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THE EFFECT OF MANAGERIAL OVERCONFIDENCE ON CONFERENCE CALLS

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ABSTRACT

This study examines the relation between managerial overconfidence and conference calls. Prior studies document that some managers tend to be overconfident because they believe they have more precise knowledge about future events than they genuinely possess. Overconfident managers tend to convene conference calls since they are an important tool to disclose information about the future. We examine how managerial overconfidence affects the occurrence and frequency of conference calls using evidence from the Taiwan stock market. To measure managerial overconfidence, following Kolasinski and Li (2013), we use an example of managers purchasing their own firm's stock over a two-year period, followed by negative average returns. Based on data from publicly listed firms in Taiwan for the period from 2005 to 2015, the results provide robust evidence, suggesting that managerial overconfidence and conference calls are significantly positively correlated. We find that companies with higher managerial overconfidence are likely to frequently convene conference calls. Prior research on managerial overconfidence mainly discussed the impact on financing and investment decisions, while this study provides further supplementary evidence of the impact of convening conference calls, and managerial decisions on disclosure behavior.

JEL: D12, D25, M10

KEYWORDS: Conference Call, Managerial Overconfidence

INTRODUCTION

The purpose of this study is to investigate whether managerial overconfidence affects the frequency and occurrence of conference calls convened by managers. Overconfidence is an important behavior of managers and has been widely studied in the academic literature in the recent years. Academia has great interest in the subject of behavioral finance in the past few decades. In all fields of finance, researchers have made efforts to integrate behavioral finance into traditional finance and as a result, behavioral finance has become a complete academic field. Behavioral finance mainly focuses on the premise that "humans may not be entirely rational". Therefore, humans' financial behavior may not be as rational as expected by the traditional finance. Behavioral financial scholars usually call it Quasi-Rational (Thaler, 1991).

In the economic world, the main actors, either firm (or institutional) managers or general investors (or consumers), may all operate using irrational behavior. These behaviors include overreaction and underreaction. Behind the overreaction or underreaction, there is some psychological factors that drive these behaviors, such as over-optimism, overconfidence, conservative, representative bias, psychological accounts, and so on. Among these various psychological factors, finance researchers pay most attention to overconfidence. People with overconfidence oftentimes overestimate his/her ability, judgment, or career success. But in reality, results are not the same as expected and the bias has a significant impact. Prior research focuses on the behavior of individual investors (or consumers). Research concerning the behavior

of managers in the enterprise (or institution) has received increasing attention recently. Managerial overconfidence (or also usually called CEO overconfidence) has become an interesting issue of study. However, the definition of managerial confidence in this article is different from CEO overconfidence, and will be explained and discussed it in the later sections.

Literature has argued that overconfident managers were overly optimistic and overconfident. Based on both empirical and theatrical research, there is an ongoing debate about the benefits and costs for a firm with managerial overconfidence. One view is that managers overconfidence has a positive impact on the firm's performance, implying that overconfident managers may actually benefit shareholders through higher stock returns, greater profitability, and lower risk. Another view, however, suggested that overconfident CEOs may have a negative impact on firm performance because of the CEOs' over financing and investing actions. Previous theoretical literature (Gervais, Heaton, and Odean 2011) and empirical studies (Baker, Ruback, and Wurgler 2007) support that overconfident managers affect firm's material financial decision-making. The financial decisions include investment decisions (Malmendier and Tate 2005a; 2005b; Yu 2014), financing decisions (Malmendier, Tate, and Yan 2011), dividend policy (Deshmukh, Goel, and Howe 2013), and acquisition (Brown and Sarma, 2007; Doukas and Petmezas 2007; Malmendier, and Tate 2008; Martin and Davis 2010; Ferris, Jayaraman, and Sabherwal 2013; Yim 2013; Kolasinski and Li 2016), etc.

Whether overconfident managers affect firm's information disclosure behavior is another stream of prior research. For instance, Nagar, Nanda, and Wysocki (2003) hypothesize and find that managers with more stock-based incentives will issue more frequent forecasts to avoid equity mispricing. Ajinkya, Bjojraj, and Sengupta (2005) study the effect of corporate governance mechanisms on forecast properties and find that firms with greater institutional ownership and outside directors are more likely to provide forecasts. Their forecasts are also less optimistically biased and more precise. Bamber, Jiang, and Wang (2010) investigate whether individual managers play an economically significant role in their firms' voluntary financial disclosure choices and find that managers' unique disclosure styles are associated with observable demographic characteristics of their personal backgrounds. Hribar and Yang (2016) find that overconfident CEOs increase the likelihood of issuing a forecast, the amount of optimism in management forecast, and the precision of the forecast.

Managers tend to be overconfident when they believe that they have more precise knowledge about future events than they actually do. And consequently, overconfident managers usually overestimate future returns from their firms' investment and therefore, the expectation of the future performance. Prior studies also contend that managers consider a variety of costs and benefits when deciding whether to disclose the firm's information about the unknown future. However, since overconfident managers overestimate their own knowledge about the future, it is reasonable to infer that overconfident managers may have the motivation to hold conference calls. As the economic environment changes rapidly and also trading patterns are increasingly complex, information obtained by investors from the financial statements provided by company is not enough to accurately evaluate the value of the company. Thus, the problem of information asymmetry between managers and investors has become increasingly serious. To decrease the information asymmetry problem, it is appropriate to deliver information to investors by convening conference calls. Traditionally, firms communicate with investors by financial reports. But more and more research has indicated that financial statements may not properly convey corporate performance and future prospects. For example, information about getting new markets or customers and developing new products is hard to convey by traditional financial statements (Tasker, 1998). Therefore, in addition to financial statements, other external communication tools are also needed.

Conference calls not only allow companies to communicate with their investors, but also allow investors to express their views to the company. More companies use it as a communication tool (Kimbrough 2005). Since confident managers are more optimistic about future prospects, they will be more apt to hold conference calls to share and disclose information about future. Hopefully, investors will response

positively about the information disclosed and reflect that optimism in stock prices. Based on the above discussion, it is worth investigating whether managerial overconfidence is associated with firm's convening conference calls since conference calls are a useful tool for disclosing information, especially for Taiwan's listed companies. Managerial overconfidence contributes to decisions of disclosure and may increase their willingness to disclose material regarding future information about the firms. Conference calls are an important tool for Taiwan's listed companies to disclose information. The purpose of this research is to examine whether companies with higher managerial overconfidence would be more likely and more frequently to convene conference calls.

This study discusses the following issues of Taiwan's public listed companies through corporation's convening conference calls: First, whether companies with higher managerial overconfidence would be more likely to convene conference calls. Second, whether companies with higher managerial overconfidence would increase the frequency of convening conference calls. Third, whether companies with higher managerial overconfidence would increase the frequency of convening conference calls. In order to confirm whether there is a relationship between managerial overconfidence and conference calls, further sensitivity tests are provided including separating firms with different category and using different proxy of measuring overconfidence. The remainder of this paper is organized as follows: In the next section, we provide an institutional background on convening conference calls in Taiwan and literature review of major research direction of managerial overconfidence and conference calls. In section three, we develop hypotheses for testing the linkage between managerial overconfidence and conference calls, and also describe the methodology, empirical model, variables and data. We then present the empirical results and discuss the findings in the section Four. The final section concludes the study with recommendations for further research.

LITERATURE REVIEW

Prior Research of Managerial Overconfidence

Behavioral finance theory had its formal beginnings in the 1980s, quickly receiving the attention of economic, accounting and financial scholars. It became a main-stream economic theory in the 1990s. Presently, all fields of finance have integrated and researched behavioral issues, and behavioral finance has become a structural integrity discipline. In contract to the efficient market hypothesis, behavioral finance considers investors to be not completely rational, and therefore the financial behavior of people may not be as rational as expected by traditional finance. For example, irrational investors often make investment decisions based on previous experiences or emotions. Earlier research focused on the behavior of individual investors (or consumers). The irrational behavior of general investors (or consumers) is discussed first since they are main actors in the financial world. Subrahmanyam (2008) offered a good review of investor's irrational behavior. However, managers of an enterprise (or institution) are also important actors worth studying. Both investors and managers may experience irrational behavior such as overreaction or underreaction. In this paper, we study the firm's convening conference calls behavior. We focus on the influence of firm managers' irrational behavior and overconfidence, instead of investors (shareholder) behavior. Although, there are many irrational behaviors discussed and studied in the prior research, heuristic bias and managers' overconfidence are well-documented theories related to investor irrational behaviors. Overconfidence is a kind of overreaction behavior that is hidden behind a variety of psychological factors, such as over optimism, overconfidence, conservativeness, representative bias, psychological accounts, and other psychology.

In psychology, heuristics are simple, efficient rules which people use to form judgments and make decisions. Heuristics are basically "rule of thumb" gained from previous experiences that create a bias based on the experience rather than logic. Overconfidence is an important heuristic bias that can influence people making investment decisions. Given the encompassing nature of overconfidence, we focus on overconfidence

instead of heuristics in this research. A number of cognitive psychology literatures, including both theoretical and application research, conclude that people are apt to be overconfident or optimum, especially being overconfident about the accuracy of their own knowledge. People systematically underestimate certain types of information and overestimate other information. Gervais, Heaton and Odean (2003) define overconfidence as a belief that the accuracy of their knowledge is higher than the degree of fact. That is, the weight given to their own information is greater than the de facto weight. The study of subjective probability measures also found an overly optimistic estimate of the accuracy of their knowledge.

Over optimism and overconfidence is a potent combination. Those with overconfidence usually judge their own ability, probability of success or career prospects with confidence. Taylor and Brown (1988) believe that overconfidence and optimism for the business manager are two of the most important personal characteristics. Ben-David, Graham, and Harvey (2013) found that senior managers are, at the same time, overconfident and optimistic. Barber and Odean (2001) analyze the common stock investments of men and women and document that men trade 45 percent more than women. Because psychological research demonstrates that, in areas such as finance, men are more overconfident than women. The result confirms that overconfident investors trade excessively. Goel and Thakor (2008) develop a model that claims that an overconfident manager has a higher likelihood to be promoted to CEO because of "value-maximizing" policy. Malmendier and Tate (2005a) argue that managerial overconfidence can account for corporate investment distortions. Overconfident managers tend to overestimate the returns on investment projects. They view external funds as unduly costly. Thus, they overinvest when they have abundant internal funds, but curtail investment when they require external financing. Malmendier and Tate (2005b) present supplementary evidence on the relationship between CEOs' press portrayals and overconfident investment decisions. Overconfidence is one of the characteristics of the high-level executive manager.

Brown and Sarma (2007); and Doukas and Petmezas (2007) both argue that managerial traits of managers affect M&A decisions. Hribar and Yang (2016) found that overconfident managers tend to delay loss recognition and generally use less conservative accounting. Schrand and Zechman (2012) argued that overconfident executives are apt to reveal an optimistic bias and thus are more likely to display a declining growth of intentional misstatements. Hirshleifer, Low, and Teoh (2012) provide evidence that firms with overconfident CEOs have greater return volatility, invest more in innovation, obtain more patents and patent citations, and achieve greater innovative success for given research and development expenditures. Hilary, Hsu, Segal and Wang (2016) show that after a series of successes, CEOs become more optimistic and exaggerate their abilities. Campbell, Gallmeyer, Johnson, Rutherford, and Stanley (2011) provide evidence that CEOs with low (high) optimism face a higher probability of forced turnover than their moderately optimistic counterparts. Kaplan, Klebanov, and Sorensen (2012) explore the relationship between CEO characteristics and hiring decisions, investment decisions and corporate performance. Ben-David, Graham, and Harvey (2007) show that companies with overconfident CFOs invest more, use more debt and are less likely to pay dividends.

Prior psychical studies have found that experts tend to be overconfident (Heath and Tversky 1991; Kirchler and Maciejovsky 2002; Glaser and Weber 2007). Financial experts, including fund managers and analyst financial advisors are more likely to be overconfident (Moore and Healy 2008; Menkhoff, Schmidt, and Brozynski 2006; Torngren and Montgomery 2004). Sivanathan and Galinsky (2007) confirmed that the higher the power of the CEO, the more likely to be overconfident. Managers, especially the CEO of the firm, are high-level supervisors in the organization and have the power to determine the future development of the enterprise. Fellner-Röhling and Krügel (2014) argue that the measurement of overconfidence can be divided into the following three categories: (1) the overconfidence of judgment (over-overestimation of the accuracy of the judgment); (2) self-enhancement biases, such as self-perceived above-average positive self-illusion and control illusion (March and Shapira 1987); (3) optimism with respect to societal risks (Hilton, Régner, Cabantous, Charalambides, and Vautier 2011). Among them, the first category is most often mentioned (e.g., Odean 1998; Kyle and Wang 1997; Benos 1998; Caballé and Sákovics 2003).

In the financial empirical literature, managers' overconfidence is measured as follows: (1) managers' equity (Malmendier and Tate 2005a; 2005b; 2008); (2) media reports (Hayward and Hambrick 1997; Malmendier and Tate 2008 ; Brown and Sarma 2007; Hribar and Yang 2016; Jin and Kothari 2008); (3) earnings forecast and actual surplus deviation (Lin, Hu, and Chen 2008; Hribar and Yang 2016); (4) initiation of enterprise M&A frequency (Malmendier and Tate 2008; Doukas and Petmezas 2007); (5) manager relative compensation (Hayward and Hambrick 1997)；(6) company's current performance (Hayward and Hambrick 1997; Cooper, Woo, and Dunkelberg 1988); (7) manager's purchases of his own firm's stock in the secondary market over the past 2 years with a negative abnormal returns (Kolasinski and Li 2013).

Each of the above measures has shortcomings. For example, the advantage of stock options is that it can expose manager's beliefs more precisely. However, the disadvantage is that the researcher must collect details of the stock options and the collecting cost is very expensive. The advantage of the media measurement method is that the outside world viewpoint is exogenous and therefore more objective, but the disadvantage is that there will be too much noise and hence needs to bear a wide range of expensive collection costs. The advantage of managers buying their own firm's stock in the secondary market is also about exposing manager's beliefs more precise, but managers' buying their own stock may also earn non-negative abnormal returns. Andriosopoulos, Andriosopoulos, and Hoque (2013) show that information disclosure and CEO overconfidence are significant determinants of share buyback completion rates using data from UK. Malmendier et al. (2011) find that CEOs who personally overinvest in their companies are significantly less likely to issue equity.

Prior Research of Conference Calls

Conference calls are a popular communication tool and have become a standard practice in well-developed markets globally (Bowen, Davis, and Matsumoto, 2002). Conference calls are a bridge between the top-executive of the firm and the investor (Tasker 1998; Frankel, Johnson, and Skinner 1999; Bushee, Matsumoto, and Miller 2003; Bowen et al. 2002; Kimbrough and Louis 2011). Usually there are two sections in a conference call, a presentation section and a question-and-answer section. It allows top executives to declare the firm's operation, investing, and financing activities. It also provides a channel for investors to inquire and challenge the company's future vision and decision-making (Hollander, Pronk and Roelofsen 2010; Dell'Acqua, Perrini, and Caselli 2010; Matsumoto, Pronkz and Roelofsen 2011). Therefore, conference calls seem to be a better way to communicate with each other and deliver information, compared with other disclosure tools. Earlier studies explore the determinants of conference calls. Frankel et al. (1999) find that firms that hold conference calls tend to be larger, more profitable, and have a larger analyst following. Tasker (1998) finds that firms with low accounting quality are more likely to hold conference calls. She measures accounting quality using a composite measure based on market-book ratios, sales growth rates, and the extent to which book value and earnings explain stock prices. Sunder (2002) shows that the Regulation Fair Disclosure requirements of the US Securities and Exchange Committee (SEC) have been an impetus to increasing the popularity of conference calls as a voluntary disclosure medium.

Extant literature also documents of the information content of conference calls in non-Taiwanese contexts. Frankel et al. (1999) found significantly increasing returns volatility during the conference-call period. Bowen et al. (2002) indicate that conference calls enhance analysts' ability to forecast earnings accurately and help level the playing field among analysts. Bushee et al. (2003) examines open conference calls where the public, including individual investors, can access the calls on a real-time basis, and these researchers also find a high level of trading activity and returns volatility during the conference-call period. As mentioned previously, while conference calls are expected to convey information about innovative activities, few studies address the effect of innovation on conference-call announcement returns. Prior literature also documents the information content of conference calls. Frankel et al. (1999) find significantly increasing returns volatility during the conference call period. Bowen et al. (2002) indicate that conference

calls enhance analysts' ability to accurately forecast earnings and help level the playing field among analysts. Bushee et al. (2003) examine open conference calls where the public, including individual investors, can access the calls on a real-time basis and these researchers also find both a higher level of trading activity and returns volatility during the conference call period.

Kimbrough (2005) find the initiation of conference calls is associated with a significant reduction in serial correlation in analyst forecast errors and associated with significant reductions of initial investor underreaction. Mayew (2008) find that conference calls, and the potential for public information, complement the existing private information of financial analysts. Bowen et al. (2002) find evidence that conference calls can increase the total information available about a firm and decrease dispersion among analysts. Hollander et al. (2010) suggests that managers regularly leave participants on the conference call in the dark by not answering their questions and investors seems to interpret silence negatively.

Another stream of prior research of conference call focus on its influence on the economic consequences. Dell'Acqua et al. (2010) find that the use of conference calls is greater in the high tech sector than in other industries, and more open conference calls results in lower idiosyncratic price volatility of high tech firms listed in the US market. Chin, Lee, Wang, and Kleinman (2007) find that the likelihood and frequency of conference calls are positively associated with innovation using Taiwan data. Kimbrough and Louis (2011) find that bidders are more likely to hold conference calls at merger announcements when the mergers are financed with stock and when the transactions are large. They also find that conference calls are associated with more favorable market reactions to merger announcements.

Matsumoto et al. (2011) examine the information content of both segments of the call - the presentation and the discussion segment. They find that both segments have incremental information content over the accompanying press release, but discussion periods are relatively more informative than presentation periods. Ahmed and Duellman (2013) argue that overconfident managers overestimate future returns from their firms' investments. Therefore, they predict that overconfident managers will tend to delay loss recognition and generally use less conservative accounting. Bushee, Matsumoto, and Miller (2004) suggest that Regulation Fair Disclosure impacts trading during the conference call window for firms more affected by new regulations. Meanwhile Irani (2004) examines the effect of Regulation Fair Disclosure (FD) on the relevance of company-sponsored conference calls and find larger improvements in both variables during the period surrounding conference calls in the post-FD era versus the pre-FD era. Bushee et al. (2003) found that companies with more shareholders, lower ratio of institutional shareholding and higher turnover ratio are more likely to hold conference calls.

METHODOLOGY AND DATA

Hypotheses Development and Estimation Models

The first part of the hypotheses-development section discusses the relation between managerial overconfidence and conference calls. Despite the increasing popularity of conference calls, there is an ongoing debate about the benefits and costs for a firm with managerial overconfidence. One view is that managerial overconfidence has a positive impact on the firm's performance, implying that managerial overconfidence may benefit shareholders through higher stock returns, greater profitability, and lower risk. The other view is that managerial overconfidence may have a negative impact on the firm because of over-financing investments. Since overconfident managers usually overestimate future returns from their firms' investments, their over-optimism increases the expectation of future performance. Prior studies also document that managers consider a variety of costs and benefits when deciding whether to issue forecasts about unknown future earnings, and managerial overconfidence may also contribute to this decision.

Prior research also concluded that the confidence of the managers may affect their decision to release

earnings forecasts. This result raises a question of the motivation of overconfident managers convening conference calls as the conference call is a useful tool for disclosing information voluntarily, especially for Taiwan's listed companies. Therefore, managerial overconfidence contributes to their decisions of voluntary disclosure and may increase their willingness to disclose information about the firms. In the meantime, since the conference call is an important tool for Taiwan's listed companies to disclose information voluntarily, the main purpose of this research is to examine whether companies with higher managerial overconfidence would be more likely to convene conference calls. Hence managerial overconfidence will increase the probability of convening conference calls. Thus, the following hypothesis is developed:

H1: Ceteris Paribus, the Likelihood of Convening Conference Calls is Positively Associated with Managerial Overconfidence.

In the past economic literature, investors were exposed to the high risk of information asymmetry during the transaction. Increasing the frequency of disclosure can reduce the degree of information asymmetry. First, conference calls make it possible for the future private information of the company to be disclosed before some investors (informed traders) find the provided information, which can reduce the information asymmetry of other uninformed traders. Secondly, the more conference calls that occur, the more information some investors receive, and the decision-making quality of investors will be better. Finally, the true expected value of the firm can be discovered by all investors. Therefore, the greater the frequency of firm's holding conference calls, the lower the degree of information asymmetry. Chin et al. (2007) find that not only the likelihood but also the frequency of conference calls are positively associated with innovation based on the Taiwan data. Confident managers tend to use conference call as a tool to disclose information since they have confidence about their ability to communicate with investors. Therefore, we argue that the frequency of conference calls is positively associated with managerial overconfidence. Thus, the following hypothesis is developed:

H2: Ceteris Paribus, the Frequency of Convening Conference Calls is Positively Associated with Managerial Overconfidence.

Based on prior research, this article first estimates the association between managerial overconfidence and conference calls using a robust probit model and ordered probit model. Based on Tasker (1998) and Frankel et al. (1999), we consider the variables that may interfere with convening conference calls as control variables including external information environment, internal shareholding structure, and other firm-specific characteristics. We use the following regression model to estimate the predicted value of the probability that firm convene conference call:

Likelihood of Conference Calls = f (Overconfidence, Control Variables)

$$Call_{it} = \alpha + \beta_1 Overconfidence_{it} + \beta_2 InstitutionalShares_{it} + \beta_3 DirectorShares_{it} + \beta_4 ManagerShares_{it} + \beta_5 BigHolderShares_{it} + \beta_6 AnalystFallow_{it} + \beta_7 Assets_{it} + \beta_8 SalesGrouth_{it} + \beta_9 Leverage_{it} + \beta_{10} ROA_{it} + \beta_{11} MB_{it} + \beta_{12} Duality_{it} + \beta_{13} Turnover_{it} + \sum Year_{it} + \sum Industry_{it} + \varepsilon_{it} \quad (1)$$

Frequency of Conference Calls = f (Overconfidence, Control Variables)

$$Frequency_{it} = \alpha + \beta_1 Overconfidence_{it} + \beta_2 InstitutionalShares_{it} + \beta_3 DirectorShares_{it} + \beta_4 ManagerShares_{it} + \beta_5 BigHolderShares_{it} + \beta_6 AnalystFallow_{it} + \beta_7 Assets_{it} + \beta_8 SalesGrouth_{it} + \beta_9 Leverage_{it} + \beta_{10} ROA_{it} + \beta_{11} MB_{it} + \beta_{12} Duality_{it} + \beta_{13} Turnover_{it} + \sum Year_{it} + \sum Industry_{it} + \varepsilon_{it} \quad (2)$$

where *Call* is an indicator variable equal to one if the firm convenes conference call in the fiscal year and zero otherwise. *Frequency* is the number of conference calls held by a firm in a fiscal year. *Overconfidence* is an indicator variable equal to one if a member of the board of directors (and supervisors) or/and anyone of top managers purchase their own firm's stock over a two-year period, followed by negative average returns and zero otherwise. *InstitutionalShares* is the ratio of institutional investors' shareholding. *DirectorShares* is the ratio of directors' shareholding. *ManagerShares* is the ratio of non-directors managers' shareholding. *BigHolderShares* is the ratio of big shareholders' shareholding. *AnalystFollow* is the analysts' coverage in the previous year. *AnalystFollowTimes* is the frequency of analysts' coverage in the previous year. *Assets* is the natural logarithm of total asset. *SalesGrowth* is the sales growth of previous year. *Leverage* is the sum of long-term debt plus debt in current liabilities, divided by total assets. *ROA* is return on assets. *MB* is the sum of fiscal year-end market value of equity and book value of liabilities, divided by total assets. *Duality* is an indicator variable equal to one if the chairman and CEO of the company is the same person and zero otherwise. *Turnover* is the yearly turnover rate (%). *Year* is an indicator variable for controlling year effects. *Industry* is an indicator variable for controlling industry effects.

Variables

To measure the dependent variable of firm's convening a conference call, we use two measurements including *Call* and *Frequency*. *Call* is an indicator variable equal to one if the firm convenes a conference call in the fiscal year and zero otherwise. *Frequency* is the number of conference calls held by a firm in a fiscal year. *OC_DMS* is an indicator variable equal to one if the firm convenes conference call in the fiscal year and zero otherwise. To measure the main independent variable of overconfidence, we first collect data on the major methods identified in the prior financial empirical literature: (i) news media reports on managers' evaluations (Hayward and Hambrick, 1997; Malmendier and Tate, 2005a, 2008; Brown and Sarma, 2007; Hribar and Yang, 2016; Jin and Kothari, 2008); (ii) deviation between earnings forecasts and actual earnings (Lin Lin, Hu, Chen, 2005, 2008; (iii) timing of managers' exercising stock options (Malmendier and Tate, 2005b, 2008); (iv) whether managers increase their own firm's stock share (Malmendier and Tate, 2005 a, 2008; Lin, Hu and Chen, 2008; Liu, Liu, and Diaz, 2016); (v) managers purchasing their own firm's stock share in the secondary market and the ex post returns are negative (Kolasinski and Li, 2013). The following are the analysis of these various kinds of overconfidence measurement, and also provide reasons why we only use the last method as a proxy for overconfidence.

First, using "news media reports on managers' evaluations" as the proxy of measuring overconfidence, it is based on the portrayal of the manager (CEO) in the news media. If the media's assessment of managers is positive or assertive, they are overconfident. This type of measurement, because it is based on outsider' perceptions, may involve subjective personal feelings and may therefore create measurement bias. In addition, there are relatively few media such as the New York Times, Business Week and the Wall Street Journal in Taiwan, which often have complete reviews of the company's managers in the stock market, and also almost only the famous managers are evaluated, and there still have a larger majority of other managers that rarely or even never been commented on in the media. Therefore, this measure of overconfidence is not applicable based on empirical limitation in Taiwan.

Second, using "deviation between earnings forecasts and actual earnings" as the proxy of measuring overconfidence, is based on the notion that managers are overconfident if they overestimate corporate earnings. Using data from Taiwan, Lin, Hu, and Chen (2005, 2008) do use deviation between earnings forecasts and actual earnings as the proxy of measuring overconfidence. However, due to the rapidly changing laws and regulations in Taiwan, the Financial Supervisory Commission of the Executive Yuan in Taiwan revised and formally adopted a voluntary financial forecasting system beginning in 2004. The number of firms that voluntarily disclose the financial forecasting has dramatically dropped since 2005. However, the empirical period of this article is from 2005 to 2015, so this measure of overconfidence is not applicable based on the limitation of sample size in the sample period in Taiwan.

Third, using "timing of managers' exercising stock options" as a proxy of measuring overconfidence, is based on the timing or holding period length to measure whether managers are overconfident. Managers are seen as overconfident if they do not immediately exercise in-the-money options. But this method must be based on the fact that the companies in general offer stock options to managers. This is factual for listed companies in the United States but maybe not for listed companies in Taiwan. In 2005, the number of executable options is only about 100 in Taiwan. Also based on the limited sample size, this measure of overconfidence is not applicable based on empirical limitation in Taiwan.

Fourth, using "whether managers increase their own firm's stock share" as the proxy of measuring overconfidence, is only based on whether the managers increase their own companies' stock. Liu et al. (2016) analyze the effect of manager overconfidence and compensation on their stock repurchase performance using data from Taiwan listed companies. Their definition of overconfidence is that the CEO continuously increases ownership of their own companies' stock or stock options in two years. This method only considers whether the ownership of shares or stock options increases or not without considering other factors. As a proxy variable of overconfidence, this measure may be inadequate. Therefore, in addition to the consideration of "increasing shareholdings for two consecutive years during their tenure of office", this study also considers the "returns during or after shareholding period".

Finally, using "managers purchasing their own firm's stock share in the secondary market and the ex post returns are negative" as the proxy of measuring overconfidence, it is proposed by Kolasinski and Li (2013). The reason why Kolasinski and Li (2013) suggested this measurement is because it is consistent with the theoretical definition of overconfidence literature (Hackbarth, 2008; Heaton, 2002; Malmendier and Tate, 2005a; Roll, 1986) and is also similar with the spirit of measurement in Malmendier and Tate (2008). In this study, following Kolasinski and Li (2013), we use "managers purchasing their own firm's stock share in the secondary market and average returns during the holding period is negative" as the proxy of overconfidence. Furthermore, we use "managers purchasing their own firm's stock share in the secondary market and ex-post 180 days return is negative" as another proxy of overconfidence for robustness testing. Observing manager' stock price performance over a period of 180 days after experiencing an increase in shareholdings for two consecutive years with negative returns indicates that managers are overconfident.

To investigate the behavior of firm decision makers, the definition of manager in the prior literature focuses primarily on the chief executive officer (CEO). It is easily found that the title of the paper usually appears with "CEO confidence. However, most of these mainstream academic papers are based on research data from the United States. According to the rights and obligations of listed companies' CEOs in the United States, it is reasonable to focus on the CEO as the representative of managers to study overconfident behavior.

This research is based on empirical data from listed companies in Taiwan. However, corporate governance is not so perfect in Asian countries like Taiwan. The board of directors has a greater inference on firm's operation. Hence, we use both top manager and directors of the board as targets for measuring managerial overconfidence. We consider whether directors of the board and supervisors are overconfident in addition to their managers. Meanwhile, the definition of top manager provided by the Taiwan Economic Journal (TEJ) is not only the chief executive officer (CEO), but also the senior executive who has an influence on the company's decision-making. Consequently, the definition of manager in this paper include directors of the board, supervisors, chief executive officer, general manager, vice general manager, and finance and accounting manager. Hereafter, we use both top manager and directors as the target of measuring managerial overconfidence. OC_Directors_2 is an indicator variable equal to one if a member of the board of directors (and supervisors) purchase their own firm's stock over a two-year period, followed by negative average returns and zero otherwise. OC_Managers_2 is an indicator variable equal to one if top managers, including the chief executive officer, general manager, vice general manager, and finance and accounting manager, purchase their own firm's stock over a two-year period, followed by negative average returns. OC_mds_2

is an indicator variable equal to one if a member of the board of directors (and supervisors) or anyone of top managers purchase their own firm's stock over a two-year period, followed by negative average returns and zero otherwise. Control variables that influence the convening conference call in the model are follow Tasker (1998) and Frankel et al. (1999).

Data

The information of conference calls is from Market Observation Post System (MOPS) provided by the Taiwan Stock Exchange. The source of transaction data and accounting variables is taken from Taiwan Economic Journal (*TEJ*). The data for conference call is from Market Observation Post System constructed by TWSE. The sampling period is from 2005 to 2015. The reason for starting the sample period in 2005 is because the Financial Supervisory Commission of the Executive Yuan in Taiwan revised and formally adopted a voluntary financial forecasting system beginning in 2004. Since 2005, the number of firms holding conference calls increased year by year. Original samples include companies listed on the Taiwan Stock Exchange and Gre Tai Securities Market (GTST). The original sample size is 14,989. Companies that presented incomplete data or those that failed to meet eligibility criteria were eliminated. Finally, 12,912 valid samples were collected. The sample screening process is tabulated in Table 1.

Table 1: Sample Selection

Research Duration: 2005 to 2015	**Observed Value**
Original samples of enterprises listed on the Taiwan Stock Exchange (including GTST)	14,989
Deleting the missing values:	
Missing data of independent variables	808
Incomplete data of other variables	1,269
Final sample size	12,912

This table shows the sample screening process.

RESULTS AND DISCUSSION

Table 2 presents the sample distribution of firm-year statistics of firm's convening conference calls. In Panel A, we classify the sample by year. The number of firms with conference calls increase steadily over time. It also shows the total ratio of firm's convening conference calls is 27.5%. The ratio in 2005 is 10.7%, and the ratio of 2015 is 37.4%. Meanwhile, since companies may arrange more than one call during a fiscal year, the right-hand size of Panel A present the total number of conference call for each year. The total average is 0.75 times per firm-year and the rising trend is very steep and become slack. In Panel B, the sample is classified by different transaction markets including stock exchange markets and over-the-counter markets. From 2005 to 2008, all conference calls are held by listed companies at the stock exchange market. There are some listed companies in the over-the-counter market holding conference calls after 2009. The main proportion still appears in the companies at the stock exchange market. In panel C, the sample is classified by different industry. As seen in the Panel C of Table 2, most conference calls are held by companies in the electronic industry.

Table 2: Sample Distributions

Panel A: Category by Year

Year	Total	The Number of Firms with Conference Call		The Total Number of Conference Call	
2005	1061	113	10.7%	216	20%
2006	1066	182	17.1%	373	35%
2007	1068	271	25.4%	727	68%
2008	1061	304	28.7%	911	86%
2009	1135	275	24.2%	756	67%
2010	1161	324	27.9%	874	75%
2011	1186	397	33.5%	1062	90%
2012	1213	372	30.7%	1055	87%
2013	1284	328	25.5%	1077	84%
2014	1325	474	35.8%	1314	99%
2015	1352	506	37.4%	1334	99%
Total	12912	3546	27.5%	9699	75%

Panel B: Category by Different Transaction Market

Year	Total	Listed Company at Stock Exchange Market with Conference Call		Listed Company at Over-the-counter Market with Conference Call	
		Number of Firms	Total Number of Call	Number of Firms	Total Number of Call
2005	1,061	113	216	0	0
2006	1,066	182	373	0	0
2007	1,068	271	727	0	0
2008	1,061	304	911	0	0
2009	1,135	273	756	2	2
2010	1,161	318	874	6	7
2011	1,186	384	1,062	13	23
2012	1,213	365	1,055	7	15
2013	1,284	326	1,077	2	6
2014	1,325	471	1,314	3	7
2015	1,352	504	1,334	2	6
Total	12,912	3,511(99%)	9,633(99.3%)	35(0.99%)	66(0.7%)

Panel C: Category by Industry

Category: by Industry		The Number of Firms with Conference Call	The Total Number of Conference Call
11	Cement	41	125
12	Food	21	143
13	Plastic and Chemical	53	101
14	Textile	84	196
15	Electric Machinery	80	155
16	Electrical and Cable	16	30
17	Chemical, Biotechnology and Medical Care	27	126
20	Iron and Steel	115	108
21	Rubber	40	50
23	**Electronics**	**2,562**	**7,448**
25	Building Material and Construction	22	129
26	Shipping and Transportation	43	55
27	Tourism	35	90
29	Trading and Consumers' Goods	62	165
99	Other	249	776
	Total	3,546	9,699

This table presents the sample distribution of firm-year statistics of firm's convening conference calls. In panel A, the sample is classified by year. In panel B, the sample is classified by different transaction market including stock exchange market and over-the-counter market. In panel C, the sample is classified by different industry.

Table 3 shows descriptive statistics for the full sample of firms. For major variables, the corresponding mean of *Call* and *Frequency* are respectively 0.28 and 0.75. The maximum of *Frequency* is 12, meaning that conference call is repeatedly used for a few firms. The corresponding mean of *OC_Directors_2*, *OC_Manangers_2*, and *OC_mds_2* are 0.17, 0.20, and 0.18 respectively. We also further examine the

correlation of all variables and the table can be provided upon request. As expected, correlation between the frequency of conference calls and the variables of overconfidence are all positive. For example, the correlation coefficient value between Frequency and OC_Managers_2 is 0.07. Basically, it supports the prediction of H1 and H2.

Table 3: Summary Statistics for Variables

Name	Mean	Median	Maximum	Minimum	Std. Dev.
Call	0.28	0.00	1.00	0.00	0.49
Frequency	0.75	0.00	12.00	0.00	1.61
OC_Directors_2	0.17	0.00	1.00	0.00	0.38
OC_Managers_2	0.20	0.00	1.00	0.00	0.40
OC_mds_2	0.18	0.00	1.00	0.00	0.38
InstitutionalShares	17.66	12.23	97.72	0.00	18.19
DirectorShares	20.72	16.84	87.83	0.00	13.61
ManagerShares	1.63	0.58	39.34	0.00	2.66
BigHolderShares	20.49	18.39	84.50	0.00	11.60
AnalystFollow	0.46	0.00	1.00	0.00	0.50
AnalystFollowTimes	9.27	0.00	92.00	0.00	11.33
Assets	15.12	14.93	21.67	9.80	1.37
SalesGrowth	743.12	0.88	7,561,630	-100	66,817
Leaverage	35.77	34.46	99.13	0.00	17.47
ROA	7.47	7.26	82.79	-104.61	10.78
MB	1.78	1.31	233.15	0.08	3.40
Duality	0.31	0.00	1.00	0.00	0.46
Turnover	198.05	6.22	350,396.8	-2,469.4	5,635.6

This table shows descriptive statistics for full sample firms. Call is an indicator variable equal to one if the firm convenes conference call in the fiscal year and zero otherwise. Frequency is the number of conference calls held by a firm in a fiscal year. OC_Directors_2 is an indicator variable equal to one if a member of the board of directors (and supervisors) purchase their own firm's stock over a two-year period, followed by negative average returns and zero otherwise. OC_Managers_2 is an indicator variable equal to one if anyone of top managers, including chief executive officer, general manager, vice general manager, and finance and accounting manager, purchase their own firm's stock over a two-year period, followed by negative average returns. OC_mds_2 is an indicator variable equal to one if a member of the board of directors (and supervisors) or anyone of top managers purchase their own firm's stock over a two-year period, followed by negative average returns and zero otherwise. InstitutionalShares is the ratio of institutional investors' shareholding. DirectorShares is the ratio of directors' shareholding. ManagerShares is the ratio of non-directors managers' shareholding. BigHolderShares is the ratio of big shareholders' shareholding. AnalystFollow is the analysts' coverage in the previous year. AnalystFollowTimes is the frequency of analysts' coverage in the previous year. Assets is the natural logarithm of total asset. SalesGrowth is the sales growth of previous year. Leverage is the sum of long-term debt plus debt in current liabilities, divided by total assets. ROA is return on assets. MB is the sum of fiscal year-end market value of equity and book value of liabilities, divided by total assets. Duality is an indicator variable equal to one if the chairman and CEO of the company is the same person and zero otherwise. Turnover is the yearly turnover rate (%). Year is an indicator variable for controlling year effects. Industry is an indicator variable for controlling industry effects.

Table 4 shows robust probit regression model results for regression model (a) and ordered probit regression model results for regression model (b) to test hypotheses H1 and H2. We use the indicator variable of measuring the likelihood of convening conference call and directors' overconfidence as the independent variable from equation (1) to equation (3). The result in equation (1) indicate the coefficient of *OC_Directors_2* is positive but not significant. However, in equation (2) and (3), the coefficients of *OC_Managers_2* and *OC_mds_2* are both positive and significant, meaning that H1 is supported. From equation (4) to equation (6), we use the indicator variable of measuring the frequency of convening conference calls and directors' overconfidence as the independent variable to test H2. Equation (4) indicates that the coefficient of *OC_Directors_2* is positive but not significant. However, in equation (5) and (6), the coefficients of *OC_Managers_2* and *OC_mds_2* are both positive and significant, meaning that H2 is also supported. The reason why the coefficients of *OC_Directors_2* are not significant in equation (1) and equation (4) is that usually the person in charge of convening conference calls is the chief executive officer (CEO), chief finance officer (CFO) or other senior executive in Taiwan. Usually the board members have limited influence on the convening conference calls. To confirm the positive and significant results between managerial overconfidence and conference calls, we further use several robustness tests to confirm the relation between managerial overconfidence and conference calls.

Table 4: Conference Calls Robust Probit Model and Ordered Probit Model for Testing Hypotheses

	(1) Call	(2) Call	(3) Call	(4) Frequency	(5) Frequency	(6) Frequency
	Robust Probit Model			Ordered Probit Model		
OC_Directors_2	0.024			0.0277		
	(0.524)			(0.379)		
OC_Managers_2		0.0467**			0.0746**	
		(0.028)			(0.032)	
OC_mds_2			0.0387**			0.0632**
			(0.036)			(0.049)
InstitutionalShares1	0.0041***	0.0073***	-0.0051***	-0.0062***	-0.0062***	-0.0062***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DirectorShares	0.0047***	0.0046***	0.0047***	0.0067***	0.0066***	0.0066***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ManagerShares	0.0281***	0.0280***	0.0280***	0.0118***	0.0116***	0.0117***
	(0.005)	(0.005)	(0.005)	(0.002)	(0.002)	(0.002)
BigHolderShares	0.0103***	0.0103***	0.0103***	0.0139***	0.0139***	0.0139***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
AnalystFallow	-0.474***	-0.478***	-0.478***	-0.547***	-0.549***	-0.547***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
AnalystFallowTimes	0.051***	0.051***	0.051***	0.051***	0.051***	0.051***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Assets	0.387***	0.386***	0.386***	0.495***	0.494***	0.494***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SalesGrowth	0.0000**	0.0000**	0.0000**	0.0000**	0.0000**	0.0000**
	(0.028)	(0.011)	(0.018)	(0.042)	(0.014)	(0.015)
Leverage	-0.0023***	-0.0023***	-0.0023***	-0.0032***	-0.0032***	-0.0032***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ROA	0.0104***	0.0104***	0.0104***	0.0144***	0.0144***	0.0144***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MB	0.0392***	0.0393***	0.0392***	0.0309***	0.0309***	0.0308***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Duality	-0.0799***	-0.0781***	-0.0781***	-0.0895***	-0.0889***	-0.0897***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Turnover	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000
	(0.477)	(0.521)	(0.511)	(0.655)	(0.681)	(0.688)
Industry	-	-	-	-	-	-
Year	-	-	-	-	-	-
Observations	12,912	12,912	12,912	12,912	12,912	12,912
R^2	0.342	0.342	0.342	0.350	0.350	0.350
Adjusted R^2	0.340	0.340	0.340	0.347	0.347	0.347

This table shows robust probit regression model results for regression model (a) and ordered probit regression model results for regression model (b) to test hypotheses H1 and H2.

Robust Test Using Different Measure of Overconfidence

To confirm whether the relationship between managerial overconfidence and conference call is robust, we provide other tests with the firm's category and method of calculating returns conditioned in different industries. Closely following the model of Kolasinski and Li (2013), we use "managers purchasing their own firm's stock in the secondary market and the ex post 180 days return is negative" as another proxy of overconfidence for robustness testing. Because updating manager's shareholding data is irregular and the missing data problem of quarterly data is serious, we collect manager's shareholding data on a yearly bases. Therefore, the starting day of "180 days after" takes place from the beginning of next year. This definition of overconfidence is consistent with other prior theoretical articles including Kolasinski and Li (2013), such as Hackbarth (2008), Heaton (2002), Malmendier and Tate (2005a) and Roll (1986). Based on this new definition of managerial overconfidence, the empirical results of are shown in Table 5. We compare the robust probit model in Table 4 with Table 5. Under the same conditions that the dependent variable is whether the firm convenes conference call in the fiscal year, the significance of the regression coefficient for *OC_Managers_2* 及 *OC_mds_2* is slightly lower in Table 5 using abnormal returns than in Table 4 using average returns. But it is still positively correlated. Similar results can be found by comparing the ordered

probit model in Table 4 and Table 5. Table 5 provides additional evidence that there is a significantly positive correlation between managerial overconfidence and the likelihood and frequency of firm's convening conference calls.

Table 5: Robust Probit Model and Ordered Probit Model with Different Overconfidence Measure

	(1) Call	(2) Call	(3) Call	(4) Frequency	(5) Frequency	(6) Frequency
	Robust Probit Model			Ordered Probit Model		
OC_Directors_2	0.056			0.0323		
	(0.753)			(0.569)		
OC_Managers_2		0.067*			0.0821*	
		(0.068)			(0.076)	
OC_mds_2			0.0582**			0.0721*
			(0.046)			(0.056)
InstitutionalShares1	-0.0032***	-0.0053***	-0.0043***	-0.0058***	-0.0058***	-0.0058***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DirectorShares	0.0057***	0.0056***	0.0057***	0.0053***	0.0053***	0.0053***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ManagerShares	0.0181***	0.0180***	0.0180***	0.0218***	0.0216***	0.0217***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
BigHolderShares	0.0201***	0.0201***	0.0201***	0.0121***	0.0121***	0.0121***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
AnalystFallow	-0.474***	-0.478***	-0.478***	-0.556***	-0.559***	-0.557***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
AnalystFallowTimes	0.0491***	0.0491***	0.0491***	0.0516***	0.0516***	0.0516***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Assets	0.291***	0.290***	0.290***	0.562***	0.562***	0.562***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SalesGrowth	0.0000**	0.0000**	0.0000**	0.0000*	0.0000**	0.0000**
	(0.032)	(0.031)	(0.018)	(0.052)	(0.024)	(0.024)
Leverage	-0.0021***	-0.0021***	-0.0021***	-0.0032***	-0.0032***	-0.0032***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ROA	0.0101***	0.0101***	0.0101***	0.0156***	0.0156***	0.0156***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MB	0.0381***	0.0382***	0.0381***	0.0201***	0.0201***	0.0201***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Duality	-0.0689***	-0.0688***	-0.0689***	-0.0969***	-0.0969***	-0.0968***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Turnover	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000
	(0.654)	(0.632)	(0.631)	(0.736)	(0.745)	(0.755)
Industry	-	-	-	-	-	-
Year	-	-	-	-	-	-
Observations	12,912	12,912	12,912	12,912	12,912	12,912
R^2	0.321	0.321	0.321	0.340	0.340	0.340
Adjusted R2	0.319	0.319	0.319	0.337	0.337	0.337

This table shows robust probit regression model results for regression model (a) and ordered probit regression model results for regression model (b) to test hypotheses H1 and H2 using different overconfidence measure. Following the model of Kolasinski and Li (2013), we use "managers purchasing their own firm's stock share in the secondary market and the ex post 180 days return is negative" as another proxy of overconfidence in this table.

Robust Test Using Electronics and Non-Electronics Industry Data

Next, we provide additional tests by dividing the sample into electronic and non-electronic firms to verify whether the positive relationship between managerial overconfidence and conference calls maintains in different industries. In Panel B of Table 2, we first divide the research sample into listed companies and OTC companies, while Panel C groups firms according to firm industry. As can be seen from Panel B in Table 2, listed companies account for about 99% of the total number of firm and frequency of convening conference calls, while OTC companies account for only 1% of the total. Based on the large disparity in proportion, it is not necessary to do further testing by dividing companies according to the trading market (listed / OTC) for sensitivity testing. As can be seen from Panel C in Table 2, of the total number of firms and frequency of convening conference calls by the electronics industry is about 72.3% and 76.8%

respectively. Because operating performance of the electronics industry and the changes in future industry outlook are more drastic, in line with our expectation, there is stronger incentive for firms in the electronics industry to provide timely information by convening conference calls. Even though the electronics industry accounts for a high proportion of listed companies, about 57%, the ratio of the number and frequency, around 70%, are still relatively higher. Table 6 shows results from examining whether the relationship between managerial overconfidence and conference calls is affected by industry category.

Table 6: Robust Probit Model and Ordered Probit Model Using Electronics and Non-Electronics Data

	(1)	(2)	(3)	(4)
	Electronics Industry		Non-Electronics Industry	
	Call	Frequency	Call	Frequency
OC_mds_2	0.0412**	0.0752**	0.0245*	0.0387*
	(0.022)	(0.046)	(0.075)	(0.069)
InstitutionalShares1	-0.0061***	-0.0072***	-0.0031***	-0.0041***
	(0.000)	(0.000)	(0.000)	(0.000)
DirectorShares	0.0055***	0.0076***	0.0016***	0.0027***
	(0.000)	(0.000)	(0.000)	(0.000)
ManagerShares	0.0345***	0.0230***	0.0155**	0.0160**
	(0.005)	(0.003)	(0.055)	(0.065)
BigHolderShares	0.0156***	0.0195***	0.0073***	0.0103***
	(0.000)	(0.000)	(0.000)	(0.000)
AnalystFallow	-0.675***	-0.748***	-0.356***	-0.389***
	(0.000)	(0.000)	(0.000)	(0.000)
AnalystFallowTimes	0.1570***	0.1570***	0.0410***	0.0410***
	(0.000)	(0.000)	(0.000)	(0.000)
Assets	0.4970***	0.5230***	0.386***	0.478***
	(0.000)	(0.000)	(0.000)	(0.000)
SalesGrowth	0.0000**	0.0000**	0.0000*	0.0000*
	(0.045)	(0.032)	(0.071)	(0.065)
Leverage	-0.0071***	-0.0083***	-0.0035***	-0.0041***
	(0.000)	(0.000)	(0.000)	(0.000)
ROA	0.0212***	0.0263***	0.0138***	0.0211***
	(0.000)	(0.000)	(0.000)	(0.000)
MB	0.0392***	0.0393***	0.0393***	0.0392***
	(0.004)	(0.004)	(0.004)	(0.004)
Duality	-0.1218***	-0.1582***	-0.0121***	-0.0231***
	(0.000)	(0.000)	(0.000)	(0.000)
Turnover	-0.0000	-0.0000	-0.0000	-0.0000
	(0.597)	(0.658)	(0.435)	(0.526)
Industry	-	-	-	-
Year	-	-	-	-
Observations	9,332	9,332	3,580	3,580
R^2	0.455	0.455	0.283	0.283
Adjusted R^2	0.453	0.453	0.280	0.280

This table shows robust probit regression model results for regression model (a) and ordered probit regression model results for regression model (b) to test hypotheses H1 and H2 using electronic and non-electronic industry data

Table 6 show that the relationship between managerial overconfidence and the convening conference calls is significant in the electronics industry, while in the non-electronics industry it is relatively insignificant. The results in Table 6 show that managers are excessively confident.

Robust Test Using the Data Deleting the Year 2008-2009

To consider whether the financial crisis during 2008 to 2009 would cause corporate managers to have doubts about increasing their shareholdings, we further provide sensitive test using the data deleting the year 2008-2009. In Table 7, compared with Table 4, the significance of coefficients *OC_Managers_2* and *OC_mds_2* is slightly higher in all four models but the differences are not significant. The reason why the differences

are not significant may be because the shareholding behavior patterns of managers in Taiwan have not been affected by the financial crisis.

Table 7: Conference Calls Robust Model Deleting the Year 2008-2009 Data

	(1)	(2)	(3)	(4)
	Probit Model		Ordered Model	
	Call	Call	Frequency	Frequency
OC_Managers_2	0.0552**		0.0352**	
	(0.035)		(0.021)	
OC_mds_2		0.0452**		0.0712**
		(0.042)		(0.032)
InstitutionalShares1	-0.0065***	-0.0041***	-0.0052***	-0.0053***
	(0.000)	(0.000)	(0.000)	(0.000)
DirectorShares	0.0036***	0.0037***	0.0066***	0.0065***
	(0.000)	(0.000)	(0.000)	(0.000)
ManagerShares	0.0350***	0.0348***	0.0211***	0.0213***
	(0.003)	(0.003)	(0.001)	(0.001)
BigHolderShares	0.0203***	0.0203***	0.0145***	0.0145***
	(0.000)	(0.000)	(0.000)	(0.000)
AnalystFallow	-0.564***	-0.564***	-0.635***	-0.635***
	(0.000)	(0.000)	(0.000)	(0.000)
AnalystFallowTimes	0.0630***	0.0630***	0.0630***	0.0630***
	(0.000)	(0.000)	(0.000)	(0.000)
Assets	0.253***	0.253***	0.365***	0.365***
	(0.000)	(0.000)	(0.000)	(0.000)
SalesGrowth	0.0000*	0.0000*	0.0000*	0.0000*
	(0.065)	(0.065)	(0.054)	(0.054)
Leverage	-0.0044***	-0.0044***	-0.0062***	-0.0062***
	(0.000)	(0.000)	(0.000)	(0.000)
ROA	0.0096***	0.0096***	0.0104***	0.0104***
	(0.000)	(0.000)	(0.000)	(0.000)
MB	0.0425***	0.0425***	0.0378***	0.0378***
	(0.003)	(0.003)	(0.003)	(0.003)
Duality	-0.0881***	-0.0881***	-0.0968***	-0.0969***
	(0.000)	(0.000)	(0.000)	(0.000)
Turnover	-0.0000	-0.0000	-0.0000	-0.0000
	(0.621)	(0.625)	(0.782)	(0.782)
Industry	-	-	-	-
Year	-	-	-	-
Observations	10,716	10,716	10,716	10,716
R^2	0.325	0.325	0.233	0.233
Adjusted R^2	0.323	0.323	0.230	0.230

This table shows robust probit regression model results for regression model (a) and ordered probit regression model results for regression model (b) to retest hypotheses H1 and H2 by deleting 2008-2009 data to consider whether the financial crisis during 2008 to 2009 would cause corporate managers to have doubts about increasing their shareholdings.

CONCLUSION

The purpose of the present study is to examine the correlation between managerial overconfidence and the occurrence and frequency of firm's convening conference calls. Previous research indicates that overconfident managers overestimate future returns from their firms' investment and therefore their over-optimism increase the expectation of future performance. This result raises the motivation to convene conference calls since the conference call is an important tool for Taiwan's listed companies to disclose information voluntarily. Therefore, this paper examines how managerial overconfidence affects the occurrence and frequency of conference calls using data from Taiwan. Following Kolasinski and Li (2013), we use a manager's purchases of his own firm's stocks over the past 2 years as the measure of managerial overconfidence. Using data from firm publicly listed firms in Taiwan for the period from 2005 to 2015, the results provide robust evidence of a positive relation between managerial overconfidence and conference calls. That is, companies with higher managerial overconfidence would be more likely to convene

conference calls. Prior research of managers' overconfidence mainly discussed their impact on financial decisions. This study provides further evidence of its impact on management decisions. The main objective of business firms is to create shareholder value. Convening conference calls can reduce the information asymmetry and help investors estimate firm's valuation correctly and hence enhance the company's value.

In this article, we focus on investigating the relationship between managerial overconfidence and the firm's holding conference calls using data from Taiwan. There are two main contributions of the research: All the existing literature, both international and domestic, mainly discusses the influence of convening conference calls on other variables. There is relatively little discussion about factors influencing the holding of conference calls. Nor was there prior literature from the behavioral and financial viewpoint to explore whether managerial overconfidence would affect the convening of conference calls. This study helps fill the void in the existing literature. Secondly, the protocol of holding conference calls in financial institutions in Taiwan has been gradually completed in recent years. Investors have come to rely on it increasingly. It can be concluded that: "The higher the level of managerial overconfidence is, the higher the possibility and frequency of convening a legal meeting will be." This conclusion provides investors with a thinking direction.

There are several research limitations in this article. First, the measure of managerial overconfidence is follows Kolasinski and Li (2013). We use two different methods determining overconfidence including "manager's purchasing his own firm's stock over the past 2 years and the average return is negative" and "manager's purchasing his own firm's stock over the past 2 years and the ex post 180 days return is negative". However, there are many other measurement methods used in the prior literature which are not included in this article due to the difficulties of data collection. The data used these methods usually is hand-collected data and not available in the TEJ archive. Other measurements using options or news media reports can be the issue of supplement research in the future. Secondly, we only consider manager's purchase of his/her own firm's stock when measuring managerial overconfidence. We do not take treasury stock into consideration even though treasury stock has been an important way for managers to obtain their own firm's share. Although these limitations do not change the conclusions of this article, they can provide direction for further research.

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THE ROLE OF DIVIDENDS IN EQUITY MARKETS: EVIDENCE FROM SECTORAL-LEVEL ANALYSIS

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ABSTRACT

The purpose of this research is to identify how dividend payments affect the U.S. equity market at the sectoral level. A conventional stock valuation model predicts a positive response of equity price to higher dividend payment. Higher dividends convey confidence about the firm's future to the general investors, which is supported by the signaling hypothesis. Using representative exchange traded funds for 11 sectors in the U.S. along with traditional OLS and panel regression analysis, this paper shows that the stock valuation model is generally confirmed. Eight sectors show positive impacts of dividends with statistical significance found in three sectors; Consumer Staples, Utilities, and Real Estate.

JEL: G10, G12

KEYWORDS: Dividend Payment, Sectoral-level ETF, Equity Market Response

INTRODUCTION

According to the Stock Valuation Model, dividend payments affect the stock price in a positive way by giving a positive signal to the investors regarding future income (or cash flows). Due to informational asymmetry between the managers and the public, investors utilize any changes in dividend payments in their estimations of firms' future. Hence, any increase in dividend payments will convey more confidence about the firm's future among both managers and general investors.

There has been a great volume of empirical research on dividends and their impact on equity value. However, conflicting findings, due to firm-specific factors, create a lack of consensus on its effects. Some show positive responses that are consistent with the theory (Brzeszczynski and Gajdka, 2007; Lacina and Zhang, 2008) whereas others show no or negative responses to the dividend announcement or change (Jin, 2000; Vieira, 2011). In addition, some have found that firm size affects the equity market response to dividend payment changes (Ghosh and Woolridge, 1988; Eddy and Seifert, 1988; Haw and Kim, 1991; Mitra and Owers, 1995).

However, few studies have examined the issue at the sector level, even though varying results are expected across various industries due to informational asymmetry, differential characteristics, and market perceptions. Informational asymmetry differs across different-sized firms and industries. In addition, as shown by Baker and Wurgler (2006), investor sentiment has a substantial impact on stock prices, and its impact varies across sectors and different-sized firms. Stock returns are greatly differentiated depending on how high/low the initial investor sentiment was. Stocks that had below average sentiment earned higher returns during the subsequent period.

The purpose of this research is to identify the effects of dividends on the equity market at the sector level, as few authors have conducted similar research. To this end, this paper uses quarterly average Exchange Traded Funds (ETF) prices representing major sectors, which departs from many previous studies. We find

the stock valuation model is generally supported even at the sector level. This paper presents a literature review, data analysis and interpretation in Sections 2, 3 and 4. Concluding remarks are addressed in the last section.

LITERATURE REVIEW

Mozes and Repaccioli (1995) show that information conveyed by dividend announcements is more crucial in the stock price responses of smaller-sized firms. This is effectively shown in the *signaling hypothesis* which is examined by numerous researchers, such as Divecha and Morse (1983), Woolridge (1983), Miller and Rock (1985), Ofer and Thakor (1987), and Gwilym et al. (2000).

Using Polish stock market data, Brzeszczynski and Gajdka (2007) show that portfolios composed of high dividend yield growth beat the entire market in their dividend-driven investment strategy. Even though the findings are not consistent in their 10-year data analysis, they find that dividends play an important role in affecting stock prices by providing fundamental information about the investment. Gupta (2012) further shows that dividend policy can play a key role in affecting investment performance. Using the Dow Jones U.S. 2500 Universe decomposed into 19 categories, he compared the returns of dividend-paying stocks to non-paying stocks. The finding does not show a universally positive response. However, dividend-paying stocks outperform the non-paying firms, especially in the following sectors: industrials, consumer goods, telecommunications, utilities, and technology.

Lacina and Zhang (2008) also suggest that both stock price and trading volume are positively affected by dividend initiations. They studied if stock price and volume responses differ across high-tech and non-high-tech firms using data from 1997 to 2004. After controlling for firm size and dividend yield, both tech and non-tech firms show positive responses to dividend initiations, even though stronger responses are found in the tech-sector firms. Using post-Great Recession data of U.S. (2008-2015), Khanal and Mishra (2017) show more positive responses to dividend announcements. Their work shows how stock prices react to dividends by employing an event study method, in which 460 dividend announcement events were explored. Even though an abnormal response is not as strong as those of the pre-Great Recession period, the paper shows more prevalent positive responses.

Another positive relationship between stock prices and dividend payments is found in an earlier research by Docking and Koch (2005). They show that a negative response to lower dividends is greater during rising but volatile periods, whereas a positive response to higher dividends is more substantial during weak or normal periods.

By contrast, Jin (2000) indicates that 30 to 40 percent of firms had *negative* abnormal returns at dividend initiation announcements, which conflicts with the general theory. Jin (2000) shows the market reaction to dividend announcements differs from firm to firm, depending on the size of the benefits and costs. However, such negative responses are explained by the fact that more investors perceive dividend initiation as an event that lowers the firm's value. Vieira (2011) also shows that negative responses to dividend change announcements are commonly found, unlike the popular theory. Such negative responses are more profound in small-size firms that have higher growth opportunities with lower dividend variations, which confirms the signaling hypothesis in European stock markets.

Some papers that have worked on how investors' perception about the market may differentiate the effects of dividends on stock prices. Baker and Wurgler (2006) show the effects of dividends on stock returns depend on investors' sentiment. When sentiments are low, returns are greater for small growing firms that do not pay any dividends. However, the opposite is found when sentiments are high.

DATA AND METHODOLOGY

This paper uses quarterly data ranging between 1999 and 2017 in the U.S., obtained from Bloomberg and St. Louis Federal Reserve. The variables are dividend payment, sector equity price, total market index, interest rate, unemployment rate, and exchange rate (USD value). The variables are generally used in the equity market research.

The most representative ETFs for the sector equity price are used for 11 sectors in the U.S., as shown in Table 1. The table shows the sectors and corresponding ETFs of State Street SPDR and iShares. Table 2 shows the top 10 firms held by each ETF in the order of percent of the total assets. Furthermore, three-month average ETF prices are used to capture the three-month responses to dividends, which differ from those of previous research. Generally, dividends are paid quarterly, and their effect can last up to three months (or until the next dividend payment). The dividends' influence on the equity price is strongest when they are first declared, and gradually decline thereafter. However, it is worth taking into account the effects regarding the ex-dividend date as well. In addition, the actual payments that are also expected to affect stock price are made several weeks later. For these reasons, it is meaningful to identify three-month effects for longer-term responses, as most of the previous research focused on the short-term (or daily) responses to dividend declarations. All ETFs employed in this research pay dividends every three months (March, June, September, and December).

Table 3 shows the characteristics of each ETF for following categories: dividend yield as of 2017, average annual rate of return, annual dividend growth rate, and beta coefficient. For the total market index, we use an ETF that represents the S&P 500 index, SPY. The SPY is SPDR S&P 500 ETF, which is the biggest and most representative for the equity market. To determine the interest rate, we use the federal funds rate. However, the 10-year Treasury Note of U.S. is also used for checking the robustness of our results, and no qualitative difference is found. For the exchange rate, we use the value of US dollars (USD) against a basket of major foreign currencies. Hence, higher value means appreciation of USD.

Table 1: 11 Sectors and Corresponding Exchange-Traded Funds

Sectors	ETF
Consumer Discretionary	XLY
Consumer Staples	XLP
Energy	XLE
Finance	XLF
Health Care	XLV
Industrial	XLI
Materials	XLB
Technology	XLK
Utilities	XLU
(U.S.) Real Estate	IYR
Telecommunication	IYZ

Each ETF of 11 sectors in this paper is the most liquid and has the greatest net asset value among each sectoral ETFs. They are issued by State Street SPDR and iShares (IYR and IYZ), respectively.

Table 2: 10 Largest Holdings in Each ETF

	10 Largest Firms Held by the Fund
XLY	Amazon (AMZN), Home Depot (HD), Comcast (CMCSA), Walt Disney (DIS), McDonald's (MCD), Priceline (PCLN), Time Warner (TWX), Netflix (NFLX), Starbucks (SBUX), Nike (NKE)
XLP	Procter & Gamble (PG), Coca-Cola (KO), Phillip Morris (PM), Pepsi (PEP), Altria (MO), CVS (CVS), Wal-Mart (WMT), Costco Wholesale (COST), Colgate-Palmolive (CL), Mondelez International (MDLZ)
XLE	Exxon (XOM), Chevron (CVX), Schlumberger (SLB), Conoco Phillips (COP), EOG Resources (EOG), Occidental Petroleum (OXY), Halliburton (HAL), Phillips 66 (PSX), Kinder Morgan (KMI), Valero Energy (VLO)
XLF	Berkshire Hathaway (BRK.B), JPMorgan (JPM), Bank of America (BAC), Wells Fargo (WFC), Citigroup (C), US Bancorp (USB), Goldman Sachs (GS), Morgan Stanley (MS), Chubb (CB), American Express (AXP)
XLV	Johnson & Johnson (JNJ), Pfizer (PFE), United Health (UNH), Merck (MRK), AbbVie (ABBV), Amgen (AMGN), Gilead Sciences (GILD), Medtronic PLC (MDT), Bristol-Myers (BMY), Eli Lilly (LLY)
XLI	General Electric (GE), Boeing (BA), 3M (MMM), Honeywell (HON), Union Pacific (UNP), United Technologies (UTX), United Parcel Service (UPS), Lockheed Martin (LMT), Caterpillar (CAT), General Dynamics (GD)
XLB	DowDuPont (DWDP), Monsanto (MON), Praxair (PX), Ecolab (ECL), Air Products & Chemicals (APD), Sherwin-Williams (SHW), LyondellBasell (LYB), PPG Industries (PPG), International Paper (IP), Newmont Mining (NEM)
XLK	Apple (AAPL), Microsoft (MSFT), Facebook (FB), Alphabet A (GOOGL), Alphabet C (GOOG), AT&T (T), Visa (V), Intel (INTC), Cisco (CSCO), Verizon (VZ)
XLU	NextEra (NEE), Duke Energy (DUK), Dominion (D), Southern (SO), Exelon (EXC), PG&E (PCG), American Electric Power (AEP), Sempra Energy (SRE), Edison International (EIX), Consolidated Edison (ED)
IYR	American Tower (AMT), Simon Property (SPG), Crown Castle (CCI), Equinix (EQIX), Prologis (PLD), Public Storage (PSA), Welltower (HCN), Weyerhaeuser (WY), AvalonBay (AVB), Equity Residential (EQR)
IYZ	AT&T (T), Verizon (VZ), T-Mobile (TMUS), CenturyLink (CTL), Spring (S), Telephone and Data System (TDS), Shenandoah Telecommunications (SHEN), Vonage Holdings (VG), Consolidated Communications (CNSL), Iridium Communications (IRDM)

This table shows the top ten firms held by each ETF as of November 2017. They are listed in the order of percent out of total assets. The stock symbols are shown in parentheses.

Table 3: Statistic Summary of ETFs and Macro Variables

ETFs	**Dividend Yield (as of Nov. 2017, %)**	**Annual Rate of Return of ETF (Between 1999 and 2017, %)**	**Annual Growth Rate of Dividend (Between 1999 and 2017, %)**	**Beta Coefficient (of Last Three Years)**
SPY	1.86	5.77	6.87	1.00
XLY	1.46	7.89	13.18	0.93
XLP	2.74	6.41	9.80	0.48
XLE	3.14	7.82	9.09	0.99
XLF	1.47	5.04	2.68	0.93
XLV	1.47	8.70	19.07	0.85
XLI	1.85	7.94	8.66	0.88
XLB	1.78	7.99	6.48	1.28
XLK	1.36	3.89	15.85	1.10
XLU	3.09	7.79	4.42	0.09
IYR	4.03	9.70	5.07	0.56
IYZ	3.29	-1.39	0.81	0.74
Variables	**Lowest Value**	**Highest Value**	**Mean**	**Standard Deviation**
Federal Funds Rate (%)	0.07	6.53	1.93	2.09
Unemp. Rate (%)	3.90	9.90	6.04	1.76
Inflation (%)	-0.82	1.38	0.19	0.31
USD Value	95.28	128.94	111.36	9.75

To account for the dividend payments, the adjusted closing price is used for each annual rate of return. The numbers of Beta Coefficient are obtained using the standard deviation of each ETF, SPY and the correlation coefficient between the two, which is standard for the number. In general, the Beta Coefficients of the last three years are lower than those of entire period, which is reflecting that the market has been more stabilized during recent period. All macroeconomic variable data (monthly) are from St. Louis Fed web site. USD Value is a Trade Weight USD Index, and Jan. 1997 = 100. Inflation rate is derived from Consumer Price Index for All Urban Consumers.

To identify the robustness of the results, we regress the model first by including the economic recession as a dummy variable (Equation 1). Then, we re-estimate the model with the dummy variable excluded (Equation 2). There have been two recessions in the U.S. during the period according to the National Bureau of Economic Research: March 2001 – Nov. 2001 (8 months) and Dec. 2007 to June 2009 (1 and a half years).

Using OLS regression models, we estimate the impacts with and without a dummy variable of recession, (1) and (2), to better control for potential collinearity issue.

Two OLS regression models are as follows:

$$Price_{it} = \alpha + \beta_1 Dividend_{it} + \beta_2 SPY_t + \beta_3 IntRate_t + \beta_4 UnempRate_t + \beta_5 Inflation_t + \beta_6 USD_t + \beta_7 Recession_t + u_{it} \quad (1)$$

$$Price_{it} = \alpha + \beta_1 Dividend_{it} + \beta_2 SPY_t + \beta_3 IntRate_t + \beta_4 UnempRate_t + \beta_5 Inflation_t + \beta_6 USD_t + u_{it} \quad (2)$$

$Price_{it}$ is the price of the ETF of sector *i* at time *t*, $Dividend_{it}$ is the corresponding dividend of sector *i* at time *t*, and u_{it} is the idiosyncratic component, α is the intercept, $\beta_1 - \beta_7$ is a coefficient of each independent variable.

To study the overall impact of dividends on stock prices, panel regression models are also used. Panel regressions are similar to the OLS regressions in Equations 1 and 2, with the exceptions that all sectors are pooled together, as shown in Equation 3. $Price_{it}$ is the price of the ETF of sector *i* at time *t*, $Dividend_{it}$ is the corresponding dividend of sector *i* at time *t*, and u_{it} is the idiosyncratic component.

$$Price_{it} = \alpha + \beta Dividend_{it} + u_{it} \quad (3)$$

The variability across sectors can also be modelled with sector-specific intercepts by applying fixed effects. The sector-fixed effect controls for time-invariant observed and unobserved variables that might influence a sector's ETF price by adding dummies for each sector, $Sector_i$ (Equation 4). This allows us to control for some omitted variables that may be correlated to dividends and stock prices.

$$Price_{it} = \alpha + \beta Dividend_{it} + \gamma_1 Sector_1 + \cdots + \gamma_n Sector_n + u_{it} \quad (4)$$

Most variables that affect the financial markets tend to be time varying. Sector-fixed effects do not control for sector-specific time-varying variables, for instance demand for energy that might influence energy ETF. They also do not control for macroeconomic variables that vary over time, such as the business cycle. Time-fixed effects, on the other hand, control for time-varying variables that are common across all sectors. Dummy $Quarter_t$ is added for each quarter, as shown in Equation 5.

$$Price_{it} = \alpha + \beta Dividend_{it} + \delta_1 Quarter_1 + \cdots + \delta_T Quarter_T + u_{it} \quad (5)$$

The two-way-fixed effects, sector- and time-fixed effects, control for both sector-specific variables and common time-varying variables, as shown in Equation 6.

$$Price_{it} = \alpha + \beta Dividend_{it} + \gamma_1 Sector_1 + \cdots + \gamma_n Sector_n + \delta_1 Quarter_1 + \cdots + \delta_T Quarter_T + u_{it} \quad (6)$$

Random effects are estimated with partial pooling across cross-sectional groups, or in our case, sectors.

Random effects are useful when some sectors are underrepresented in the data. The sector random effects model in Equation 7 assumes that the sector-specific variable, γ_i, is uncorrelated with dividends. Therefore, if there are sector-specific variables correlated with dividends and ETF prices, they must be added to avoid omitted variable bias.

$$Price_{it} = \alpha + \beta Dividend_{it} + \gamma_i + u_{it} \quad (7)$$

Time-random effects assume that common time-varying variables captured in δ_t are uncorrelated with dividends, which is shown in Equation 8.

$$Price_{it} = \alpha + \beta Dividend_{it} + \delta_t + u_{it} \quad (8)$$

Both time- and sector-fixed effects are incorporated in a two-way random effect model as shown in Equation 9.

$$Price_{it} = \alpha + \beta Dividend_{it} + \gamma_i + \delta_t + u_{it} \quad (9)$$

Mixed effects models are also applied with a combination of sector and time, fixed, and random effects, as shown in Equations 10 and 11.

$$Price_{it} = \alpha + \beta Dividend_{it} + \gamma_1 Sector_1 + \cdots + \gamma_n Sector_n + \delta_t + u_{it} \quad (10)$$

$$Price_{it} = \alpha + \beta Dividend_{it} + \gamma_i + \delta_1 Quarter_1 + \cdots + \delta_t Quarter_t + u_{it} \quad (11)$$

A Hausman specification test (1978) is performed to test if the unmeasured sector-specific errors, γ_i, and period-specific errors, δ_t, are uncorrelated with the regressors. If γ_i and δ_t are uncorrelated with the regressors, random effects are consistent and efficient, and should be applied. If there is correlation, fixed effect should be applied. Under the null, random effect is the preferred model, while the alternative is that fixed effects is the preferred model.

RESULTS AND DISCUSSIONS

From the OLS regression of Model 1, we find more sectors whose dividend impacts are positive. Out of 11 sectors, eight sectors demonstrate positive impacts as shown in Table 4 (Consumer Discretionary, Consumer Staples, Finance, Health Care, Industrial, Materials, Utilities, and Real Estate). Only three sectors exhibit negative effects (Energy, Technology, and Telecommunication). Furthermore, those three negative impacts are all statistically insignificant. Thus, even though we have no homogeneous effects from dividends, the general impact of dividend on equity price is positive, which is in line with the stock valuation model.

However, only three out of eight sectors show that dividend is statistically significant in affecting the equity market: Consumer Staples (XLP), Utilities (XLU), and Real Estate (IYR). This is consistent with the general belief in the actual financial market, as dividends are a key factor and play a more important role in affecting the equity price in these three sectors. The investors take into account the dividend yield and stabilities for their investments in these sectors, as the sectors are relatively more stabilized compared to other sectors.

As Table 3 shows, the three sectors (XLP, XLU, and IYR) have the lowest beta coefficient numbers over the last three years (0.48, 0.09, 0.56, respectively). This implies that the three sectors have been less sensitive and volatile (or more stabilized) to market-wide shocks. In addition, the dividend yields of three sectors were 2.74, 3.09, and 4.03%, respectively, which were higher than the average market yield (1.86%). Furthermore, the average annual rates of return (including all the dividend payments) during the entire

period for the three sectors are 6.41, 7.79 and 9.70%, respectively. These are higher than the market average of 5.77% (partially due to higher dividend payments). Based on these characteristics (low beta, high dividend yield, and high rate of return), firms in these three sectors are advised to stabilize their dividend payment policy as much as possible as a way of boosting their share prices.

Table 4: Summary of Results of Equation 1 (3-Month Average Price with Dummy Variable)

	Intercept	Dividend	SPY	Int Rate	Unemp Rate	Inflation	USD	Recession
XLY	-10.64	7.38	0.38	-2.19	-0.76	-80.25	0.10	-3.32
(0.99/0.99)	(-1.35)	(1.10)	(24.27**)	(-7.54**)	(-1.89**)	(-0.78)	(2.40**)	(-3.50**)
XLP	-18.51	10.98	0.23	-0.71	0.69	-87.17	0.10	1.22
(0.98/0.98)	(-3.66**)	(2.15**)	(21.43**)	(-3.70)	(2.57**)	(-1.28)	(3.69**)	(2.03**)
XLE	130.56	-5.43	0.36	-0.88	0.62	-39.06	-1.15	5.06
(0.93/0.92)	(7.23**)	(-0.40)	(8.15**)	(-1.28)	(0.67)	(-0.16)	(-11.40**)	(2.31**)
XLF	14.81	0.15	0.05	-0.01	-1.29	85.35	-0.01	-1.30
(0.73/0.71)	(2.13**)	(0.26)	(5.54**)	(-0.06)	(-3.64**)	(0.93)	(-0.03)	(-1.58)
XLV	-12.94	10.40	0.33	-1.84	-0.78	-68.15	0.14	-0.24
(0.99/0.98)	(-1.74)	(1.24)	(23.67**)	(-6.29**)	(-2.16**)	(-0.72)	(3.27**)	(-0.28)
XLI	0.88	3.51	0.29	-0.44	0.07	31.07	-0.04	0.33
(0.99/0.99)	(0.17)	(0.68)	(28.57**)	(-2.24**)	(0.27)	(0.45)	(-1.38)	(0.51)
XLB	37.02	2.92	0.22	-0.96	-0.13	80.17	-0.30	1.14
(0.96/0.96)	(5.03**)	(0.95)	(23.30**)	(-3.50**)	(-0.34)	(0.82)	(-7.32**)	(1.31)
XLK	-60.64	-6.66	0.28	2.49	2.41	143.05	0.31	-0.87
(0.86/0.84)	(-4.25**)	(-0.64)	(13.42**)	(4.58**)	(3.33**)	(0.75)	(3.83**)	(-0.52)
XLU	0.42	26.55	0.21	-0.09	0.21	-24.02	-0.07	2.41
(0.97/0.97)	(0.07)	(3.48**)	(14.82**)	(-0.37)	(0.61)	(-0.29)	(-2.10**)	(3.10**)
IYR	57.47	11.12	0.32	-0.47	-0.74	-103.54	-0.48	-4.79
(0.93/0.92)	(3.09**)	(2.51**)	(16.70**)	(-0.73)	(-0.82)	(-0.48)	(-5.10**)	(-2.52**)
IYZ	-22.20	-5.12	0.15	2.17	1.49	45.71	0.11	0.44
(0.86/0.85)	(-2.99**)	(-1.31)	(15.66**)	(7.39**)	(3.89**)	(0.46)	(2.72**)	(0.50)

*The table shows the results of Equation 1. t-statistics are shown in parentheses, and ** indicates a significance at .05 level. Both R square and adjusted R square numbers are reported below each ETF symbol in the first column. Out of 11 sectors, eight sectors show positive responses to dividend changes. Furthermore, statistical significance is found in three sectors: consumer staples, utilities, and real estate.*

However, our findings further show that any dividend payment initiation and increase can be taken as a negative sign in the Energy (XLE), Technology (XLK), and Telecommunication (IYZ) sectors. This is consistent with the general beliefs in the market. Investors in the three sectors may thus assume that the firm(s) are nearing full maturity and further growth may be limited going forward. Hence, they may need to shift their investments out of the firms in the three sectors looking for more growth in other sectors. The Technology and Telecommunication sectors demonstrate 3.89% and -1.39% annual returns, respectively, during this period, which is lower than the average market rate (5.77%).

Due to the possibility of a collinearity issue between the dummy variable and SPY, we re-estimate the model, with the dummy variable for recession excluded (Model 2). As shown in Table 5, the results are very similar to those of Model 1 with no qualitative differences. Hence, our findings are robust to different model specifications.

Table 5: Summary of Results of Equation 2 (3-Month Average Price with No Dummy Variable)

	Intercept	Dividend	SPY	Int Rate	Unemp. Rate	Inflation	USD
XLY	-17.03	1.64	0.40	-2.11	-0.50	-93.96	0.13
(0.98/0.98)	(-2.06**)	(0.23)	(25.29**)	(-6.73**)	(-1.17**)	(-0.85)	(2.76**)
XLP	-16.46	12.05	0.23	-0.75	0.59	-82.49	0.10
(0.98/0.98)	(-3.25**)	(2.32**)	(21.10**)	(-3.84)	(2.21**)	(-1.19)	(3.38**)
XLE	139.13	1.55	0.33	-0.99	0.22	-34.47	-1.18
(0.92/0.91)	(7.64**)	(0.11)	(7.58**)	(-1.39)	(0.23)	(-0.14)	(-11.39**)
XLF	12.63	0.12	0.05	0.03	-1.21	83.83	0.01
(0.72/0.70)	(1.84**)	(0.21)	(6.15**)	(0.13)	(-3.41**)	(0.91)	(0.20)
XLV	-13.29	10.28	0.33	-1.83	-0.77	-68.72	0.14
(0.99/0.98)	(-1.82)	(1.23)	(24.44**)	(-6.33**)	(-2.15**)	(-0.73)	(3.34**)
XLI	1.29	4.23	0.29	-0.45	0.05	32.76	-0.04
(0.99/0.99)	(0.25)	(0.85)	(30.84**)	(-2.29**)	(0.20)	(0.48)	(-1.43)
XLB	38.88	3.21	0.22	-1.01	-0.20	82.80	-0.31
(0.96/0.96)	(5.36**)	(1.04)	(23.77**)	(-3.68**)	(-0.55)	(0.85)	(-7.51**)
XLK	-62.07	-6.82	0.28	2.53	2.46	141.23	0.31
(0.86/0.84)	(-4.45**)	(-0.65)	(14.05**)	(4.69**)	(3.46**)	(0.75)	(3.95**)
XLU	3.47	34.00	0.19	-0.17	-0.06	-6.55	-0.08
(0.97/0.96)	(0.53)	(4.42**)	(13.98**)	(-0.71)	(-0.17)	(-0.07)	(-2.26**)
IYR	45.79	12.97	0.34	-0.26	-0.28	-88.45	-0.44
(0.92/0.92)	(2.44**)	(2.85**)	(17.39**)	(-0.38)	(-0.30)	(-0.40)	(-4.53**)
IYZ	-21.49	-5.17	0.15	2.16	1.47	45.71	0.11
(0.86/0.85)	(-2.96**)	(-1.33)	(16.14**)	(7.41**)	(3.88**)	(0.46)	(2.70**)

*The table shows the results of Equation 2. t-statistics are shown in parentheses, and ** indicates a significance at .05 level. Both R square and adjusted R square numbers are reported below each ETF symbol in the first column. The results are similar to Table 4 (equation 1) with no qualitative difference found.*

Within our longer-term sector-level analysis that is different from previous research, we support the numerous findings of the positive role of dividends in the equity market. Thus, our findings generally support the stock valuation model, even in the long term. For the robustness of our findings, we perform panel data analysis as well.

Results from the panel regressions are robust in supporting a positive relationship between dividends and stock prices. Table 6 presents the key results from the panel regressions. Three-month average ETF prices are used for panel estimations. The first column indicates the panel regression specification, what kind of effects are applied - simple pooling, fixed effects, random effects, and mixed effects; for sector, time, and both. The second and third columns report the intercept and dividends' beta coefficients along with their corresponding t-statistics in parenthesis for panel regressions. *** indicates significance at 0.01 level, ** a significance at 0.05 level, and * a significance at 0.10 level. The fourth and fifth columns report the R-square and Adjusted R-square of the corresponding regression, respectively. As can be seen from Table 6 panel regressions with sector and time fixed effects have the highest R-squares, and a dividend coefficient of 4.155 is significant at the 5% level, with a t-statistics of 2.391. In all other specifications, the coefficient for dividends is positive and significant. Use of the three-month average prices stabilize ETF price volatility around announcements. The results reflect a longer-term impact of dividend on prices than just a momentary reaction to dividend declaration or announcement. Thus, in a longer-term analysis, the empirical results support the theoretical asset-pricing framework that stocks with higher dividends also have higher prices.

Table 6: Summary of Panel Regression Results (3-Month Average Price with No Control Variables) (Equations 3 – 11)

Panel Regression Specification	Intercept	Dividend	R-Squared	Adjusted R-Squared
Panel Regression with Simple Pooling	23.79 (31.03***)	31.79 (13.06***)	0.1733	0.1723
Panel Regression with Sector Fixed Effects	23.83 (32.40***)	31.62 (12.17***)	0.4061	0.3980
Panel Regression with Time Fixed Effects	27.21 (44.27***)	15.95 (7.771***)	0.5627	0.5183
Panel Regression with Sector and Time Fixed Effects	29.75 (64.20***)	4.155 (2.391**)	0.8236	0.8030
Panel Regression with Sector Random Effects	23.78 (8.294***)	31.63 (12.27***)	0.1566	0.1556
Panel Regression with Time Random Effects	26.26 (26.15***)	20.04 (9.998***)	0.1004	0.0993
Panel Regression with Sector and Time Random Effects	29.75 (9.027***)	6.813 (3.846***)	0.0189	0.0176
Panel Regression with Sector Fixed Effects and Time Random Effects	29.79 (64.27***)	6.648 (3.98***)	0.6097	0.6040
Panel Regression with Sector Random Effects and Time Fixed Effects	30.37 (65.08***)	4.047 (2.396***)	0.7591	0.7350

*Notes: This table presents the key results from the panel regressions. The first column indicates the panel regression specification, what kind of effects are applied - simple pooling, fixed effects, random effects, and mixed effects; for sector, time, and both. The second and third columns report the intercept and dividends' beta coefficients along with their corresponding t-statistics in parenthesis for panel regressions. *** indicates significance at .01 level, ** a significance at .05 level, and * a significance at .10 level. The fourth and fifth columns report the R-square and Adjusted R-square of the corresponding regression, respectively.*

The Hausman specification tests' Chi-Squared statistics are presented in Table 7, with p-values in parentheses. Under the null hypothesis, random effects is the preferred model, while the alternative is that fixed effects is the preferred model. The Hausman test for sector random effects yields a Chi-Square measure of 0.0009 and a p-value of 0.9755. The test fails to reject the null, that at the sector level, random effects is preferred. Thus, random effects are more consistent and efficient and that sector-specific unmeasured variables are uncorrelated with dividends. The test for time random effects, however, rejects the null hypothesis with a p-value of 0.0000. The test reveals that, at the univariate level, dividends are correlated with events across time, plausibly market events that affect dividends and stock prices, and time fixed effect is the preferred specification.

Based on the Hausman tests the preferred panel specification is sector random effects and time fixed effects. From Table 6 we can see the panel regression with sector random effects and time fixed effects yields a dividend coefficient of 4.047, which is positive and significant at the 1% level. The associated R-squares are also at the higher range compared to most other specifications, which is reinforcing earlier findings of this paper.

Table 7: Summary of Hausman Specification Tests

Panel Regression Specification	Chi-Sq. Statistic
Panel Regression with Sector Random Effects	0.0009 (0.9755)
Panel Regression with Time Random Effects	83.89 (0.0000)

This table shows the results of the Hausman specification tests for panel regressions with sector random effects and time random effects. The second column reports the Chi-Squared statistics, with p-values in parentheses. Under the null, random effects is the preferred model, while the alternative is that fixed effects is the preferred model.

CONCLUDING COMMENTS

Unlike previous research, this study identifies the sector-level equity market responses to dividend changes by employing traditional OLS and panel regression analysis tools with three-month (quarterly) average ETF prices of eleven sectors. Even though they are different across sectors, the effects of dividends on the *quarterly* equity market are generally positive. Eight out of eleven sectors show positive impacts of the dividend. In addition, three sectors (Consumer Staples, Utilities, and Real Estate) show that dividends are statistically significant in their effects on the *quarterly* equity price. Hence, the results of this sector-level analysis with quarterly data support the general stock valuation model in which the dividend affects the equity market positively. Panel regressions further reveal that dividends and ETF prices are positively related. The results are robust across different panel specifications, controlling for sector and time specific variables. However, this research does not perform the dividend impacts during two different market periods, bull and bear market, mainly due to the lack of ETF data. The effects are expected to differ across the two different periods. Hence, examining these periods will benefit future research. The findings will help identify the level of validity of the stock valuation model. Future research may also include firm level data to study the impact of dividends on stock prices for different company sizes.

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GLOBAL FINANCIAL CRISIS AND DETERMINANTS OF CAPITAL STRUCTURE: EVIDENCE FROM GHANAIAN NON-FINANCIAL LISTED FIRMS

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ABSTRACT

This study uses Generalized Method of Moments (GMM) to analyze the effects of macroeconomic and firm-specific factors on the capital structure of non-financial listed firms in Ghana, for both the normal period (2006-2016) and the global financial crisis period (2008-2009). Real GDP growth, firm size, profitability, tangibility, and growth opportunities have a significant effect on varying leverage ratios of sample firms in the normal period. Inflation and real GDP growth do not significantly influence the financing choice of sample firms during the global financial crisis period. However, profitability, firm size, tangibility, liquidity, and growth opportunities have significant effects on capital structure decisions of sample firms, which could differ in periods of the global financial crisis. Our findings illuminate the possible role of the trade-off, pecking order and agency cost theories in the capital structure of sample firms despite the crisis period. The study also offers policy implications on the need for the development of capital markets as well as the ability of managers to influence corporate capital structure to remain competitive regardless of a global financial crisis event.

JEL: G01, G32

KEYWORDS: Global Financial Crisis, Capital Structure, Macroeconomic Factors, Firm-Specific Factors, Ghana

INTRODUCTION

Since corporate establishments work in a multifaceted outer condition, it is necessary to examine variations in capital structure choices over time. Adjustment in capital structure can be considered a firm's reaction to changes in non-money related factors or changes in budgetary market conditions, as a result of speculators' reaction to financial and non-monetary factors (Friedman, 1986). The changing phase of globalization could influence developments in monetary and non-financial elements. A developing country like Ghana, which functions as an open economy, has for some time been entangled in the globalization process supported by economic growth policies mostly centred on exports. A majority of these export destinations are countries which operate as participants of the Organization for Economic Co-operation and Development (OECD) (Otoo and Asafu-Adjaye, 2009). Such a level of economic integration between Ghana and advanced economies including OECD members can make Ghana susceptible to economic and financial shocks that originate from the advanced economies.

The worldwide money related and monetary emergency of the early 2,000's was the worst receccion since the Great Depression in 1930. It was characterized by crumbling financial markers prompting a diminishing world yields and exchange by 2% and 13% respectively in 2009 (Brinkman, Bauer and Casley-Hayford, 2010). The reaction of different economies to the worldwide money related emergency, shifted in scope

and degree, since the idea of budgetary market improvement combined with responses to outside monetary stuns contrasts among economies. In the advent of a Global Financial Crisis, the impact of the crisis on various aspects of the Ghanaian economy was recognizable. The crisis impact in Ghana included a shift in the composition of international financial flows from private sources to official source and a decline in international remittance to Ghana by 2.4% between the end of the year 2008 and 2009 (Brinkman et al., 2010). Furthermore, the banking sector witnessed increasing non-performing loans from 6.9% in December 2007 to 14.9% in December 2009 (Bank of Ghana, 2010 c) though not exhaustive. The need to determine which factors influence the choice of financing sources by listed firms in developing countries during the 2008/2009 worldwide financial crisis cannot be overemphasized.

Some researchers have analyzed contributing macroeconomic factors of firms' financing choice (see Bokpin, 2009; Elkhaldi and Daadaa, 2015; Mensah, 2014; Mokhova and Zinecker, 2014), others have mostly focused on firm-level and institutional determinants (Abor, 2008; Lemma and Negash, 2013; Oppong-Boakye, Appiah, and Afolabi, 2013). Nonetheless, aftermath of the 2008/09 Global Financial Crisis elicited concerns for policymakers, corporate managers, and researchers to delve into crisis externalities. However, to the best of our knowledge, our review of existing studies suggests that empirics on the recent financial crisis across the globe and its interrelations with capital structure have been mostly linked to firm-specific determinant of capital structure (Zabolotna, 2013; Proença, Laureano and Laureano, 2014; Trinh and Phuong, 2015) with much focus on firms outside the Sub-Saharan economies. Examination of both macroeconomic and firm-specific factors of the capital structure of non-financial listed organizations in developing economies of Sub-Saharan Africa such as Ghana during the Global Financial Crisis remains under-researched. This study offers unique evidence at the country-specific level, with data from Ghana reflecting the distinctiveness of economic situations in inducing the capital structure of listed firms.

This study considers 17 non-financial companies listed on the Ghana Stock Exchange for investigation of both macroeconomic and firm-level factors affecting the capital structure decisions. The study covers the time period of the recent worldwide financial crisis as well as the normal period that does not exclusively focus on the period of the global financial crisis. Our study uses a dynamic panel approach, specifically the system Generalized Method of Moments (GMM) to mitigate potential endogeneity. Findings indicate real GDP growth, growth opportunities, profitability, firm size, and tangibility as important determinants of leverage ratios when considering the normal period. The crisis period reveals a unique finding of a negative effect of growth opportunities on leverage ratios contrary to the normal period. Nonetheless, profitability, firm size, tangibility, and liquidity, also significantly affect leverage ratios subject to the composition and maturity of the leverage during the 2008/2009 financial crisis. Inflation and real GDP growth as macroeconomic factors do not determine the choice of financing for listed Ghanaian non-financial companies in a global financial crisis event. The subsequent sections review the relevant literature, discuss the data and methodological approach to the study, results, and offer concluding remarks.

LITERATURE REVIEW

This section reviews relevant literature within the framework of the trade-off theories and pecking order theory. The interrelationship among capital structure, macroeconomic factors, firm-level factors, and the global financial crisis are discussed. The term trade-off theory in capital structure decisions encapsulates a range of theories that unveil the reasoning behind the merits and demerits related to debt and equity financing (Luigi and Sorin, 2009). Agency theory, tax benefits and bankruptcy costs together, constitute core theories of the trade-off theory (Frank & Goyal, 2009; Lemma & Negash, 2013; Lim, 2012). The tax/bankruptcy cost under the trade-off theory is geared towards an ideal capital structure, where the decision to exceed the optimum capital debt level could result in the marginal benefit of debt eroded by the marginal cost of equity due to financial distress (Kraus & Litzenberger, 1973; Lemma & Negash, 2013; Ross, 1977). The use of agency costs in explaining capital structure has also revealed the importance of

debt financing. The concept of agency cost, as elucidated by Jensen and Meckling (1976) provides insight into a possible disparity of interest between shareholders and managers on one side, and agency problem between shareholders and debt-holders on the other side. Grossman and Hart (1982) theorize how the use of debt in the firm's financial structure could be used to maximize profit. The authors opined that debt raises the issue of bankruptcy, which may not bode well for management. However, the cost to management of forfeiting their position during bankruptcy forces them to maximize profit with the use of debt, leading to an expectation of higher market value. Conversely, agency costs may arise between shareholders and managers. When management fails to maximize profit under no pressure, which occurs if there are no bankruptcy costs, there exists an opportunity for management to remain unpunished for a low market value (Grossman and Hart, 1982).

Whereas, attaining an optimal mix of debt and equity may be a concern for business financing decisions, the source of finance in order of preference is the focus of the pecking order theory. Myers and Majluf (1984) shed light on capital structure under the concept of information asymmetry. The pecking order theory meant firms could follow a hierarchical order of financing by using retained earnings if possible. In the absence of retained earnings, less risky debt should be raised prior to relatively more risky debt and external equity. The choice of equity issuance as the last resort of financing strategy is associated with a relatively serious degree of adverse selection (Frank & Goyal, 2009). Evidence of the pecking order theory has been confirmed by authors such as Abor (2008) who conclude that the pecking order theory dominates the capital structure of firms in Ghana, hence the need for policymakers to advance the free flow of information.

Macroeconomic Factors and Capital Structure

Empirical studies have considered the possible effect of macroeconomic factors such as inflation and real GDP on the capital structure choices. The use of debt financing over equity during inflationary periods might be associated with the diminishing influence of inflation on the real cost of debt hence an increase in the real value of tax advantage of debt (DeAngelo and Masulis, 1980; Myers, 1984; Frank and Goyal, 2009) as supported by the trade-off theory. However, lenders can adjust the firm's future borrowing rate which is suitable for long-term financing (Muthama, Mbaluka, and Kalunda, 2013). However, there is no predetermination for seamless inflation adjustment on debt, making debt financing a preferable choice during inflationary periods (Mans, 2010). The tax-trade off theory predicts a positive relationship between inflation and capital structure as established empirically by Frank and Goyal (2009), Tomschick (2015) and Lemma and Negash (2013). Nonetheless, inflation can adversely affect the variability of earnings through consumer demand, increase business risk, and financial distress tendencies despite the increase in pricing power by firms. Muthama et al. (2013), and Elkaldi and Daadaa (2015) identified a negative relationship between inflation and some leverage ratios. Further, it could be argued theoretically that favourable economic growth provides the right climate for firm growth (Khanna, Srivastava, and Medury, 2015), suggesting a rise in the value of firm turnover, profitability and other assets of the company. By extension, financial distress is expected to drop with an increase in collateral value, stock prices and free cash flow (Lemma and Negash, 2013) during economic growth. Firms could, therefore, increase their debt financing, upon weighing debt gains during growth in the economy, signifying a positive relationship between economic growth and capital structure (see Mensah, 2014; Taoulaou and Giorgi, 2014). The pecking order theory suggests a negative relationship between GDP growth and capital structure due to increases in retained earnings or easy access to external equity financing during an economic boom (see Bokpin, 2009; Muthama et al., 2013; Köksal and Orman, 2014).

Firm-specific Determinants of Capital Structure

The ability of corporate managers to influence the financing choice of firms could be easily linked to the characteristics of the firm. Among such firm characteristics, are firm-size, profitability, asset tangibility,

liquidity, firm growth albeit not exhaustive that have been largely expounded empirically. Its implication on capital structure, however, remains diverse. Large firms are usually expanded or diversified in their operation or asset base relative to small firms. This might result in a minor possibility of non-repayment when debt as a choice of finance is contracted, thus reducing the agency cost between debt holders and shareholders (Abor, 2007). Increasing firm size is therefore associated with higher leverage (Abor, 2008; Fan, Titman, & Twite, 2012; Trinh & Phuong, 2015; Zabolotna, 2013). Profitable firms could use a great deal of retained earnings, hence, less need for external funding and, by implication, debt especially under the conditions of fixed investments and dividend (Frank & Goyal, 2009). This intuitively follows the pecking order theory. Abor (2008) realized a statistically significant negative relationship between the profitability of Ghanaian firms and leverage ratios. Profitable firms could also easily access debt financing for investment opportunities without battling with default risk yet enjoying the tax shelter associated with debt financing. Trade-off theory may postulate a positive relationship between profitability and capital structure (Oppong-Boakye et al., 2013; Wald, 1999).

With higher tangibility and collateral, firms enjoy a lower interest rate and therefore might utilize high debt levels (Bradley, Jarrell, & Kim, 1984). This conjecture follows the trade-off theory of capital structure. Previous literature demonstrates a positive effect of tangibility on capital structure (Abor, 2007; Lemma and Negash, 2013; Köksal and Orman, 2014). Tangibility, however, has been established by other authors to have a negative relationship with capital structure as lenders may consider the short duration of liabilities against the liquidity nature of collateral of the firms (Proença et al., 2014; Trinh & Phuong, 2015). Although liquidity and capital structure relationship remain varied relative to the composition of the liquid assets, this may also affect conditions in debt covenants hence the direction of relationship (Morellec, 2001). The positive relationship between liquidity and capital structure, suggests a reflection of the trade-off theory since secured liquid assets can decrease the probability of non-repayment during financial distress and increase the optimal capital structure. However, firms with high liquidity could have access to internal financing and may capitalize on the advantage of converting liquid assets to cash flow for their investment needs, instead of relying on external financing.

Nonetheless, a negative relationship between liquidity (current ratio) and debt ratios were observed in a study of Malaysian listed firms (Ghasemi and Razak, 2016). Similarly, Proença, Laureano, and Laureano (2014) observed a negative relationship between liquidity and debt ratios (short-term debt and total debt ratio), but a positive relationship with long-term debt for Portuguese SME's firms. As argued by Ross (1977), an opportunity for firm growth reveals the identity of the firm as less likely to avoid debt repayment. This allows firms to obtain favorable terms of credit hence a positive relationship. Furthermore, firms with high growth opportunities may require additional external financing to augment the inadequate internal funds available to the firm (Michaelas, Chittenden, and Poutziouris, 1999; Muijs, 2015) hence providing support for the pecking order theory. Proença, Laureano, and Laureano (2014) therefore observed a positive relationship between firm growth and capital structure (Long-term debt and short-term debt ratios) of Portuguese firms. Notwithstanding the above arguments, empirical evidence also supports a negative relationship between growth opportunities and capital structure (Demirguc-Kunt, Martinez-peria, and Tressel 2015; Iqbal & Kume, 2014) supporting moral hazard reasoning (Myers, 1977).

Global Financial Crisis and Capital Structure

The effect of the global financial crisis on both advanced and developing economies offer an insightful transmission of the financial crisis on the capital structure decisions for both listed and unlisted firms by several authors. Empirical evidence on the effects of the Global Financial Crisis using the ordinary least squares regression analysis on firm-specific variables of Ukrainian firms was observed by Zabolotna (2013). Variables such as firm size, profitability, tangibility, liquidity, and growth proved a significant relationship when the average values of variables in the long pre-crisis period (the year 2001 to 2007) were compared to the crisis period (the year 2008 to 2009). Nevertheless, profitability was the only identifiable

variable that showed a significant influence on leverage ratios when the pre-crisis period was shortened to the year 2006-2007 (Zabolotna, 2013). Relating the effect of the Global Financial Crisis on the short-term debt financing, Fosberg (2013) documents that firms increased their short-term debt from 1.3% of their assets in the year 2006 to 2.2% in 2008 which later declined by the end of the year 2009. The rise in short-term debt financing during the 2008 crisis period by firms, was nearly ascribed to a decrease in accounts payable financing from suppliers, long-term finance, equity, and asset sales. Proença, Laureano, and Laureano (2014) observed a downward tendency in the debt ratios of Portuguese SMEs, considering the effect of the 2007/2008 global financial crisis on the capital structure of listed firms using the Ordinary Least Square regression analysis. The study also considered profitability, liquidity, and asset structure as significant determinants of capital structure.

A study by Iqbal and Kume (2014) provides evidence of the 2008/2009 financial crisis' impact on leverage ratios for both the market-based UK economy and bank-based German and French economy. The authors observed that debt ratios increased from the pre-crisis period (2006-2007) to the crisis period (2008-2009) and later decreased in the post-crisis (2010-2011) period. They also observed the significance of firm-level characteristics such as profitability, firm size, firm growth and tangibility in determining the capital structure of UK, German and French firms. Trinh and Phuong (2015) conducted a study on capital structure determinants including financial crisis dummies on listed firms together with other firm-level determinants of capital structure. The authors concluded there was no significant change in the capital structure of listed firms in Vietnam during the financial crisis period. Nonetheless, they found a statistically significant effect of profitability, size, and tangibility on the capital structure of Vietnamese listed firms within a sample period of 2006 to 2013. Dermiguc-Kunt, Martinez-Peria, and Tressel (2015) revealed a significant reduction in leverage and debt maturity of both developed and developing countries during the period of the global financial crisis using the feasible generalized least square estimator in their cross-country study. Findings were limited to privately held firms and small and medium enterprises. The same could not be said for publicly listed firms with weaker evidence of a significant decline in leverage.

DATA AND METHODOLOGY

Model Specification

Our study uses a balanced panel framework to investigate macroeconomic and firm-specific factors which could influence the financing mix of Ghanaian listed non-financial business entities. This is critical in the current study owing to the inadequate number of observations because a balanced panel reduces the noise introduced by firm heterogeneity. Panel data has an added advantage of controlling for individual heterogeneities (Baltagi, 1998). Nevertheless, this added advantage can only be harnessed if the appropriate technique is used (Park, 2011). The study is conducted for a full sample period from the year 2006 to 2016, signifying a normal period, and the sub-sample period from the year 2008 to 2009, which accounts for the global financial crisis period. For robustness checks of the empirical results, we employ more than one estimation technique including the ordinary least squares (OLS), fixed and random effects, and the generalized method of moments (GMM). The panel regression model is represented formally as follows:

$$C_{it} = \alpha_i + \beta_t + \gamma X_{it} + \varepsilon_{it} \quad (1)$$

Where, C_{it} represents the capital structure of the company *i* at time *t*; α_i, represents firm fixed effect while β_t is year fixed effects; X_{it} depicts the vector of independent variables incorporated in the model, which are observed for each firm *i* at time *t.* The independent variables are the inflation rate, real GDP growth rate, firm size, tangibility, profitability, liquidity, and growth opportunities. γ signifies the parameter estimates, and ε_{it} denotes the random error term. More specifically, Equation (1) is expressed functionally as:

$$TL_{it} = \alpha_i + \beta_t + B_1 INF_{it} + B_2 RGDP_{it} + B_3 FS_{it} + B_4 TAN_{it} + B_5 PROF_{it} + B_6 LIQ_{it} + B_7 GROWTH_{it} + \varepsilon_{it} \quad (2)$$

$$STL_{it} = \alpha_i + \beta_t + B_1 INF_{it} + B_2 RGDP_{it} + B_3 FS_{it} + B_4 TAN_{it} + B_5 PROF_{it} + B_6 LIQ_{it} + B_7 GROWTH_{it} + \varepsilon_{it} \quad (3)$$

$$LTL_{it} = \alpha_i + \beta_t + B_1 INF_{it} + B_2 RGDP_{it} + B_3 FS_{it} + B_4 TAN_{it} + B_5 PROF_{it} + B_6 LIQ_{it} + B_7 GROWTH_{it} + \varepsilon_{it} \quad (4)$$

Where, $TL_{it,}$ STL_{it}, and LTL_{it} are the total leverage, short-term leverage, and long-term leverage respectively for the firm *i* at time *t*. α is the constant; INF is inflation rate; *RGDP* is the real GDP growth rate; *FS* is firm size; *TAN* is tangibility; *PROF* is profitability; *LIQ* represents liquidity; GROWTH is growth opportunities of sample firms. β_t is year fixed effects; the $B_1 \ldots B_6$ are the parameters to be estimated and $\boldsymbol{\varepsilon_{it}}$ is the error term**.**

Dealing with a Potential Endogeneity Problem

Based on the observation from the existing empirical works on determining factors of firm capital structure, a potential endogeneity problem in the underlying relationship could be present. Such endogeneity concerns may arise from three main sources, namely, simultaneity (or reverse causality), measurement error and misspecification. The problem of endogeneity including dynamic endogeneity could make estimates from the OLS, fixed-effects model, and random effects model biased and inaccurate. To deal with potential endogeneity in our model, Equation (1) would be estimated using the system generalized method of moments (GMM) estimation technique. As such, a dynamic version of Equation (1) can be expressed as:

$$C_{it} = \alpha_i + \beta_t + \delta C_{i,t-1} + \gamma X_{it} + \varepsilon_{it} \quad (5)$$

Where, $C_{i,t-1}$ is the lagged value of C_{it} which is the dependent variable and the capital structure for firm *i* at time *t*. α_i, denotes firm fixed effect, β_t are year fixed effects, X_{it} is the vector of independent variables in the model, γ is the parameter estimates of the independent variables and ε_{it} is the random error term. Equation (5) is estimated using the GMM technique which deals with the endogeneity problem (Arellano and Bond, 1991; Arellano and Bover, 1995; Blundell and Bond, 1998). Following the works of Alhassan, Kyereboah-Coleman, and Andoh (2014) who suggest that the system GMM of Arellano and Bover (1995) and Blundell and Bond (1998) has high predictive ability in small samples with short time periods such as our data, compared to the difference GMM of Arellano and Bond (1991). We therefore, adopt the system GMM in our study. The GMM procedure is found to be manageable by relying on internal instruments given the seeming difficulty in recognizing valid external instruments. We express Equation 5 functionally as follow:

$$TL_{it} = \alpha_i + \beta_t + \delta TL_{i,t-1} + B_1 INF_{it} + B_2 RGDP_{it} + B_3 FS_{it} + B_4 TAN_{it} + B_5 PROF_{it} + B_6 LIQ_{it} + B_7 GROWTH_{it} + \varepsilon_{it} \quad (6)$$

$$STL_{it} = \alpha_i + \beta_t + \delta STL_{i,t-1} + B_1 INF_{it} + B_2 RGDP_{it} + B_3 FS_{it} + B_4 TAN_{it} + B_5 PROF_{it} + B_6 LIQ_{it} + B_7 GROWTH_{it} + \varepsilon_{it} \quad (7)$$

$$LTL_{it} = \alpha_i + \beta_t + \delta LTL_{i,t-1} + B_1 INF_{it} + B_2 RGDP_{it} + B_3 FS_{it} + B_4 TAN_{it} + B_5 PROF_{it} + B_6 LIQ_{it} + B_7 GROWTH_{it} + \varepsilon_{it} \quad (8)$$

Where TL_{it}, STL_{it} and LTL_{it} represent the total leverage, short-term leverage and long-term leverage for firm *i* at time *t* correspondingly. $\delta TL_{i,t-1}$,$\delta STL_{i,t-1}$ *and* $\delta LTL_{i,t-1}$ are the lagged value of the total

leverage, short-term leverage, and long-term leverage respectively for firm *i* at time *t-1*. α_i is the firm fixed effects, β_t is year fixed effects, $B_1 \ldots B_6$ are the parameter estimates. INF is the inflation rate, RGDP is the real GDP growth rate, FS is the firm size, TAN is the tangibility of the firm, PROF is the profitability, LIQ is the liquidity, and GROWTH is the growth opportunities of sample firms. ε_{it} is the error term.

Data Description and Sample

We employ firm-specific and macroeconomic annual data for an 11-year period (2006 to 2016) and a 2-year period (2008 to 2009) representing the normal period and the global financial crisis period respectively. Some 187 observations for the normal period and 34 observations for the period of the financial crisis are realized upon considering our sample of 17 non-financial listed firms in Ghana. We focus our sample selection on listed firms who are likely to fulfil the disclosure requirement (Enos and Gyapong, 2017). Listed financial firms are not considered in this study, due to the unique nature of their capital structure which is governed by special regulations (Simon, 2009). Firms with missing financial statements are also excluded in this study to obtain a balanced panel data. This is because balanced panels allow observations of the same unit in every time period (Gyapong, Monem, and Hu, 2016). In addition, firms with financial statements presented in foreign currency are eliminated to avoid distortions in currency translation and ensure accuracy and reliability in the computed financial ratios. Our firm-specific and capital structure variables are financial ratios computed from the audited financial statements of sample firms, which were obtained from the Annual Report Ghana database and Ghana Stock Exchange database. Firm-specific variables used as independent variables in our study are firm size, profitability, tangibility, liquidity, and growth opportunities. Macroeconomic data consisting of the annual inflation rate and annual real GDP growth rate are also captured as independent variables in our study and the data obtained from the World Development Indicator Database and IMF Database correspondingly. In the spirit of Welch (2011), our book measure of leverage (total leverage, short term leverage and long term leverage) as a proxy for the capital structure includes the interest and non-interest bearing debt which, follows previous empirical studies (Elkhaldi and Daadaa, 2015; Mokhova and Zinecker, 2014; Perera, 2015). The definition of the variables is summarized in Table 1.

Table 1: Variable Definitions and Data Source

Code	**Dependent Variable Name**	**Definition**
TL	Total Leverage	The ratio of total liabilities to total asset
STL	Short-term Leverage	The ratio of current liabilities to total assets
LTL	Long-term Leverage	The ratio of long-term liabilities to total asset
Code	**Independent Variable Name**	**Definition**
INF	Inflation	The annual percentage change in the consumer price index
RGDP	Real GDP growth	The annual percentage change in GDP growth
FS	Firm size	The natural log of total sales
PROF	Profitability	The ratio of earnings before interest and tax to total assets
TAN	Tangibility	The ratio of net property, plants, and equipment to total assets
LIQ	Liquidity	The ratio of current assets to current liabilities
GROWTH	Growth Opportunities	The ratio of net sales to total assets

This table illustrates the codes used to depict the variables and the meaning of the variables. The total leverage, short-term leverage, and long-term leverage are used as a proxy for capital structure hence the dependent variables. Inflation and Real GDP growth constitute the macroeconomic variables used as independent variables. The firm size, profitability, tangibility, liquidity, and growth opportunities are computed as financial ratios for the analysis, which also represents the firm-level determinants to be empirically established in this study. The definition column of Table 1 describes the variables used in our study.

Table 2 illustrates the descriptive statistics of the variables used in this study. STL, LTL, and TL depict the short-term leverage, long-term leverage, and the total leverage respectively and considered as

measurements of capital structure in the study. RGDP is the annual real GDP growth rate; INF is the annual inflation rate; PROF is the profitability of the firm; LIQ is the liquidity; TAN is the tangibility, and GROWTH is the growth opportunities of the firm. The definitions of these variables are the same as those defined in Table 1 above. The total number of observations for the normal period (2006-2016) is 187. Mean is the average value of the variables; Std. Dev. signifies the standard deviation of the variables; Min. and Max. are the minimum and maximum values of the variables used in our study respectively. Table 3 illustrates the descriptive statistics of the variables during the global financial crisis in the year 2008/2009. Table 4 shows the pairwise correlation between the regression variables used in our study. The p-values are in parenthesis and are used to test the significance of the correlation coefficient for the variables in our model.

Table 2: Summary Statistics of the Variables Used in the Econometric Analysis for the Normal Period (2006-2016)

Variable	Observations	Mean	Std. Dev.	Min.	Max.
STL	187	0.656	1.598	0.018	21.126
LTL	187	0.108	0.244	0.000	1.994
TL	187	0.764	1.611	0.045	21.126
RGDP	187	6.764	3.052	3.700	14.000
INF	187	13.431	3.609	8.727	19.251
PROF	187	0.078	0.297	-2.530	1.569
LIQ	187	1.537	1.837	0.033	13.337
TAN	187	0.446	0.339	0.001	3.353
GROWTH	187	1.381	2.266	-0.906	22.452
FS	187	16.695	2.300	11.474	21.361

This table illustrates the descriptive statistics of the variables used in this study. STL, LTL, and TL depict the short-term leverage, long-term leverage, and the total leverage respectively and considered as measurements of capital structure in the study. RGDP is the annual real GDP growth rate; INF is the annual inflation rate; PROF is the profitability of the firm; LIQ is the liquidity; TAN is the tangibility, and GROWTH is the growth opportunities of the firm. The definitions of these variables are the same as those defined in Table 1 above. The total number of observations for the normal period (2006-2016) is 187. Mean is the average value of the variables; Std. Dev. signifies the standard deviation of the variables; Min. and Max. are the minimum and maximum values of the variables used in our study respectively.

Table 3: Summary Statistics of the Regression Variables During the Global Financial Crisis Period (2008-2009)

Variable	Observations	Mean	Std. Dev.	Min.	Max.
STL	34	0.434	0.18	0.077	0.861
LTL	34	0.106	0.157	0	0.611
TL	34	0.54	0.241	0.773	1.078
RGDP	34	6.95	2.155	4.8	9.1
INF	34	17.886	1.384	16.522	19.251
PROF	34	0.081	0.134	-0.151	0.39
LIQ	34	1.615	1.883	0.359	9.806
TAN	34	0.451	0.245	0.041	0.834
GROWTH	34	1.193	1.144	-0.012	4.53
FS	33	16.537	2.262	13.984	19.111

This table illustrates the descriptive statistics of the variables during the global financial crisis in the year 2008/2009. STL, LTL, and TL depict the short-term leverage, long-term leverage, and the total leverage respectively and considered as a proxy of capital structure in the study. RGDP is the annual real GDP growth rate; INF is the annual inflation rate; PROF is the profitability of the firm; LIQ is the liquidity; TAN is the tangibility, and GROWTH is the growth opportunities of the firm. The definitions of these variables are the same as those defined in Table 1 above. Mean is the average value of the variables; Std. Dev. signifies the standard deviation of the variables; Min. and Max. are the minimum and maximum values of the data set for the variables respectively. The global financial crisis period represents the year 2008 to 2009.

Table 4: Correlation Matrix of Regression Variables

	STL	LTL	TL	RGDP	INF	PROF	LIQ	TAN	GROWTH	FS
STL	1									
LTL	-0.024	1								
	(0.745)									
TL	0.9884	0.1278	1							
	(0.000)	(0.081)								
RGDP	-0.0652	0.1054	-0.0487	1						
	(0.375)	(0.151)	(0.508)							
INF	0.0309	-0.0791	0.0186	-0.6155	1					
	(0.675)	(0.282)	(0.800)	(0.000)						
PROF	-0.5979	-0.0771	-0.6048	0.0497	-0.0155	1				
	(0.000)	(0.295)	(0.000)	(0.499)	(0.833)					
LIQ	-0.1668	-0.1668	-0.1908	0.0723	-0.0753	0.1797	1			
	(0.023)	(0.023)	(0.009)	(0.326)	(0.306)	(0.014)				
TAN	-0.0165	0.2492	0.0214	0.0264	-0.0127	0.1567	-0.0704	1		
	(0.823)	(0.001)	(0.771)	(0.720)	(0.864)	(0.032)	(0.338)			
GROWTH	0.2412	-0.0685	0.2289	0.0252	-0.0891	0.0239	-0.0828	-0.0374	1	
	(0.001)	(0.351)	(0.002)	(0.732)	(0.225)	(0.746)	(0.260)	(0.611)		
FS	-0.1133	-0.1972	-0.1424	-0.0385	0.0573	0.2434	0.0817	-0.1492	0.259	1
	(0.124)	(0.007)	(0.053)	(0.602)	(0.437)	(0.001)	(0.268)	(0.042)	(0.000)	

This table shows the pairwise correlation between the regressions variables used in our study. The p-values are in parenthesis and are used to test the significance of the correlation coefficient for the variables in our model. STL is the short-term leverage; LTL is the long-term leverage; TL is the total leverage, RGDP is the real GDP growth; INF is the inflation rate; PROF is the profitability of the sample firm; LIQ is the liquidity of the firm; TAN is the tangibility of the firm; GROWTH is the growth opportunity variable, and FS is the firm size. It is worthy of note however that weak correlation exists amongst most of the independent variables, indicating perhaps the absence of a potential multicollinearity problem.

EMPIRICAL RESULTS AND DISCUSSION

This section presents and discusses the empirical results. The regression results presented in this section are structured into two main subsections. The first sub-section presents and discusses the estimated results of the macroeconomic and firm-specific contributing factors of firm capital structure in the normal period (2006 to 2016) without emphasis on the global financial crisis period. The second sub-section presents estimated results of the macroeconomic and firm-specific contributing factors of firm capital structure focusing on the global financial crisis period (2008-2009).

Capital Structure Determinants of Non-Financial Listed Firms in Ghana: Full Sample Period (2006-2016)

Empirical outcomes on the determinants of capital structure for the full sample period are presented in Table 5, 6, and 7. Specifically, Table 5, 6, and 7 present the results of the macroeconomic and firm-specific contributing factors of total leverage, short-term leverage, and long-term leverage respectively. Columns I, II and III of each of the regression tables under this section present the results of the OLS, the random effects, and the system GMM respectively indicating the robustness of our findings. To make a choice between the fixed effects and the random effects model, the study employs the Hausman test to determine the preferred model (random effects model) at the 5% level of significance. The Adjusted R-Squared of the OLS model in Column I, of Table 5, 6, and 7 indicates that 44.5%, 43.1% and 10.1% of the variations in total leverage, short-term leverage and long-term leverage respectively are explained by the independent variables. Previous studies on capital structure determinants have highlighted the potential endogeneity problem including serial correlation process (Gonzalez and Gonzalez, 2012; Nyeadi, Banyen, and Mbawuni, 2017), as evident in our data. This makes the estimates of the OLS and random effects models

less efficient relative to the GMM model, which could mitigate possible endogeneity. We, therefore, focus our discussion of the results on the system GMM in Column III of Table 5, 6, and 7. The significance of each of the estimated parameters, holding all other variables constant is tested at the conventional 1%, 5%, and 10% levels of significance for establishing the determinants of capital structure.

The estimated outcomes of the system GMM as presented in Column III of Table 5, 6, and 7, indicates that real GDP growth is the only macroeconomic variable that has a negative and statistically significant effect on short-term leverage for the full sample period. Thus, unit growth in real GDP results in a 0.039 decrease in the use of short-term debt of the firms, holding all other variables constant. We infer that during the period of increased economic growth, listed non-financial firms in Ghana are likely to increase revenue and consequently profit. This may offer firms the opportunity to access internal funds prior to considering short-term debt as maintained by the pecking order theory. This finding contradicts the study by Mensah (2014), but is consistent with the findings by Köksal and Orman (2014) and Bokpin (2009). Inflation has no significant effect on the leverage ratios of sample firms. There is a significant positive relationship between firm size and long-term leverage (see Table 7, Column III). This could imply that large firms as demonstrated by high sales values may show less inconsistency in their profits, hence a minor possibility of non-repayment of long-term debt to lenders or creditors. The positive relationship between firm size and long-term leverage follows previous findings (see Köksal and Orman, 2014; Fan, Titman and Twite, 2012).

As indicated in Column III, of Table 5, 6, and 7, profitability has statistically significant negative effects on total leverage and short-term leverage contrary to the significant positive effect on long-term leverage. The significant negative effect of profitability on short-term leverage and total leverage could point to the importance of utilizing internal funds relative to seeking short-term debt when the profitability of sampled firms increases. This finding does not depart from the conclusion made by Abor (2008), Köksal & Orman (2014), and Lemma & Negash (2013) with further support from the pecking order theory. In agreement with the trade-off theory, we infer that creditors are likely to provide long-term debt financing to sampled firms with high profitability since they exhibit low risk of default on debt repayment. Previous findings reveal such a positive relationship between profitability and long-term debt (see Oppong-Boakye et al., 2013; Wald, 1999).

Tangibility, as shown in our findings in Column III of Table 5, 6 and 7, has a negative relationship with total leverage, short-term leverage, and long-term leverage, although only long-term leverage is statistically significant as presented in Column III of Table 7. The negative relationship between long-term leverage and tangibility could be attributed to the fact that the capital market, especially the debt market where firms could borrow to finance their long-term assets, remains under-developed in Ghana. Further, our evidence shows that liquidity which is measured by current ratio has a statistically insignificant negative relationship with all the measures of leverage in our study as illustrated in Column III of Table 5,6, and 7. This implies that liquidity is not an important factor in determining leverage of sample firms for the full sample period. From the estimates of the system GMM in Column III of Table 5, 6, and 7, total leverage, short-term leverage and long-term leverage of sample firms are positively influenced by growth opportunities at a statistically significant level of 1 %. This finding suggests that as opportunities for business growth increase, sample firms utilize debt to augment inadequate internal financing with likely credit support from lenders. This corroborates the results of Michaelas et al. (1999) and Muijs (2015) and intuitively confirms the pecking order theory. Testing for over-identifying restrictions (i.e. the Sargan test), it is observed from Table 5,6, and 7 that, the null hypothesis that the over-identifying assumptions are valid is overruled at the 1% level of statistical significance given the P-value of 0.000. This implies that the internal instruments identify the same vector of parameters so the model does not suffer from over-identifying bias.

Table 5: Determinants of the Total Leverage of Non-financial Listed Firms in Ghana for the Full Sample Period (2006-2016)

Variables	I OLS	II Random Effects	III System GMM
Dependent Variable: Total leverage (TL)			
INF	0.012	0.012	0.003
	(0.032)	(0.032)	(0.020)
RGDP	-0.004	-0.004	-0.035
	(0.038)	(0.037)	(0.023)
FS	-0.029	-0.019	-0.030
	(0.043)	(0.048)	(0.025)
PROF	-3.311***	-3.406***	-3.264***
	(0.325)	(0.332)	(0.380)
TAN	0.561**	0.677**	-0.428
	(0.275)	(0.289)	(0.475)
LIQ	-0.045	-0.041	-0.017
	(0.053)	(0.057)	(0.616)
GROWTH	0.183***	0.179***	0.912***
	(0.042)	(0.042)	(0.108)
L.TL	-	-	-0.103**
			(0.045)
Constant	0.929	0.72	-
	(0.943)	(1.000)	
Observations	186	186	170
R-squared/Overall R-squared	0.446	0.445	-
Adjusted R-squared	0.424	-	-
Number of years	11	11	10
Wald chi2/F statistic	20.47	141.22	80.7
Hausman test (p-value)	-	0.359	-
AR(1)	-	-	0.005
AR(2)	-	-	0.518
Sargan test (p-value)			0.000

*This table presents the results of regression equations 2 and 6 for the full sample period. The standard errors are reported in parenthesis. ***, **, * indicates statistical significance at 1%, 5%, and 10% respectively. TL is the total leverage. INF is the annual inflation rate. RGDP is the annual real GDP growth rate. FS is the firm size. PROF is profitability. LIQ is the liquidity ratio measured as the current ratio. TAN is tangibility. GROWTH is the growth opportunities of the firm. L.TL is the lag of total leverage. AR(1) and AR(2) is the first-order and second-order serial correlation respectively.*

Capital Structure Determinants of Listed Non-Financial Firms in Ghana: Global Financial Crisis Period

This section discusses the empirical results of both macroeconomic and firm-specific determinants of listed non-financial firms' capital structure in Ghana, during the global financial crisis of 2008 and 2009. Given that three variables, namely, total leverage, short-term leverage, and long-term leverage, proxies capital structure, three types of results are presented in Table 8, 9 and 10 correspondingly. For robustness check of our empirical findings, we provide results of the OLS, the preferred random effects and system GMM in Column I, II, and III of Table 8, 9, and 10 respectively. The Adjusted R-Squared of the OLS model in Column I of Table 5, 6, and 7 shows that 47.1%, 61%, and 15.9% of the variations in total leverage, short-term leverage and long-term leverage respectively of sample firms during the crisis period are explained by the regressors. Nonetheless, possible endogeneity issues that affect the underlying relationship in previous studies of capital structure determinants make estimates from OLS, fixed effects model and random effects model biased and inefficient compared to the GMM model which deals with this endogeneity problem (Nyeadi, Banyen, and Mbawuni, 2017). Hence, our discussion mainly focuses on the results of the system GMM in Column III of Table 8, 9 and 10. From the observation of our results in Column III of Table 8, 9, and 10, macroeconomic factors such as inflation rate and real GDP growth do not have any statistically significant relationship with the sample firms' leverage during the 2008/2009 global financial crisis period.

Table 6: Determinants of Short-term Leverage of Non-financial Listed Firms in Ghana for the Full Sample Period (2006-2016)

	I	II	III
Variables	**OLS**	**Random Effects**	**System GMM**
Dependent Variable: Short-term leverage (STL)			
INF	0.014	0.013	0.006
	(0.032)	(0.031)	(0.197)
RGDP	-0.012	-0.012	-0.039*
	(0.037)	(0.036)	(0.023)
FS	-0.015	0.001	0.013
	(0.043)	(0.051)	(0.025)
PROF	-3.261***	-3.424***	-.3.536***
	(0.326)	(0.335)	(0.380)
TAN	0.398	0.639**	-0.233
	(0.276)	(0.298)	(0.478)
LIQ	-0.242	-0.021	-0.01
	(0.053)	(0.059)	(0.062)
GROWTH	0.188***	0.188***	0.885***
	(0.042)	(0.042)	(0.107)
L.STL	-	-	-0.074*
			(0.043)
Constant	0.667	0.311	-
	(0.945)	(1.048)	
Observations	186	186	170
R-squared/Overall R-squared	0.434	0.431	-
Adjusted R-squared	0.412	-	-
Number of years	11	11	10
Wald Chi2/F statistic	19.49	137.61	77.35
Hausman test (p-value)	-	0.289	-
AR(1)	-	-	0.004
AR(2)	-	-	0.767
Sargan test (p-value)	-	-	0.000

*This table presents the results of regression equations 3 and 7 for the full sample period. The standard errors are reported in parenthesis. ***, **, * indicates statistical significance at 1%, 5%, and 10% respectively. STL represents short-term leverage. INF is the inflation rate. RGDP is the real GDP growth rate. FS is the firm size. PROF is profitability. LIQ is the liquidity ratio measured as the current ratio. TAN is tangibility. GROWTH is the growth opportunities of the firm. L.STL is the lag of short-term leverage. AR (1) and AR (2) is the first-order and second-order serial correlation respectively.*

Interestingly, firm size has a statistically significant negative and positive relationship with short-term leverage and long-term leverage respectively (see Column III of Table 9 and Table 10), contrary to the statistically insignificant positive relationship between total leverage and firm size as illustrated in Column III of Table 8. The negative relationship between firm size and short-term leverage is crucial during the crisis period since lenders could be uncertain in extending debt claims to firms. Therefore, firms which are small in size could be compelled to opt for the short-term debt even in the crisis period since lenders may associate smaller firms with high risk making access to long-term funds difficult relative to large firms, following the argument of Muijs (2015). This finding is consistent with the study of Muijs (2015), Zabolotna (2013) and Proença et al. (2014). The positive effect of firm size on long-term leverage indicates the importance of large firms mitigating the possible adverse selection and information asymmetry they may face with lenders during the crisis period. Evidence from the system GMM results in Column III of Table 8, 9, and 10 suggest that, during the crisis period, profitable firms are likely to reduce their long-term funding and take advantage of the lower cost of financing their operational activities with an internal source of funding as predicted by the pecking order theory. This confirms previous studies by Proença (2014) but contradicts the findings of Muijs (2015).

An increase in tangibility is found to be unimportant in securing high leverage during the global financial crisis period as evidenced in Table 8, 9 and 10 of Column III. Besides, a statistically significant negative relationship exists between tangibility and firm leverage (i.e. total leverage and short-term leverage). Consequently, lenders perhaps are not likely to extend their liability claims for a long period during the crisis period. They may not consider the tangible non-current assets of sample firms for security due to the illiquid nature of the asset. Firms could additionally bear the relatively higher cost in perfecting the non-current assets as collateral in a period of crisis. Moreover, high short-term liabilities composition in the total debt structure of sample firms suggests a decline in total leverage when an increase in current assets is substituted for tangible non-current assets. Trinh and Phuong (2016), as well as Zabolotna (2013), found a similar negative relationship between tangibility and total debt ratio in their study of the global financial crisis and business financing choices. Iqbal and Kume (2014) also realized a negative relationship between tangibility and the total debt ratio of firms in France. Although the findings of these authors were not restricted to the global financial crisis period compared to our study, our results do not depart from intuition behind the pecking order theory.

Table 7: Determinants of Long-term Leverage of Non-financial Listed Firms in Ghana for the Full Sample Period (2006-2016)

	I	II	III
Variables	**OLS**	**Random Effects**	**System GMM**
Dependent Variable: Long-term leverage (LTL)			
INF	-0.002	-0.002	-0.003
	(0.007)	(0.006)	(0.004)
RGDP	0.008	0.008	0.003
	(0.007)	(0.006)	(0.004)
FS	-0.013	-0.002	0.010**
	(0.008)	(0.012)	(-0.004)
PROF	0.163	-0.033	0.200*
	(0.052)	(0.056)	(0.068)
TAN	0.163**	0.058	-0.273***
	(0.052)	(0.053)	(0.084)
LIQ	-0.021**	-0.007	-0.001
	(0.010)	(0.010)	(0.011)
GROWTH	-0.004	-0.003	0.073***
	(0.008)	(0.008)	(0.020)
L.LTL	-	-	-0.072
			(0.080)
Constant	0.262	0.118	-
	(0.180)	(0.227)	
Observations	186	186	170
R-squared/Overall R-squared	0.125	0.101	-
Adjusted R-squared	0.091	-	-
Number of years	11	11	10
Wald Chi2/F statistic	3.64	5.79	19.16
Hausman test (p-value)	-	0.703	-
AR(1)	-	-	0.013
AR(2)	-	-	0.117
Sargan test (p-value)	-	-	0.000

*This table presents the results of regression equations 4 and 8 for the full sample period. The standard errors are reported in parenthesis. ***, **, * indicates statistical significance at 1%, 5%, and 10% respectively. TL is the long-term leverage. INF is the annual inflation rate. RGDP is the annual real GDP growth rate. FS is the firm size. PROF is profitability. LIQ is the liquidity ratio measured as the current ratio. TAN is tangibility. GROWTH is the growth opportunities of the firm. L.LTL is the lag of long-term leverage. AR(1) and AR(2) is the first-order and second-order serial correlation respectively.*

An illustration of our findings in Column III of Table 8, 9, and 10 suggest that liquidity exhibits a negative relationship with all measures of leverage ratio used in our study. However, total leverage and short-term leverage is observed with a negative relationship statistically significant at 10% (see Column III of Table 8 and Table 9). Thus, sample firms could rely on the availability of current assets to meet their pressing obligations by generating an internal source of funding as opposed to relying on external debt.

This may not be surprising as the financial crisis period could possibly be associated with a relatively high cost of lending due to weak economic indicators such as high inflation during the crisis period. The pecking order theory offers an insight into this finding as firms may consider the lower cost of financing their assets during the financial crisis period. Zabolotna (2013) and Proença (2014) examine capital structure determinants alongside the impact of the global financial crisis. They confirm the negative relationship between liquidity and leverage ratio (total leverage and short-term leverage). During the global financial crisis period, sample firms' total leverage and long-term leverage show a negative sensitivity to an increase in the growth opportunities at a 1% level of statistical significance (Column III of Table 8 and Table 10). Short-term leverage, however, has a statistically significant level of 10% albeit a negative relationship with growth opportunities as illustrated in Column III of Table 9.

Table 8: Determinants of Total Leverage of Non-Financial Listed Firms in Ghana During the Global Financial Crisis Period (2008-2009)

	I	II	III
Variables	**OLS**	**Random Effects**	**Systems GMM**
Dependent Variable: Total leverage (TL)			
INF	-	0.059***	0.001
		(0.020)	(0.006)
RGDP	-0.010	0.028**	-0.003
	(0.010)	(0.013)	(0.002)
FS	-0.032	-0.032	0.041
	(0.020)	(0.027)	(0.009)
PROF	-0.154	-0.093	-0.721**
	(0.311)	(0.261)	(0.259)
TAN	-0.267	-0.152	-0.360**
	(0.168)	(0.208)	(0.130)
LIQ	-0.089	-0.067***	-0.031*
	(0.019)	(0.019)	(0.017)
GROWTH	-0.002	-0.021	-0.146***
	(0.426)	(0.043)	(0.034)
L.TL	-	-	0.631***
			(0.153)
Constant	1.416	-	-
	(0.320)	1	-
Observations	34	34	34
R-squared/Overall R-squared	0.568	0.548	-
Adjusted R-squared	0.471	-	-
Number of years	2	2	2
Wald chi2/F statistic	5.9	167.14	118.46
Hausman test (p-value)	-	-3.13	-
AR(1)	-	-	0.246
AR(2)	-	-	-
Sargan test (p-value)	-	-	0.005

*This table presents the results of regression equations 2 and 6 for the global financial crisis period. The standard errors are reported in parenthesis. ***, **, * indicates statistical significance at 1%, 5%, and 10% respectively. TL is the total leverage. INF is the inflation rate. RGDP is the real GDP growth rate. FS is the firm size. PROF is profitability. LIQ is liquidity. TAN is tangibility. GROWTH is the growth opportunities of the firm. L.TL is the lag of total leverage. AR(1) and AR(2) is the first order and second-order serial correlation respectively. Inflation (INF) was omitted from the OLS estimates for the crisis period due to collinearity.*

A possible reason for the inverse relationship between leverage ratios and growth opportunities may be that firms could forgo investments openings that may yield positive returns during periods of global financial crisis since debt-holders may benefit from high-risk premiums from lending. Further, due to the possibility

of moral hazard within the financial crisis period lenders may be reluctant to offer debt. Previous studies confirm such a negative relationship (see Demirguc-Kunt et al., 2015, Iqbal and Kume, 2014) contrary to the findings of Zabolotna (2013). The Sargan test with a P-value of 0.005 suggests statistical significance level at 1%, indicating a rejection of the null hypothesis that the overidentifying restrictions are valid. Consequently, internal instruments identify the same vector of parameters making the model not to suffer from over-identifying bias.

Table 9: Determinants of Short-term leverage of Non-financial Listed firms in Ghana During the Global Financial Crisis Period (2008-2009)

Variables	**I OLS**	**II Random Effects**	**III System GMM**
Dependent Variable: Shortterm leverage (STL)			
INF	-	0.036***	0.003
		(0.013)	(0.005)
RGDP	-0.008	0.015*	0.001
	(0.009)	(0.009)	(0.008)
FS	0.003	0.002	-0.024***
	(0.013)	(0.017)	(0.008)
PROF	-0.490**	-0.340*	-0.465*
	(0.200)	(0.201)	(0.237)
TAN	-0.424***	-0.448***	-0.249**
	(0.109)	(0.141)	(0.112)
LIQ	-0.062***	-0.058***	-0.027*
	(0.013)	(0.013)	(0.014)
GROWTH	-0.012	-0.02	-0.064*
	(0.027)	(0.036)	(0.032)
L.STL	-	-	0.617***
			(0.171)
Constant	0.784***	-	-
	(0.206)		
Observations	34	34	34
R-squared/Overall R-squared	0.681	0.664	-
Adjusted R-squared	0.61	-	-
Number of years	2	2	2
Wald Chi2/F statistic	9.59	275.84	97.24
Hausman test (p-value)	-	0.997	-
AR(1)	-	-	0.196
AR(2)	-	-	-
Sargan test (p-value)	-	-	0.053

*This table presents the results of regression equations 3 and 7 for the global financial crisis period. The standard errors are reported in parenthesis. ***, **, * indicates statistical significance at 1%, 5%, and 10% respectively. STL represents short-term leverage. INF is the annual inflation rate. RGDP is the annual real GDP growth rate. FS is the firm size. PROF is profitability. LIQ is the liquidity of the firms measured as the current ratio. TAN is tangibility. GROWTH is the growth opportunities of the firm. L.STL is the lag of short-term leverage. AR(1) and AR(2) is the first order and second-order serial correlation respectively. Inflation (INF) was omitted from the OLS estimates for the crisis period due to collinearity.*

SUMMARY AND CONCLUSION

Past literature demonstrates macroeconomic indicators and firm-characteristics as important elements that affect the choice of financing, with further evidence of the direct influence of the global financial crisis on the financing mix of businesses. This study investigates macroeconomic and firm-level characteristics affecting the capital structure of listed non-financial firms in a normal period and the era of the global financial crisis within the context of the developing Sub-Saharan African economy of Ghana. Our findings on the influential elements of capital structure decisions for the sample companies in the normal period

indicate that real GDP growth has a significant negative effect on capital structure specifically the short-term leverage. However, macroeconomic variables (inflation and real GDP) do not significantly influence capital structure decisions during the global financial crisis period. The insignificant relationship between the macroeconomic variables and the various measures of firm leverage could be associated with the fact that firms do not have control over those variables as less attention is given to them in capital structure decisions. Perhaps managers of the firm pay more attention to microeconomic variables in their capital structure decisions to make them more competitive and profitable.

Table 10: Determinants of Long-Term Leverage of Non-Financial Listed Firms in Ghana During the Global Financial Crisis Period (2008-2009)

	I	II	III
Variables	**OLS**	**Random Effects**	**System GMM**
Dependent Variable: Long-term leverage (LTL)			
INF	-	0.023	-0.001
		(0.017)	(0.003)
RGDP	-0.002	0.013	-0.003
	(0.012)	(0.011)	(0.005)
FS	-0.035	-0.035	0.017***
	(0.016)	(0.024)	(0.004)
PROF	0.335	0.200	-0.273*
	(0.255)	(0.216)	(0.147)
TAN	0.157	0.355*	-0.084
	(0.138)	(0.179)	(0.071)
LIQ	-0.026	0.011	-0.008
	(0.016)	(0.018)	(0.009)
GROWTH	0.011	0.213	-0.093***
	(0.350)	(0.045)	(0.019)
L.LTL	-	-	0.488***
			(0.118)
Constant	0.632	-	-
	(0.263)		
Observations	34	34	10
R-squared/ Overall R-squared	0.312	0.257	-
Adjusted R-squared	0.159	-	-
Number of years	2	2	2
Wald Chi2/F statistic	2.04	17.2	19.16
Hausman test (p-value)	-	0.344	-
AR(1)	-	-	0.944
AR(2)	-	-	-
Sargan test (p-value)	-	-	0.000

*Notes: This table presents the results of regression equations 4 and 8 for the global financial crisis period. The standard errors are reported in parenthesis. ***, **, * indicates statistical significance at 1%, 5%, and 10% respectively. LTL represents long-term leverage. INF is the annual inflation rate. RGDP is the annual real GDP growth rate. FS is the firm size. PROF is profitability. LIQ is the liquidity ratio measured as the current ratio. TAN is tangibility. GROWTH is the growth opportunities of the firm. L.LTL is the lag of long-term leverage. AR(1) and AR(2) is the first order and second-order serial correlation respectively. Inflation (INF) was omitted from the OLS estimates for the crisis period due to collinearity.*

Large firms have high long-term leverage in the normal period and in the global financial crisis period, contrary to small firms, which exhibit high access to short-term liabilities during the crisis period. This offers a plausible insight into the trade-off theories of capital structure. Sample firms that have high

profitability demonstrate less short-term and long-term leverage during the period of the financial crisis, highlighting the problem of information asymmetry in relation to the pecking order theory. Conversely, the normal period reveals a significant positive effect of profitability on long-term leverage. Tangibility is negatively associated with long-term leverage and short-term leverage of sample firms in the normal period as well as the crisis period. This raises the implication for policymakers to reflect and delve into the provision and implementation of a seamless system. The system taking charge of collateral in the event of default as well as the cost of perfecting tangible assets as collateral especially in a financial crisis period. High liquidity measured as the current ratio of the firm has a negative association with short-term leverage and total leverage. Our evidence further suggests that listed non-financial firms in Ghana respond positively to an increase in leverage when opportunities for firm growth increase. However, the association is negative in the global financial crisis period. This suggests to corporate managers must efficiently and effectively manage their working capital especially during crisis periods. They must adopt strategies that seek to curtail the moral hazard problem, which may restrict lenders from extending debts in the awakening of a crisis period in spite of opportunities for firm growth.

The results of our study signify managers' ability to influence the financing choice of firms in the pursuit of optimal value creation. Our results render insight to firms in designing financing policies that position the firm to take advantage of various sources of finance, especiall, in times of financial and economic upheaval. This is critical in an era where countries and firms find it necessary to shield their operations from unanticipated financial shocks and economic recession. Continuous financial innovation leading to sophisticated financial products and advancement in technology are not without their associated risks. Moreover, policymakers and regulatory bodies should take the necessary steps to develop the capital market especially debt markets to enhance firms' access to long-term funds to finance their long-term assets.

Despite the useful findings of this study, limitations in our study exist. Future studies could apply the measurement and constructs of the financial sector and Small and Medium Scale Enterprises (SMEs) to substantiate the findings in this study. Further research might also examine the effect of other macroeconomic indicators on the financing choice of firms. Aside from inflation and real GDP growth other variables could offer holistic evidence on how macroeconomic indicators contribute to the financing mix of business entities. Finally, determining factors of financing choices of listed-non financial firms prior to and after the global financial crisis period could render comprehensive findings on the extent of the impact of the financial crisis on the macroeconomic and firm-specific determinants of capital structure.

APPENDIX

APPENDIX A: Regression Results for the Fixed Effects Model

	Full Sample Period (2006-2016)			Global Financial Crisis Period (2008-2009)		
Variables	**I Total Leverage**	**II Short-term Leverage**	**III Long-term Leverage**	**IV Total Leverage**	**V Short-term Leverage**	**VI Long-term Leverage**
INF	0.009	0.011	-0.002	0.013	0.009	0.004
	(0.031)	(0.031)	(0.005)	(0.012)	(0.009)	(0.008)
RGDP	0.005	-0.012	0.007	-	-	-
	(0.037)	(0.036)	(0.006)			
FS	-0.044	0.035	0.008	0.014	0.128	-0.114
	(0.103)	(0.101)	(0.015)	(0.170)	(0.143)	(0.128)
PROF	-3.836***	-3.817***	-0.019	-0.082	-0.446	0.365
	(0.380)	(0.374)	(0.058)	(0.401)	(0.335)	(0.301)
TAN	1.232***	1.201***	0.030	-0.252	-0.68	0.932**
	(0.368)	(0.362)	(0.056)	(0.465)	(0.389)	(0.349)
LIQ	-0.021	-0.019	-0.003	-0.021	-0.014	-0.007
	(0.082)	(0.080)	(0.012)	(0.042)	(0.035)	(0.032)
GROWTH	0.155***	0.157***	-0.002	-0.096	-0.111	0.015
	(0.045)	(0.045)	(0.007)	(0.117)	(0.097)	(0.087)
Constant	0.489	-0.431	-0.058	1.116	-1.344	1.46
	(1.791)	(1.763)	(0.272)	(2.772)	(2.317)	(2.078)
Observations	186	186	186	34	34	34
Overall R-squared	0.426	0.410	0.011	0.060	0.046	0.236
Number of years	11	11	11	2	2	2
F statistic	18.53	19.12	0.65	0.780	1.590	2.400
Hausman test (p-values)	0.359	0.288	0.703	-3.13	0.997	0.344

*This table shows the fixed effect results for total leverage, short-term leverage, and long -term leverage in Column I, II and III respectively, for the full sample period. Column IV, V and VI reveal the fixed effect estimates for total leverage, short-term leverage, and long-term leverage accordingly during the period of the global financial crisis. Standard errors are reported in parenthesis. ***, **,* illustrate statistical significance at 1%, 5% and 10% respectively. INF is the annual inflation rate, RGDP is the annual real GDP growth rate, PROF is the profitability, TAN is the tangibility, LIQ is the liquidity, and GROWTH is the growth opportunities of the firm. The Hausman test is used to test the null hypothesis that, the regressors are uncorrelated with the error term. The real GDP growth rate was omitted for the crisis period due to collinearity.*

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THE RELATIONS BETWEEN EXCHANGE RATES AND STOCK INDEXES FOR BRAZIL

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ABSTRACT

This research investigates the dynamic relations between exchange rates and stock indexes for Brazil by adopting the Granger causality test and the quantile regression model. The causality test results show that changes in stock indexes cause changes in exchange rates in the full sample period and all five sub-periods. The results of different quantile regressions reveal an inverse U-shape pattern of the negative coefficients, which indicates that the negative correlation between changes in exchange rates and changes in stock indexes is even clearer when exchange rates become extremely low or high. The empirical results are consistent with the portfolio approach, which suggests that changes in stock indexes result in changes in exchange rates (the stock market leads the foreign exchange market) with the negative sign of correlation.

JEL: F31, G15

KEYWORDS: Exchange Rates, Stock Indexes, Granger Causality, Quantile Regression

INTRODUCTION

The dynamic relations between exchange rates and stock indexes have been an important research topic in academia. However, the literature regarding the direction of causality for these two financial variables is still inconclusive. This is possibly due to the characteristics of different markets, frequency of data adopted, and different time periods used for the studies. Previous studies show the causality between exchange rates and stock indexes can be either unidirectional or bidirectional. For the unidirectional causality, the traditional approach (Aggarwal, 1981; Abdalla and Murinde, 1997) indicates that the exchange rate leads the stock index while the portfolio approach (Krueger, 1983; Bahmani-Oskooee and Sohrabian, 1992) illustrates that the stock index leads the exchange rate. For the bidirectional causality (or feedback interaction), the exchange rate leads the stock index and the stock index also leads the exchange rate so both variables simultaneously interact with each other.

The traditional approach states that changes in exchange rates cause changes in stock prices but the sign of correlation can be either negative or positive. If an individual firm is an exporter, the domestic currency depreciation (appreciation) relative to U.S. dollar will reduce (rise) its exporting cost (quoted in U.S. dollar) and make the firm's products become more (less) competitive in the international market. Therefore, the firm's earnings may increase (decrease) and the good (poor) earnings report drives the firm's stock price up (down). Thus, the domestic currency depreciation (appreciation) has a positive (negative) effect on an exporter and causes its stock price to increase (decrease). On the contrary, if an individual firm is an importer, the domestic currency depreciation (appreciation) relative to U.S. dollar will increase (decrease) its importing cost (quoted in its home currency) and make the firm's products become less (more) competitive in the domestic market. Therefore, the firm's earnings may decrease (increase) and the poor (good) earnings report drives the firm's stock price down (up). Thus, the domestic currency depreciation (appreciation) has a negative (positive) effect on an importer and causes its stock price to decrease (increase). If an individual firm involves in both export and import operations,

change in the domestic currency (depreciation or appreciation) could lead to either a higher or a lower stock price, depending on which one (export or import) outweighs the other in the firm. In addition, the overall (aggregate) effect on the stock market index cannot be determined, depending on which one (export or import) outweighs the other in aggregation. Hence, the sign of correlation is uncertain.

Opposite to the traditional approach, the portfolio approach expects that changes in stock prices result in changes in exchange rates and the sign of correlation is negative. When the domestic stock prices go up (down), the wealth of domestic investors will also increase (decrease). As the wealth of domestic investors increases (decreases), the demand for money will also increase (decrease). Increase (Decrease) in demand for money will cause the interest rate to climb (drop). A higher (lower) interest rate will attract more foreign capital to flow into (out of) the domestic market. More foreign capital inflows (outflows) increase the demand (supply) for the domestic currency. Therefore, the domestic currency will appreciate (depreciate). An alternative way to explain the portfolio approach is that increase (decline) in domestic stock prices will attract (alert) foreign capital to flow into (out of) the domestic market for engaging in (ending) speculation. Foreign capital inflows (outflows) mean a higher demand (supply) for the domestic currency, which will lead to appreciation (depreciation) of the domestic currency. The sign of correlation is negative because the exchange rate is expressed as the price of domestic currency per U.S. dollar. Thus, decrease (increase) in exchange rate represents that one U.S. dollar can convert to less (more) amount of domestic currency, which means domestic currency appreciation (depreciation).

Feedback interaction (relation) is the bidirectional causality, which combines the traditional approach and the portfolio approach simultaneously. The causality exists from the stock market to the exchange rate market and the causality also occurs from the exchange rate market to the stock market. Hence, either exchange rates or stock indexes can take the lead and the sign of correlation is uncertain.Although a lot of studies have discussed the relationship between stock price indexes and exchange rates, most of them focus on emerging Asian countries and many of them use the low frequent (monthly) data with the older range of time period. In 1999, Brazil changed from a crawling peg exchange rate arrangement to a floating exchange rate system. There are very few literatures focusing on discussing the dynamic relations between the exchange rate and stock markets for Brazil. In this research, the Granger causality test and the quantile regression model are adopted to examine the relations between exchange rates and stock indexes for Brazil. Moreover, the daily data with more recent time period (from January 2007 to April 2019) are used to see whether there are new findings. During the full sample period of this study, there are important events such as the global financial crisis and Brazilian economic crisis. The impact of these events on the relations between exchange rates and stock indexes is worth observing and analyzing. The remaining sections of this paper are presented as follows. The next section describes the literature review, followed by data and methodology. After that, results and discussion are shown. The conclusion is summarized, finally.

LITERATURE REVIEW

Aggarwal (1981) investigates the impact of changes in exchange rates on U.S. stock prices (the traditional approach) using the monthly data from July 1974 to December 1978, the floating rate period for U.S. dollar. For this time period, the results show that exchange rates and stock prices are positively correlated; a decline (an increase) in the value of U.S. dollar was correlated with a decrease (an increase) in U.S. stock prices. Bahmani-Oskooee and Sohrabian (1992) propose that changes in stock prices could affect changes in exchange rates (the portfolio approach) and the bidirectional causality between exchange rates and stock prices is possible. They use monthly data of the effective exchange rate of the dollar and S&P 500 index from July 1973 to December 1988 to test the causality and cointegration between these two variables. They find that there is a short-run two-way relationship between exchange rates and stock prices but they are not able to find the long-run relationship between these two variables.

Several studies have investigated the relationship between stock prices and exchange rates for Asian emerging countries. Abdalla and Murinde (1997) examine the causal linkages between exchange rates and stock prices in emerging markets of India, Korea, Pakistan and Philippines. Using the monthly data on the International Finance Corporation (IFC) stock price index and the real effective exchange rate from January 1985 to July 1994, they find the unidirectional causality from exchange rates to stock prices in all countries, except for Philippines.

Using the daily data from January 1986 to June 1998 (including the time period of the 1997 Asian financial crisis), Granger *et al.* (2000) apply unit root and cointegration models to test the Granger causality between stock prices and exchange rates for nine Asian economies. They find that exchange rates lead stock prices for South Korea but also find that stock prices lead exchange rates for Philippines. Their results for Hong-Kong, Malaysia, Singapore, Thailand, and Taiwan show strong bidirectional causality. Tabak (2006) uses the daily stock price index and exchange rate data from August 1994 to May 2002 to study the dynamic relationship between stock prices and exchange rates for Brazil. He finds that stock prices lead exchange rates in the linear Granger causality test but exchange rates lead stock prices in the nonlinear Granger causality test.

Lin (2012) uses the monthly data of exchange rate, stock price, interest rate, and foreign reserves from January 1986 to December 2010 and study the comovement between exchange rates and stock prices for six Asian emerging countries. Lin's empirical results indicate that the comovement becomes stronger during the crisis periods, compared to the tranquil periods. Using the monthly data of stock price indexes and exchange rates from January 1992 to December 2009 for six Asian countries, Tsai (2012) examines the relationship between the stock price index and the exchange rate by utilizing the quantile regression model. Tsai finds that the negative relation between stock and exchange rate markets is even greater when exchange rates are extremely low or high.

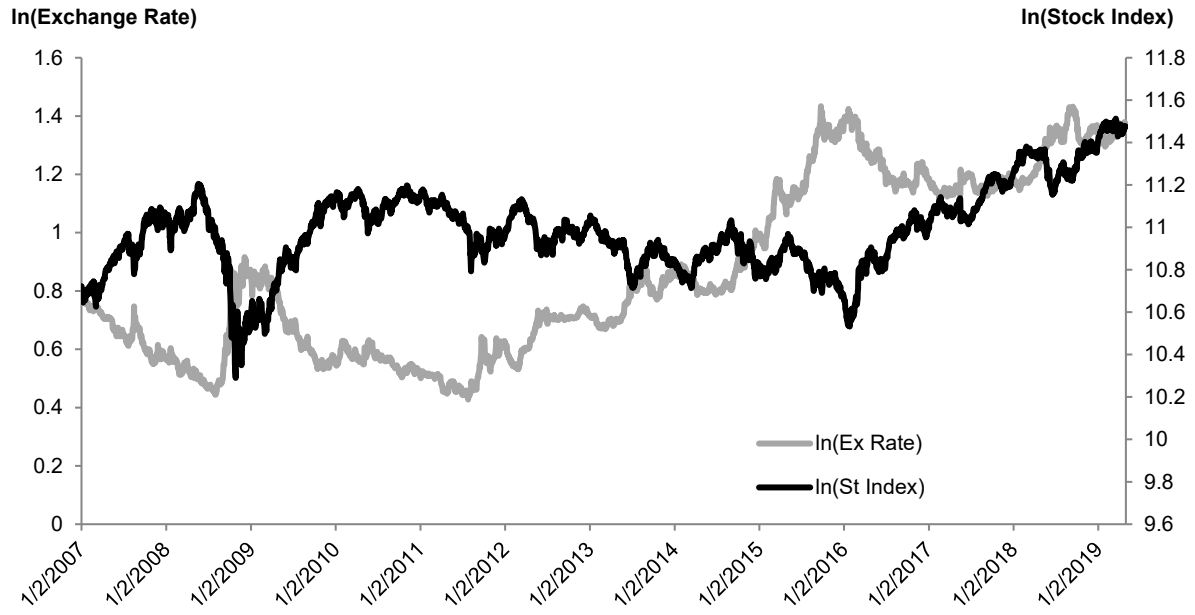
Tudor and Popescu-Dutaa (2012) use the monthly data from January 1997 to March 2012 to examine the Granger causality between movements in stock prices and exchanges rates for thirteen developed and emerging markets (Australia, Canada, France, Hong Kong, Japan, U.K., U.S., Brazil, China, India, Korea, Russia, and South Africa). They collect monthly stock price indexes from the Morgan Stanley Capital International database and monthly exchange rates from the Pacific Exchange Rate Service. They find a two-way causality between stock indexes and exchange rates for Korea, a unidirectional causality from exchange rates to stock indexes for Brazil and Russia, and a unidirectional causality from stock indexes to exchange rates for U.K.Cakan and Ejara (2013) investigate linkages between exchange rates and stock prices for twelve emerging markets from May 1994 to April 2010 by adopting the linear and nonlinear Granger causality tests. Their empirical test results show that there is bidirectional causality in most of markets for both the linear and nonlinear Granger causality tests. However, there is only a unidirectional causality (the direction is only from exchange rates to stock prices) for Korea, Mexico, and Taiwan and the causality direction is only from stock prices to exchange rates for India in the linear Granger causality test. In the nonlinear Granger causality test, only stock prices lead exchange rates for Brazil and Poland but there is no causality in either direction for Taiwan.Mishra (2016) uses monthly data from January 1998 to June 2015 to analyze the dynamic interlinkage between exchange rate changes and stock returns for Brazil, Russia, India, and China (BRIC nations). The estimation of the quantile regression approach shows significantly negative coefficients across quantiles for Brazil, Russia, and India, but not for China. The coefficients estimated from different quantile regressions for Brazil roughly show a pattern of downward trend.

DATA AND METHODOLOGY

In this study, the daily exchange rate and stock index data from January 2, 2007 to April 30, 2019 are collected. The daily exchange rates (bid rates, price of Brazilian real (BRL) per U.S. dollar) are from

Central Bank of Brazil (Banco Central do Brasil) website. Ibovespa is the major stock market index in Brazil and it represents the average performance of most active and benchmark stocks traded in the São Paulo Stock Exchange (Bovespa). The daily closing Ibovespa data are from Bovespa website. All exchange rate and stock index data are transformed into natural logarithmic scale and their time series plots are shown on Figure 1.

Figure 1: Time Series Plots of Exchange Rates and Stock Indexes (Natural Logarithmic Scale) from January 2, 2007 to April 30, 2019 for Brazil



This figure shows the time series plots of exchange rates and stock indexes (natural logarithmic scale) from January 2, 2007 to April 30, 2019 for Brazil. Note: The exchange rate is expressed as the price of Brazilian real per U.S. dollar. Thus, decrease (increase) in exchange rate represents that one U.S. dollar can convert to less (more) Brazilian real, which means that Brazilian real appreciates (depreciates).

Unit Root Test

If the independent and dependent variables exhibit a unit root (nonstationary), the regression result will be spurious. To avoid the false regression, a unit root test is needed. Dickey and Fuller (1979) test a unit root of autoregressive part of relation but include only a first-order autoregressive process. The augmented Dickey-Fuller (ADF) test accommodates a higher-order autoregressive process and includes lagged difference terms of Y_t in the test regression. The equation for the augmented Dickey-Fuller (ADF) test with a linear time trend is as follow.

$$\Delta Y_t = \alpha + \gamma t + \omega Y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta Y_{t-i} + \varepsilon_t \quad (1)$$

where $\Delta = 1 - L$; L is the lag operator; t is a trend variable; p is the order of lags. Y_t is a financial time series (the exchange rate or the stock index). Y_t is said to have a unit root if we fail to reject the null hypothesis, H_0: $\omega = 0$. The selection of the lag length (p) is based on Schwarz Bayesian information criterion (SBC) and data-dependent selection procedure suggested by Ng and Perron (1995).

Unit Root Test with a Structural Break

A financial time series may happen to a structural change because of a main event, such as a financial crisis. The standard unit root test may be biased if a series of data are stationary with a breakpoint. To resolve the issue of the structural break and make the unit root test remain valid, Zivot and Andrews (1992) suggest a unit root test model with a structural break as follow:

$$\Delta Y_t = \alpha + \gamma t + \omega Y_{t-1} + \rho DU_t(\theta) + \sum_{i=1}^{p} \beta_i \Delta Y_{t-i} + \varepsilon_t \quad (2)$$

where $DU_t\ (\theta) = 1$ for $t > T\theta$, and $DU_t\ (\theta) = 0$ otherwise; $\theta = T_b/T$, representing the place where the structural break occurs; T is the sample size and T_b is the structural break date.

Cointegration Tests

If the independent and dependent variables are nonstationary, the cointegration tests could be conducted to test the long-run relationship between these variables. Johansen (1991, 1995) cointegration rank test and Engle and Granger (1987) two-step cointegration test are used to examine whether exchange rates and stock indexes are cointegrated in Brazil for this study. If the test results show that there is no cointegration, the long-run equilibrium relationship does not exist between exchange rates and stock indexes.

Johansen Cointegration Rank Test

A vector autoregressive (VAR) of order p is written as follow:

$$Y_t = \sum_{i=1}^{p} A_i Y_{t-i} + BD_t + \varepsilon_t \quad (3)$$

Y_t is a k-vector of nonstationary I(1) variables, integrated of order one; D_t is a d-vector of deterministic variables (intercept, trend, and/or dummy variables); ε_t is a k-vector of innovations.

We may rewrite this VAR as follow:

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + BD_t + \varepsilon_t \quad (4)$$

where $\Pi = \sum_{i=1}^{p} A_i - I$; $\Gamma_i = -\sum_{j=i+1}^{p} A_j$

If the coefficient matrix (Π) has reduced rank ($r < k$), then there exist $k \times r$ matrices α and β so that $\Pi = \alpha\beta'$ and $\beta' Y_t$ is I(0). r is the number of the cointegrating rank and each column of β is the cointegrating vector. The elements of α are known as the adjustment parameters in the vector error correction model (VECM). Johansen's maximum likelihood method is to estimate the Π matrix from an unrestricted VAR and to test the null hypothesis H_0: Rank(Π) $\leq$ k versus the alternative hypothesis H_1: Rank(Π) > k. The trace statistic of Johansen's cointegration rank test is calculated as $-T \sum_{i=r+1}^{k} \ln(1 - \lambda_i)$ where T is the sample size and λ_i is the eigenvalue.

Engle and Granger Two-step Cointegration Test

Engle and Granger (1987) two-step model is the residual-based cointegration test. The first step is to estimate the following regressions.

$$X_t = \alpha_1 + \kappa_1 t + \beta_1 Y_t + e_{1t} \quad (5)$$

$$Y_t = \alpha_2 + \kappa_2 t + \beta_2 X_t + e_{2t} \quad (6)$$

The second step is to examine whether the estimated residuals, $\hat{e}_{1t}$ and $\hat{e}_{2t}$, are I(0) using ADF test. The null hypothesis is that non-cointegration exists between X_t (exchange rates) and Y_t (stock indexes). If the residuals are not I(0), we fail to reject the null hypothesis and there is no cointergration between X_t and Y_t, If the residuals are I(0), we reject the null hypothesis and there is cointergration between X_t and Y_t,

Granger Causality Test

If the cointegration does not exist, the following linear equations are used in testing the Granger (1969) causality.

$$\Delta X_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \Delta X_{t-i} + \sum_{i=1}^{p} \beta_i \Delta Y_{t-i} + \varepsilon_{1t} \quad (7)$$

$$\Delta Y_t = \gamma_0 + \sum_{i=1}^{p} \gamma_i \Delta X_{t-i} + \sum_{i=1}^{p} \rho_i \Delta Y_{t-i} + \varepsilon_{2t} \quad (8)$$

On equation (7), the null hypothesis is H_0: $\beta_1 = \beta_2 = \beta_3 = \ldots = \beta_p = 0$. Failing to reject the null hypothesis indicates that stock indexes do not Granger cause exchange rates. Similarly, on equation (8), the null hypothesis is H_0: $\gamma_1 = \gamma_2 = \gamma_3 = \ldots = \gamma_p = 0$. Failing to reject the null hypothesis indicates that exchange rates do not Granger cause stock indexes. The selection of the lag length (p) is based on Schwarz Bayesian information criterion (SBC) and data-dependent selection procedure suggested by Ng and Perron (1995). If the cointegration exists, an error correction term is needed in testing the Granger causality. The linear equations are as follows.

$$\Delta X_t = \alpha_0 + \lambda_1 (X_{t-1} - \varphi Y_{t-1}) + \sum_{i=1}^{p} \alpha_i \Delta X_{t-i} + \sum_{i=1}^{p} \beta_i \Delta Y_{t-i} + \varepsilon_{1t} \quad (9)$$

$$\Delta Y_t = \gamma_0 + \lambda_2 (X_{t-1} - \varphi Y_{t-1}) + \sum_{i=1}^{p} \gamma_i \Delta X_{t-i} + \sum_{i=1}^{p} \rho_i \Delta Y_{t-i} + \varepsilon_{2t} \quad (10)$$

where λ_1 and λ_2 represent speeds of adjustment. On equation (9), the null hypothesis is H_0: $\beta_1 = \beta_2 = \beta_3 = \ldots = \beta_p = 0$ and $\lambda_1 = 0$. Failing to reject the null hypothesis indicates that stock indexes do not Granger cause exchange rates. Similarly, on equation (10), the null hypothesis is H_0: $\gamma_1 = \gamma_2 = \gamma_3 = \ldots = \gamma_p = 0$ and $\lambda_2 = 0$. Failing to reject the null hypothesis indicates that exchange rates do not Granger cause stock indexes. In this research, in addition to conducting the Granger causality test for the full of sample period (12⅓ years, from January 2, 2007 to April 30, 2019), we also divide it into five sub-periods and conduct the Granger causality test for each sub-period. These five sub-periods are described as follows.

Period I (January 2, 2007 to February 28, 2009): This time period includes the global financial crisis, originally resulted from the U.S. subprime mortgage crisis. Eun and Resnick (2017) point out that the U.S. subprime mortgage crisis began in summer 2007 and Lehman Brothers went bankrupt in September 2008; Dow Jones Industrial Average (DJIA) fell by 50% from October 2007 to February 2009. Brazil is the main producer and exporter of commodities (iron ore, soybean, coffee, sugar, meat, etc.) in the world. Before the global financial crisis, high economic growth in China and other emerging markets increased the demand for commodities and the higher prices of commodities benefited Brazil. Moreover, a stronger consumption growth also fueled the Brazilian economy. According to the International Monetary Fund (IMF), Brazilian real GDP growth was 6.1% and 5.1% in 2007 and 2008, respectively. During the global financial crisis, the low growth in China decreased the demand of commodities, leading to lower prices of commodities. According to the IMF, Brazilian real GDP growth decreased to –0.1% in 2009. To respond the crisis, Brazil enacted policies of increasing public spending and reducing the interest rate to stimulate

the economy. Period II (March 1, 2009 to July 31, 2011): This period is from the post global financial crisis to the end of the U.S. debt ceiling gridlock. The Brazilian economy recovered after the global financial crisis, resulting from the recovery of commodity prices and economic stimulation policies. From Figure 1, we can see that the stock market index went up and Brazilian real appreciated in this time period. According to the IMF, Brazilian real GDP growth rose to 7.5% in 2010 and maintained at 4% in 2011. Period III (August 1, 2011 to July 31, 2014): This is the relatively stable time period prior to Brazilian economic crisis. The stock market index was quite stable and the depreciation of Brazilian real was managed. According the IMF, Brazilian real GDP growth was 1.9% in 2012 and 3% in 2013.

Period IV (August 1, 2014 to December 31, 2016): Brazil experienced economic crisis during this time period. Falling commodity prices, excessive spending and subsidies of the government, and multiple corruption scandals negatively affect investment and consumption. Figure 1 shows that the depreciation of Brazilian real escalated in 2015. According to the World Bank (2019), the economic activities in Brazil reduced significantly in 2015 and 2016. Based on the IMF, Brazilian real GDP growth was 0.5% in 2014 and became negative in 2015 and 2016 (–3.5% in 2015 and –3.3% in 2016). Period V (January 2, 2017 to April 30, 2019): This is the post economic crisis period. Brazilian economy began with a gradual recovery in 2017. Economic reforms intend to limit the growth of public spending and restore economic health. The reforms and recovery process may take time to see the result. According to the IMF, Brazilian real GDP growth was 1.1% in both 2017 and 2018 and is projected to be 2.1% in 2019. In addition to the Granger causality test, the dynamic relations between exchange rates and stock indexes can be investigated using the quantile regression.

Quantile Regression

Koenker and Bassett (1978) introduce quantile regression, which extends the ordinary least squares (OLS) regression model to conditional specific percentiles (or quantiles) of the dependent variable. A quantile regression estimates the change in a specified quantile of the dependent variable affected by a unit of change in the independent variable(s). It is especially useful where the extreme values are important in the research. It is also meaningful to estimate quantile regressions of different quantiles to see whether there is a pattern. The quantile regression is described as follows.

For a random sample of Y ($y_1, y_2, y_3, \ldots, y_n$), the sample mean is to minimize the sum of squared residuals, $\underset{\mu \in R}{Min} \sum_{i=1}^{n} (y_i - \mu)^2$, which can be extended to the conditional mean function $E(Y|x) = x'\beta$ by solving $\underset{\beta \in R^p}{Min} \sum_{i=1}^{n} (y_i - x_i'\beta)^2$.

The linear conditional quantile function, $Q(\tau|x) = x'\beta(\tau)$, can be estimated by solving $\underset{\beta \in R^p}{Min} \sum_{i=1}^{n} \rho_\tau (y_i - x_i'\beta)$, where $\rho_\tau(\cdot)$ is the tilted absolute value function. For any quantile τ ($0 < \tau < 1$), the estimate $\hat{\beta}(\tau)$ is the τ-th regression quantile. If $\tau = 0.5$, it is the median regression, which minimizes the sum of absolute residuals.

RESULTS AND DISCUSSION

Table 1 shows the results of ADF unit root test. The tau test statistics for both exchange rates and stock indexes are not significant in level, which indicates that the null hypothesis of unit root cannot be rejected. Therefore, this result suggests nonstationary in level. The tau test statistics for both exchange

rates and stock indexes are significant in the first difference, which points out that the null hypothesis of unit root is rejected. Therefore, this result suggests stationary in the first difference. Although not shown on Table 1, Phillips-Perron (PP) (1988) unit root test is also performed and PP test results are consistent with ADF test results. Thus, the unit root test results show that exchange rates and stock indexes are nonstationary and integrated of order one, I(1). If a time series follows the random walk, its first difference will be stationary. The difference stationary for exchange rates and stock indexes indicates the random walk process. Thus, the nonstationary problem can be avoided by using the difference (change) of each time series.

Table 1: ADF Unit Root Test

Time Series	**Level (Y_t)**	**First Difference (Δy_t)**
Exchange Rate	–2.3936 (0.3828)	–38.8589*** (< 0.0001)
Stock Index	–2.2442 (0.4643)	–40.2713*** (< 0.0001)

*This table shows the results of ADF unit root test. Tau test statistic is shown first and p-value is shown below in a parenthesis. *** indicates significance at 1% level.*

The time series data used in this research cover twelve and one-third years. It is likely to happen to the structural break because the important event occurred. To address this issue, ADF unit root test with a structural break is conducted and the test results are displayed on Table 2. The test results on Table 2 show that the null hypothesis of unit root cannot be rejected in level and it is rejected in the first difference for both exchange rates and stock indexes. Therefore, the test results of ADF unit root test with a structural break are not different from the test results of standard ADF unit root test. The structural break does not change the test results.

Table 2: ADF Unit Root Test with a Structural Break

Time Series	**Level (Y_t)**	**First Difference (ΔY_t)**
Exchange Rate	–2.9328 (0.3009) [0.1821]	–38.8796*** (< 0.0010) [0.1473]
Stock Index	–3.4733 (0.1095) [0.8508]	–40.2863*** (< 0.0010) [0.1397]

*This table shows the results of ADF unit root test with a structural break. $\theta = T_b/T$, representing the place where the structural break occurs; T is the sample size and T_b is the structural break date. Tau Test Statistic is shown first and p-value is shown below in a parenthesis, followed by θ shown in a bracket. *** indicates significance at 1% level.*

Table 3 shows the results of Johansen cointegration rank test. By default, the critical values at 5% significance level are used for testing the null hypothesis (H_0) of no cointegration For the null hypothesis of rank = 0, the trace test statistic of 7.1852 is less than the 5% significance critical value of 15.34 so the null hypothesis cannot be rejected. For the null hypothesis of rank = 1, the trace test statistic of 0.0021 is less than the 5% significance critical value of 3.84 so the null hypothesis cannot be rejected, either. Based on the test results on Table 3, there is no cointegration between exchange rates and stock indexes. The long-run relationship between these two financial series does not exist.

Table 3: Johansen Cointegration Rank Test

H_0	H_1	Eigenvalue	Trace	5% Critical Value
Rank = 0	Rank > 0	0.0024	7.1852	15.34
Rank = 1	Rank > 1	< 0.0001	0.0021	3.84

This table shows the results of Johansen cointegration rank test. H_0 is the null hypothesis and H_1 is the alternative hypothesis. Trace test statistic is computed by $-T\sum_{i=r+1}^{k} ln\,(1-\lambda_i)$ where T is the sample size and λ_i is the eigenvalue.

Table 4 shows the results of Engle-Granger two-step cointegration test. The tau test statistics for both exchange rates and stock indexes are not significant. Therefore, the test results suggest that exchange rate series and stock index series do not cointegrate. Since the test results from Table 3 and Table 4 indicate no cointegration between exchange rates and stock indexes, we can conduct the Granger causality test using system equations (7) and (8), without adding an error correction term.

Table 4: Engle-Granger Two-step Cointegration Test

Time Series	Test Statistic (*p*-value)
Exchange Rate	–1.9003 (0.6667)
Stock Index	–1.8567 (0.6821)

This table shows the results of Engle-Granger two-step cointegration test. Tau test statistic is shown first, and p-value is shown below in a parenthesis.

Table 5 presents the results of the Granger causality test between changes in exchange rates and changes in stock indexes. For the full sample period (January 2, 2007 to April 30, 2019), the test results show feedback interaction (bidirectional causality): changes in stock indexes Granger cause changes in exchange rates (significant at 1% level) and changes in exchange rates also Granger cause changes in stock indexes (significant at 5% level). In addition, we divide the full sample period into five sub-periods. The test result for each sub-period is different from that for the full sample period. Period I (January 2, 2007 to February 28, 2009) includes the event of global financial crisis. The results for Period I show that the stock index leads the exchange rate significantly (at 1% level) but the exchange rate leads the stock index only with a weak significance (at 10% level). Therefore, the stock market significantly takes the lead during this time period. The results for Period II and III show feedback interaction; the bidirectional causality results indicate that either the stock or the exchange rate market can lead the other and the interaction between these two markets is strong.

The results for Period IV and Period V show the unidirectional causality from changes in stock indexes to changes in exchange rates, meaning that only the stock market leads the exchange rate market. The portfolio approach can explain the results. Period IV covers the time period of Brazilian economic crisis. During the economic crisis, the stock prices decline, leading to the decline in the wealth of investors. The decline in the wealth of investors causes foreign capital to flow out the equity market and leave Brazil. Foreign capital outflows result in the depreciation of Brazilian real. Period V is the post economic crisis (recovery) period. When the economy begins to recover, the stock prices gradually increase, and foreign investors regain the confidence. Foreign capital starts flowing into the domestic stock market and the capital inflows result in the appreciation of Brazilian real. Overall, changes in stock indexes cause changes in exchange rate significantly (at 1% level) in the full sample period and all sub-periods as well. Changes in exchange rates cause changes in stock indexes significantly (at 5% level) in the full sample period and only two sub-periods. The portfolio approach matched the situation of the stock and exchange rate markets in Brazil during all of time periods in this study,

Table 5: The Granger Causality Test between Changes in Exchange Rates (ΔEX) and Changes in Stock Indexes (ΔSI) for Brazil

Time Period	H_0: ΔSI → ΔEX F-statistic (*p*-value)	H_0: ΔEX → ΔSI F-statistic (*p*-value)
Period I: 01/02/2007 – 02/28/2009	29.94*** (0.0001)	2.54* (0.0796)
Period II: 03/01/2009 – 07/31/2011	9.43*** (0.0001)	3.97** (0.0191)
Period III: 08/01/2011 – 07/31/2014	8.58*** (0.0002)	4.85*** (0.0080)
Period IV: 08/01/2014 – 12/31/2016	13.74*** (0.0001)	0.57 (0.5642)
Period V: 01/02/2017 – 04/30/2019	10.52*** (0.0001)	1.05 (0.3511)
Full Sample Period: 01/02/2007 – 04/30/2019	75.32*** (0.0001)	3.66** (0.0258)

*This table shows the results of the Granger causality test between changes in exchange rates and changes in stock indexes for Brazil. All exchange rate and stock index data are transformed into natural logarithmic scale. F-statistic is shown first and p-value is shown below in the parenthesis. ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.*

The quantile regression can also examine the dynamic relations between exchange rates and stock indexes. Since Table 5 results support the portfolio approach, indicating the causality from changes in stock indexes to changes in exchange rates, we use change in the stock index at date t (ΔSI_t) as the independent variable and change in the exchange rate at date t (ΔEX_t) as the dependent variable in the quantile regression. The results of estimating quantile regressions for the full sample period are summarized on Table 6. First of all, the coefficients (β_τ) estimated under different quantiles are all negative and significant. This indicates that increase (decrease) in the stock price causes decrease (increase) in the exchange rate, which means the Brazilian real appreciation (depreciation). Second, the absolute value of the coefficient is even higher when the quantile is extremely low (0.05^{th}) or high (0.95^{th}). This indicates that decrease (increase) in the stock price during the economic crisis (boom) will lead to even more depreciation (appreciation) of the Brazilian real.

Table 6: The Results of Estimating Quantile Regression: $\Delta EX_t = \alpha_\tau + \beta_\tau \Delta SI_t + \varepsilon_\tau$

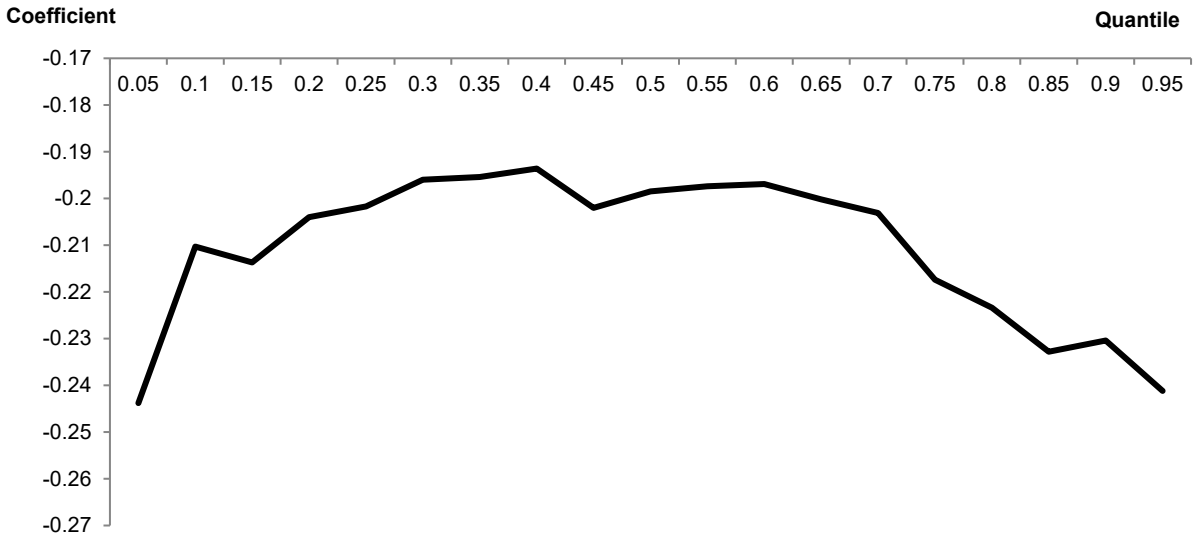
Quantile	Coefficient (β_τ)	t-statistic (*p*-value)	Quantile	Coefficient (β_τ)	t-statistic (*p*-value)
0.05	–0.2438	– 9.68*** (<0.0001)	0.55	–0.1974	–22.80*** (<0.0001)
0.10	–0.2103	–13.54*** (<0.0001)	0.60	–0.1969	–23.58*** (<0.0001)
0.15	–0.2137	–15.91*** (<0.0001)	0.65	–0.2002	–22.25*** (<0.0001)
0.20	–0.2040	–19.11*** (<0.0001)	0.70	–0.2031	–30.91*** (<0.0001)
0.25	–0.2017	–21.20*** (<0.0001)	0.75	–0.2174	–22.24*** (<0.0001)
0.30	–0.1960	–22.38*** (<0.0001)	0.80	–0.2234	–36.18*** (<0.0001)
0.35	–0.1954	–22.60*** (<0.0001)	0.85	–0.2328	–17.43*** (<0.0001)
0.40	–0.1936	–23.47*** (<0.0001)	0.90	–0.2304	–11.58*** (<0.0001)
0.45	–0.2020	–23.86*** (<0.0001)	0.95	–0.2412	–10.82*** (<0.0001)
0.50	–0.1985	–22.95*** (<0.0001)			

*This table shows the results of estimating quantile regression: $\Delta EX_t = \alpha_\tau + \beta_\tau \Delta SI_t + \varepsilon_\tau$. All exchange rate and stock index data are transformed into natural logarithmic scale. t-statistic is shown first, followed by p-value in the parenthesis. *** indicates significance at 1% level. $\Delta EX_t = EX_t – EX_{t-1}$; $\Delta SI_t = SI_t – SI_{t-1}$*

The test of equal coefficient across quantiles is also performed. The chi-square (χ^2) statistic is 39.7617 (*p*-value is 0.0022, significant at 1% level), which indicates that the null hypothesis of equal coefficient

across quantiles is rejected. Therefore, the coefficients across quantiles are significantly different. Based on Table 6, the graphical presentation of coefficients (β_τ) estimated under different quantiles is shown on Figure 2. The negative coefficients exhibit an inverse U-shape pattern. Therefore, the influence of changes in stock indexes on changes in exchange rates will be greater when exchange rates become very low or very high.

Figure 2: Coefficients of Different Quantile Regressions



This figure shows the graphical presentation of coefficients estimated under different quantiles. The vertical axis represents the coefficient and the horizontal axis represents the quantile.

CONCLUSION

This study examines the dynamic relations between exchange rates and stock market indexes for Brazil by using the linear Granger causality test and the quantile regression model. The standard unit root test and the unit root with a structural break test show a unit root for both exchange rate and stock index series and stationarity for the first difference of both financial series. The cointegration tests show there is no cointegration between exchange rates and stock indexes. Therefore, there is no evidence of the long-run relationship between these two financial series. The results of the linear Granger causality test show that changes in stock indexes cause changes in exchange rates significantly in the full sample period and all five sub-periods. Although the test results also show that changes in exchange rates cause changes in stock indexes in the full sample period, the causality from changes in exchange rates to changes in stock indexes is only significant for two sub-periods and weakly significant (at 10% level) for one sub-period. The results of different quantile regressions reveal an inverse U-shape pattern of the negative coefficients, which indicates that the negative correlation between changes in exchange rates and changes in stock indexes is even clearer when exchange rates become extremely low or high.

The empirical results are in line with the portfolio approach, which suggests that changes in stock indexes result in changes in exchange rates (the stock market leads the foreign exchange market) with a negative sign of correlation. For stock traders who are in the markets exhibiting the characteristics described above, they need to be cautious about the negative event such as the economic crisis. As stock traders perceive the signal of occurrence of a negative event, they should quickly liquidate their investment in the stock market to minimize their potential loss and then buy U.S. dollar (or the other safer currency) to take advantage of its appreciation relative to the domestic currency. As to the limitations of this paper, first,

this paper focuses on the relations between exchange rates and stock indexes; other possible determinants of exchange rates are not included in this research. Second, the results are based on the methodologies adopted in this research; the results might be different if different (nonlinear) methodologies are used.

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THE EFFECTS OF CANADIAN SOX ON THE PRICE DISCOUNT OF CANADIAN EQUITY OFFERINGS

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ABSTRACT

This study studies the effects of Canadian SOX on the price discount of seasoned equality offerings of Canadian issuers. Canadian SOX is legislation similar to the U.S. Sarbanes-Oxley of 2002. It passed in October 2002 and became effective December 2005. It finds Canadian SOX did not have a significant effect on the offer price discount of all Canadian issuers. These include those listed on the Toronto Stock Exchange only and those simultaneously listed on the Toronto Stock Exchange and major U.S. exchanges (cross-listed). On the other hand, when distinguishing offers by underwriting method, the price discount is not different between bought deals and marketed underwritten offers after the passage of Canadian SOX. These findings are consistent with the general hypothesis the Canadian law should not have a significant effect in the price discount of equity offers. This is because the 3-year period allowed regulators, issuers, investors, and investment banks enough time to adapt to the new law with minimum effects. Unlike Sarbanes-Oxley, where many difficulties have occurred in its implementation.

JEL: G24, G32

KEYWORDS: Canadian Sox, Seasoned Equity Offerings, Price Discount, Sarbanes-Oxley Act, Cross-Listed, Bought Deals, Marketed Underwritten Offers

INTRODUCTION

The purpose of this study is to explore the effects of the Canadian SOX on the price discount of seasoned equity offerings by Canadian issuers. The Canadian SOX is legislation comparable to the U.S. Sarbanes-Oxley Act -a far-reaching law passed by the U.S. Congress in July 2002. The main objective of the U.S. legislation is to protect investors and restore confidence in capital markets damaged by corporate financial fraud. Afterwards, many other countries passed similar legislation including Canada, UK, Australia, the European Union, Japan, China, and the Philippines (Rubalcava, 2012). The Canadian government passed the legislation in October 2002 and became effective three years later; unlike the U.S. legislation, which immediately became effective. This paper builds on the study by Rubalcava (2016) about the impact of Sarbanes-Oxley on the price discount or underpricing of seasoned equity offerings by Canadian cross-listed firms in major U.S. exchanges (NYSE, NASDAQ, and AMEX). Both studies come from the study by Eckbo, Masulis, and Norly (2007). They suggest that laws such as Sarbanes-Oxley (and by extension Canadian SOX) are worth exploring their impact on issuance costs of seasoned equity offerings. A seasoned equity offering (SEO) or follow-on is an equity offering following an initial public offering. The price discount of seasoned equity offerings is an important issuance cost for firms. The discount usually occurs when the offer price is lower than the closing price on the day before the issue date. For example, the average price discount and the gross offer revenue for Canadian issuers during 1999-2011 were 4 percent and $118 million (Canadian), respectively. This means issuers forego revenue of $4.72 million by pricing the issue below market value.

Unlike Rubalcava (2016) study, the current paper examines the effects of the price discount of Canadian SOX on all offer issuers, including those listed in the Toronto Stock Exchange only and those cross-listed

in U.S. exchanges. By comparison purposes, I include offers of Canadian cross-listed issuers (which are subject to Sarbanes-Oxley) and offers of Canadian issuers (non-cross-listed). I find the Canadian SOX (CSOX) does not show any impact on the price discount of all equity offerings, including cross-listed and non-cross-listed after conditioning for offer and firm controls. Similar finding occurs when comparing cross-listed versus non-cross-listed offers during the pre-CSOX period (January 1999-2005) and post-CSOX period (January 2006-2011), respectively. On the other hand, when comparing offers by underwriting method –bought deals versus marketed underwritten-, the price discount is higher (at the ten percent level) for bought deals versus marketed underwritten offers during the pre-CSOX period only. These findings are consistent with the general hypothesis that CSOX should not have a meaningful effect in offer price discount. This is because the three-year period (2003-2005) allowed regulators, issuers, investors, and investment banks enough time to adapt to the new legislation by reducing market uncertainty. Unlike the USSOX, where many obstacles prevented its proper implementation (Gray, 2005). In other words, Canadian regulators made the correct decision by following a gradual approach to complete CSOX. The paper is organized as follows. Next section presents the related literature and testable hypotheses. The following section presents the data and methodology. Next section reports and discusses the empirical results. The last section shows the conclusion.

RELATED LITERATURE AND HYPOTHESES

This section starts with commonalities and differences between the Sarbanes-Oxley (USSOX) and the Canadian SOX (CSOX). Next, it describes two underwriting methods for seasoned equity offerings (SEOs) – Canadian bought deals and marketed underwritten offers - and defines price discount. Also, it reports relevant research on offer price discount. Finally, it presents the research hypotheses.

The Canadian SOX (also known as Bill 198) is a law equivalent to the U.S. Sarbanes-Oxley of 2002. The main goals of both legislations are to improve corporate governance, better financial disclosure, and to strengthen corporate internal controls. These address restoring confidence in financial markets harmed by corporate fraud in the U.S. and Canada. However, CSOX does not exactly mirror USSOX. For example, USSOX is stricter in disclosure of internal controls over financial reporting, criminal penalties and civil liability on secondary market disclosures (such as equity offerings) (Ben-Ishai, 2008). Essentially, CSOX adapts to the needs of much smaller Canadian firms, compared with those in the United States. Thus, copying the same USSOX rules would be inconvenient and costly. Despite their differences, the main objective of both legislations is protecting investors from deceptive corporate financial practices.

Two common methods for underwriting seasoned equity offerings are Canadian bought deals –similar to overnight offers or extremely accelerated offers in the U.S. (Gustafson, 2018) -, and marketed underwritten offers (non-accelerated or book-built offers). In both types of underwritings, an investment bank or bank syndicate (led by a book-runner) commits to buy the equity offer from the issuer and sell it mostly to institutional investors. (Most research studies call marketed underwritten offers as firm commitment offers. However, bought deals and marketed underwritten offers are both on a firm commitment basis). They charge an underwriting fee called gross spread or investment banking fee, which is a percent of gross offer revenues. The main differences between bought deals (overnight offers in the U.S.) and marketed underwritten offers as reviewed by Bortolotti, Megginson, and Smart (2008) and Pandes (2010) are as follows. In a bought deal the issue date is the same as the announcement date, unlike a marketed offering which occurs several days after the announcement. There is no *market-out* clause in bought deals, which means that if the share price declines before the issue date the investment bank cannot cancel the bought deal, unlike a marketed underwritten offer. Bought deals do not include *road shows.* This is the procedure followed in marketed underwritten offers to gauge the demand for the equity offering among potential investors. According to Calomiris and Tsoutsoura (2010), "the most important differences between fully marketed SEOs and accelerated SEOs is the amount of marketing effort expended and the speed with which the offering is brought to market." Thus, the advantages of a bought deal are less marketing effort and faster

completion at the expense of price risk. The advantage in a marketed underwritten offer is low price risk at the expense of more marketing effort and longer completion.

The price discount on a seasoned equity offering usually occurs by pricing the offer below the closing market price the day before the issue. It is an important issue cost for exchange-traded companies. For example, it is around 2.4 percent for U.S. firms (Autore, 2011), 4.58 percent for global offers (Bortolotti et al. (2008), 5.34 percent for Canadian firms (Pandes, 2010), and 4.08 percent for Canadian cross-listed firms (Rubalcava, 2016). The price discount is an incentive investment banks offer to selected investors (mostly institutional investors) for providing information about the potential demand of the equity offering before the issue date (Benveniste and Spindt, 1989; Chemmanur, 1993; Booth and Chua, 1996). Eckbo, Masulis, and Norly (2007) and Papaioannou and Karagozoglu (2017) provide an excellent review of theoretical and empirical studies on price discount of equity offerings. Most research studies include determinants associated with information asymmetry (between issuers and underwriters, among investors -informed and uninformed-, between issuers and investors, and between underwriters and investors). Other factors include risk (total, firm-specific, systematic), price pressure, underwriter prestige and certification, liquidity risk, exchange trade venue (e.g., NASDAQ, NYSE), offer placement (domestic, global), underwriting method (bought deal, marketed underwritten offer), inside ownership, institutional investment, and offering purpose among others. (The Data and Methodology section reviews the references for the expected determinants on this study.) The research evidence on whether bought deals or marketed underwritten offers incur in lower price discount is not clear. For instance, Bortololotti, Megginson, and Smart (2008), Pandes (2010) and Gustafson (2018) find the offer price discount is higher for Marketed underwritten offers than bought deals. Pandes (2010) argues Canadian marketed underwritten offers report higher price discounts because are not certified by underwriters, unlike bought deals which are. Rubalcava (2016) finds the price discount is higher only for global issues of market underwritten offers of Canadian cross-listed firms after the passage of USSOX. Gustafson (2018) asserts U.S. overnight offers (bought deals) have lower price discounts because they avoid the negative price pressure pre-issue date of market-underwritten offers, resulting in a higher market price on the issue day. On the other hand, Autore (2011) finds U.S. overnight offers show a higher price discount compared with non-accelerated or marketed underwritten offers. The objective of this paper is to answer the following research questions: What has been the effect of CSOX on the price discount of seasoned equity offerings by Canadian issuers? What has been the effect on the price discount of bought deals versus marketed underwritten offers? To answer these questions, I examine the effects of CSOX by comparing the period from January 1999 to December 2005 (pre-CSOX) with the period from January 2006 to December 2011 (post-CSOX) and confirm whether significant differences occur between these periods.

Research Hypotheses

The price discount of Canadian seasoned equity offering consists of two sets of hypotheses. Set number one includes five auxiliary hypotheses as follows.

H1[a]: The offer price discount is the same for the pre- and post-CSOX periods for:
- (i) all Canadian issuers
- (ii) cross-listed issuers
- (iii) non-cross-listed issuers

H1[b]: The offer price discount of cross-listed vs. non-cross-listed issuers is the same for:
- (i) the pre-CSOX period
- (ii) the post-CSOX period

Set number two consists of three auxiliary hypotheses as follows.

H2: The offer price discount of bought deals vs. marketed underwritten are the same for the pre – and post-CSOX periods, respectively, for:

(i) all Canadian issuers
(ii) cross-listed issuers
(iii) non-cross-listed issuers

All hypotheses control for firm, trade and offer variables such as firm size, return volatility, share price, gross proceeds, offer size, and others, which are described later. The justification for the first auxiliary hypotheses is as follows. After the USSOX, Canadian regulators considered prudent taking a moderate and gradual approach in implementing the Canadian legislation. This avoids the errors occurred on the USSOX implementation (Gray, 2005). CSOX, passed in October 2002, became effective three years later, on December 2005. Thus, the 3-year period allowed Canadian regulators to make changes as they fit. Also, for Canadian firms, investors and investment banks with a plenty time to adapt to the new law. Therefore, no changes in the price discount of seasoned equity offerings are expected for the overall, and pre- and post-CSOX periods for all issuers. These include cross-listed (which are subject of USSOX since 2002) and non-cross-listed. Are similar findings expected for the second auxiliary hypotheses between bought deals versus marketed underwritten offers? The empirical result section reports the results of the hypotheses.

DATA AND METHODOLOGY

Sample and Data

The sample includes 629 seasoned equity offerings (SEOs) of Canadian firms from 1999 to 2011. The pre-CSOX period (January 1999 - December 2005) includes 187 offers (79 cross-listed, 108 non-cross-listed); the post-CSOX period (January 2006 - December 2011) includes 442 offers (83 cross-listed and 359 non-cross-listed). Of the 629 offers, 519 are bought deals (122 pre-CSOX and 397 post-CSOX) and 110 are marketed underwritten offers (65 pre-CSOX and 45 post-CSOX). For comparison purposes matching samples of cross- and –non-cross-listed issuers are from the 4-digit SIC industry code. FP Advisor and the System for Electronic Documents Analysis and Retrieval (SEDAR) are the sources on seasoned equity offerings including announcement and issue dates, cross- and non-cross-listed offers, offer type (marketed underwritten offer, bought deal), offer location for cross-listed issues (domestic, global). Also, for expected determinants such as gross proceeds, firm size, offer size, overallotment option, and book runners (lead underwriters). The Canadian Financial Markets Research Centre (CFMRC) is the source of market data including common stock prices, stock market index, bid-ask spreads, and the monthly number of shares outstanding. The sample does not include equity offers with missing data or errors.

Hypotheses Testing Model

The OLS cross-sectional model used for testing hypotheses sets 1 and 2 is as follows.

$$\begin{aligned} \mathrm{PrDisc_i} = {} & \mathrm{a_0} + \mathrm{a_1DumPost\,CSOX} + (\mathrm{a_2} + \lambda_{\mathrm{DumCross}}\mathrm{DumCSOX})\mathrm{DumCross_i} \\ & + (\mathrm{a_3} + \lambda_{\mathrm{DB}}\mathrm{DumCSOX})\mathrm{DumBD_i} + (\mathrm{a_4} + \lambda_{\mathrm{StdRet}}\mathrm{DumCSOX})\mathrm{StdRet_i} + \ldots \\ & + \mathrm{a_n DumYEAR}_{\mathrm{t=2000}} + \cdots + \mathrm{a_{n+12}DumYEAR}_{\mathrm{t=2011}} + \mathrm{e_i} \end{aligned} \quad (1)$$

This model examines the relation between offer price discount (*PrDisc)* and the expected determinants simultaneously for the pre- and post-CSOX periods, for the overall sample of firms –including cross-listed and non-cross-listed. Specifically, the model tests whether the offer price discount (*PrDisc*) is the same for the pre- and post-CSOX periods after controlling for offer, trade and firm determinants (hypotheses set 1).

Also it tests whether the price discount is the same for bought deals and marketed underwritten offers (hypotheses set 2).

Variables Description

This section describes the variables on equation (1) as follows. The independent variable, $PrDisc_{i,}$ is the price discount of the seasoned equity offering in percent and equals $(P_c\text{-}P_o/P_c)x100$, where P_c is the equity offering closing share price at the end of previous trading day and P_o is the offer price. The subscript *i* indicates issuer firm for issue *i*. The price discount occurs when the offer price is lower than the closing market price on the day before the issue day. This measure is for marketed underwritten offers only. I use an adapted discount measure for bought deals as in Narayann, Rangan, and Rangan (2004) and Autore (2011). This adapted measure is the discount of the offer price from the closing price on the *offer (issue) day.* That is, $PrDisc_i$ equals $(P_{o*}\text{-}P_o/P_{o*})x100$, where P_{o*} is the closing share price on the offer (issue) day and P_o is the offering price. The adapted price discount (or underpricing) is net of the offer announcement effect. At the offer announcement date, a negative market reaction usually occurs, which for bought deals include also the price discount. The offer price in bought deals takes place at the announcement date of the offering (Pandes, 2010). Thus, the resulting decrease in price on the announcement date includes the information effect (market reaction) and discount effect. The adapted discount adjusts for the information effect. Marketed underwritten offers do not need this adjustment because the offer price is several days after the announcement date. The price discount data includes daily prices around the issue dates.

The relevant explanatory variables for testing hypotheses sets 1 and 2 are dummy variables that account for the CSOX period (pre-CSOX, post-CSOX), listing type (cross, non-cross-listed) and offer underwriting method (marketed underwritten, bought deal). They are described next. *DumPostCSOX* is a dummy variable equal to one during the period after CSOX. On the other hand, *DumCSOX* is a dummy variable equal to one during the period before *CSOX* (*DumPreCSOX*) and zero otherwise (*DumPostCSOX*). The dummy variable *DumCSOX* interacts with the expected determinants to capture the differential effect of each determinant on *PrDisc* for the pre- and post CSOX time periods, respectively. (The section of empirical results examines in detail the coefficient estimates of the dummies and control variables.) *DumCross* is a dummy variable that equals one if the Canadian issuer is cross-listed on the NYSE, AMEX or NASDAQ and zero if listed on the Toronto Stock Exchange (TSX) only. *DumBD* is a dummy variable that equals one if the offer is bought deal (BD) and zero if it is marketed underwritten (*DumMUO*).

The following control variables (in italics) are from research studies on price discount of seasoned equity offerings and data availability. *StdRet* is the standard deviation of daily annualized stock returns during the three months before the offer announcement. Proxy for stock volatility or price uncertainty (Corwin, 2003; Altinkilic and Hansen, 2003; Kim and Shin, 2004; Pandes, 2010; Autore, 2011; Huang and Zhang, 2011; Kim & Masulis, 2012). *GProceeds* is the offer gross revenue scaled by the firm's market capitalization before the offer announcement (Pandes, 2010; Dempere, 2012). *Reloffer* is the ratio of the offer size to the total number of shares outstanding pre-announcement. It measures price pressure (Corwin, 2003; Altinkilic and Hansen, 2003; Autore, 2011; Huang and Zhang, 2011; Kim and Masulis, 2012). *LnME* is the natural log of the issuer's market equity. Proxies for firm size (Corwin, 2003; Huang and Zhang, 2011). *Price* is the share price 2 days before the offer announcement day (Corwin, 2003; Mola and Loughran, 2004; Huang and Zhang, 2011). Proxy for offer distribution risk. *Runup* is the price run-up or cumulative abnormal return 25 days prior to the offer announcement. The estimated cumulative abnormal return is from a market model regression between the daily excess return of a Canadian issuer and the Canadian market risk premium around the announcement date of the equity offer (Corwin, 2003; Pandes, 2010; Rubalcava, 2016). *Brunners* is the number of added SEOs an investment bank acts as a book-runner from the previous year. It measures underwriter reputation (Safieddine and Wilhelm, 1996; Kim and Shin, 2004; Mola and Loughran, 2004; Kim, Palia and Saunders, 2010; Kim and Masulis, 2012). *DumOAO* is a dummy variable equal to one if the offer has an overallotment option and zero otherwise (Hansen, Fuller, Janjigian, 1987).

StdTSX is the *s*tandard deviation of daily annualized returns on the Toronto Stock Exchange index during the three months before the offer announcement. Proxy for stock market volatility (Bhagat, Marr and Thompson, 1985). *Spread* is the quoted bid-ask spread divided by the quote mid-point. It measures information asymmetry between issuers and investors (Corwin, 2003). *DumGLO* is a dummy variable that equals one if the offer is concurrently issued in the U.S. and Canada, and zero if issued in Canada only (Rubalcava, 2016). *DumYEAR* are dummy variables to control for annual fixed effects (market conditions) from 1999 to 2011. e_i is the error term, which is assumed to be independently and normally distributed; i.e., $e_i \sim N(0, \sigma^2)$

Descriptive Statistics: Preliminary Results

Table 1 displays the mean and median offer price discounts for all Canadian issuers, including cross-listed and non-cross-listed for the pre-CSOX period (column 1) and the post-CSOX period (column 2). (The medians in parentheses.) Column (3) reports the two-tailed p-values for the difference in mean (median) price discount. The number of seasoned equity offerings (SEOs) is in brackets. The second row of column (1) shows the mean offer price discount for *all* SEOs is 3.68% and the median (in parenthesis) is 2.63% for the pre-CSOX period. The p-values of the difference in mean (0.4197) and median (0.1160) between both periods are not statistically significant (column 3). Similarly, the next row reports the mean offer price discount for *cross-listed* offers is 3.09% and the median (in parenthesis) is 1.88% for the pre-CSOX period. The p-values of the difference in mean (0.0753) and median (0.0053) are significantly at the 10, and 1 percent levels, respectively (column (3)). On the other hand, when comparing *cross-listed* versus *non-cross-listed* the mean offer price discount is slightly significant for cross-listed offers during the post-CSOX period only (p-value of 0.0542) (shown in the last row of column (2)). These preliminary results show CSOX had some effect on the offer price discount for the cross-listed offers only

Table 1: SEO Price Discount for the Pre- and Post-CSOX Periods

	(1) Pre-CSOX Period	(2) Post-CSOX Period	(3) P-value Diff. Mean (Median)
All SEOs	[187] 3.68% (2.63%)	[442] 4.11% (3.19%)	 0.4197 (0.1160)
Cross-listed	[79] 3.09% (1.88%)	[83] 5.28% (4.94%)	 0.0753* (0.0053)***
Non-cross-listed	[108] 4.12% (3.23%)	[359] 3.84% (2.96%)	 0.6178 (0.9951)
P-value diff. Mean (Median) [Cross vs Non]	0.2154 (0.1920)	0.0542* (0.0128)**	

This table reports the mean and median price discounts of seasoned equity offerings (SEOs) for all Canadian issuers, including cross-listed and non-cross-listed for the pre-CSOX period (column 1) and the post-CSOX period (column 2).The SEOs include marketed underwritten offers (MUO) and bought deals (BD). The price discount formula in % for all marketed underwritten offers MUO is $PrDisc_i = (P_c\text{-}P_o/P_c)x100$, *where* P_c *is the stock offer closing share price at the end of previous trading day and* P_o *is the offer price. The formula in % for BD is* $(P_{o*}\text{-}P_o/P_{o*})x100$, *where* P_{o*} *is the closing share price on the offer (issue) day and* P_o *is the offering price as in Narayann et al. (2004). The number of SEOs is in brackets. ***, ** and * show significance at the 1, 5 and 10 percent levels. Tests for the difference in means and medians are t-tests and Wilcoxon/Mann-Whitney, respectively..*

Table 2 reports the mean and median offer price discounts for the pre- and post-CSOX periods for bought deals (BD) and marketed underwritten offers (MUO), respectively. Panel A includes *all* 629 SEOs, and Panels B and C include 162 *cross-listed* and 467 *non-cross-listed* offers, respectively. Columns (3) and (6) report two-tailed p-values for the difference in mean (median) price discount. For example, column (1) of Panel A shows the mean price discount is 4% and a median of 3.9% (in parenthesis) for all SEOs and the

pre-CSOX period. The p-value of the difference in means between BD and MUO is not significant (0.2464) but significant for the median at the 5 percent level (0.0220), for the pre-CSOX period (column 3). Similarly, panels B and C report the mean and median values for cross-listed and non-cross-listed offers, respectively. Based on the p-values of Panels A, B, and C, no difference in mean offer price discount exists between bought deals and marketed underwritten offers for the pre- and post-CSOX periods, respectively. These preliminary results suggest CSOX did not have any effect on offer the price discount between bought deals versus marketed underwritten offers for all issuers, including cross-listed and non-cross-listed. The section of empirical results explores whether similar results occur using OLS regressions.

Table 2: SEO Price Discount - Bought Deals (BD) vs. Marketed Underwritten Offers (MUO)

Panel A: All SEOs						
	Pre-CSOX Period			**Post-CSOX Period**		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	BD [122]	MUO [65]	P-value Diff. Mean (Median)	BD [397]	MUO [45]	P-value Diff. Mean (Median)
Price Disc.						
Mean	4.04%	3.03%	0.2464	4.00%	5.04%	0.2800
(Median)	(3.19%)	(1.21%)	(0.0220)**	(3.06%)	(4.75%)	(0.0949)*
Panel B: Cross-Listed SEOs						
	Pre-CSOX Period			**Post-CSOX Period**		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	BD [47]	MUO [32]	P-value Diff. Mean (Median)	BD [63]	MUO [20]	P-value Diff. Mean (Median)
Price Disc.						
Mean	3.28%	2.80%	0.6791	5.25%	5.38%	0.9559
(Median)	(2.08%)	(1.49%)	(0.4908)	(4.49%)	(5.31%)	(0.9830)
Panel C: Non-Cross-Listed SEOs						
	Pre-CSOX Period			**Post-CSOX Period**		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	BD [75]	MUO [33]	P-value Diff. Mean (Median)	BD [334]	MUO [25]	P-value Diff. Mean (Median)
Price Disc.						
Mean	4.51%	3.26%	0.3204	3.77%	4.77%	0.3264
(Median)	(3.49%)	(0.92%)	(0.0196)**	(2.85%)	(3.34%)	(0.2291)

This table reports the mean and median price discounts of seasoned equity offerings (SEOs) by underwriting method: Bought deals (BD) and Marketed Underwritten Offers (MUO) for all SEOs (Panel A), Cross-listed SEOs (Panel B) and Non-Cross-listed SEOs (Panel C). The price discount formula in % for MUOs is $PrDisc_{i,} = (P_c\text{-}P_o/P_c)x100$, *where* P_c *is the equity offering closing share price at the end of previous trading day and* P_o *is the offer price. The formula for BD is* $(P_{o*}\text{-}P_o/P_{o*})x100$, *where* P_{o*} *is the closing share price on the offer (issue) day and* P_o *is the offering price as in Narayann et al. (2004). The number of SEOs is in brackets. ** and * show significance at the 5 and 10 percent levels. Tests for the difference in means are t-test and the Wilcoxon/Mann-Whitney for the difference in medians.*

EMPIRICAL RESULTS

Tables 3A and 3B report regressions to test hypotheses sets 1 and 2 for *all* Canadian issues, including *cross-listed* and *non-cross-listed*. For the testing, the information reported in Tables 3A and 3B is used interchangeably, starting with Hypotheses Testing: Set 1 followed by Hypotheses Testing: Set 2.

Hypotheses Testing: Set 1

This section tests the first set of hypotheses, that is, the five H1 auxiliary hypotheses using adapted versions of the general regression model (1). Columns (1) to (3) of the Table 3A show regressions of the offer price discount (*PrDisc*) with the independent variables for *all* issues and the overall, pre- and post-CSOX periods,

respectively. The equation regression model (1a) is used to tests hypotheses H1[a](i), H1[a](ii) and H1[a](iii). Model (1a) is a reduced version of the general regression model (1) reviewed in the methodology section.

$$\begin{aligned}\mathrm{PrDisc_i} = {} & \mathrm{a_0} + \mathrm{a_1DumPostCSOX} + \mathrm{a_2DumCross} + \mathrm{a_3\,DumBD} + \mathrm{a_4StdRet_i} + \cdots \\ & + \mathrm{a_n DumYEAR}_{\mathrm{t=2000}} + \cdots + \mathrm{a_{n+12}DumYEAR}_{\mathrm{t=2011}} + e_{\mathrm{i}}\end{aligned} \tag{1a}$$

Regression (1) of Table 3A -which tests H1[a](i)-, reports the coefficient estimates of the determinants for *all* issues and for the overall period. *DumPostCSOX* is the variable of interest to test the first three auxiliary hypotheses. *DumPostCSOX* is a dummy variable equal to one during the period after CSOX and zero otherwise. The coefficient estimate a_1 (1.3658) of *DumPostCSOX* is not significant after controlling for offer and firm characteristics. This result shows *the price discount* is not significantly different between the pre- and post-CSOX periods for *all* offers. Thus, it does not reject hypothesis H1[a](i), which is consistent with the preliminary results reported in Table 1.

Similarly, regression (4) of Table 3B -which tests H1[a](ii)-, displays the coefficient estimates of the determinants for the *cross-listed* offers and for the overall period. The coefficient estimate a_1 (1.2697) of *DumPostCSOX* is not significant. This result shows the offer price discount is not significantly different between the pre- and post-CSOX periods for the *cross-listed* offers. Thus, it also does not reject hypothesis H1[a](ii). In the same vein, regression (7) -which test H1[a](iii)-, reports the coefficient estimates of the determinants for the *non-cross-listed* offers for the overall period. Here, the coefficient estimate a_1 (7.2724) of *DumPostCSOX* is also not significant. Thus, it also does not reject H1[a](iii). In other words, these results reveal the offer price discount is not significantly different between the pre- and post-CSOX periods for cross-listed *and* non-cross-listed offers, respectively, after conditioning on offer and firm determinants.

The equation regression models (1b) and (1c) tests hypotheses H1[b](i) and H1[b](ii). Models (1b) and (1c) are adapted versions of the general regression model (1).

$$\begin{aligned}\mathrm{PrDisc_i} = {} & \mathrm{a_0} + \mathrm{a_1DumPost\,CSOX} + (\mathrm{a_2} + \lambda_{\mathrm{DumCross}}\mathrm{DumPostCSOX})\mathrm{DumCross_i} \\ & + (\mathrm{a_3} + \lambda_{\mathrm{DB}}\mathrm{DumPostCSOX})\mathrm{DumBD_i} + (\mathrm{a_4} + \lambda_{\mathrm{StdRet}}\mathrm{DumPostCSOX})\mathrm{StdRet_i} \\ & + \ldots + \mathrm{a_n DumYEAR}_{\mathrm{t=2000}} + \cdots + \mathrm{a_{n+12}DumYEAR}_{\mathrm{t=2011}} + \mathrm{e_i}\end{aligned} \tag{1b}$$

$$\begin{aligned}\mathrm{PrDisc_i} = {} & \mathrm{a_0} + \mathrm{a_1DumPost\,CSOX} + (\mathrm{a_2} + \lambda_{\mathrm{DumCross}}\mathrm{DumPreCSOX})\mathrm{DumCross_i} \\ & + (\mathrm{a_3} + \lambda_{\mathrm{DB}}\mathrm{DumPreCSOX})\mathrm{DumBD_i} + (\mathrm{a_4} + \lambda_{\mathrm{StdRet}}\mathrm{DumPreCSOX})\mathrm{StdRet_i} \\ & + \ldots + \mathrm{a_n DumYEAR}_{\mathrm{t=2000}} + \cdots + \mathrm{a_{n+12}DumYEAR}_{\mathrm{t=2011}} + \mathrm{e_i}\end{aligned} \tag{1c}$$

The tests of auxiliary hypotheses H1[b](i) and H1[b](ii) is as follows. Regression (2) of Table 3A displays the estimated coefficients for the determinants of the offer price discount *(PrDisc)* from equation model (1b). Here the coefficient estimate of *DumPostCSOX* determines the marginal impact CSOX has on the determinants. Similarly, regression (3) displays the estimated coefficients for the determinants of the offer price discount *(PrDisc)* from equation (1c). The coefficient estimates reported in regressions (2) and (3) allow identifying the differential impact (if any) that each determinant has on *PrDisc* for the pre- and post-CSOX periods, respectively. The coefficient estimates of each independent variable reported in regression (2) show the effect that each determinant has on *PrDisc* for the pre-CSOX period only. For instance, in regression (2) the negative and not significant coefficient estimate a_2 (-0.6903) of the cross-listing dummy *DumCross* shows cross-listed offers have no effect on *PrDisc* for the pre-CSOX period. This implies the offer price discount is *not* different between cross-listed and non-cross-listed offers for the pre-CSOX period. Thus, it does not reject hypothesis H1[b](i). In the same way, the marginal shift $\lambda_{DumCross}$(1.3990) of *DumCross* for the post-CSOX period (i.e., *DumCross* x *DumPostCSOX*) is also not significant. From equation (1c), the coefficient estimate a_2 of *DumCross* for the post-CSOX period of 0.7086 (which is equal to -0.6903+1.3990 from regression 2, or $a_2+\lambda_{\mathrm{DumCross}}$ from equation 1b) is also not significant.

Table 3A: Determinants of Price Discount of *All* SEOs for the Overall, Pre and Post-CSOX Periods

	All SEOs [629]		
		Regression	
Variables	**(1)**	**(2)** ***DumCSOX is DumPostCOX***	**(3)** ***DumCSOX is DumPreCSOX***
Constant	-8.7301	-0.7076	-0.7076
DumCSOX	1.3658	-10.94	-10.94
DumCross	-0.3385	-0.6903	0.7086
DumCross DumCSOX*		1.3990	-1.3990
DumBD	0.4857	2.3730**	-0.7760
*DumBD*DumCSOX*		-3.1491**	3.1491
StdRet	0.3344**	0.4839*	0.1578
*StdRet*DumCSOX*		-0.3261	0.3261
GProceeds	-0.0669	0.0666	0.1365**
*GProceeds*DumCSOX*		-0.2032*	0.2032
Reloffer	0.0748	0.0003	0.1414**
*Reloffer*DumCSOX*		0.1411	-0.1411
LnME	0.5759*	-0.1532	0.9752***
*LnME*DumCSOX*		1.1284*	-1.1284
Price	-0.1239***	-0.0402	-0.1586***
*Price*DumCSOX*		-0.1183***	0.1183
Runup	2.2031*	3.3876	0.3353
*Runup*DumCSOX*		-3.0523	3.0523
Brunners	-0.0478*	-0.0705	-0.0505*
*Brunners*DumCSOX*		0.0199	-0.0199
DumOAO	0.9295*	0.9881	1.0128*
*DumOAO*DumCSOX*		0.0246	-0.0246
StdTSX	1.3279**	-0.0819	1.4947***
*StdTSX*DumCSOX*		1.5767	-1.5767
Spread	0.5219	0.9432	0.6715
*Spread*DumCOX*		-0.2716	0.2716
DumGLO	2.9558**	4.6342***	1.6050
*DumGLO*DumCSOX*		-3.0283	3.0283
Dummy Years	Yes	Yes	Yes
R^2 Adj.	0.186	0.208	0.208

*This table reports the coefficient estimates from regressions of price discount (PrDisc) of seasoned equity offerings (SEOs) and expected determinants of all offers. It includes the overall period (regression 1), the pre-CSOX period (regression 2) and the post-SOX period (regression 3) by Canadian issuers. Specifically, to test hypothesis H1[a](i) and H2(i), it uses equation (1a): $PrDisc_i = a_0 + a_1DumPostCSOX + a_2DumCross + a_3DumBD_i + a_4StdRet_i + \ldots + a_nDumYEAR_{t=2000} + \ldots + a_{n+12}DumYEAR_{t=2011} + e_i$ from regression (1). To test hypothesis H1[b](i), it uses equation (1b): $PrDisc_i = a_0 + a_1DumPostCSOX + (a_2 + \lambda_{DumCross}DumPostCSOX)DumCross_i + (a_3 + \lambda_{DumBD}DumPostCSOX)DumBD_i + (a_4+\lambda_{StdRet}DumPostCSOX)StdRet + \ldots + a_nDumYEAR_{t=2000} + \ldots + a_{n+12}DumYEAR_{t=2011} + e_i$ from regression (2). To test hypothesis H1[b](ii), it uses Equation (1c): $PrDisc_i = a_0 + a_1DumPreCSOX + (a_2 + \lambda_{DumCross}DumPreCSOX)DumCross_i + (a_3 + \lambda_{DumBD}DumPreCSOX)DumBD_i + (a_4+\lambda_{StdRet}DumPreCSOX)StdRet_i + \ldots + a_nDumYEAR_{t=2000} + \ldots + a_{n+12}DumYEAR_{t=2011} + e_i$ from regression (3). The dummy variables to test the hypotheses are DumCSOX (PreCSOX and PostCSOX), DumCross (cross-listed offer) and DumNon (non-cross-listed). The Data and Methodology section defines the dummy variables and controls; also, it examines the coefficient estimates. Coefficient estimates for StdRet, GProceeds, Reloffer, StdTSX, and Spread are multiplied by 10^{-2}. The first row shows the number of SEOs in brackets. ***, ** and * indicate significance at the 1, 5 and 10 percent levels.*

This means the *PrDisc* is also *not* different between cross-listed and non-cross-listed offers for the post-CSOX after controlling for offer and firm characteristics. Thus, it also does not reject hypothesis H1b(ii).

On the other hand, the signs of the coefficient estimates for the control variables that are significant such as *StdRet* (return volatitlity), *GProceeds* (gross offer proceeds), *Reloffer* (offer size), *LnME (*firm size), *Price* (share price), *Brunners* (underwriter prestige), *StdTSX* (market return volatility), *DumGlo* (global offer), and *Spread* (bid-ask quote) are consistent with previous empirical studies. In short, it does not reject the set of hypotheses number one after controlling for firm and offer characteristics. This is also consistent with the preliminary results reported in Table 1.

Hypotheses Testing: Set 2

This section tests the second set of hypotheses. That is, for the three H2 auxiliary hypotheses related to bought deals versus marketed underwritten offers using also equation models (1a), (1b) and 1(c). Regression (1) of Table 3A shows the coefficient estimate a_3 of 0.4857 for bought deals (*DumBD*) is not significant for the full-time period 1999-2011 for *all* SEOs, from equation (1a). This means the price discount is not significantly different between bought deals and marketed underwritten offers for the full period.

On the other hand, from equation (1b), regression (2) shows the coefficient estimate a_3 of *DumBD* is positive (2.3730) and significant at 5 percent level. This means the price discount is higher for bought deals than marketed underwritten offers for the pre-CSOX period. However, from equation (1c), regression (3) shows the coefficient estimate a_3 of *DumBD* is negative and not significant (-0.7760). This means the price discount is not significantly different for bought deals and marketed underwritten offers for the post-CSOX period. Thus, it rejects hypothesis H2(i) for the pre-CSOX period only.-Regressions (4) to (6) of Table 3B report coefficient estimates for the determinants of *cross-listed* offers for the entire, pre- and post-CSOX periods, respectively. Regression (4) shows the estimated coefficient of a_3 of *DumBD* is negative (-1.8596) but not significant for the overall period, from equation (1a). Similarly, the coefficient estimates of *DumBD* for the pre-CSOX period (Regression 5, from equation 1b) and post-CSOX period (regression 6, from equation 1c) are not significant. This means bought deals and marketed underwritten offers are not significantly different in both periods. Thus, it does not reject hypothesis H2(ii) for the *cross-listed* offers. Regressions (7) to (9) of Table 3B report regression results of *non-cross-listed* offers for the overall, pre- and post-CSOX periods, respectively. From equation (1b), regression (8) shows the coefficient estimate a_3 of *DumBD* is positive (2.2311) and slightly significant (at the 10 percent level) for the pre-CSOX period only. On the other hand, from equation (1c), the coefficient estimate a3 of *DumBD* is negative (-0.1073), but not significant. This means the fixed portion of the offer price discount is weakly higher for bought deals than marketed underwritten offers for the pre-SOX period only. Thus, it slightly rejects hypothesis H2(iii) for the pre-CSOX period only.

On the other hand, regressions (4)-(9) of Table 3B show the signs of the coefficient estimates of the control variables that are significant such as *GProceeds, Reloffer*, *Price*, *Runup*, *Brunners*, *StdTSX* and *Spread.* This is consisting with previous research studies on equity offers.

Table 3B: Determinants of Price Discount of *Cross-Listed* and *Non-Cross-Listed* SEOs For the Overall, Pre- and Post-CSOX Periods

	Cross-Listed SEOs [162]			**Non-Cross-Listed SEOs [467]**		
	Regression					
Variables	**(4)**	**(5)** ***DumCSOX* Is *DumPostCSOX***	**(6)** ***DumCSOX* Is *DumPreCSOX***	**(7)**	**(8)** ***DumCSOX* is *DumPostCSOX***	**(9)** ***DumCSOX* Is *DumPreCSOX***
Constant	-1.7256	-0.2229	-0.2295	-7.9059	-2.6810	-2.6810
DumCSOX	1.2697	-0.4592	-0.4592	7.2724	0.8617	0.8617
DumBD	-1.8596	0.5152	-2.9556	0.8068	2.2311*	-0.1073
*DumBD*DumCSOX*		-3.4708	3.4708		-2.3384	2.3384
StdRet	0.1955	0.3079	0.0846	0.3361**	0.4456	0.1595
*StdRet*DumCSOX*		-0.2233	0.2233		-0.2860	0.2860
GProceeds	-0.1238	-0.2813	-0.1398	-0.0791	0.0967	-0.2161***
*GProceeds*DumCSOX*		0.1414	-0.1414		-0.3129***	0.3129***
Reloffer	0.1079	0.2363	0.1304	0.0861*	0.0060	0.2141***
*Reloffer*DumCSOX*		-0.1059	0.1059		0.02080**	-0.2080**
LnME	0.2704	-0.1914	0.4918	0.0707	-0.1869	0.1824
*LnME*DumCSOX*		0.6832	-0.6832		0.3694	-0.3694
Price	-0.1714***	-0.0777*	-0.2196***	-0.0310	-0.0257	-0.0260
*Price*DumCSOX*		-0.1418**	0.1418**		-0.0003	0.0003
Runup	4.6047	4.1642	-0.4140	1.4346	6.1559**	-0.5597
*Runup*DumCSOX*		-4.5783	4.5783		-6.7157**	6.7157**
Brunners	-0.0724	0.0603	-0.1195	-0.0274	-0.2950***	-0.0067
*Brunners*DumCSOX*		-0.1795	0.1799		0.2882***	-0.2882***
DumOAO	0.5012	1.5392	-0.3404	0.8155	-0.1969	1.1894**
*DumOAO*DumCSOX*		-1.8796	1.8796		1.3863	-1.3863
StdTSX	4.7005***	5.3447	4.7282***	0.4993	-3.0485	1.0216*
*StdTSX*DumCSOX*		-0.6164	0.6164		4.0702*	-4.0702*
Spread	-1.3606	-1.1873	-0.9730	0.8094**	1.1931	0.8719**
*Spread*DumCOX*		0.2142	-0.2142		-0.3212	0.3212
DumGLO	2.3876*	3.5224	1.1099	-	-	-
*DumGLO*DumCSOX*		-2.4124	2.4124	-	-	-
Dummy Years	Yes	Yes	Yes	Yes	Yes	Yes
R^2 Adj.	0.433	0.439	0.439	0.110	0.171	0.171

This table reports the coefficient estimates from regressions of offer price discount (PrDisc) and expected determinants. It includes the overall period (regression 4), the pre-CSOX period (regression 5) and the post-SOX period (regression 6) for Canadian cross-listed issuers. Similarly, regressions (7), (8) and (9) report the coefficient estimates for non-cross-listed issuers. Specifically, to test hypotheses H1[a](ii) and H1[a](iii), it uses equation (1a): $PrDisc_i = a_0 + a_1 DumPostCSOX + a_2 DumCross + a_3 DumBD_i + a_4 StdRet_i + \ldots + a_n DumYEAR_{t=2000} + \ldots + a_{n+12} DumYEAR_{t=2011} + e_i$ *from regressions (4)[cross-listed] and (7)[non-cross-listed], respectively. To test hypothesis H2(ii) for the pre-CSOX period, it uses equation (1b):* $PrDisc_i = a_0 + a_1 DumPostCSOX + (a_2 + \lambda_{DumCross} DumPostCSOX) DumCross_i + (a_3 + \lambda_{DumBD} DumPostCSOX) DumBD_i + (a_4 + \lambda_{StdRet} DumPostCSOX) StdRet + \ldots + a_n DumYEAR_{t=2000} + \ldots + a_{n+12} DumYEAR_{t=2011} + e_i$ *from regression (5)[cross-listed]and regression (8)[non-cross-listed]. To test hypothesis H2(iii) for the post-CSOX period, it uses Equation (1c):* $PrDisc_i = a_0 + a_1 DumPreCSOX + (a_2 + \lambda_{DumCross} DumPreCSOX) DumCross_i + (a_3 + \lambda_{DumBD} DumPreCSOX) DumBD_i + (a_4 + \lambda_{StdRet} DumPreCSOX) StdRet + \ldots + a_n DumYEAR_{t=2000} + \ldots + a_{n+12} DumYEAR_{t=2011} + e_i$ *from regression (6)[cross-listed] and regression (9)[non-cross-listed].The dummy variables to test the hypotheses are DumCSOX (PreCSOX and PostCSOX), DumBD (bought deal) and DumMUO (marketed underwritten offer). The Data and Methodology section defines the dummy variables and controls; also, it examines the coefficient estimates. Coefficient estimates for StdRet, GProceeds, Reloffer, StdTSX and Spread are multiplied by* 10^{-2}*. The first row reports the number of SEOs in brackets. ***, ** and * indicate significance at the 1, 5 and 10 percent levels.*

CONCLUDING REMARKS

The purpose of this study is to find out whether the price discount of seasoned equity offerings for Canadian issuers changed after the Canadian SOX. This is a law similar to the U.S. Sarbanes-Oxley of 2002 (USSOX). The passage of CSOX was in 2002 and became effective three years later in 2005. The main purpose of both laws is improving governance and disclosure of publicly traded companies. This includes disclosure on seasoned equity offerings. A price discount of seasoned equity offerings is an important issuance cost, which in the period 1999-2011 averaged four percent. This study builds on Rubalcava (2016), which examines the impact of USSOX on the price discount of seasoned equity offerings of Canadian cross-listed issuers. These are offers simultaneously listed on major U.S. exchanges and the Toronto Stock Exchange. It extends the literature on the impact of similar legislation, such as CSOX, has had on the price discount of all Canadian seasoned equity offerings. These include cross-listed and non-cross-listed offers (that is, listed on the Toronto Stock Exchange only).

Using a sample of 629 seasoned equity offerings, this study finds no significant difference in offer price discount between the pre-CSOX period (1999-2005) and the post-CSOX period (2006-2011). These include all issues, cross-listed (162) and non-cross-listed (467), respectively. When distinguishing offers by underwriting method -bought deals (519) and marketed underwritten (110) -, the offer price discount between both alternatives is not significantly different after the passage of CSOX. These results are after controlling for the offer and firm characteristics from an OLS cross-sectional regression model. An important policy implication of these findings is the gradual approach to implement CSOX by Canadian regulators was a wise decision. It has allowed issuers, investment banks, and investors with plenty of time to adjust to the new legislation and reduce market uncertainty. Unlike USSOX, where many difficulties have occurred in its implementation (Gray, 2005). Some limitation of the study is that does not include data beyond 2011 due to data constraints. This may reduce the strength of the results of this study. Future research is to find out whether these results can be generalizable to other countries that passed legislation similar to the Canadian SOX.

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A RECONSIDERATION OF PRICES USING THE BALASSA-SAMUELSON THEORY: EVIDENCE FROM JAPAN

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ABSTRACT

This paper theoretically and empirically reevaluates price policy associated with deflation using the Balassa-Samuelson theory (Balassa (1964), Samuelson (1964)). The theoretical model developed in this paper shows the relative price level (or real exchange rate) between two countries is explained by the relative wage rate and the relative labor productivity between two countries. The empirical results confirm that relative wage rate has more impact on relative price, compared to the relative labor productivity. Since the convergence of price levels in the long run is confirmed in this paper, the theory developed implies that the tendency of nominal appreciation (depreciation) of a country's currency causes declining (increasing) nominal wages and price levels in the long run under a free market economy. To raise the price level, it is necessary to raise labor productivity which causes a rise in the nominal wage rate in the longer run and which eventually results in a rise in the price level. The policy implication is that operating an effective price policy is difficult for countries experiencing deflation.

JEL: E31, E58, F39

KEYWORDS: Price Level, Inflation, Deflation, Inflation Targeting, Nominal Wage Targeting, the Balassa-Samuelson Hypothesis

INTRODUCTION

Japan has experienced deflation for two decades. Not every economist agrees with the effectiveness of inflation targeting. The aim of this paper is to reevaluate price policy associated with deflation. This paper theoretically and empirically investigates the price mechanism by developing the Balassa-Samuelson theory (Balassa (1964), Samuelson (1964), Fukao (2008), Oguro (2012)). The Balassa-Samuelson (BS) theory was originally intended to explain real exchange rate appreciation in countries experiencing rapid economic growth. This is caused by differential productivity growth in a tradable sector which is growing fast and in a non-tradable sector which is relatively stable. As a consequence, the BS theory explains the tendency for relative prices (real exchange rates) to be higher in more developed and higher income countries compared to less developed and lower income countries. Thus, the theory has been played a key role in studies of real exchange rate determination in the long run.

This paper first confirms the convergence of prices over time. The theoretical model developed shows the relative price level (or real exchange rate) between two countries is explained by relative wage rate and relative labor productivity between two countries. The model implies that a rise (decline) in the relative wage rate and/or a decline (rise) in the relative labor productivity result(s) in a rise (decline) in relative prices. Empirical analysis provides support for the theoretical model presented in this paper. The empirical results confirm the relative wage rate has more impact on the relative price level (or real exchange rate) compared to the relative labor productivity. Since convergence of price levels in the long run is confirmed in this paper, the theory implies the tendency of nominal appreciation (depreciation) of a country's currency

can cause declining (increasing) nominal wages and price levels in the long run under the economy that allows the market to decide everything. To raise the price level, it is necessary to raise labor productivity which causes a rise in the nominal wage rate in the long run and eventually results in a rise in the price level. The results are not optimistic for Japan. The policy implication is that operating an effective price policy is not easy and takes time for countries experiencing deflation and very low interest rates. The remainder of the paper is organized as follows. The next section refers to previous studies which are related to this paper. In the following section, we discuss the data and methodology. The theoretical model is developed and presented in this section. Then, the empirical results are presented and discussed. The paper closes with some concluding comments.

LITERATURE REVIEW

As noted earlier, the Balassa-Samuelson theory has been a key theory in the field of real exchange rate determination. A series of earlier works on real exchange rates and prices are based on the Balassa-Samuelson (BS) theory. There have also been studies that include and/or refer to Japan. Several earlier works, at least to some extent, confirm the BS hypothesis. In an early study, Hsieh (1982) studied Germany and Japan which estimated real exchange rates based on the BS hypothesis. Hsieh's (1982) data covered years from mid 1950s through mid 1970s. Marston (1987) discussed the Yen's real appreciation against the U.S. dollar from the mid 1970s to mid 1980s based on the productivity growth of tradable goods and non-tradable goods in Japan and the U.S. using the BS theory. The results confirmed the BS hypothesis. Rogoff (1992) concludes that correlation between labor productivity differentials and the real exchange rates is only for very long periods based on the studies on the yen/dollar exchange rates from 1975 to 1990. His investigation also includes the effects of government spending shocks and capital market liberalization on the real exchange rate. Asea and Mendoza (1994) found correlation between labor productivity differentials and relative price differentials for OECD countries. Canzoneri et al. (1999) investigated the BS hypothesis using 1970-1993 OECD panel data and cointegration techniques. The results confirmed the correlation between relative labor productivities and relative prices in the long run. Chinn (2000) investigates real exchange rates in East Asian countries including Japan based on the productivity-based model. Results show consistency with the BS hypothesis.

Earlier studies, however, put an emphasis on skeptical aspects of the BS hypothesis. Ito, Isard, and Symansky (1999), Drine and Rault (2003), and Thomas and King (2004) emphasize the findings on East Asian countries that do not follow the BS hypothesis. Bordo et al. (2017) investigated the effect of productivity on the real exchange rates for 14 countries, including Japan, from 1880 to 1997. The results are not consistent with the traditional BS theory, although they are consistent with the modern versions of the BS theory. Obstfeld (2009) argues the Yen's value, Japan's bubble, and subsequent stagnation from 1985 to 2008 using the BS theory. His findings show that the Japan's real exchange rate is inversely related to the predictions based on the BS hypothesis both in the short and long run.

This paper is the first investigation that develops the BS theory, and theoretically shows real exchange rates can be explained by relative wage and/or relative labor productivity. Additionally, this paper empirically finds that relative wage better explains real exchange rates compared to relative labor productivity. Thus, it is crucial to raise nominal wages to overcome deflation. However, apparently it is not easy to politically raise nominal wages and no countries have adopted nominal wage targeting. Tobin (1980) and Bean (1983) argue the effectiveness of nominal income targeting in the context of pursuing target growth rates. Phelps (1978) and Aoki (2001) note that higher prices can be ensured by consequent higher wages backed up by loose monetary policy.

DATA AND METHODOLOGY

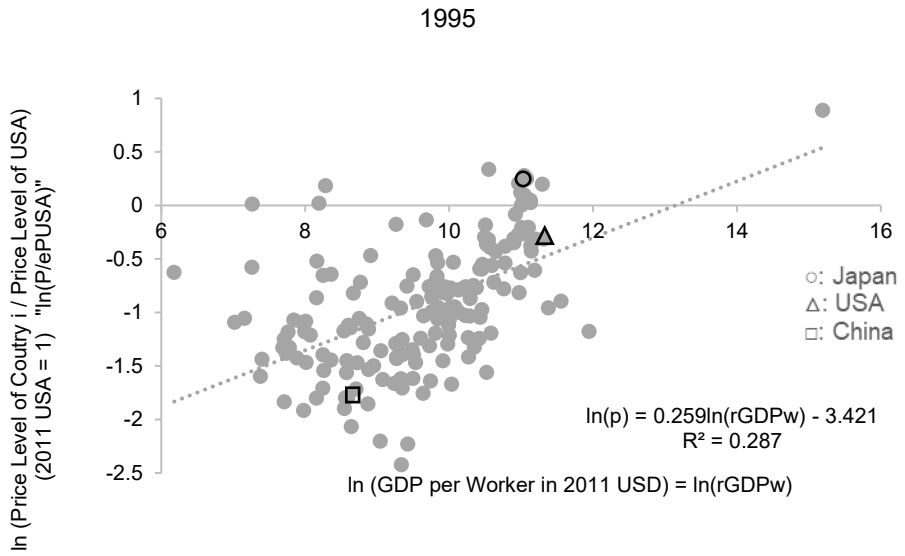
Data Analysis: The Convergence of Price Levels in the Long Run

This section verifies the convergence of price levels based on the Balassa-Samuelson hypothesis in the long run. The Balassa-Samuelson theory explains the positive correlation between income levels and price levels (Balassa (1964), Samuelson (1964)). Following Fukao (2012) and Oguro (2012), data from the Penn World Table 9.0 (Feenstra et al. (2015)) are used for the analysis. The investigation period is from 1985 to 2015. The total number of countries investigated is 178, but the number of countries reported in the data slightly varies from year to year. The data used as the income level, ln(rGDPw), is the natural logarithm of the output-side real GDP at constant 2011 PPPs (in mil. 2011 USD) divided by the number of persons engaged (in mils). The data used as the price level, ln(p), is the natural logarithm of the price level of country i (the country i's price level of output-side real GDP at current PPPs (in mil. 2011USD, PPP/nominal exchange rate)) over the price level of USA in 2011 which equals 1.

Figures 1 to 3 are simple plots of income levels and price levels in 1995, 2011, and 2014, respectively. In the years 1995 and 2011, the value of the yen to the US dollar drastically appreciated (in comparison with other years). A comparison of Figures 1, 2, and 3 reveal the convergence of price levels in the long run. Figure 4 depicts a decline in the sample standard deviation of ln(p) and the relative price levels (ln(price level of country i / price level of USA)), for 168 countries which are constantly reported in the Penn World Table 9.0 (Feenstra et al. (2015)). Figure 4 supports the existence of price convergence. The number of countries included in Figures 1 to 3 is slightly different since each figure uses all data available in the Penn World Table 9.0 (Feenstra et al. (2015)) as shown in Table 1. Table 1 shows the sample standard deviation of ln(p), the relative price levels, for all available data, and implicitly shows that the change in the number of data reported for each year could be an obstacle to convergence.

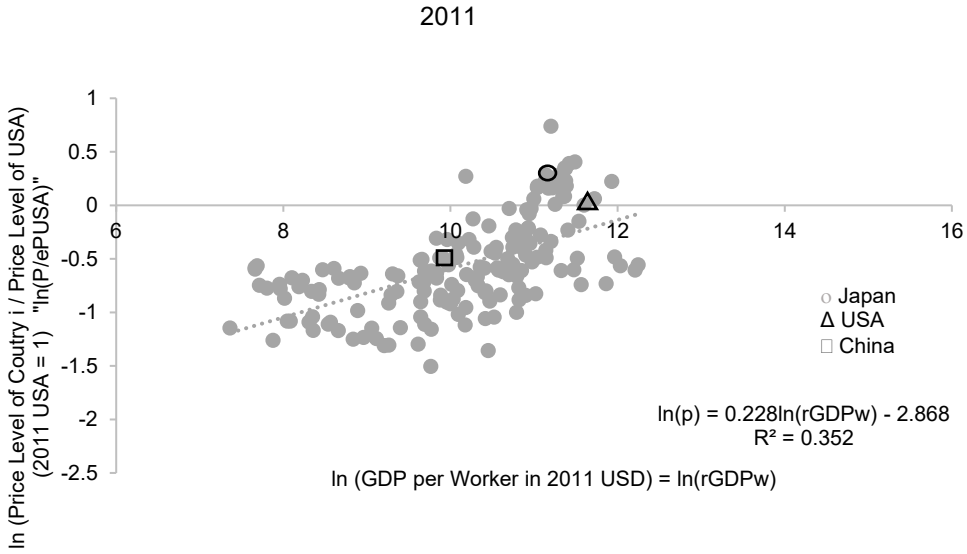
Table 2 shows results of OLS and Fixed Effects tests of the Balassa-Samuelson Hypothesis for the data used in Figures 1 to 3. Based on the Breusch-Pagan Lagrange multiplier test and the Hausman test, the fixed effects model is selected for the panel estimation from 1985 to 2015. All estimated coefficients for the income level, ln(rGDPw), are statistically significant, and thus the Balassa-Samuelson Hypothesis is confirmed for the three figures. For the years 1985 to 2015, according to the fixed effects model, a one percent increase in income level results in a 0.136 percent increase in relative price level. Japan's price levels in the three years, 1995, 2011, and 2014 (marked with a circle in Figures 1 to 3) can be recognized as relatively high. This is because Japan's price level in each year is above each regression line. As a whole, Figures 1 to 4 and Table 1 provide support for the convergence in price levels in the long run.

Figure 1: The Positive Correlation between Income Levels and Price Levels in 1995



This figure shows the positive correlation between income levels and price levels in 1995. Figures 1 to 3 reveal the convergence of the price levels in the long run. Income and price level data are obtained from the Penn World Table 9.0 (Feenstra et al. (2015))

Figure 2: The Positive Correlation between Income Levels and Price Levels in 2011

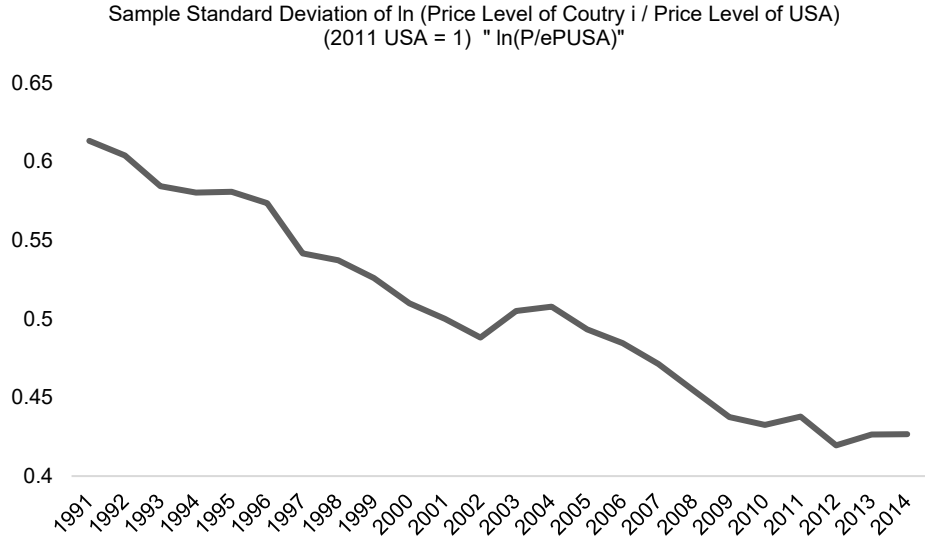


This figure shows the positive correlation between income levels and price levels in 2011. Figures 1 to 3 reveal the convergence of the price levels in the long run. Income and price level data are obtained from the Penn World Table 9.0 (Feenstra et al. (2015))

Figure 3: The Positive Correlation between Income Levels and Price Levels in 2014

This figure shows the positive correlation between income levels and price levels in 2014. Figures 1 to 3 reveal the convergence of the price levels in the long run. Income and price level data are obtained from the Penn World Table 9.0 (Feenstra et al. (2015))

Figure 4: Sample Standard Deviation of the Relative Price Levels



This figure depicts a decline in the sample standard deviation, and strongly supports the existence of price convergence. The data are the author's calculation from the Penn World Table 9.0 (Feenstra et al. (2015)) database.

Table 1: Sample Standard Deviation of the Relative Price Levels

Sample standard deviation (all available data, ( ): number of samples)	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
	0.480	0.495	0.507	0.497	0.597	0.616	0.613	0.600	0.619	0.594	0.592	0.565	0.656	0.552	0.540
	(145)	(145)	(145)	(147)	(170)	(174)	(174)	(174)	(174)	(174)	(174)	(174)	(174)	(173)	(173)
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	
	0.544	0.541	0.631	0.627	0.539	0.530	0.535	0.481	0.469	0.459	0.469	0.496	0.454	0.535	
	(175)	(174)	(173)	(173)	(173)	(173)	(173)	(171)	(169)	(169)	(169)	(169)	(169)	(169)	
Sample standard deviation (168 countries)						**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
						0.613	0.604	0.584	0.580	0.581	0.574	0.542	0.537	0.526	0.510
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	
	0.500	0.488	0.505	0.508	0.493	0.485	0.471	0.454	0.438	0.433	0.438	0.420	0.426	0.427	

This table is the author's calculation and depicts a decline in the sample standard deviation for 168 countries which are constantly reported in the Penn World Table9.0 (Feenstra et al. (2015)).

Table 2: Results of OLS and Fixed Effects to Test the Balassa-Samuelson Hypothesis

	Dependent Variable: Ln (P) = Ln (P/Ep^{usa})				
	OLS	**OLS**	**OLS**	**OLS**	**Fixed Effects**
ln rGDPw	0.259 ***	0.228 ***	0.223 ***	0.250 ***	0.136 **
	(8.33)	(9.52)	(9.31)	(43.57)	(2.17)
cons	-3.421 ***	-2.867 ***	-2.817 ***	-3.309 ***	-2.201 ***
	(-11.32)	(-11.78)	(-11.50)	(-58.55)	(-3.57)
R^2 adj.	0.283	0.348	0.338	0.274	
R^2 within					0.026
between					0.332
overall					0.274
Number of observations	174	169	169	5029	5029
Number of countries (groups)					178
Year(s)	1995	2011	2014	1985~2014	1985~2014

*This table shows the results of the OLS and fixed effects estimation of the data used in Figures 1 to 3 (Penn World Table9.0 (Feenstra et al. (2015))). For the years from 1985 to 2014, a one percent increase in the income level results in a 0.136 percent increase in the price level relative to the price level of USA based on the fixed effects model. *** and ** indicate significance at the 1 and 5 percent levels respectively. T-values are reported in parentheses. The fixed effects model adopts heteroskedasticity-robust estimation. Based on the Breusch-Pagan Lagrange multiplier test and the Hausman test, the fixed effects model is selected for the panel estimation from 1985 to 2014.*

Theoretical Model for Empirical Analysis

The original Balassa-Samuelson theory (Balassa (1964), Samuelson (1964)) is a key theory of real exchange rate determination in the long run. As one of the contributions of this paper, the B-S theory (Balassa (1964), Samuelson (1964), Fukao (2008) and Oguro (2012)) is developed to show the relative price levels (or real exchange rate) between two countries is explained by the relative wage rate and/or the relative labor productivity. The outcome can be obtained by including some additional assumptions to the B-S theory. This section starts by reconsidering each Balassa-Samuelson assumption. The theory consists of two countries, home and foreign (*) countries, and two sectors, tradable (T) and non-tradable (N) sectors.

Assumption 1: The law of one price holds for tradable goods.

$$P_T = e \cdot P_T^* \tag{1}$$

Assumption 2: The real wage rate is equal to the labor productivity.

$$\frac{W_T}{P_T} = \frac{Q_T}{L_T} \qquad \frac{W_T^*}{P_T^*} = \frac{Q_T^*}{L_T^*} \tag{2}$$

$$\frac{W_N}{P_N} = \frac{Q_N}{L_N} \qquad \frac{W_N^*}{P_N^*} = \frac{Q_N^*}{L_N^*} \tag{2'}$$

T: tradable goods,
N: non-tradable goods, *: foreign country,
e: nominal exchange rate between two countries,
W: nominal wage rate, P: price, Q: output, L: the number of hours worked

Assumption 3: The perfect mobility of labor is assumed only within a country (and not across countries). Thus, the wage rates between the two sectors will be equalized in both countries.

$$W_T = W_N = W \qquad W_T^* = W_N^* = W^* \tag{3}$$

Assumption 4: The price level of each countries is determined as the geometric mean of the tradable goods price and the non-tradable goods price in each country.

$$P = (P_T)^{\alpha} \cdot (P_N)^{1-\alpha} \qquad P^* = (P_T^*)^{\beta} \cdot (P_N^*)^{1-\beta} \tag{4}$$
$$0 < \alpha, \beta < 1$$

Using Equations (2), (2)', and (4), the relative price level (= real exchange rate) between home and foreign counties can be written as follows.

$$\frac{P}{e \cdot P^*} = \frac{\left[\frac{W_T}{\left(\frac{Q_T}{L_T}\right)}\right]^{\alpha} \cdot \left[\frac{W_N}{\left(\frac{Q_N}{L_N}\right)}\right]^{1-\alpha}}{e \cdot \left[\frac{W_T^*}{\left(\frac{Q_T^*}{L_T^*}\right)}\right]^{\beta} \cdot \left[\frac{W_N^*}{\left(\frac{Q_N^*}{L_N^*}\right)}\right]^{1-\beta}} \tag{5}$$

Equation (5) can be simplified as Equation (7) under Assumption 3) (Equation (3)) and with the additional assumption, Equation (6). Equation (6) defines that the labor productivity of each country is the geometric mean of the labor productivity of the tradable goods sector and the non-tradable goods sector in each country.

$$\frac{Q}{L} = \left(\frac{Q_T}{L_T}\right)^{\alpha} \cdot \left(\frac{Q_N}{L_N}\right)^{1-\alpha} \qquad \frac{Q^*}{L^*} = \left(\frac{Q_T^*}{L_T^*}\right)^{\beta} \cdot \left(\frac{Q_N^*}{L_N^*}\right)^{1-\beta} \tag{6}$$

$$\frac{P}{e \cdot P^*} = \frac{W}{e \cdot W^*} \cdot \frac{\left(\frac{Q^*}{L^*}\right)}{\left(\frac{Q}{L}\right)} \tag{7}$$

Equation (7) shows the relative price level (or real exchange rate) (P/eP*) between two countries is explained by the relative wage rate (W/eW*) and the relative labor productivity((Q*/L*)/(Q/L)). A rise (decline) in the home country's relative wage rate, and/or a decline (rise) in the home country's relative labor productivity cause(s) a rise (decline) in the home country's relative price level (= an appreciation (a depreciation) of the home country's real exchange rate). In the empirical analysis, the log linearized version of Equation (7), Equation (8), is estimated to assess the determinants of the relative price level.

$$ln\left(\frac{P}{e \cdot P^*}\right)_{i,t} = \propto + \beta \cdot ln\left(\frac{W}{e \cdot W^*}\right)_{i,t} + \gamma \cdot ln\left[\frac{\left(\frac{Q^*}{L^*}\right)}{\left(\frac{Q}{L}\right)}\right]_{i,t} + \varepsilon_{i,t} \tag{8}$$

$\propto$: constant、$\varepsilon_{i,t}$: error term

Data for Checking Theoretical Model and for Empirical Analysis

Before running regressions, the equalization of wage rate within a country (Assumption 3)) and theoretical model derived in the previous section (Equation (7)) are tested using data. To conduct the test for Japan and USA, it is necessary to have overall nominal wage rate in Japan (W) and in USA (W*). In addition, it is necessary to obtain the nominal wage rate for tradable goods sector in Japan (Wm) and in USA (Wm*). Manufacturing industry is treated as the tradable goods sector. To obtain the wage rate data for longer years, we use data from both EUKLEMS database released in November 2009 and OECD index database. The OECD data are connected to the EUKLEMS data using the EUKLEMS 2006 data value as the base. The availability of EUKLEMS data is until 2006 for Japan, and until 2007 for USA. Using both EUKLEMS and OECD data, it is possible to obtain data from 1973 to 2015 for Japan, and from 1977 to 2015 for USA.

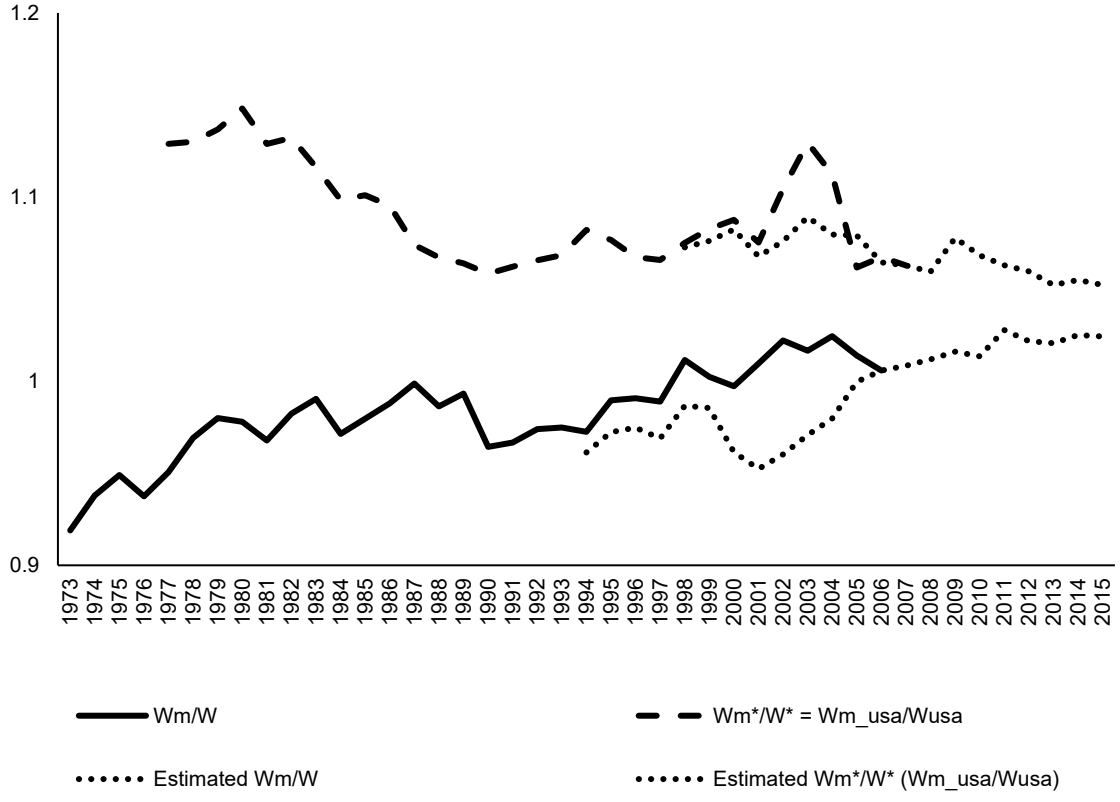
Wage rate data is calculated from EUKLEMS database as the compensation of employees (national currency basis, in millions) over the total hours worked by employees (millions). OECD provides index data of labour compensation per hour worked, which are used as the wage rate data in this paper. To check the equalization of wage rate in Japan and in USA (Assumption 3)) Figure 5 depicts the nominal wage rate for the manufacturing industry divided by the overall nominal wage rate in Japan (Wm/W) and in USA (Wm*/W*). Figure 5 confirms the tendency of wage equalization especially in Japan. Figure 6 shows the nominal wage rates taken from both EUKLEMS and OECD database in Japan and in USA from 1985 to 2015. Nominal exchange rate data are obtained from IMF. For Japan, the wage rate in yen, which is mostly constant, and that in US dollar, which fluctuates, are drawn. The US nominal wage rate in USD is constantly increasing. As a whole, it is possible to predict from Figure 6 that the fluctuations are mainly caused by nominal exchange rates.

Before running regressions, the accuracy of Equation (7), which is derived in this paper as one of the contributions, is tested by Japan and US data as shown in Figure 7. In other words, the test is done to check whether or not a rise (decline) in a country's relative price level (= an appreciation (a depreciation) of a country's real exchange rate) is caused by a rise (decline) in a country's relative wage rate, and/or a decline (rise) in a country's relative labor productivity. The relative wage rate (W/eW*) and the relative labor productivity ((Q*/L*)/(Q/L)) are calculated from OECD index data. The relative price level (P/eP*) is calculated from the Penn World Table (PWT)9.0 (Feenstra et al. (2015)) data and the IMF nominal exchange rate data. The dataset covers the period from 1985 to 2015. Looking at Figure 7, it seems that the relative price level (= real exchange rate) between Japan and USA is mostly explained by the relative

nominal wage rate between the two countries. Based on this result it seems the accuracy of Equation (7) is confirmed.

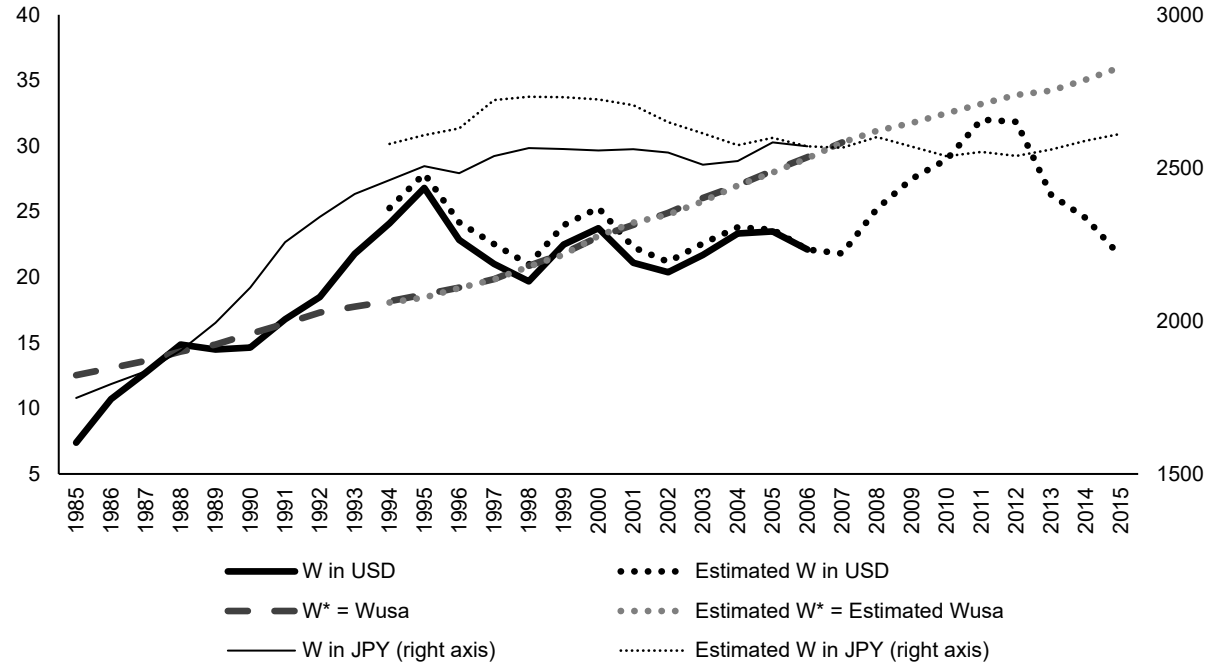
In the empirical analysis, the dataset is created from OECD and the Penn World Table (PWT)9.0 (Feenstra et al. (2015)) database in the same way as Figure 7. However, when running regressions, the dataset contains 33 countries excluding the base country, USA: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Japan, Korea, Latvia, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom, Lithuania, South Africa. The dataset covers the period from 1999 to 2014. The base year is 2011. Table 3 shows summary statistics of the panel dataset, which is used for the empirical analysis. The panel is unbalanced, and the number of the observations in regressions equals 478. The relative price level (P/ePUSA) is the dependent variable, and the relative wage rate (W/eWUSA) and relative labor productivity (QUSA/LUSA)/(Q/L) are explanatory variables.

Figure 5: Nominal Wage Rate for Manufacturing Industry (Wm) / Nominal Wage Rate for All Industries (W) in Japan and USA (*)



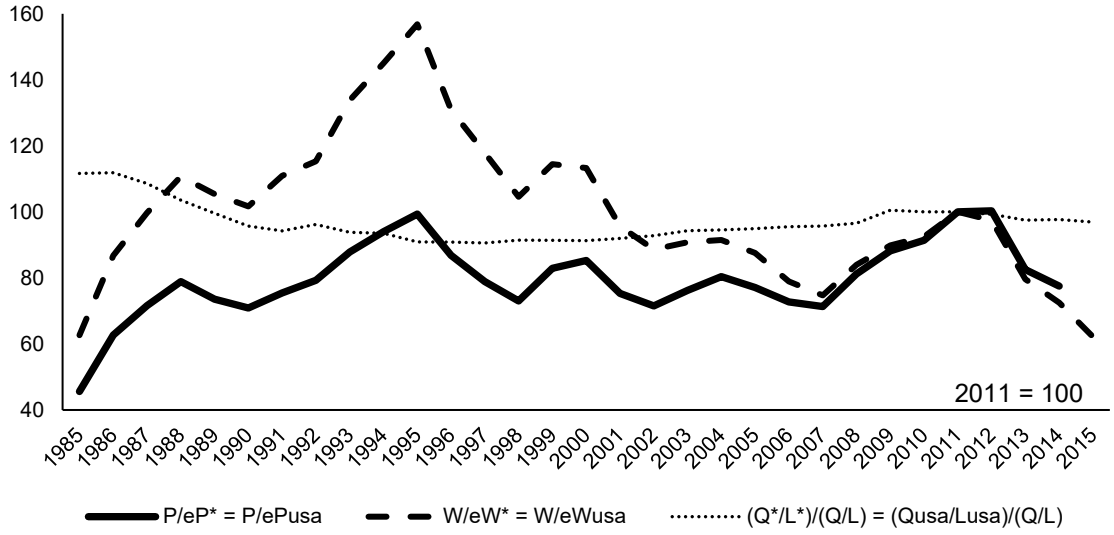
This figure depicts the nominal wage rate for manufacturing industry divided by the overall nominal wage rate in Japan (Wm/W) and in USA (Wm/W*). This figure shows the tendency of wage equalization in Japan and USA. The data are the author's calculation from EUKLEMS and OECD dataset.*

Figure 6: Nominal Wage Rates in Japan and USA



This shows the nominal wage rates taken from both EUKLEMS and OECD database in Japan and in USA from 1985 to 2015. Nominal exchange rate data are obtained from IMF. This figure shows the nominal wage rate in Japan in yen, which is mostly constant, and that in US dollar, which fluctuates. It seems that the price and wage rate fluctuations are mainly caused by nominal exchange rates.

Figure 7: Checking Equation (7) by Japan and US data



This figure shows the relative price level (= real exchange rate) between Japan and USA is mostly explained by the relative nominal wage rate between the two countries. The accuracy of Equation (7) is confirmed. The relative wage rate (W/eW) and the relative labor productivity ((Q*/L*)/(Q/L)) are calculated from OECD index data. The relative price level (P/eP*) is calculated from the Penn World Table (PWT)9.0 (Feenstra et al. (2015)) data and the IMF nominal exchange rate data. The dataset covers the period from 1985 to 2015.*

Table 3: Summary Statistics

	P/eP^{USA}	W/eW^{USA}	$(Q^{USA}/L^{USA})/(Q/L)$
	USA in 2011 = 100	Base year 2011 = 100	Base year 2011 = 100
Min	26.77	36.30	80.57
Max	208.94	127.34	146.10
Average	87.98	86.66	99.88
Standard deviation	31.22	16.46	9.53
Number of observations	528	478	525
Number of countries	33		
Time frame	1999~2014		

This table is the summary statistics of the data used to estimate Equation (8). The relative wage rate (W/eWUSA) and the relative labor productivity ((QUSA/LUSA)/(Q/L)) are calculated from OECD index data. The relative price level (P/ePUSA) is calculated from the Penn World Table (PWT)9.0 (Feenstra et al. (2015)) data and the IMF nominal exchange rate data. The dataset contains 33 countries excluding the base country, USA. The dataset covers the period from 1999 to 2014. The number of the observations in regressions equals 478.

EMPIRICAL RESULTS

The empirical model adopts the log linearized version of Equation (7), Equation (8):

$$ln\left(\frac{P}{e\cdot P^*}\right)_{i,t} = \propto + \beta\cdot ln\left(\frac{W}{e\cdot W^*}\right)_{i,t} + \gamma\cdot ln\left[\frac{\left(\frac{Q^*}{L^*}\right)}{\left(\frac{Q}{L}\right)}\right]_{i,t} + \varepsilon_{i,t} \quad (8)$$

$\propto$: constant、$\varepsilon_{i,t}$: error term

For the empirical analysis, this paper constructs the unbalanced panel dataset which consists of 33 countries for the years from 1999 to 2014. Due to the start of the Euro in 1999, the period of investigation is limited to data after 1999. USA is defined as a foreign (*) country and the base country throughout the empirical analysis. Table 4 shows the result of the panel fixed effects robust estimation of Equation (8).

Table 4: Results of Panel Regression of Equation (8)

Dependent Variable: $\ln (P_i/e\cdot P_{USA})$				
	Fixed Effects		**2SLS IV**	
$\ln (W_i/eW_{usa})$	1.180	***	1.162	***
	(27.95)		(60.54)	
$\ln [(Q_{USA}/L_{USA})/(Q_i/L_i)]$	0.869	***	0.845	***
	(5.43)		(14.86)	
Constant	-9.404	***	-9.204	***
	(-10.82)		(-30.83)	
R^2 within	0.912		0.920	
between	0.018		0.008	
overall	0.330		0.307	
Number of observations	478		444	
Number of countries	33		33	
Time frame	1999~2014		1999~2014	

This table shows the regression estimates of Equation (8):

$$ln\left(\frac{P}{e\cdot P^*}\right)_{i,t} = \propto + \beta\cdot ln\left(\frac{W}{e\cdot W^*}\right)_{i,t} + \gamma\cdot ln\left[\frac{\left(\frac{Q^*}{L^*}\right)}{\left(\frac{Q}{L}\right)}\right]_{i,t} + \varepsilon_{i,t}$$

*Relative price level (P/ePUSA) is the dependent variable, and the relative wage rate (W/eWUSA) and relative labor productivity (QUSA/LUSA)/(Q/L) are explanatory variables. *** indicates significance at the 1 percent level. Numbers in parentheses are T values using heteroskedasticity robust standard errors for fixed effects model and Z values for 2SLS IV estimation. Instrument variable is ln(Wi/eWUSA)t-1.*

Table 4 also shows the result of the estimation with instrument variable in the last column in order to check the endogeneity problem. In the instrument variable (IV) estimation, relative wage term is instrumented by its one-year lagged term. However, the result of the IV estimation is similar to that of the fixed effects estimation and is with much larger standard deviations. All estimated coefficients in Table 4 are statistically significant at the one percent level. According to the fixed effects estimation, a one percent increase in the relative wage results in a 1.18 percent increase in the relative price level, and a one percent increase in the foreign country's relative productivity results in a 0.869 percent increase in the relative price level.

Table 5 indicates the result of panel regression of equation (8) with country dummy variables. The result reveals each country's situation. Japan, who has been experiencing deflation for two decades, has the smallest impact of the relative wage on the relative price level among 33 countries. A one percent increase in the relative wage causes only a 0.481 percent increase in the relative price level in Japan. To sum up, the results of the estimations of Equation (8) confirm that relative wage rate has more impact on relative price level (or real exchange rate) than the relative labor productivity.

Since the convergence of price levels in the long run is confirmed in the earlier section (See Figures 1 to 4, and Table 1 for the details.), Equation (7) implies that when the nominal appreciation (depreciation) of a country's currency occurs, it would be possible to cause the tendency of the declining (increasing) nominal wage and price level in the long run under the economy that allows the market to decide everything. Unfortunately, the nominal wage targeting seems not to be practical. According to the theoretical model depicted by Equation (7), a rise (decline) in relative labor productivity results in a decline (rise) in the relative price. However, the theoretical model also implies that a rise in labor productivity causes a rise in the nominal wage rate in the longer run, which eventually results in a rise in the price level (Equations (2) and (2)'). The estimation of Japan Productivity Center (2017) confirms that a rise in productivity causes a rise in prices with a rise in wages, whereas it causes a decline in prices without a rise in wages.

CONCLUDING COMMENTS

The goal of this paper is to theoretically and empirically reevaluate the effective price policy as a method to deal with deflation using the Balassa-Samuelson theory (Balassa (1964), Samuelson (1964)). The model developed in this paper shows the relative price level (or real exchange rate) between two countries is explained by the relative wage rate and the relative labor productivity between two countries. The empirical analysis of 33 countries from 1999 to 2014 provides support for the theoretical model presented in this paper. The empirical results confirm that relative wage rate has more impact on relative price level (or real exchange rate) than relative labor productivity. Since the convergence of the price levels in the long run is confirmed by the data analysis for 178 countries in this paper, the theory developed implies that the tendency of the nominal appreciation (depreciation) of a country's currency can cause declining (increasing) nominal wages and price levels in the long run under a free market economy. It seems that nominal wage targeting is not practical, but the theoretical model implies that a rise in the labor productivity causes a rise in the nominal wage rate in the longer run, which eventually results in a rise in the price level. The policy implication of the results is that operating an effective price policy is difficult for countries experiencing deflation such as Japan. The limitations of the investigation in this paper is that the results rely on the Balassa-Samuelson Hypothesis, which requires many assumptions. Development of investigation methods to relax the assumptions is left for future research.

Table 5: Results of Panel Regression of Equation (8) with Country Dummy Variables

Dependent Variable	**Ln (P_i/Ep_{usa})**		**Number of Obs.**	**478**
			Number of countries	33
ln (W_i/eW_{usa})	1.128	***		
	(69.03)		R^2 within	0.942
ln [(Q_{USA}/L_{USA})/(Q_i/L_i)]	0.859	***	between	1.000
	(3.35)		overall	0.978
-	Estimated Coefficient of ln (W_i/eW_{usa}) + [ln (W_i/eW_{usa}) × D]		Significance of Dummy Variable at: *** 1%, ** 5%, * 10%	
Australia	1.226	**		
Austria	1.427	***		***
Belgium	1.429	***		**
Canada	1.405	***		**
Czech Republic	1.144			
Denmark	1.082			***
Estonia	0.799	***		***
Finland	1.273	***		
France	1.261	*		
Germany	1.340	***		
Greece	1.227	***		
Hungary	1.191			
Ireland	0.946	***		***
Israel	1.578	***		***
Italy	1.173			
Japan	0.481	***		***
Korea	1.460	**		**
Latvia	1.100			
Luxembourg	1.778	***		***
Mexico	0.572	***		***
Netherlands	1.294	**		
New Zealand	1.185	***		***
Norway	0.736	***		***
Poland	1.470	***		***
Portugal	1.265	**		
Slovakia	0.974	***		***
Slovenia	1.221			
Spain	1.123			
Sweden	1.380	***		***
Switzerland	0.874	***		***
United Kingdom	1.263	***		***
Lithuania	1.202			
South Africa	(omitted)			

This table shows the regression estimates of Equation (8) with country dummy variables:

$$ln\left(\frac{P}{e \cdot P^*}\right)_{i,t} = \propto + \beta \cdot ln\left(\frac{W}{e \cdot W^*}\right)_{i,t} + \gamma \cdot ln\left[\frac{\left(\frac{Q^*}{L^*}\right)}{\left(\frac{Q}{L}\right)}\right]_{i,t} + \varepsilon_{i,t}$$

*Relative price level (P/ePUSA) is the dependent variable, and the relative wage rate (W/eWUSA) and relative labor productivity (QUSA/LUSA)/(Q/L) are explanatory variables. *** and ** indicate significance at the 1 and 5 percent levels respectively.*

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