments system and blocks the operations of the financial intermediaries. In other words, a financial crisis becomes problematic and constitutes a real threat when it takes the form of a banking crisis, monetary crisis, or both (twin crisis). Thus, the impact of the financial crises on exports can be studied according to the different types of crises.

A. Impact of Banking Crises

The recent literature relating negative export performance to financial constraints considers that a financial crisis is essentially a banking crisis.

A banking crisis is marked by the deterioration of the quality of assets held by banks. The financial position of banks is difficult due to the deterioration of the portfolio's value and increased non-performing loans. Banks are unable to pay all creditors because of difficulties in liquidating investments.

Theoretically, a bank is considered insolvent when it is unable to meet all its commitments. The insolvency of a bank may involve bankruptcy. This happens when bad news on the state of the banking assets lead to the phenomenon of massive withdrawals of deposits.[6] A bank's bankruptcy can cause a domino effect in all the other banks and then the bank run is transformed into a banking panic.

In the case where a financial crisis turns into a banking crisis, the exports' collapse is caused by two channels. The first is a credit channel where the struck banking sector reduces lending due to a negative liquidity shock (Bernanke, 1983; Chang and Velasco, 2001; Yousefi, 2011).The second is a balance channel where the financial crisis weakens the valuations of the companies and decreases their net worth. Bernanke and Gertler (1989) highlight the dynamic effects of the financial accelerator mechanism. In the presence of information asymmetries, the net worth of borrowers plays a central role in the dynamics of investment. The authors show that shocks to the net worth of firms contribute to amplifying the fluctuations by changes in the conditions of access to finance.

In short, firms cannot export either because they are insolvent (balance channel) or because they cannot borrow as banks tighten lending conditions due to a credit crunch (credit channel).

Most empirical studies dealing with the relationship between banking crises and trade consider systemic crises. Ma and Cheng (2005) used a sample of 52 countries over the period1981-1998.They

---

[4]Chaney (2005, p. 3).
[5]Compared to the fall in GDP.
[6]Random withdrawal theory (Diamond and Dybvig, 1983).

found that imports and exports decline significantly two years after the occurrence of banking crises. Berman and Martin (2012) studied the effects of the 2008 financial crisis (banking crisis in particular) on trade when the crisis occurs in a partner country. The authors found that exports of sub-Saharan Africa fell following the financial and banking crisis of 2007-2008. The authors concluded that the low financial development in Africa does not protect its countries' economies against financial crises. Similar to the two previous studies, Abiad *et al.* (2011) use a gravity model to study the effects of banking crises on trade. The authors find that—over the period 1970-2009 and for a large sample of countries (153)—trade is negatively affected by financial crises (banking and currency crises). Amiti and Weinstein (2011) take the case of Japan between 1990 and 2010 to show that financial shocks, in the form of bank fragility, affect exports much more than they affect local sales. The authors establish the link between exporting firms and institutions that fund them. Thus, the fall in exports is explained by the high sensitivity of exporting firms to the financial fragility of banks.

B. Impact of Monetary Crises

The financial crisis may be associated with a currency crisis but not automatically. A country with a closed economy may face a financial crisis without experiencing a crisis in the balance of payments due to the absence of foreign exchange transactions. However, within a global economy that is commercially and financially integrated, currency crises have become more frequent. A country may be affected by a currency crisis due to imbalance in its balance of payments or simply by contagion. Crises can spread to several countries due to growing financial interdependence. A monetary crisis generally appears after speculative attacks on the domestic currency, which causes a run to sell that currency. This leads to a loss in official foreign exchange reserves, an increase in interest rates and, generally, to a devaluation of the domestic currency. In doing so, the crisis may weaken demand and aggregate supply, particularly by raising the cost of imports, investment and external debt services. The depreciation of the currency and the temporary increase in interest rates may force firms into bankruptcy (Ben Abdallah and Diallo, 2004).

In traditional models, the impact of the currency crisis on exports passes through the variation of the exchange rate. It is a competitiveness effect induced by the devaluation of the real exchange rate. The change in relative prices should theoretically increase exports. However, empirical studies on this subject fail to detect such a positive effect. Thus, contrary to the expectations of theoretical models, the recent currency crises in emerging markets, accompanied by devaluations of the real exchange rate, have often been followed by a decline or stagnation in exports. Such was the case of South-East Asian countries after the 1997-1998 crisis. Despite devaluation in the real exchange rate of approximately 60 percent, Asian exports moved in the opposite direction of the competitiveness effect (Berman, 2009). The same phenomenon was observed in the case of some Latin American countries (Brazil in 1999, and Argentina and Uruguay in 2002).

Berman (2009) explains these results by the existence of an effect of "destruction" that goes against the competitive effect. Accompanied by an increase in interest rates, the currency crisis has a financial aspect. It exerts a balance effect that threatens the solvency of some firms. The expected result is negative and leads to the decrease in the number of exporting firms. This decrease in the number of exporting firms was detected by Blalock and Roy (2007) in the case of Indonesia after the Asian crisis of 1997-1998. Some firms that exported before the crisis left the export market despite a favorable exchange rate.

In sum, the full effect of currency crises on exports depends on the relative importance of the effects of competitiveness and destruction. It depends on the country's specialization and degree of financial market imperfections (Berman, 2009).

Under certain conditions, a currency crisis may cause a banking crisis and vice versa. The coincidence of these two crises gives rise to a twin crisis.

C. Impact of Twin Crises

For Kaminsky and Reinhart (1999), the twin crises are a particularly important feature of the contemporary international financial integration. The link between monetary and banking crises was absent in the early 1970s but became obvious since the 1980s. Its main cause is the financial liberalization in several countries. Financial crises are increasingly crises of illiquidity in the sense that banks or monetary authorities are unable to meet their commitments in terms of internal (for the banks) or external (for the authorities defending a fixed parity) convertibility of the currency. On one side, banks are short for liquidity due to massive withdrawals of deposits. On the other side, the authorities face a loss of foreign exchange reserves. Kaminsky and Reinhart (1999) established that the difficulties of the banking sector generally precede the monetary crisis which further exacerbates the banking crisis giving rise to a vicious circle. However, the causal relationship between the two crises is not unidirectional.

Thus, balance of payments problems (Stoker, 1995) or a devaluation of the currency (Mishkin, 1997) may cause problems for the banking sector and transform a currency crisis in a banking crisis.

A priori, the impact of the twin crises on exports of a country is a result of the impact of both crises. In reality, the effects are much more important. The reason is that in case of the coincidence of the two types of crises, each one feeds the other and they both draw the economy into a negative vicious circle. Thus, financial sector problems undermine the currency. Devaluations, in turn, aggravate the existing banking sector problems and create new ones. These adverse feedback mechanisms are in line with those suggested by Mishkin (1997) and can be amplified, as in several of the recent Asian crises, by banks' inadequate hedging of foreign exchange risk. The presence of vicious circles would imply that the twin crisis is more severe than a currency or a banking crisis that occurs in isolation (Kaminsky and Reinhart (1999, p. 479).

Thus, in the case of a twin crisis, the impact on the real economy can be more devastating than the combined negative effects of currency and banking crises. Bordo *et al.* (2001) find that a twin crisis is more persistent in time and costs more than double the cost of a financial crisis (banking or monetary).

IV. Financial Crises and Exports in the MENA Region: Some Stylized Facts

Before studying, econometrically, the impact of financial crises on exports of goods and services in the MENA region, we present some stylized facts. We first describe the nature of exports of the MENA countries, and then we identify the financial crises in these countries. Finally, we present the behavior of exports of goods and services around the dates of the various types of crises.

A. Nature of Exports of MENA Countries

As previously reported, the effects of financial crises (especially monetary) depend on the country's specialization amongst other things. A high concentration of trade in commodities increases vulnerability. In this sense, Berman and Martin (2012) reported a strong dependence of sub-Saharan African countries on primary products. This has contributed to the severe impacts of the financial crisis on exports from these countries to the United States. Similarly, Abiad *et al.* (2011) find that the decline in exports consecutive to financial crises is more persistent for primary products.

However, knowledge of the nature of exports is important before considering the vulnerability of exports to financial crises. Table 1 shows the characteristics of MENA exports compared to other regions and the global average.

The composition of exports from the MENA region has not changed significantly since the 1960s reflecting a low mutation of productive structures of the economies of the region. The value of primary product exports (mining products and agricultural products) has represented more than three-quarters of MENA region's total value of exports during the 1990s and 2000s. It thus appears that countries of the MENA region are rather specialized in exporting primary products. We note, however, a tendency for some countries in the MENA region to specialize in exports of manufactured goods (Malta and Tunisia).

Table 1: Nature of Exports of Goods and Services (Percentage), Period Averages

	Share of manufactured products in exports of goods		Share of services in total exports		Share of travel services in exports of services		Share of transport services in exports of services	
	1990-	2000-	1990-	2000-	1990-	2000-	1990-	2000-
East Asia and Pacific	83.5	83.4	15.6	15.3	28.4	24.7	28.5	29.5
Europe and Central Asia	77.9	74.7	21.8	22.9	31.2	25.6	26.3	23.2
Latin America and Caribbean	51.6	54.4	14.2	11.2	53.4	55.9	23.5	17.8
MENA	24.9	19.4	19.8	16.5	-	35.1	-	25.4
North America	74.2	71.9	24.2	25.0	36.1	28.6	22.0	15.4
South Asia	76.0	73.2	20.7	29.0	29.0	15.6	28.7	21.0
Sub-Saharan Africa	29.0	31.4	15.3	13.7	33.8	43.0	25.3	25.4
World	75.0	72.7	20.3	20.3	33.1	28.2	26.3	23.3
Some countries in the MENA region								
Algeria	3.2	2.0	3.4	4.9	17.9	8.2	43.4	28.8
Bahrain	31.7	10.8	13.8	19.0	41.6	43.2	48.1	24.5
Djibouti	10.1	90.7	81.7	83.4	17.5	9.5	63.1	77.7
Egypt	37.4	32.3	64.9	51.0	31.3	46.0	37.2	31.7
Iran	9.4	9.7	4.7	4.6	13.0	36.9	25.8	49.4
Iraq	-	0.2	-	1.9	-	37.6	-	39.8
Jordan	50.6	70.7	52.3	38.5	38.5	63.1	21.7	18.8
Kuwait	10.3	4.4	16.0	11.7	14.3	4.9	81.6	60.4
Lebanon	68.8	69.3	-	78.0	-	53.2	-	3.5

**Table 1: Nature of Exports of Goods and Services (Percentage),
Period Averages: Continues**

|	Share of manufactured products in exports of goods		Share of services in total exports		Share of travel services in exports of services		Share of transport services in exports of services	
	1990-	2000-	1990-	2000-	1990-	2000-	1990-	2000-
Libya	5.1	-	0.7	1.7	17.7	50.2	66.6	31.8
Malta	96.9	91.9	37.9	44.7	63.2	38.4	24.6	18.7
Morocco	55.4	66.2	27.8	40.0	67.4	62.2	17.3	17.4
Saudi Arabia	8.6	8.8	7.1	5.5	-	51.1	-	18.5
Syria	14.0	17.0	29.5	23.7	66.3	76.4	20.4	11.8
Tunisia	76.1	76.2	32.2	27.5	63.1	55.5	25.2	26.9
United Arab Emirates	15.3	3.1	-	-	-	-	-	-
Yemen	0.5	1.2	9.1	8.0	38.4	57.0	22.8	12.3

Source: World Bank, *World Development Indicators*

In the 2000s, the average share of total export earnings derived from exports of commercial services was about 17 percent of overall revenues from exports of goods and services in the MENA region. In several countries of the region, exports of services generally represented more than 50 percent of total exports of goods and services, especially in Djibouti (83.4 percent), Egypt (51 percent), and Lebanon (78 percent). Over the period 2000-2010, among the categories of services exported most were travel services with an average share of 35 percent. The transport service and other commercial services represented 25 percent and 40 percent respectively.

The vulnerability of exports to financial crises also depends on the structure of exports. A strong geographical concentration makes the fall in exports more dramatic in the event of a financial crisis hitting the main trading partner. Contrarily, a portfolio of diversified exports would be less affected by financial shocks. In MENA countries, export structures differ considerably.

B. Frequency of Financial Crises

Figure 1 shows the frequency of crises over the period 1970-2007 in the world, MENA and other regions. Frequency corresponds to the number of episodes of financial crises divided by the number of country-year observation, by region.[7]

---

[7]Episodes of financial crises are extracted from Laeven and Valencia (2008 and 2010).

**Figure 1: Frequency of Crises**
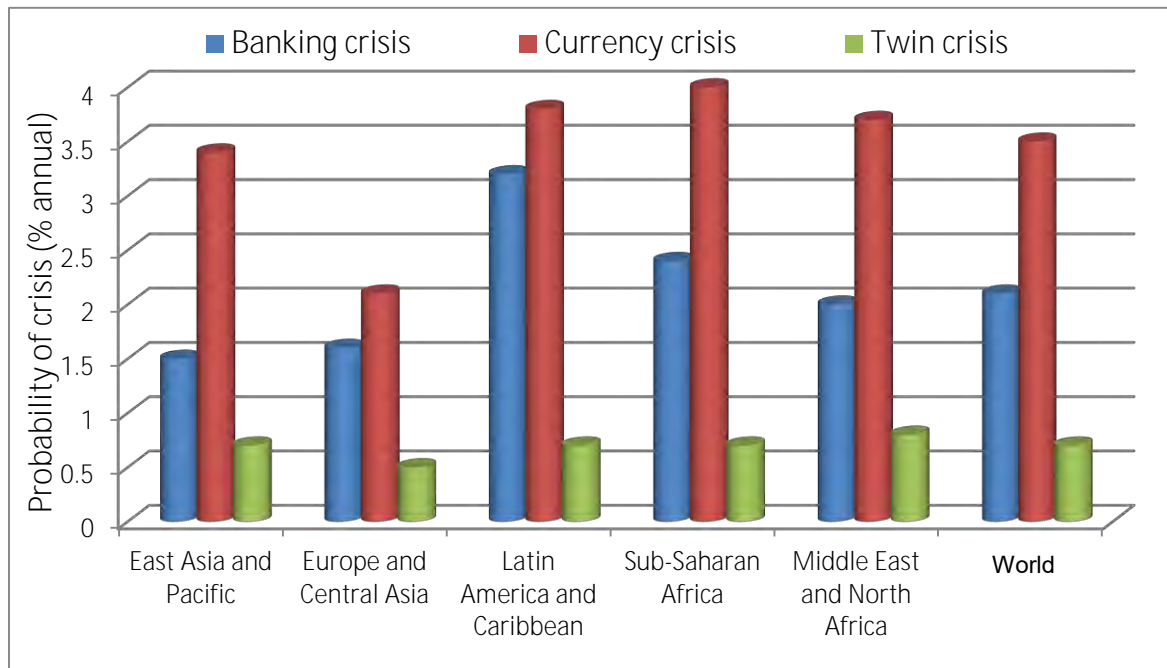
Source: Compiled by the author

The frequency of crises in the MENA region is very close to the global average (3.7 percent and 3.5 percent respectively). For emerging countries, we find that Latin American countries are more likely to experience a currency crisis or a banking crisis than South-East-Asian countries. At the aggregate level, we find that the frequency of a currency crisis is higher than that of a banking crisis. However, the frequency of twin crises is very low and thus it is more difficult to analyze their impact on the evolution of exports.

Given the high frequency of banking and monetary crises both in MENA countries and in the partners of the region (the United States of America and Europe), it is quite natural and logical to examine their economic consequences on the region's exports. As a first step, one can sense the trend by examining the stylized facts concerning the evolution of exports of goods and services during periods of financial crises.

C. Evolution of Exports around the Dates of Crises

In order to proceed with the preliminary statistical analysis of our data, we calculated for our sample of countries in the MENA region and period, the average exports after a crisis. Figure 2 shows the evolution of these averages over a period of 4 years.

Figure 2: Behavior of Exports of Goods after the Date of the Financial Crisis (T)
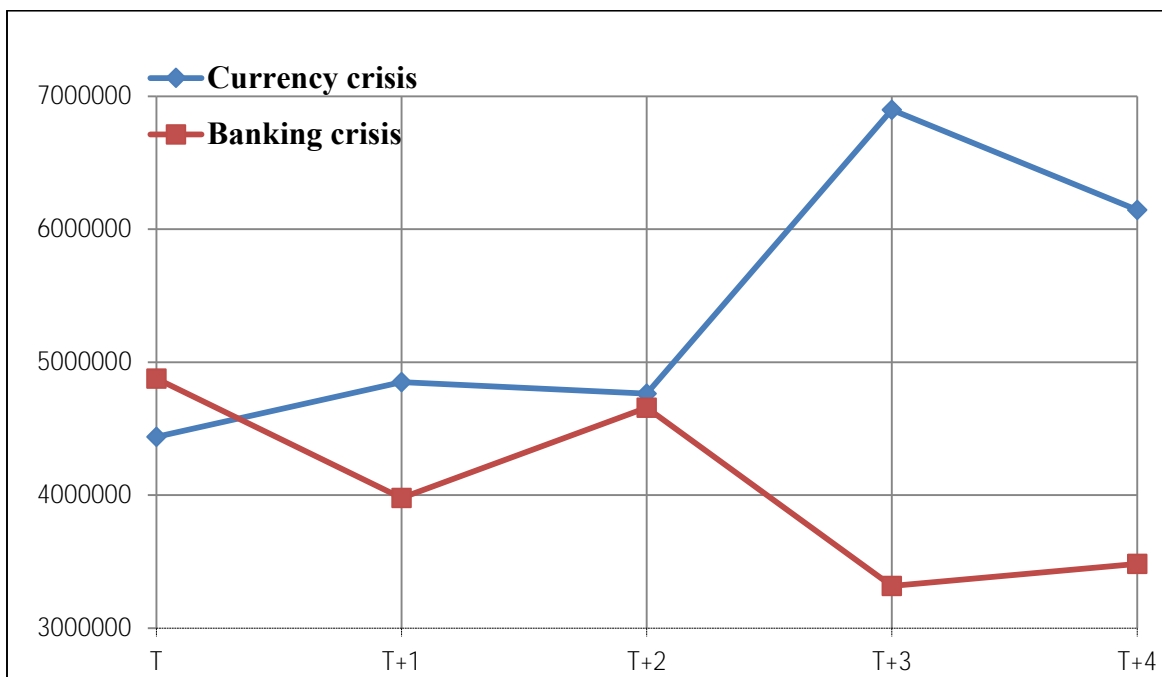
Source: Compiled by the author

It appears that the banking crises are on average followed by a decline in exports. We note that, unlike banking crises, currency crises have a positive impact on exports. It also appears that the twin crises have a positive effect on exports after two years of their occurrence.

However, the stylized facts and the preliminary statistical analyses conducted are not enough to prove whether these contractions in real activity are a result of only the crises or whether they are a result of other factors. The econometric analysis in the next section will allow us—while controlling for the effect of a number of factors that affect growth and investment—to see how crises affect the evolution of exports.

V. Empirical Analysis of the Impact of Financial Crises

The aim of our empirical analysis is to evaluate the occurrence of monetary and banking crises on exports of goods and exports of services in MENA countries for the period 1970-2011. This objective is achieved using an augmented gravity model approach which seems appropriate to study this kind of question.

A. *Methodology and Analysis*

The volume of exports between countries i and j in year t can be characterized by:

$$LnX_{ijt} = \alpha_{ij} + \alpha_t + \sum \alpha_k crise_{i,t-k} + \delta_1 Ln\text{GDP}_{i,t} + \delta_2 LnPopulation_{i,t} +$$
$$\sum \beta_k crise_{j,t-k} + \sigma_1 Ln\text{GDP}_{j,t} + \sigma_2 LnPopulation_{j,t} + \theta' LnZ_{ijt} + \varepsilon_{ijt},$$

$t = 1,…,T,$ (1)

where X_{ijt} is real exports of goods from country i to country j in year t,[8] and $Z_{ijt} = [\; z_{it}z_{jt}... \;]$ is the $1 \times k$ row vector of gravity variables (contiguity, colonial links, common language and distance).

$Crise_{it-k}$ is a dummy variable taking the value of 1 if MENA exporter country i has a financial crisis at year t-k and zero otherwise.

$Crise_{jt-k}$ is a dummy variable taking the value of 1 if the importer country j has a financial crisis at year t-k and zero otherwise.

For these financial crisis variables we consider four lags to test the persistence of the impact of financial crises on exports. We choose four years as the lag variable because the coefficients of crises in the importing and exporting country become statistically insignificant after 4 lags.[9]

The intercept has two parts, one is specific to year t and common to all pairs, α_t, and the second is specific to the country pairs and common to all years, α_{ij}. α_t represents time dummies, which capture factors that affect all countries' trade simultaneously, such as global changes in commodity prices, and α_{ij} controls for all possible time-invariant country-pair characteristics such as distance, common language, common border, etc.[10] The disturbance term ε_{ijt} is assumed to be normally distributed with zero mean and constant variance for all observations. It is also assumed that the disturbances are pair wise uncorrelated. The other variables are defined in Table A.1.

Our sample contains 29,785 bilateral importer*exporter*year observations. We use the unidirectional trade value of 23 exporting MENA countries and 39 partner countries for 42 years. This gives us 881 country pairs. Table A.2 presents summary statistics of the variables used in the empirical analysis.

B. Results

Giving the fact that we have a panel of 42 years, we check the stationarity of the variables considered. We cannot implement the standard tests (Levin-Lin-Chiu, Im-Pesaran-Shin, Hadri LM Stationarity) of stationarity because they require strongly balanced data. Hence, we use Fisher-type unit-root test for panel-data which reveals that, except the GDP in partner country which is weakly stationary, all variables are stationary. So the OLS methodology that we use to estimate gravitational model is valid.

Table 2 presents the coefficients estimated from the augmented gravity model using the specification of equation (1). Since the baseline specification includes importer*exporter fixed effects, the usual gravity time-invariant country-pair controls, such as distance, etc., are not included. We incorporate into the standard gravity model the current and lagged crisis indicators in the partner and exporter countries. Notice that the banking crisis dummy and the currency crisis dummies are introduced separately.

---

[8]To avoid the mirror statistics issue instead of the real exports of goods from country i to country j we use the real imports of goods of country j from country i.

[9]Ma and Cheng (2005) claim that lags in excess of two years would run into an identification problem of whether an observed effect was caused by the current or previous crisis.

[10]The importer-exporter pair dummies also proxy for the multilateral trade resistance effects (Anderson and Van Wincoop, 2003).

Table 2: Exports Following Currency Crises: Pooled Panel
Gravity Estimates. 1970-2011

Dependent variable: log (exports) at level in year t		
	Currency Crises	Banking Crises
Exporter Crisis t	-0.041 [0.062]	0.038 [0.097]
Exporter Crisis t-1	0.041 [0.056]	0.136 [0.093]
Exporter Crisis t-2	-0.092 [0.065]	-0.054 [0.086]
Exporter Crisis t-3	0.006 [0.063]	0.039 [0.088]
Exporter Crisis t-4	-0.036 [0.061]	0.143* [0.080]
Partner Crisis t	-0.260** [0.111]	-0.141*** [0.072]
Partner Crisis t-1	-0.018 [0.103]	-0.235*** [0.068]
Partner Crisis t-2	0.009 [0.092]	-0.164*** [0.064]
Partner Crisis t-3	0.031 [0.095]	-0.007 [0.063]
Partner Crisis t-4	0.028 [0.103]	0.015 [0.076]
Log Exporter GDP	1.810*** [0.109]	1.575 [0.113]
Log Partner GDP	1.640*** [0.110]	1.828 [0.107]
Log Exporter Population	-0.366*** [0.110]	2.014 [0.260]
Log Partner Population	1.973*** [0.262]	-0.381 [0.110]
R-squared	0.810	0.811
Number of Observations	16330	16330
Number of Partner-Exporter Pairs	881	881
Partner-Exporter Dummies	Yes	Yes

Notes: This table shows the estimates from regression Equation (1) in the text. All reported coefficients are from the same regression. The regression includes year and partner-exporter dummies. Robust standard errors clustered at the partner-exporter pair level in parentheses. Significance at the 1. 5 and 10 percent indicated by ***. ** and * respectively.

As expected, the gravity model fits the data well, explaining about 81 percent of the variation of exports. On average, the estimated coefficients of the partner-and exporter-time varying control variables such as GDP and population are plausible and similar to findings in the literature.

The key variables of interest are the partner and exporter crisis dummies and their lags, which capture the effect that a crisis has on a country's partners and exports during its onset and in the following 4 years, after controlling for the standard gravity determinants of trade (some of which are also affected by the crisis).

The first column of Table 2 shows the impact of the exporter and partner currency crises on exports. Only the short-term effects of partner currency crises on exports were negative and significant (i.e., the coefficient of t is significantly positive). There is a small drop in exports in the year of the partner's currency crisis. Exports recover quickly and are back to their predicted level in the year following the crisis. In contrast, the effects of the exporter's currency crisis on exports were insignificant. This result can be explained by the fact that, on average, the MENA countries are specialized in the production of primary goods including commodities which are often priced in foreign currency. Hence, the exchange rate depreciation associated with the crisis does not boost exports to an extent similar to other product categories.[11]

The second column of Table 2 shows the effects of exporter's and partner's banking crises. We find that exports decrease significantly after a partner's banking crisis. Thus, the estimated coefficients on contemporaneous and lagged partner's banking crisis dummies are all negative and statistically significant at the one percent level (except the third lag, which is insignificant). On average, exports fall by 14 percent below the gravity-predicted level in the year of the crisis, and by 20 percent in the following year.

The evolution of exports following an exporter's banking crisis is much more muted. The estimated coefficients on the crisis dummy and its lags in Table 2 are often statistically insignificant.

So why does a crisis in a partner country have a stronger and more persistent impact on exports of MENA region relative to a crisis in the exporter's country, and especially a banking crisis?[12]

One possible explanation is that exports of a country are dependent on external demand and we should not observe a harmful effect of a crisis at home on exports.

Another potential explanation could be that crises are associated with an increase in protectionism. After a crisis, interest groups that favor protecting domestic production may be strengthened. Finally, another possible channel through which partner crises may adversely affect exports is through the volatility of the exchange rate that could be an important potential channel through which crises affect exports adversely in the short run.

The results reported in Table 2 present the effect of crises on the exports of MENA countries for all products. In order to analyze whether the effect of a financial crisis varies for manufactured goods, we estimate Equation (1) only for such goods. In fact, the 2008-2009 global recession showed that the impact of financial crises on trade varied across different product categories. Abiad *et al.* (2011) confirmed empirically this pattern for all earlier crises.[13]

Table 3 presents the estimated coefficients for the exports of manufactured goods.

---

[11]See Abiad *et al.* (2011).

[12]Abiad *et al.* (2011) find a similar result; that there is a sharp decline in a country's imports in the year following a crisis and in contrast, exports of the crisis country are not adversely affected.

[13]"Capital and consumer durables experience the largest short-term drop, with an average drop of 23 percent in the year after crises…Finally, imports of primary goods seem to be least affected by a crisis." (Abiad *et al.,* 2011, p. 19).

Table 3: Exports Following Crises: Pooled Panel Gravity Estimates. 1970-2011

Dependent variable: log (exports of manufactured) at level in year *t*		
	Currency Crises	Banking Crises
Exporter Crisis t	0.032 [0.073]	0.125 [0.105]
Exporter Crisis t-1	0.146** [0.069]	0.204** [0.100]
Exporter Crisis t-2	-0.005 [0.070]	0.121 [0.099]
Exporter Crisis t-3	0.025 [0.070]	0.188** [0.090]
Exporter Crisis t-4	-0.055 [0.068]	-0.024 [0.097]
Partner Crisis t	-0.212* [0.112]	-0.273*** [0.077]
Partner Crisis t-1	-0.014 [0.106]	-0.332*** [0.071]
Partner Crisis t-2	0.066 [0.103]	-0.321*** [0.069]
Partner Crisis t-3	0.013 [0.100]	-0.203*** [0.075]
Partner Crisis t-4	0.043 [0.114]	-0.060 [0.081]
Log Exporter GDP	0.175 [0.118]	0.179* [0.115]
Log Partner GDP	1.743*** [0.133]	1.587*** [0.136]
Log Exporter Population	1.683*** [0.092]	1.670*** [0.092]
Log Partner Population	1.229*** [0.310]	1.365*** [0.306]
R-squared	0.805	0.805
Number of Observations	15575	15575
Number of Partner-Exporter Pairs	881	881
Partner-Exporter Dummies	Yes	Yes

Notes: This table shows the estimates from regression Equation (1) in the text. All reported coefficients are from the same regression.

The regression includes year and partner-exporter dummies. Robust standard errors clustered at the partner-exporter pair level in parentheses. Significance at the 1, 5, and 10 percent indicated by ***. ** and * respectively.

While currency crises in partner countries seem to have the same impact in the case of manufactured goods and that of total exports (same magnitude and duration), banking crises in partner countries have a more pronounced impact. On average, exports fall about 33 percent in the year

after a banking crisis and remain 20 percent below normal after 3 years. The decline in exports of manufactured goods is also more persistent; those exports recover to normal 3 years after the crises against 2 years for total exports. This result shows that primary goods seem to be less affected by a banking crisis in partner countries than manufactured goods.[14]

In contrast to total exports, where currency crises do not have any impact on exports, the exports of manufactured goods seem to be boosted after a currency crisis. This conforms with the competitiveness effect which seems to be more pronounced than the destruction effect. However, the positive impact persists for only one year.

C. Robustness

We check now if our main results are robust to a number of robustness tests, such as bilateral country-pair variables or reverse causality.

As an alternative to estimating Equation (1) with importer*partner fixed effects, we present, in tables A.3a and A.3b, the traditional gravity model which includes fixed effects for the exporter and partner countries separately. This specification makes it possible to estimate the coefficients on the standard time-invariant country-pair characteristics such as distance, a common land border, common language, and colonial ties. The main results are robust to this alternative specification: exports fall substantially and persistently following banking crises in partner countries especially for manufactured goods, while exports are less affected and recover quickly after currency crises in partner countries. The estimated coefficients on most other bilateral trade variables are similar to what has been found in the literature. For example, increased distance reduces exports, while common land border and colonial linkages enhance trade significantly.

In addition, our estimates may be biased due to the reverse causality. For example, the occurrence of a crisis may be affected by the behavior of exports. To treat this problem, we drop contemporaneous crisis episodes which are more likely to be endogenous to the behavior of exports. The estimated coefficients on the crisis indicators are almost identical to the baseline specification. These results are not reported for brevity.

Concerning endogeneity issue between GDP and crises variables, we have estimated several specifications of the model by dropping and inserting different lags we have not observed any change in the estimated coefficients on the crisis indicators. In addition, this problem has been evoked in precedent work (Ben Abdallah and Diallo, 2004). Endogeneity between GDP and crises is not relevant.

These various robustness tests support the main results that currency and banking crises of trade partners are associated with a persistent decline in exports of the MENA region. These effects persist for one and three years respectively after the date of crises, especially for manufactured goods, while exporter currency crises have a positive impact on exports but only for one year.

D. Exports of Services

We now turn to the impact of financial crises on the exports of commercial services in the MENA region. For this, we estimate an aggregate version of the gravity model. We decide on this

---

[14]This may be due to the fact that the demand for manufactured goods is more elastic than the demand for primary goods.

particular model due to data constraints; there is a lack of detailed data on exports of all MENA countries by trading partner pair.[15]

Notice that the aggregate version is analogous to estimating Equation (1) weighted by size of the partner.[16]

The estimating equation for the aggregate gravity model is specified as follows:

$$LnX_{i,t} = \alpha_i + \pi_t + \sum \beta_j crise_{i,t-j} + \delta_1 Ln\text{GDP}_{i,t} + \delta_2 Lnpopulation_{i,t} +$$
$$\sum \gamma_j Pcrise_{i,t-j} + \gamma_1 LnPGDP_{i,t} + \gamma_2 LnPpopulation_{i,t} + \mu_{i,t}, \qquad (2)$$

where $X_{i,t}$ stands for exports of services, $PGDP_{i,t}$, $Ppopulation_{i,t}$, and $Pcrise_{i,t}$ represent partners' trade-weighted GDP, population and crises respectively. The weight of each partner country in the exports of services is assumed to be the same as its weight in the exports of goods. This hypothesis can be justified by the fact that there is a similarity in the structure of trade of goods and trade of services, and is imposed by the lack of data.

The estimated coefficients on the different crisis dummies are shown in Table 4.

**Table 4: Exports Following Crises: Pooled Panel Aggregate
Gravity Estimates. 1980-2011**

Dependent variable: log (exports of services) at level in year t		
	Currency Crises	Banking Crises
Exporter Crisis t	0.289* [0.187]	0.170 [0.129]
Exporter Crisis t-1	0.242 [0.162]	0.216 [0.241]
Exporter Crisis t-2	0.264* [0.167]	0.365** [0.142]
Exporter Crisis t-3	0.210 [0.139]	0.383*** [0.141]
Exporter Crisis t-4	0.251** [0.103]	0.219 [0.169]
Partner Crisis t	0.375 [0.296]	-0.103 [0.116]
Partner Crisis t-1	0.307 [0.193]	0.053 [0.144]
Partner Crisis t-2	0.254 [0.434]	0.094 [0.134]
Partner Crisis t-3	0.033 [0.162]	0.257 [0.221]
Partner Crisis t-4	0.043 [0.167]	0.015 [0.121]

---

[15]Except for Tunisia and Malta.
[16]Whereas Equation (1) puts equal weight on all trading partners, the aggregate version puts more weight on larger trading partners (Abiad *et al.*, 2011).

**Table 4: Exports Following Crises: Pooled Panel Aggregate
Gravity Estimates. 1980-2011: Continues**

Dependent variable: log (exports of services) at level in year t		
	Currency Crises	Currency Crises
Log Exporter GDP	1.364*** [0.279]	1.207*** [0.268]
Log Partner GDP	0.066 [0.126]	0.077 [0.131]
Log Exporter Population	-0.157 [0.242]	-0.125 [0.230]
Log Partner Population	-0.368*** [0.091]	-0.302*** [0.074]
R-squared	0.928	0.927
Number of Observations	367	367
Exporter Dummies	Yes	Yes

Notes: This table shows the estimates from regression Equation (2) in the text. All reported coefficients are from the same regression.
The regression includes year and exporter dummies. Robust standard errors are in parentheses.
Significance at the 1. 5 and 10 percent indicated by ***. ** and * respectively.

A currency crisis in the exporter country has a positive influence on the exports of services. It also seems that, after a banking crisis in the partner or in the exporter country and after a currency crisis in the partner country, exports of services do not deviate significantly from normal both in the short and medium terms.

VI. Conclusions

This paper examines empirically how financial crises affect the exports of goods and services of MENA countries. We contribute to the literature studying the impact of financial crises on international trade in two ways: to our knowledge, this is the first analysis conducted on MENA countries; it is also the first to study the impact of financial crises on services.

We estimate a gravitational model for unilateral trade for MENA countries over the period 1970-2011 and find that after currency and banking crises in partner countries exports of MENA countries decrease significantly by 21 percent and 28 percent respectively. This effect persists for 3 years after the onset of the banking crises and only for one after the currency crises. It should be noted that the negative impact of banking crises in partner countries was more pronounced in the case of manufactured goods than total exports, with an average drop of 33 percent in the year after a banking crisis and remaining at 20 percent below normal after 3 years.

However, exports of services of MENA countries were not as adversely affected by financial crises and their behavior can be explained by standard gravity determinants. We found only a competitive effect for the exports of manufactured goods viable for one year.

Exporter currency crises influenced the exports of services positively. It also seems that after banking crises in partner countries or in the exporter countries, and after currency crises in partner

countries, exports of services do not deviate significantly from normal both in the short and medium terms.

In sum, vulnerability of MENA economies to financial crises seems to be the least when we consider trade of services in comparison to trade of goods. This result cannot be ignored when considering development strategies. Thus, to further diversify their economies and exports, MENA countries should place trade in services at the core of their development strategies. This is particularly relevant for countries looking for reducing their excessive oil dependence.

References

Abiad, Abdul, Prachi Mishra, and Petia Topalova. 2011, "How Does Trade Evolve in the Aftermath of Financial Crises?" IMF Working Paper 11/3.

Amiti, Mary, and David E. Weinstein. 2011. "Exports and Financial Shocks." *The Quarterly Journal of Economics*, 126(4): 1841-77.

Anderson, James E., and Eric van Wincoop. 2003. "Gravity with Gravitas: A Solution to the Border Puzzle." *American Economic Review,* 93(1): 170-92.

Bellone, Flora, Patrick Musso, Lionel Nesta, and Stefano Schiavo. 2011. "L'impact des contraintes financières sur les performances à l'exportation des entreprises françaises." *Économie et statistique,* 435-436: 65-83.

Ben Abdallah, Mohamed, and Kalidou Diallo. 2004. "Incidence des crises financières : une analyse empirique à partir des pays émergents." Working Paper (Cahiers de la Maison des Sciences Economiques, série blanche [2004.12]).

Berman, Nicholas. 2009. "Financial Crises and International Trade: The Long Way to Recovery." EUI Working Paper ECO 2009/23.

Berman, Nicholas, and Philippe Martin. 2012. "The Vulnerability of Sub-Saharan Africa to Financial Crises: The Case of Trade." *IMF Economic Review,* 60(3): 329-64.

Bernanke, Ben S. 1983. "Nonmonetary Effects of the Financial Crisis in the Propagation of the Great Depression." *The American Economic Review,* 73(3) (June): 257-76.

Bernanke, Ben S., and Mark Gertler. 1989. "Agency Costs, Net Worth and Business Fluctuations." *American Economic Review,* 79(1): 14–31.

Bernard, Andrew B., and J. Bradford Jensen. 1999. "Exceptional Exporter Performance: Cause, Effect, or Both?" *Journal of International Economics,* 47(1):1-25.

Bernard, Andrew B., and J. Bradford Jensen. 2004. "Why Some Firms Export." *The Review of Economics and Statistics,* 86(2): 561-69.

Blalock, Garrick, and Sonali Roy. 2007. "A Firm-Level Examination of the Exports Puzzle: Why East Asian Exports Didn't Increase After the 1997-1998 Financial Crisis?" *The World Economy,* 30(1): 39-59.

Bordo, Michael, Barry Eichengreen, Daniela Klingebiel, and Maria Soledad Martinez-Peria. (2001), "Is the Crisis Problem Growing More Severe?" *Economic Policy*, 16 (32): 51-82.

Campa, José Manuel, and J. Myles Shaver. 2002. Exporting and Capital Investment: On the Strategic Behavior of Exporters. IESE Business School Research Paper no. 469.

Caramazza, Francesco, Luca Ricci, and Ranil Salgado. 2004. "International Financial Contagion in Currency Crises." *Journal of International Money and Finance,* 23(1): 51-70.

Chaney, Thomas. 2005. "Liquidity Constrained Exporters." Mimeo, University of Chicago.

Chang, Roberto, and Andres Velasco. 2001. "A Model of Financial Crises in Emerging Markets." *The Quarterly Journal of Economics*, 116(2): 489-517.

Diamond, Douglas W., and Philip H. Dybvig. 1983. "Bank Runs, Deposit Insurance, and Liquidity." *Journal of Political Economy,* 91(3): 401-19.

Eaton, Jonathan, Samuel Kortum, Brent Neiman, and John Romalis. 2011. "Trade and the Global Recession." NBER Working Paper 16666.

Eichengreen, Barry, and Andrew K. Rose. 1999. "Contagious Currency Crises: Channels of Conveyance." In *Changes in Exchange Rates in Rapidly Developing Countries: Theory, Practice, and Policy Issues*, ed. I. Takatoshi and A. O. Krueger, 29-56. University of Chicago Press.

Forbes, Kristin J. 2001. "Are Trade Linkages Important Determinants of Country Vulnerability to Crises?" NBER Working Paper 8194.

Forbes, Kristen J., and Roberto Rigobon. 2002. "No Contagion, Only Interdependence: Measuring Stock Market Comovements." *The Journal of Finance,* 57(5): 2223-61.

Frankel, Jeffrey. A., and Eduardo A. Cavallo. 2004. "Does Openness to Trade Make Countries More Vulnerable to Sudden Stops, or Less? Using Gravity to Establish Causality." NBER Working Paper 10957.

Ganesh-Kumar, A., Kunal Sen, and Rajendra R. Vaidya. 2001. "Outward Orientation, Investment and Finance Constraints: A Study of Indian firms." *Journal of Development Studies,* 37(4): 133-49.

Glick, Reuven, and Andrew K. Rose. 1999. "Contagion and Trade: Why are Currency Crises Regional." *Journal of International Money and Finance,* 18(4): 603-17.

Kaminsky, Graciela L., and Carmen M. Reinhart. 1999. "The Twin Crises: The Causes of Banking and Balance-of-Payments Problems." *American Economic Review,* 89(3): 473-500.

Kaminsky, Graciela L., and Carmen M. Reinhart. 2000. "On Crises, Contagion and Confusion." *Journal of International Economics,* 51(1): 145-68.

Laeven, Luc, and Fabian Valencia. 2008. "Systemic Banking Crises: A New Database." IMF Working Paper 08/224.

Laeven, Luc, and Fabian Valencia. 2010. "Resolution of Banking Crises: The Good, the Bad, and the Ugly." IMF Working Paper 10/146.

Ma, Zihui, and Leonard Cheng. 2005. "The Effects of Financial Crises on International Trade." International Trade in East Asia, NBER−East Asia Seminar on Economics, vol. 14.

Manova, Kalina. 2008. "Credit Constraints, Heterogeneous Firms, and International Trade." NBER Working Paper 14531.

Mishkin, Frederic S. 1997. "Understanding Financial Crises: A Developing Country Perspective." In *Annual World Bank Conference on Development Economics 1996,* ed. M. Bruno, and B. Pleskovic, 29-62. Washington, DC: The World Bank.

Obstfeld, Maurice, and Kenneth Rogoff. 2009. "Global Imbalances and the Financial Crisis: Products of Common Causes." CEPR Discussion Paper 7606.

Portes, Richard. 2009. "Global Imbalances," In *Macroeconomic Stability and Financial Regulation: Key Issues for the G20,* ed. M. Dewatripont, X. Freixas, and R. Portes, 19-26, London: Centre for Economic Policy Research.

Stoker, James. 1995. "Intermediation and the Business Cycle under a Specie Standard: The Role of the Gold Standard in English Financial Crises, 1790-1850." Mimeo, University of Chicago.

Yousefi, Seyed Reza. 2011. "International Trade and Financial Crises: The Role of Credit Conditions." Mimeo, The University of Texas at Austin.

Appendices

Table A.1: Definitions of Variables

1. *Real Exports[17] of Goods* measured in millions of U.S. dollars, from *COMTRADE,* Deflated using CPI-US from *World Development Indicators*.
2. *Real Exports of Services*, measured in millions of U.S. dollars, from "Trade Map" which is a web-based application with statistics, trends and indicators on global trade flows and developed by the International Trade Center (ITC, Geneva), Deflated using CPI-US from *World Development Indicators*.
3. *Real Gross Domestic Product* is in millions of U.S. dollars constant prices (2005) and *Population* in thousands of inhabitants are from the World Bank's *World Development Indicators*.
4. *Distance, contiguity and colonial links* come from CEPII bilateral distance database (www.cepii.fr/anglaisgraph/bdd/distances.htm).
5. Episodes of financial crises come from Laeven and Valencia (2008 and 2010).

Table A.2: Summary Statistics of Main Variables

Variable	Nobs	Mean	St. Dev.	Min	Max
Currency crisis in exporter	29785	0.025	0.156	0	1
Currency crisis in partner	29785	0.015	0.122	0	1
Banking crisis in exporter	29785	0.011	0.104	0	1
Banking crisis in partner	29785	0.028	0.165	0	1
Twin crisis in exporter	29785	0.006	0.074	0	1
Twin crisis in partner	29785	0.007	0.083	0	1
Log Exports total	29785	4.973	3.544	-11.823	12.711
Log Exports of manufactured	26884	2.973	3.349	-11.823	12.569
Log Exporter GDP	24081	23.720	1.41	20.100	26.352
Log Partner GDP	28395	26.312	1.560	22.985	41.607
Log Exporter Population	29330	17.090	1.493	14.545	21.019
Log Partner Population	28986	15.521	1.550	11.594	18.229
Log Distance	29785	8.483	0.667	6.331	9.850
1 if Common Language	29785	0.058	0.234	0	1
1 if Common Border	29785	0.004	0.063	0	1
1 if Colonial Times	29785	0.033	0.179	0	1

---

[17]Exports from country i to country j are assimilated to the imports from country j to country i.

Table A.3a: Exports Following Currency Crises: Pooled Panel Gravity Estimates. 1970-2011

Dependent variable: log (exports) at level in year *t*	Currency Crises	Banking Crises
Exporter Crisis t	-0,013 [0,085]	0,076 [0,131]
Exporter Crisis t-1	0,050 [0,080]	0,134 [0,128]
Exporter Crisis t-2	-0,083 [0,088]	-0,064 [0,124]
Exporter Crisis t-3	0,009 [0,086]	0,023 [0,119]
Exporter Crisis t-4	-0,049 [0,087]	0,092 [0,117]
Partner Crisis t	-0,288** [0,145]	-0,082 [0,097]
Partner Crisis t-1	-0,093 [0,140]	-0,119 [0,090]
Partner Crisis t-2	-0,071 [0,135]	-0,095 [0,090]
Partner Crisis t-3	-0,035 [0,146]	0,106 [0,087]
Partner Crisis t-4	-0,007 [0,141]	0,057 [0,109]
Log Exporter GDP	2,008*** [0,133]	2,024*** [0,130]
Log Partner GDP	1,769*** [0,141]	1,768*** [0,144]
Log Exporter Population	-0,614*** [0,121]	2,096*** [0,319]
Log Partner Population	2,144*** [0,320]	-0,626*** [0,121]
Log Distance	-2,057*** [0,055]	-2,058*** [0,055]
Contiguity	1,019*** [0,169]	1,022*** [0,168]
Colony	0,626*** [0,066]	0,625*** [0,066]
Common language	0,492*** [0,070]	0,492*** [0,070]
R-squared	0.625	0.625
Number of Observations	16330	16330
Partner Dummies Exporter Dummies	Yes Yes	Yes Yes

Notes: This table shows the estimates from regression Equation (1) in the text. All reported coefficients are from the same regression. The regression includes year and partner-exporter dummies. Robust standard errors clustered at the partner-exporter pair level in parentheses. Significance at the 1, 5 and 10 percent indicated by ***, ** and * respectively.

Table A.3b: Exports Following Currency Crises: Pooled Panel Gravity Estimates. 1970-2011

Dependent variable: log (exports of manufactured) at level in year t	Currency Crises	Banking Crises
Exporter Crisis t	0.046 [0.089]	0.108 [0.135]
Exporter Crisis t-1	0.161** [0.086]	0.191 [0.136]
Exporter Crisis t-2	-0.012 [0.087]	0.110 [0.124]
Exporter Crisis t-3	0.044 [0.084]	0.218 [0.118]
Exporter Crisis t-4	-0.046 [0.089]	-0.057* [0.126]
Partner Crisis t	-0.211* [0.140]	-0.262*** [0.092]
Partner Crisis t-1	-0.032 [0.130]	-0.276*** [0.084]
Partner Crisis t-2	0.076 [0.126]	-0.276*** [0.084]
Partner Crisis t-3	0.029 [0.140]	-0.160* [0.089]
Partner Crisis t-4	0.070 [0.134]	-0.059 [0.103]
Log Exporter GDP	0.104 [0.134]	0.099 [0.130]
Log Partner GDP	1.654*** [0.151]	1.534*** [0.154]
Log Exporter Population	1.571*** [0.102]	1.666*** [0.340]
Log Partner Population	1.575*** [0.343]	1.561*** [0.102]
Log Distance	-1.504*** [0.053]	-1.505*** [0.053]
Contiguity	-0.773*** [0.257]	-0.783*** [0.257]
Colony	0.368*** [0.068]	0.367*** [0.067]
Common language	0.869*** [0.077]	0.870*** [0.077]
R-squared	0.686	0.687
Number of Observations	15575	15575
Partner Dummies Exporter Dummies	Yes Yes	Yes Yes

The Impact of Religion on Corruption

By Leila Shadabi[*]

Religion can influence human behavior and actions. One of the social behaviors is corruption which is important due to its effect on growth, inflation, investment and innovation and is rejected by all religions. The effect of religion on corruption has been investigated in this study. It is not the first time this issue is being investigated, but we can see certain paradoxes about it in some studies. Some of them show that religion as a cultural index has a positive effect on corruption and some others show that this effect is negative. This study uses data of 174 countries in 2010 and all of the economic and non-economic control variables were considered in its cross-sectional estimations. Although in some previous studies, religion was a factor in increasing corruption, this study shows that Islam and Christianity have no significant effect on corruption. Also, the robustness test strongly confirmed the results of the study. So, all the results showed that religion does not increase corruption.

Keywords: Religion, Corruption, Muslims, Christians

JEL Classification: Z120, D730

I. Introduction

Corruption is defined as the misuse of entrusted power for private gains according to UNDP (2010). This phenomenon is present in some countries more than others. Many researchers like Blackburn and Powell (2011), Evrensel (2010) as well as Aidt *et al.* (2008) showed that it has a negative effect on growth. Egger and Winner (2005) showed that increasing corruption has a negative effect on direct foreign investment and Anokhin and Schulze (2009) concluded that corruption has a negative effect on innovation. Corruption is an important variable resulting from social and cultural conditions. There are several researches regarding the causes of corruption. These factors can be divided into two groups: economic and non-economic.

In the existing literature, one of the non-economic factors is religion. It was introduced as an indicator of cultural factors. Religion can affect all human behaviors and decisions. Although the impact of religion on corruption has already been investigated, the results of the studies have not been similar. It should be noted that although embezzlement and bribery are forbidden in Christianity and Islam, corruption is found in Islamic and Catholic countries more than in the others. Some studies concluded that not only the same religion but also the multiplicity of religions is an important factor in corruption, but other studies like Shabbir and Anwar (2007) showed that the level of corruption is not affected by the religion. As Lambsdorff (2005) reported, La Porta *et al.* (1997) showed that Catholicism and Islam have a positive effect on corruption because of their

hierarchical forms. They examined the mentioned hypothesis in 33 countries and reported a positive association between the percentage of population belonging to a hierarchical religion and corruption. In a larger sample consisting of 114 countries, the relationship was examined by La Porta *et al.* (1999) who found the relationship between religion and corruption is weak. As Lambsdorff (2005) explained, La Porta *et al.*'s finding is such because GDP per capita was also included as a control variable.

Treisman (2000) obtained a strong significant negative effect of percentage of Protestants on corruption in 64 countries. This result was also found by Gerring and Thacker (2005), but was not confirmed by Sandholtz and Gray (2003). Paldam (2002) considered a model for corruption in a cross-country pattern in 1999. His model included the growth of real income per capita, inflation rate and the economic freedom index. He identified several different groups of cultures and tested their impact on corruption. Paldam tried to explain corruption by a mixed economic-cultural model. He used religion as the key to cultural dimension. By comparing economic and cultural models, his results showed that both models lead to the same conclusion. The coefficient of each cultural dummy variable for Western Europe, Latin America and former communist countries is significant in all of his estimations. He concluded that the transition is influenced by culture and the countries tend to have much or little corruption relative to the transition trend.

Alesina *et al.* (2003) showed that multiple languages and religions have affected corruption and Gokcekus (2008) showed that Protestantism had a more robust impact on corruption in the past. He explained that the percentage of Protestants 100 years ago, i.e., in 1900, had a more significant effect on the level of corruption. He estimated this relationship by using data of 1900, 1970, 1990 and 2000 and found a lower t-statistic. This result indicates the Protestant effect is weaker than before.

Samanta (2011) reported that religion, especially Islam, has a positive effect in OPEC countries and leads to less corruption. Samanta estimated the effect of religion on economic growth, using panel data. It was found that economic growth reduces corruption in a unidirectional manner.

According to the current studies, there are two different impacts of religion on corruption. La Porta *et al.*'s (1999) and Treisman's (2000) theoretical analysis showed that corruption is more common in Islam and Catholicism because of their harmful effects on democracy and equality. But other studies, e.g., Samanta (2011) and North *et al.* (2013) rejected this finding. In all of these studies, religion is a cultural factor but their control variables are not the same. The control variables have an important role in the final result, i.e., the result depends on which index was used for a country. In the current study, the number of Muslims and Christians per 100 inhabitants, the sum of both groups and the government regulation of religion were used as indexes for the definition of the country's religion. This study analyzes the following questions:

1) Is religion a good factor for forecasting social behavior and if it is an acceptable variable for cultural factors, especially in social norms which can influence corruption?
2) Do Islam and Christianity, which are the most widespread religions in the world, have any significant effect on corruption?

To answer these questions, this study is organized as follows: Section II deals with the importance of corruption around the world. In Section III, causes of corruption will be discussed. Section IV is devoted to the data and the model. The empirical cross-sectional analysis is carried out by using the available data for countries in 2010. Section V reports and analyzes the empirical results and Section VI is devoted to conclusions.

II. The Importance of Corruption Around the World

Everyone agrees that corruption is a negative phenomenon and is prohibited by religions like Islam[1] and Christianity[2]. But surprisingly, some Islamic countries have the highest corruption level in the world. Corruption is measured by three institutions: Transparency International, the World Bank and the PRS group. Judge *et al.* (2011) explain the method of these indexes and report that they have correlation with each other. The corruption perception index (CPI) is the most popular measure. This measure is an aggregate indicator which brings together data from sources that cover the past two years. Transparency International, using data from 13 sources by 10 independent institutions, has calculated this index. Table 1 reports the CPI of 174 countries in 2010.

Table 1: Corruption Around the World (2010)

World Bank Code	Country	Transparency	World Bank Code	Country	Transparency
AFG	Afghanistan	1.4	KHM	Cambodia	2.1
ALB	Albania	3.3	CMR	Cameroon	2.2
DZA	Algeria	2.9	CAN	Canada	8.9
AGO	Angola	1.9	CPV	Cape Verde	5.1
ARG	Argentina	2.9	CAF	Central African Republic	2.1
ARM	Armenia	2.6			
AUS	Australia	8.7			
AUT	Austria	7.9	TCD	Chad	1.7
AZE	Azerbaijan	2.4	CHL	Chile	7.2
BHR	Bahrain	4.9	CHN	China	3.5
BGD	Bangladesh	2.4	COL	Colombia	3.5
BRB	Barbados	7.8	COM	Comoros	2.1
BLR	Belarus	2.5	COD	Congo, Democratic Republic of	2
BEL	Belgium	7.1			
BEN	Benin	2.8			
BTN	Bhutan	5.7	COG	Congo, Republic of	2.1
BOL	Bolivia	2.8			
BIH	Bosnia and Herzegovina	3.2	CRI	Costa Rica	5.3
			CIV	Côte d'Ivoire	2.2
BWA	Botswana	5.8	HRV	Croatia	4.1
BRA	Brazil	3.7	CUB	Cuba	3.7
BRN	Brunei Darussalam	5.5	CYP	Cyprus	6.3
			CZE	Czech Republic	4.6
BGR	Bulgaria	3.6			
BFA	Burkina Faso	3.1	DNK	Denmark	9.3
BDI	Burundi	1.8	DJI	Djibouti	3.2

---

[1]For example, the *Quran*, see 2:188 and 5:62.
[2]For example, the *Bible*, see Exodus 23:8, Proverbs 12:14 and 15:27, and Hebrews 13:5-6.

Table 1: Corruption Around the World (2010): Continues

World Bank Code	Country	Transparency	World Bank Code	Country	Transparency
DMA	Dominica	5.2	JPN	Japan	7.8
DOM	Dominican Republic	3	JOR	Jordan	4.7
ECU	Ecuador	2.5	KAZ	Kazakhstan	2.9
EGY	Egypt, Arab Republic of	3.1	KEN	Kenya	2.1
SLV	El Salvador	3.6	KIR	Kiribati	3.2
GNQ	Equatorial Guinea	1.9	KOR	Korea, Republic of	5.4
ERI	Eritrea	2.6	KSV	Kosovo	2.8
EST	Estonia	6.5	KWT	Kuwait	4.5
ETH	Ethiopia	2.7	KGZ	Kyrgyz Republic	2
FIN	Finland	9.2	LVA	Latvia	4.3
FRA	France	6.8	LBN	Lebanon	2.5
GAB	Gabon	2.8	LSO	Lesotho	3.5
GMB	Gambia, The	3.2	LBR	Liberia	3.3
GEO	Georgia	3.8	LBY	Libya	2.2
DEU	Germany	7.9	LTU	Lithuania	5
GHA	Ghana	4.1	LUX	Luxembourg	8.5
GRC	Greece	3.5	MAC	Macao SAR, China	5
GTM	Guatemala	3.2	MKD	Macedonia, FYR	4.1
GIN	Guinea	2			
GNB	Guinea-Bissau	2.1	MDG	Madagascar	2.6
GUY	Guyana	2.7	MWI	Malawi	3.4
HTI	Haiti	2.2	MYS	Malaysia	4.4
HND	Honduras	2.4	MDV	Maldives	2.3
HKG	Hong Kong SAR, China	8.4	MLI	Mali	2.7
			MLT	Malta	5.6
HUN	Hungary	4.7	MRT	Mauritania	2.3
ISL	Iceland	8.5	MUS	Mauritius	5.4
IND	India	3.3	MEX	Mexico	3.1
IDN	Indonesia	2.8	MDA	Moldova	2.9
IRN	Iran, Islamic Republic of	2.2	MNG	Mongolia	2.7
			MNE	Montenegro	3.7
IRQ	Iraq	1.5	MAR	Morocco	3.4
IRL	Ireland	8	MOZ	Mozambique	2.7
ISR	Israel	6.1	MMR	Myanmar	1.4
ITA	Italy	3.9	NAM	Namibia	4.4
			NPL	Nepal	2.2
JAM	Jamaica	3.3	NLD	Netherlands	8.8

X

X

X

X

Table 1: Corruption Around the World (2010): Continues

World Bank Code	Country	Transparency	World Bank Code	Country	Transparency
NZL	New Zealand	9.3	LKA	Sri Lanka	3.2
NIC	Nicaragua	2.5	SDN	Sudan	1.6
NER	Niger	2.6	SWZ	Swaziland	3.2
NGA	Nigeria	2.4	SWE	Sweden	9.2
NOR	Norway	8.6	CHE	Switzerland	8.7
OMN	Oman	5.3	SYR	Syrian Arab Republic	2.5
PAK	Pakistan	2.3	TJK	Tajikistan	2.1
PAN	Panama	3.6	TZA	Tanzania	2.7
PNG	Papua New Guinea	2.1	THA	Thailand	3.5
PRY	Paraguay	2.2	TLS	Timor-Leste	2.5
PHL	Philippines	2.4	TGO	Togo	2.4
POL	Poland	5.3	TON	Tonga	3
PRT	Portugal	6	TTO	Trinidad and Tobago	3.6
PRI	Puerto Rico	5.8	TUN	Tunisia	4.3
QAT	Qatar	7.7	TUR	Turkey	4.4
ROU	Romania	3.7	TKM	Turkmenistan	1.6
RUS	Russian Federation	2.1	UGA	Uganda	2.5
RWA	Rwanda	4	UKR	Ukraine	2.4
STP	Sao Tome and Principe	3	ARE	United Arab Emirates	6.3
SAU	Saudi Arabia	4.7	GBR	United Kingdom	7.6
SEN	Senegal	2.9	USA	United States	7.1
SRB	Serbia	3.5	URY	Uruguay	6.9
SYC	Seychelles	4.8	UZB	Uzbekistan	1.6
SLE	Sierra Leone	2.4	VUT	Vanuatu	3.6
SGP	Singapore	9.3	VEN	Venezuela, RB	2
SVK	Slovak Republic	4.3	VNM	Vietnam	2.7
SVN	Slovenia	6.4	YEM	Yemen, Republic of	2.2
SLB	Solomon Islands	2.8	ZMB	Zambia	3
SOM	Somalia	1.1	ZWE	Zimbabwe	2.4
ZAF	South Africa	4.5		Average	4.01092
ESP	Spain	6.1			

The CPI ranges from 0 to 10 and the lower value conveys high corruption.[3] In 2010, the mean of this index of the countries under discussion was 4.01. Somalia with 1.1 and Denmark with 9.3 have the highest and lowest level of corruption, respectively. Almost 63.79 percent of countries have a corruption level higher than the average value of the world.

III. Determinants of Corruption

Corruption is a social phenomenon that is hard to define mathematically. Fortunately, some of the causes of corruption have been checked by previous researchers. Theoretically, some of these factors do not have a strong effect on corruption. Dreher *et al.* (2007) concluded that these factors can be shown in four groups: political, historical, social-cultural and economic.

Democracy, electoral rules and the degree of decentralization are some of the political factors that are shown by Treisman (2000), Fisman and Gatti (2002), Paldam (2002), Chowdhury (2004) and Shrabani *et al.* (2009). The effect of democracy on corruption was investigated in many studies. Some of the researchers like Treisman (2000) mentioned that democracy increases growth and consequently reduces corruption. Treisman's research was not an empirical study and some empirical studies rejected the positive effect of democracy on growth. So one can ask if democracy leads to growth. According to some studies, the impact of democracy on growth depends on the amount of corruption in the country. However, in reality we can overlook democracy as a determinant of growth because of its unproven impact on corruption and also its high collinearity with some of the other determinants of growth. According to the existing literature, the determinants of corruption vary according to different studies.

For instance, Vorhies and Glahe (1988), Wittman (1989), Scully and Slottje (1991), Spindler (1991) and Olson (1993) showed that the increase in democracy leads to more growth because it results in a higher public participation. Also, a market economy has a structure which could lead to democracy. Przeworski and Limongi (1993) found that democracy cannot be a cause for growth. They mentioned that the lack of political stability leads to disruptive solidarity in the development of policies and the trend of democracy to redistribution of income, which is among policies, does not lead to growth especially in poor and low income nations. According to Lambsdorff (2005), the relationship between corruption and democracy is not linear. In some processes of growth, more democracy leads to more corruption and after a threshold it leads to a decrease in corruption.

In the present study, the effect of democracy on corruption, using the democracy index obtained from the Freedom House (2013), is examined. We found that democracy decreases transparency which contradicts the general view that it leads to more information. Also using dummy variable for dictatorship states it was found that it increases transparency. According to Przeworski and Limongi (1993) and Shrabani *et al.* (2009), the impact of democracy on growth cannot be analyzed without considering a social structure. The role of the judicial system has been studied by Baker (1988) and North (1990). Some other studies, e.g., La Porta (1997) and Treisman (2000), pointed to historical factors like the colonial heritage of the country and the civil law system associated with former colonies of continental European countries.

Social-cultural factors should also be included in the analysis. For example, La Porta *et al.* (1999) Treisman (2000) and Alesina *et al.* (2003) consider religion, ethnicity and multiple languages as proxies for social and cultural factors. Paldam (2002) used dummy variables for four cultural regions in the world. The impact of religion as a cultural factor has been investigated by

---

[3]This index shows transparency which is the inverse of corruption.

La Porta *et al.* (1999) and Treisman (2000) who show that Muslims and Catholics, because of their hierarchical system, are more corrupt but Protestants, due to their religion's positive effect on democracy and growth, are less corrupt. Alesina *et al.* (2003) showed that the multiplicity of religions, languages and ethnicities increases corruption because of their negative effect on government quality.

Some antithetical studies reject the above reasons and results. Gokcekus (2008) explained that the effect of Protestantism on corruption is weaker nowadays. The percentage of Protestants 100 years ago was more significant than today. The t-statistic of the coefficient of this index was double in 1900, compared to 2000. Gokcekus showed that the corruption function is not linear and different control variables can change the significance level. Also, using regional control variables led to a strange reduction in the religion effect on corruption. His result about regional control variables confirmed Paldam's (2003) results. Cameron *et al.* (2009) showed that the tendency to punish corruption is more than the tendency to eliminate it. Also they showed that there is no relationship between the level of corruption and nationality. It means that bribery is not related to nationality. They concluded that even accepting bribery from and offering bribery to Indonesian students was lower than for Singaporean students although Indonesia has one of the highest corruption indexes in the world contrary to Singapore. Finally, Barr and Serra (2010) showed that although corruption is a cultural phenomenon, we cannot prejudge the countries based on cultural differences only.
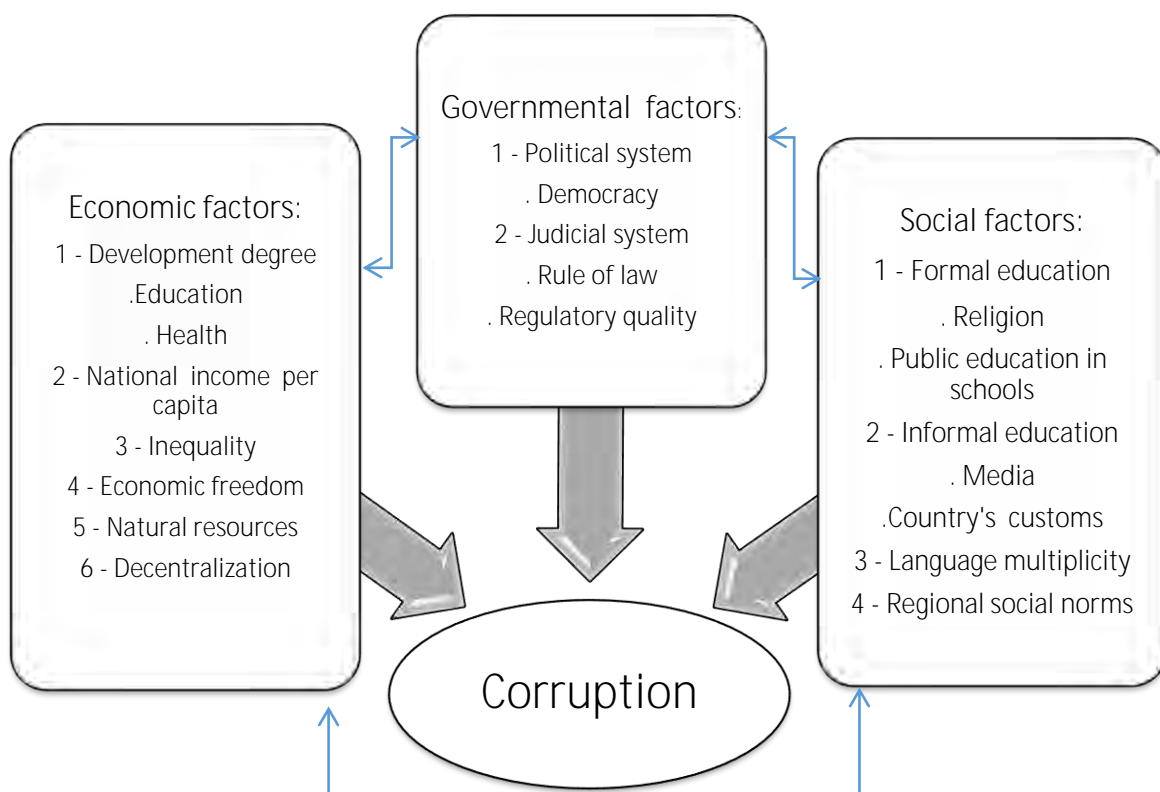
Figure 1: Causes of Corruption

Figure 1 shows the causes of corruption in a country. According to this figure, the society structure is one of the factors affecting corruption. Furthermore, such structure consists of political,

economic and cultural organizations which are related to each other. According to previous studies, the most important causes of corruption are known. In the next section, data and model are presented based on these investigations.

IV. Data and the Model

Data are drawn from a wide range of sources. There are three major measures of corruption: the corruption perception index (CPI) that is the inverse of transparency, the control of corruption index (CCI) and the corruption index (CI). The CPI is the most popular one and is drawn from 13 data sources. It ranges from 0 to 10 where low values indicate high transparency and low corruption. According to Judge *et al.* (2011), the correlation coefficient of CPI with CCI is 0.97 and with CI, 0.75. The CPI is used as an index for corruption in the present study. The corruption perception index was obtained from Transparency International (2013).

It is expected that more society facilities lead to less corruption. GDP per capita was used as a proxy for society facilities in some of the previous studies. The question is that, can GDP per capita explain the differences between available facilities for every citizen in the countries? GDP per capita is the value of all final goods and services produced in a country in a given year divided by the average population for the same year. This variable explains a total value of products without any attention to inequality in using facilities. Sims *et al.* (2012) show that human development index has a significant effect on corruption. It seems the variable inequality-adjusted human development index as an explanatory variable not only shows the level of country development but also reflects inequality. So, it can explain corruption better. If people have more available facilities with less discrimination, their tendency to do corrupt acts will be less. Inequality-human development index (IHDI) is obtained from the Human Development Report (UNDP, 2010). In the main estimation, I use this index because of its logical relation with corruption. But due to the general use of GDP per capita as an index for available facilities in different studies, I also used GDP per capita in constant 2005 US$ and PPP (GDP per capita based on purchasing power parity). However, all proxies gave the same result. Both of GDP per capita indexes are extracted from the World Bank.

Regulatory quality (RQ) is a good governmental index which is a set of judicial construction. Rules are essential for social welfare and growth. RQ reflects the judicial system of a country. It ranges from 0 to 100, which means the higher the number, the better the judicial system in a country. Finland had the highest at 99 and Eritrea and Myanmar, the lowest at 1 in 2010. RQ data is extracted from the Worldwide Governance Indicators (2013).

The total natural resources rent (NR) is the sum of resource rents from oil, natural gas, coal, minerals and forests as a percentage of GDP which is another independent variable in the model. It is extracted from the World Bank (2013). Petermann *et al.* (2007) and Kolstad and Soreide (2009) reported the positive effect of natural endowment on corruption. They confirmed that fuel mineral affects corruption positively and non-fuel can also increase it in poor countries. Bhattacharyya and Hodler (2010) have shown this effect is weak in democratic institutions. It seems that including the natural resources in the corruption function especially in a cross-sectional model is necessary. This index, obtained from the World Bank (2013), can explain the entire governmental activities.

Graeff and Mehlkop (2003), Apergis *et al.* (2012), and Pieroni and d'Agostino (2013) reported that the economic freedom (EF) has a negative effect on corruption. The economic freedom is the mean of ten sub-indexes that measure freedom in various parts of the economy and

is calculated yearly by the Heritage Foundation (2010). It should be noted that one of these sub-indexes is the control of corruption. So it is an endogenous variable in the corruption function. To solve this problem, we remove the control of corruption and calculate the average of another nine sub-indexes as a proxy. In the current study, the adjusted economic freedom index is calculated in this way and was used in the estimation. It means that economic freedom is the average of property rights, fiscal freedom, government spending, business freedom, labor freedom, monetary freedom, trade freedom, investment freedom, and financial freedom[4] in this study.

The effect of social and cultural factors on corruption is confirmed in all previous studies and religion is a proxy for social norms and human behavior as it influences this behavior. Researchers have found different effects of religion on corruption. In some studies, not only the religion, but also the multiplicity of religions, is a factor in increasing corruption. The effect of religion, whether positive or negative, on corruption was reported in studies by La Porta (1999), Treisman (2000), Alesina *et al.* (2003), Chowdhury (2004), Gokcekus (2008) and Samanta (2011), but other studies like Shabbir and Anwar (2007) showed that the level of corruption is not affected by religion.

The percentage of Muslims and Christians was used as the religion indexes in 174 countries in the current paper. These two religions have more than 55 percent believers around the world and generally every country has an impressive number of followers. The data was obtained from the Association of Religion Data Archives (ARDA, 2013).

REL is an index which explains the extent to which the government regulates the selection, practice, and profession of religion through official laws, policies, or administrative actions. It ranges from 0 to 10 in which a higher value indicates a greater governmental regulation of religion. It was obtained from ARDA. Table 2 shows the definitions of the variables and their sources.

Table 2: Variables, Definitions and Sources

Variable	Index	Definition	Source
Corruption	TI	Transparency International corruption index	Transparency International
Available facilities	IHDI	Inequality-adjusted human development index	World Bank
	$GDP_{pc}ppp$	GDP per capita based on purchasing power parity	World Bank
	$GDP_{pc}C$	GDP per capita in constant 2005 US$	World Bank
Regulatory quality	RQ	Regulatory quality capturing	Worldwide Governance Indicators
Natural resources rents	NR	The sum of oil, natural gas, coal, minerals and forests rents as a percentage of GDP	World Bank
Economic freedom	EF	Economic freedom index	Heritage Foundation

---

[4]EF=Σ (property rights, fiscal freedom, government spending, business freedom, labor freedom, monetary freedom, trade freedom, investment freedom, financial freedom)/9.

Table 2: Variables, Definitions and Sources: Continues

Variable	Index	Definition	Source
Religion	Mu	The percentage of Muslims	Association of Religion Data Archives
Religion	Ch	The percentage of Christians	Association of Religion Data Archives
	MuCh	The sum of percentage of Muslims and Christians	Association of Religion Data Archives and author's calculations
	REL	The government regulates the selection, practice, and profession of religion through official laws, policies, or administrative actions	Association of Religion Data Archives

To assess the importance of religion and the impact of Islam and Christianity on corruption I used the following equations:

$$Corruption_i = \beta_0 + \beta_1 AF_i + \beta_2 RQ_i + \beta_3 NR_i + \beta_4 EF_i + \beta_5 Mu_i + \beta_6 Ch_i + \varepsilon_i, \quad (1)$$

where β_i is a constant coefficient for all i=0,1,…,6 and $\beta_1>0$, $\beta_2>0$, $\beta_3<0$, $\beta_4>0$, $\beta_5=?$, $\beta_6=?$. ε is the error term which is assumed to be white noise.

$$Corruption_i = \gamma_0 + \gamma_1 AF_i + \gamma_2 RQ_i + \gamma_3 NR_i + \gamma_4 EF_i + \gamma_5 REL_i + \epsilon_i, \quad (2)$$

where γ_i is a constant coefficient for all i=0,1,…,6 and $\gamma_1>0$, $\gamma_2>0$, $\gamma_3<0$, $\gamma_4>0$, $\gamma_5=?$. ϵ is the error term which is assumed to be white noise.

$$Corruption_i = \varphi_0 + \varphi_1 AF_i + \varphi_2 RQ_i + \varphi_3 NR_i + \varphi_4 EF_i + \varphi_5 MuCh_i + \omega_i, \quad (3)$$

where φ_0 is a constant coefficient for all i=0,1,…,6 and $\varphi_1>0$, $\varphi_2>0$, $\varphi_3<0$, $\varphi_4>0$, $\varphi_5=?$. ω is the error term which is assumed to be white noise. In the above equations i denotes the country.

For the sake of robustness check, I replaced Mu and Ch, the percentage of Muslims and Christians with REL which indicates the governmental religious index. Furthermore, I replaced REL with MuCh variable, which is the percentage of Muslims and Christians in the country$_i$ [see Equation (3)]. Table 3 reports the estimation result of Equation (1), where the variable AF proxied by IHDI, GDP per capita PPP and GDP per capita C. Table 4 reports the estimation result of equations (2) and (3).

V. Empirical Results

Figure 2 presents the relationship between the percentage of Muslims and Christians with transparency (the inverse of corruption). As we can see, there is a negative relationship between the percentage of Muslims and transparency (Figure 2a), indicating that the higher the percentage of Muslims is, the higher corruption will be. There is, however, a positive relationship between the percentage of Christians and transparency (Figure 2b), indicating that the higher the percentage

of Christians is, the lower corruption will be. Our empirical verification will confirm if these relationships are statistically significant.
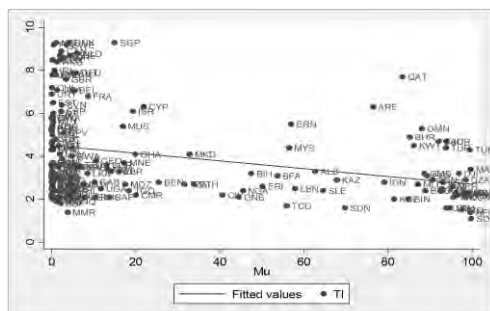
Figure 2: Corruption and Religion

Figure 2a: Percentage of Muslims and transparency in the studied countries
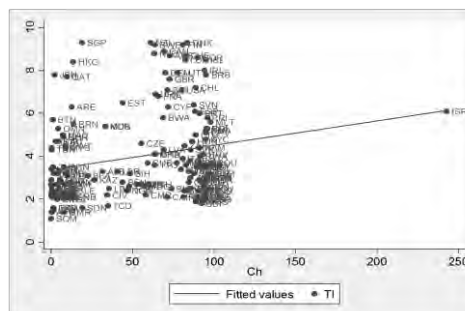
Figure 2b: Percentage of Christians and transparency in the studied countries

The estimation results of Equation (1) are shown in Table 3. It reports the result of three estimations. In column 1, the variable IHDI (inequality-adjusted human development index) is a control variable. Because IHDI is not available for all countries, the effective number of observations for column 1 is only 133. In columns 2 and 3, GDP per capita PPP and GDP per capita at constant price replace IHDI. These variables are not available for some years for some countries and, therefore, the effective number of observations is 156. According to the estimation result, these indexes have a positive and statistically significant coefficient which confirms the theoretical implication of Equation (1). Regulatory quality (RQ) in contrast with corruption has a positive and statistically significant effect on transparency, indicating that increasing the quality of law reduces corruption. According to the estimated coefficient of NR, which is negative and statistically significant in columns 2 and 3, natural endowment has a positive effect on corruption. The estimated coefficient of economic freedom (EF) does not have any effect on transparency. The t-statistic of economic freedom is less than 2, but more than 1, so it is kept in the equation. The coefficients of percentage of Muslims (Mu) and Christians (Ch) are negative and statistically insignificant in all the estimations, which indicates an unreliable relationship between religion and corruption.

Table 3: Cross-Country Estimates: Dependent Variable = Transparency (Inverse of Corruption)*

Variables	1	2	3
IHDI	2.60[a] (3.19)	—	—
GDP$_{\text{per capita}}$ PPP	—	$7.28*10^{-5a}$ (5.58)	—
GDP$_{\text{per capita}}$ C	—	—	0.0001[a] (7.48)

Table 3: Cross-Country Estimates: Dependent Variable = Transparency (Inverse of Corruption)*: Continues

Variables	1	2	3
RQ	0.044^a (4.65)	0.026^a (3.66)	0.026^a (4.23)
NR	-0.004 (-0.66)	-0.015^a (-2.70)	-0.008^a (-2.12)
EF	-0.002 (-0.11)	0.028 (1.03)	0.01 (0.78)
Mu	-0.006 (-1.51)	-0.005 (-1.47)	-0.004 (-1.16)
Ch	-0.003 (-0.89)	-0.002 (-0.60)	-0.002 (-0.53)
C	0.871 (0.898)	1.22 (1.59)	1.62^a (2.52)
Adjusted R^2	0.70	0.79	0.83
Durbin-Watson stat	1.99	1.96	2.08
No. of observations	133	156	156
Glejser** F-statistic	7.24	6.59	5.15

* The estimation method is OLS. Figures in brackets are t-statistics.
** Since the error is heteroskedastic, according to the Glejser test, the Newey-West robust error technique to correct standard errors was used.
a = Statistically significant

Table 4 reports the estimation results of equations (2) and (3). But because of heteroskedasticiy in the primary estimations, the estimation method is Newey and West's (1987) Robusterror Ordinary Least Squared. This table shows the results of robustness check of the previous estimations. The estimated coefficient of MuCh is statistically insignificant, which indicates, similar to the result in Table 3, that religion does not have any impact on corruption. The estimated coefficient of REL is weakly statistically significant. This result indicated that the measure of influence in government may affect corruption. The estimated coefficient of other variables in Table 4 also confirms what was reported in Table 3.

Table 4: Robustness Check: Cross-Country Estimates: Dependent Variable = Transparency (Inverse of Corruption)*

Variables	Equation (2)	Equation (3)
$GDP_{per\ capita}$ PPP	$7.25*10^{-5a}$ (5.26)	$7.3*10^{-5a}$ (5.54)
RQ	0.02^a (2.29)	0.028^a (3.88)
NR	-0.014^a (-2.31)	-0.017^a (-3.03)

**Table 4: Robustness Check: Cross-Country Estimates:
Dependent Variable = Transparency (Inverse of
Corruption)*: Continues**

Variables	Equation (2)	Equation (3)
EF	0.028 (1.33)	0.013 (0.86)
REL	-0.05 (-1.85)	—
MuCh	—	-0.003 (-0.87)
C	0.53 (0.58)	1.32 (1.71)
Adjusted R^2	0.79	0.79
Durbin-Watson stat	1.78	1.94
No. of observations	147	156
Glejser** F-statistic	5.23	6.01

*   The estimation method is OLS. Figures in brackets are t-statistics.
**   Since the error is heteroskedastic, according to the Glejser test, the
        Newey-West robust error technique to correct standard errors was used.
  a = Statistically significant

Consequently, religion does not influence corruption. In other words, religion is not a strong barrier for giving or taking bribes. Gokcekus (2009) has shown that the relationship between religion and corruption from 1900 to 2000 is weak. The results also confirm the finding of North *et al.* (2013) who concluded there is an insignificant effect of religion on corruption. The finding of this study is in contrast with the finding of La Porta *et al.* (1999) and Treisman (2000) as they paid no attention to the countries' structures by ignoring some important control variables. Kingston (2008) explains that patterns of interaction in a society can affect the level of corruption but these patterns result from the enforcement of rules against bribery. The interaction between formal and informal rules sometimes leads to unexpected outcome. However, it is logical to conclude that religion has no significant effect on corruption.

VI. Conclusion

The relationship between religion as a cultural factor and corruption has been studied before, but with contradictory results. This poses an interesting question: if bribery and embezzling are prohibited in Islam and Christianity, then what is the impact of religion on corruption? In the current study, the percentage of Muslims and Christians is used as indexes for religion influence in 174 countries in 2010.

All of the estimations in this paper with various control variables show that religion has no significant effect on corruption. This study also investigated the impact of government imposed religion on corruption as a robustness check. It was also found such influence has no impact on corruption. In other words, religion is an internal barrier for avoiding bad actions but religion orders are not enough for avoiding corruption. Furthermore, this study finds that corruption and

its control are not the results of any religion when the religion does not make social norms. Perhaps we have to focus on other cultural factors like media for improving our anti-corruption programs.

References

Aidt, Toke, Dutta Javasri, and Sena Vania. 2008. "Governance Regimes, Corruption and Growth: Theory and Evidence." *Journal of Comparative Economics*, 36(2): 195-220.

Alesina, Alberto, Arnaud Devleeschauwer, William Easterly, Sergio Kurlat, and Romain Wacziarg. 2003. "Fractionalization." *Journal of Economic Growth,* 8(2): 155-94.

Anokhin, Sergey, and William S. Schulze. 2009. "Entrepreneurship, Innovation, and Corruption." *Journal of Business Venturing,* 24(5): 465-76.

Apergis, Nicholas, Oguzhan C. Dincer, and James E. Payne. 2012. "Live Free or Bribe: On the Causal Dynamics Between Economic Freedom and Corruption in U.S. States." *European Journal of Political Economy,* 28(2): 215-26.

ARDA. Association of Religion Data Archives. 2013. Retrieved from http://www.thearda.com/internationalData/.

Baker, Colin. 1988. "The Genesis of the Nyasaland Civil Service." *The Society of Malawi Journal,* 41(1): 30-44.

Barr, Abigail, and Danila Serra. 2010. "Corruption and Culture: An Experimental Analysis." *Journal of Public Economics*, 94(11-12): 862-69.

Bhattacharyya, Sambit, and Roland Hodler. 2010. "Natural Resources, Democracy and Corruption." *European Economic Review,* 54(4): 608-21.

Blackburn, Keith, and Jonathan Powell. 2011. "Corruption, Inflation and Growth." *Economic Letters*, 113(3): 225-27.

Cameron, Lisa, Ananish Chaudhuri, Nisvan Erkal, and Lata Gangadharan. 2009. "Propensities to Engage in and Punish Corrupt Behavior: Experimental Evidence From Australia, India, Indonesia and Singapore." *Journal of Public Economics,* 93(7-8): 843-51.

Chowdhury, Shyamal K. 2004. "The Effect of Democracy and Press Freedom on Corruption: An Empirical Test." *Economic Letters,* 85(1): 93-101.

Dreher, Axel, Christos Kotsogiannis, and Steve McCorriston. 2007. "Corruption Around the World: Evidence From a Structural Model." *Journal of Comparative Economics,* 35(3): 443-66.

Egger, Peter, and Hannes Winner. 2005. "Evidence on Corruption as an Incentive for Foreign Direct Investment." *European Journal of Political Economy,* 21(4): 932-52.

Evrensel, Ayşe Y. 2010. "Corruption, Growth and Growth Volatility." *International Review of Economics and Finance*, 19(3): 501-14.

Fisman, Raymond, and Roberta Gatti. 2002. "Decentralization and Corruption: Evidence Across Countries." *Journal of Public Economics*, 83(3): 325-45.

Freedom House. 2013. www.freedomhouse.org/report/freedom-world/freedom-world-2013.

Gerring, John, and Strom C. Thacker. 2005. "Do Neoliberal Policies Deter Political Corruption?" *International Organization*, 59(1): 233-54.

Gokcekus, Omer. 2008. "Is it Protestant Tradition or Current Protestant Population that Affects Corruption?" *Economic Letters*, 99(1): 59-62.

Graeff, P., and G. Mehlkop. 2003. "The Impact of Economic Freedom on Corruption: Different Patterns for Rich and Poor Countries." *European Journal of Political Economy*, 19(3): 605-20.

Heritage Foundation. 2010. Retrieved from: http://www.heritageindex.org.

Judge, William Q., D. Brian McNatt, and Weichu Xu. 2011. "The Antecedents and Effects of National Corruption: A Meta-Analysis." *Journal of World Business,* 46(1): 93-103.

Kingston, Christopher. 2008. "Social structure and cultures of corruption." *Journal of Economic Behavior & Organization,* 67(1) : 90-102.

Kolstad, Ivar, and Tina Søreide. 2009. "Corruption in Natural Resource Management: Implications for Policy Makers." *Resources Policy,* 34(4): 214-26.

La Porta., Rafael, Florencio Lopez-de-silane, Andrei Shleifer, and Robert W. Vishny. 1997. "Trust in Large Organizations." *The American Economic Review, Papers and Proceedings,* 87(2): 333-38.

La Porta., Rafael, Florencio Lopez-De-Silanes, Andrei Shleifer, and Robert W. Vishny. 1999. "The Quality of Government." *Journal of Law, Economics and Organization,* 15(1): 222-79.

Lambsdorff, Johann Graf. 2005. "Consequences and Causes of Corruption: What do we know from a Cross-Section of Countries?" *Passauer Diskussionspapiere: Volkswirtschaftliche Reihe*, No. V-34-05, Universität Passau.

Newey, Whitney K., and Kenneth D. West. 1987. "A Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix." *Econometrica*, 55(3): 703-08.

North, Douglass C. 1990. *Institutions, Institutional Change and Economic Performance*. Cambridge, UK: Cambridge University Press.

North, Charles M., Wafa Hakim Orman, and Carl R. Gwin. 2013. "Religion, Corruption and the Rule of Law." *Journal of Money, Credit and Banking,* 45(5): 757-79.

Olson, Mancur. 1993. "Dictatorship, Democracy, and Development." *The American Political Science Review,* 87(3): 567-76.

Paldam, Martin. 2001. "Corruption and Religion adding to the Economic Model." *Kyklos,* 54(2-3): 383-413.

Paldam, Martin. 2002. "The Cross-Country Pattern of Corruption: Economics, Culture and the Seesaw Dynamics." *European Journal of Political Economy,* 18(2): 215-40.

Petermann, Andrea, Juan Ignacio Guzmán, and John E. Tilton. 2007. "Mining and Corruption." *Resources Policy*, 32(3): 91-103.

Pieroni, Luca, and Georgio d'Agostino. 2013. "Corruption and the Effects of Economic Freedom." *European Journal of Political Economy* 29: 54-72.

Przeworski, Adam, and Fernando Limongi. 1993. "Political Regimes and Economic Growth." *Journal of Economic Perspectives*, 7(3): 51-69.

Samanta, Subarna K. 2011. "Corruption, Religion and Economic Performance in OPEC Countries: An Analysis." *International Journal of Economics, Management and Accounting*, 19(2): 187-208.

Sandholtz, W., and M. M. Gray. 2003. "International Integration and National Corruption." *International Organization*, 57(4): 751-64.

Scully, Gerald W., and Daniel J. Slottje. 1991. "Ranking Economic Liberty Across Countries." *Public Choice*, 69(2): 121-52.

Shabbir, Ghulam, and Mumtaz Anwar. 2007. "Determinants of Corruption in Developing Countries." *The Pakistan Development Review*, 46(4): 751-64.

Shrabani, Saha, Rukmani Gounder, and Jen-Je. Su. 2009. "The Interaction Effect of Economic Freedom and Democracy on Corruption: A Panel Cross-Country Analysis." *Economic Letters*, 105(2): 173-76.

Sims, Randi L., Baiyun Gong, and Cynthia P. Ruppel. 2012. "A Contingency Theory of Corruption: The Effect of Human Development and National Culture." *The Social Science Journal*, 49(1): 90-7.

Spindler, Zane A. 1991. "Liberty and Development: A Further Empirical Perspective." *Public Choice*, 69(2): 197-210.

Treisman, Daniel. 2000. "The Causes of Corruption: A Cross-National Study." *Journal of Public Economics*, 76(3): 399-457.

Transparency International. 2013. Retrieved from: http://www.transparency.org/surveys/index.

UNDP. 2010. *Human Development Report*, Published for the United Nations Development Programme. Retrieved from: http://www.hdr.undp.org.

Vorhies, Frank, and Fred Glahe. 1988. "Political Liberty and Social Development: An Empirical Investigation." *Public Choice,* 58(1): 45-71.

Wittman, Donald. 1989. "Why Democracies Produce Efficient Results." *Journal of Political Economy*, 97(6): 1395-424.

World Bank. 2013. Retrieved from: www.worldbank.org/data/indicators.

Worldwide Governance Indicators. 2013. Retrieved from: http://www.govindicators.org.