# EFFICIENCY OF THE EASTERN CARIBBEAN SECURITIES EXCHANGE

Kirwins Charles, Carleton University Bruce Niendorf, University of Wisconsin Oshkosh Kristine Beck, University of Wisconsin Oshkosh

### ABSTRACT

This study examines the weak-form efficiency of the Eastern Caribbean Securities Exchange, which opened on October 19, 2001, by conducting tests for the day-of-the-week effect on the individual stocks listed on the Eastern Caribbean Securities Exchange. Weak-form efficiency means that current security prices reflect all past public information including past prices, rates of return, and trading volume data. Given the enormous amounts being invested in emerging markets, those countries that can maintain efficient markets may attract billions of dollars of capital to the businesses in their countries. This paper is the first to test firms listed on the Eastern Caribbean Securities Exchange for weak-form efficiency. The results of evaluating Monday returns, Friday returns and other day of the week returns are consistent with weak-form efficiency, while the results of runs tests find some evidence of weak-form inefficiency in the securities trading on the Eastern Caribbean Securities Exchange.

**JEL:** G150

**KEYWORDS:** Market Efficiency, ECSE

# **INTRODUCTION**

Developing countries with their own stock exchanges have great interest in the efficiency of their markets. One reason for a developing country to have an exchange is to make it easier for businesses located in the country to attract the capital they need to grow, and international investors have shown themselves to be hungry for emerging market growth opportunities. In 2010, for example, U.S. investors put more than \$60 billion into emerging market equity funds while also pulling \$74 billion out of developed market stock funds (Steverman 2010). In 2009 emerging market investment captured 26 percent of global equity investment versus only seven percent in 2004 (Choi 2009). A recent article in the Financial Times suggests this growth may continue, "For many people the future of investing can be summed up in two words: emerging markets" (Oakley and Meyer 2009).

One concern of investors in emerging markets, however, is being taken advantage of in a market perceived to be stacked against "outsiders". Given the enormous amounts being invested in emerging markets, those countries that can maintain efficient markets may attract billions of dollars of capital to the businesses in their countries. Thus, studies of emerging market efficiency have been of great interest to academics, regulators, and practitioners alike. The most fundamental level of efficiency, weak-form efficiency, requires the market price of a security to reflect all publicly available historical information. If a market is weak-form efficient, it is not possible to earn excess returns using trading rules or patterns identified through the study of historical stock prices. As Akdeniz (2000) notes: "it is evident that much has to be done to understand the nature of stock returns in emerging markets." Although there have been studies of the efficiency of many emerging markets, including, for example the Jamaican, Botswana, and the Bahrain exchanges (Robinson 2005, Mollah 2007, and Asiri 2008), there has never been a published study of the efficiency of the Eastern Caribbean Securities Exchange (ECSE).

The Eastern Caribbean Securities Exchange (ESCE) was established by the Eastern Caribbean Central Bank to serve the eight countries that form the Eastern Caribbean territory: Anguilla, Antigua and Barbuda, Dominica, Grenada, Montserrat, St. Kitts and Nevis, St. Lucia, and St. Vincent and the

Grenadines. The exchange began on October 19, 2001 with the trade of its first listed stock, Bank of Nevis, and is open to companies in the Caribbean region. As of December 2012, the U.S. dollardenominated ECSE had listed twelve more companies from countries including Barbados, Dominica, Grenada, Jamaica, St. Kitts & Nevis, St. Lucia, and Trinidad.

This study is the first to test the efficiency of trading in the stocks listed on the ECSE. Section 2 provides a literature review regarding previous work that addresses the efficiency of emerging stock markets. Section 3 identifies the methodology used in this study and Section 4 describes our results. Finally, Section 5 provides our conclusions.

# LITERATURE REVIEW

Fama (1965, 1970) began the tidal wave of academic research on market efficiency. Fama (1970) defines three different levels of market efficiency: weak, semi-strong, and strong-form efficiency. The first and most fundamental level is weak-form efficiency. If the market in a stock is weak-form efficient, the current price of the stock reflects all publicly available historical information about the stock. This implies that investors cannot make consistent excess returns using only historical data. While semi-strong and strong-form efficiency place more stringent requirements on the information contained in stock prices, for a market to be semi-strong or strong-form efficient it must first be weak-form efficient. Semi-strong form efficiency focuses on the efficiency with which the market reflects all publicly available information while strong-form focuses on the efficiency is of great importance to companies seeking capital and investors.

As described by Robinson (2005), academics have focused on looking for predictable patterns in stock returns to test for weak-form market efficiency. The existence of predictable patterns in stock returns would be inconsistent with weak-form efficiency since these patterns represent information which should already be reflected in stock returns in an efficient market. If stock prices follow a random walk, there should be no discernible patterns in stock prices. The presence of patterns in cross-sectional returns, returns across time, or returns associated with calendar timing points such as the beginning or end of the year, month, or week have provided much insight into the weak-form efficiency of the market being studied in previous studies of the weak-form efficiency of emerging markets. The results of these studies have varied. Across emerging markets, day-of-the-week and turn of year effects have been the source of some of the most serious past findings of violations of weak-form efficiency. Though Robinson's (2005) tests of stocks trading on the Jamaican Stock Exchange find no evidence of weak-form inefficiency in forty-six of the fifty-eight stocks tested when testing for day-of-week and turn of the year effects, he does reject the hypothesis of weak-form efficiency using autocorrelation and runs tests.

Asiri (2008) studies the weak-form efficiency of the forty companies listed on the Bahrain Stock Exchange using both cross-sectional and time series methods. Asiri finds that returns follow a random walk with no drift or trend. Further, autocorrelation and exponential smoothing tests are also consistent with the weak-form efficiency of the Bahrain market. Thus, Asiri finds no evidence of inefficiency in the Bahrain market. Loc, Lanjouw, and Lensink (2010) use the runs test to examine the thinly traded securities in the Vietnamese Stock Trading Centre and reject the hypothesis of weak-form efficiency. Mollah (2007) finds evidence of serial autocorrelation in the returns on an index of the Botswana Stock Exchange – a violation of weak-form efficiency. Hassan, Abdullah, and Shah (2007) study the time series and distributional characteristics of the Karachi Stock Exchange 100 Index. Though they find no violations of weak-form efficiency in monthly returns, they find significant evidence of weak-form inefficiency in returns over shorter periods. Canestrelli and Ziemba (2000) find that stock returns are significantly higher in January than any other months of the year for the Milan Stock Exchange.

This study follows the lead provided by French (1980), who looks at day-of-the-week effects in the United States, and tests for day-of-the-week effects in individual stock returns on the ECSE. In addition, we use runs tests similar to Loc, Lanjouw, and Lensink (2010) to further test the returns of the individual securities that trade on the ECSE for weak-form efficiency. The extreme thin trading on the ECSE has major implications for our methodology, as described in the following section, which leads us to expect results consistent with the nature of inefficient markets as described by Claessens and Gooptu (1993). They find that emerging markets are frequently characterized by thin trading, high transactions costs, inefficient information flows, and inefficient market making. These are characteristics which are generally associated with a market that is weak-form inefficient.

### **DATA AND METHODOLOGY**

This study uses the daily stock prices for thirteen of the fourteen companies listed on the Eastern Caribbean Securities Exchange (ECSE) as of December 31, 2010. In these tests, we omitted one of the fourteen listed companies, First Caribbean International Bank, since its first trading date of January 5, 2009 and its subsequent seven total trades through the end of 2010 left too few trading days for our analysis. We conduct efficiency tests on the individual stocks rather than on an ECSE market index as a whole as Harvey (1993) finds that the use of individual stocks for efficiency tests provides better results than the testing of a market index. To test the weak-form efficiency of the ECSE market, we include the daily closing prices of each of the companies beginning the day it was first traded on the ECSE. The first company to trade on the ECSE was the Bank of Nevis, which began trading on the day the ECSE opened, October 19, 2001. We obtained daily closing prices from the official website of the ECSE: www.ecseonline.com.

Stocks on the ECSE are very thinly traded. The most frequently traded stock, East Caribbean Financial Holding company Ltd. traded on just under one day out of five while the most infrequently traded stock, St. Lucia Electricity Services Ltd. traded on just 1.9 percent of trading days. Due to this thin trading, tests of the autocorrelation structure of returns have little meaning since we cannot assume returns are independent and identically distributed. Instead, we test for ECSE efficiency using a runs test including Miller, Muthuswamy, and Whaley's (1994) correction for thin trading, and day-of-the-week tests using Fama's (1965) natural log of daily prices.

First we test for ECSE weak-form efficiency using a runs test (Bradley 1968) before and after correcting for thin trading. The runs test examines whether average returns are different at different points in the sequence, i.e. whether returns are random. We use methodology similar to Loc, Lanjouw & Lensink (2010) to determine three types of runs, up, down, or flat, to test the following hypothesis:

H<sub>o</sub>: returns of ECSE listed stocks are random; the ECSE is weak-form efficient

H<sub>1</sub>: returns of ECSE listed stocks are not random; the ECSE is not weak-form efficient.

The runs test statistic is calculated as:

$$Z = \frac{R \pm 0.5 - m}{\sigma_m},$$
(1)  
where the total expected number of runs is

$$m = \frac{(N(N+1) - \sum_{i=1}^{3} n_i^2)}{N},$$
(2)

and the standard error of the expected number of runs is

$$\sigma_m = \sqrt{\left[\frac{\sum_{i=1}^3 n_i^2 (\sum_{i=1}^3 n_i^2 + N(N+1)) - 2N \sum_{i=1}^3 n_i^3 - N^3}{N^2 (N-1)}\right]}.$$
(3)

We also use Miller, Muthuswamy, and Whaley's (1994) correction for thin trading to adjust for bias in the runs test due to infrequent returns. Miller's model estimates the number of non-trading days using the residuals from a first-order autoregressive model to adjust returns,

$$AR(1) \text{ model } R_t = \alpha_0 + \alpha_1 R_{t-1} + \varepsilon_t.$$
(4)

The residuals from the regression are used to generate estimates of changes,

$$\widehat{\mathbf{e}}_{\mathbf{t}} = \frac{\varepsilon_{\mathbf{t}}}{1 - \alpha_1},\tag{5}$$

which are then substituted for the observed returns. This process substantially reduces negative first-order autocorrelation.

Second, we perform day-of-the-week tests on the first differences of the natural logarithms of the daily prices. Fama (1965) identifies several reasons for using changes in log price rather than simple price changes including that the change in log price is the yield, with continuous compounding, from holding the security for that day. Also, Moore (1962) shows that using logarithms seems to neutralize most of the problem that price changes for a given stock is an increasing function of the price level of the stock. Daily returns,  $r_t$  for each day t were calculated consistent with Fama (1965) for each of the ten stocks as:

$$r_t = \ln(P_t) - \ln(P_{t-1}) \text{ (non dividend days)}$$
(6)

$$r_t = \ln(P_t + d) - \ln(P_{t-1}) \text{ (on dividend days)}, \tag{7}$$

where  $P_t$  and  $P_{t-1}$  are the closing stock price on days t and t-1, d is the dividend paid, and ln is the natural log function. None of the listed companies had stock splits during the sample period. Given the thin trading on the ECSE relative to more developed exchanges, the stocks on the ECSE experience many nontrading days. Fama's (1965) method of calculating returns for these days merely results in a zero return for those days.

One implication of weak-form market efficiency is that returns should not demonstrate any calendar effects. If the market in a stock is weak-form efficient, daily mean stock returns should not differ significantly across the days of the week. Thus to test the weak-form efficiency of each company on the ECSE, we test whether the mean return for Mondays is different from the mean returns for the rest of the week, whether the mean return for Fridays is different from the mean return for the other days of the week, and whether the mean return for Mondays is different from the mean return for Fridays. If the ECSE is weak-form efficient, there should be no significant differences between any of these mean returns. Specifically, the null and alternative hypotheses are:

H<sub>o</sub>:  $(\mu_1-\mu_2) = 0$ ; ECSE is weak-form efficient H<sub>1</sub>:  $(\mu_1-\mu_2) \neq 0$ ; ESCE is not weak-form efficient.

In our first test,  $\mu_1$  represents the mean Monday return and  $\mu_2$  represents the mean return for Tuesday through Friday. In our second test,  $\mu_1$  represents the mean Friday return and  $\mu_2$  represents the mean return for Monday through Thursday. Finally, in our third test,  $\mu_1$  represents the mean Monday return and  $\mu_2$  represents the mean Friday return. In these tests, four of the fourteen listed companies were omitted as their relatively recent beginning trading dates left too few trading days for our analysis.

#### **RESULTS AND DISCUSSION**

Table 1 provides a list of the thirteen companies traded on the Eastern Caribbean Securities Exchange (ECSE) as well as their listing date, average trading volume, and the percentage of possible trading days that shares of each company were actually traded. The companies traded on the ECSE show wide variation in both average trading volume and the percentage of days the securities traded. While trades of Republic Bank (Grenada) Ltd. averaged only 89 shares per day on days it traded (approximately \$4,900 per day), Trinidad Cement, Ltd. traded an average of 16,510 shares (approximately \$58,600 per day) on days it traded. In terms of the percentage of possible trading days a security was actually traded, the range was from 1.9 percent for St. Lucia Electricity Services Ltd. up to 19.6 percent for East Caribbean Financial Holding Company, Ltd. Nine of the thirteen companies included in this study traded on 8.6 percent or fewer of possible trading days with four of those trading on 2.7 percent or fewer of possible trading days. The ECSE is a market that truly characterizes thin trading. Table 2 identifies the sample sizes (number of days each security traded during the sample period), and the results of the runs test before correcting for thin trading.

Company	Ticker	Listing Date	Average Trading Volume	Trading Days (%)
Bank of Nevis	BON	10/19/2001	9,938	12.6
Cable and Wire St Kitts & Nevis Ltd	CWKN	4/10/2008	957	14.6
Dominica Electricity Services Ltd	DES	9/12/2003	1,679	5.7
East Caribbean Financial Holding Company Ltd	ECFH	10/22/2001	7,633	19.6
Grenada Electricity Services Limited	GESL	8/6/2008	537	5.9
Grenreal Property Corporation Ltd	GPCL	7/31/2008	3,241	4.7
GraceKennedy	GKC	9/29/2005	3,351	2.7
Republic Bank (Grenada) Ltd	RGBL	7/25/2008	89	6.6
St Kitts-Nevis-Anguilla National Bank Ltd	SKNB	11/20/2003	2,692	17.9
St Lucia Electricity Services Ltd	SLES	5/29/2003	13,522	1.9
S L Horsford & Company Ltd	SLH	7/15/2004	12,437	3.5
Trinidad Cement Ltd	TCL	12/15/2006	16,510	2.6
St. Kitts-Nevis-Anguilla Trading and Development Co. Ltd	TDC	6/26/2003	4,199	8.6

Table 1: Companies Listed on the ECSE as of 12/17/10

Table1 provides the name, stock ticker symbol, and initial listing date for thirteen of the fourteen firms traded on the Eastern Caribbean Stock Exchange for the period October 19, 2001 through 12/17/2010. The average daily trading volume and percentage of trading days is also provided.

Table 2: Runs Test

Company	Ticker	Ν	% Up	% Down	% Flat
Bank of Nevis	BON	289	19%	19%	62%
Cable and Wire St Kitts & Nevis Ltd	CWKN	98	14%	18%	67%
Dominica Electricity Services Ltd	DES	104	20%	25%	55%
East Caribbean Financial Holding Company Ltd	ECFH	449	25%	25%	50%
Grenada Electricity Services Limited	GESL	34	26%	18%	56%
Grenreal Property Corporation Ltd	GPCL	27	4%	0%	96%
GraceKennedy	GKC	35	11%	26%	63%**
Republic Bank (Grenada) Ltd	RGBL	39	33%	33%	33%
St Kitts-Nevis-Anguilla National Bank Ltd	SKNB	318	15%	18%	68%**
St Lucia Electricity Services Ltd	SLES	35	37%	20%	43%
S L Horsford & Company Ltd	SLH	55	27%	33%	40%
Trinidad Cement Ltd	TCL	25	20%	20%	60%**
St. Kitts-Nevis-Anguilla Trading and Development Co. Ltd.	TDC	160	28%	22%	51%

Table 2 provides sample sizes for each company traded on the Eastern Caribbean Securities Exchange during the sample period October 19, 2001 through 12/17/2010. N represents the number of days the security traded minus one. The last three columns represent the percentage of up, down, and flat runs in returns from the listing date to the end of the sample period. \*\* denotes significance at the 5% level

We use methodology similar to Loc, Lanjouw & Lensink (2010) to determine three types of runs: up, down, or flat, to test the hypothesis that ECSE-traded stock returns are randomly distributed and weak-

form efficient. Using this test, we identify three companies with non-random returns and thus reject the null hypothesis of weak-form efficiency for GraceKennedy, St. Kitts-Nevis-Anguilla National Bank Ltd., and Trinidad Cement Ltd.

In Table 3 we provide the results of runs tests using both raw returns and returns adjusted for thin trading using the methodology of Miller, Muthuswamy, and Whaley (1994) to adjust for bias in the runs test due to infrequent returns. Before correcting for thin trading, we reject the null hypothesis of independent returns for three of the thirteen companies on the ECSE. After adjusting for thin trading, we reject the null hypothesis of independent returns for eight of the thirteen companies. These results are consistent with weak-form inefficiency of the ECSE.

Table 3: Runs Test Raw and after Adjusting for Thin Trading

Company	Ticker	Z Test Statistic Raw	Z Test Statistic
Daula of Norma	DON	0.(2	5 04**
Bank of Nevis	BON	0.62	5.84**
Cable and Wire St Kitts & Nevis Ltd	CWKN	-1.59	0.64
Dominica Electricity Services Ltd	DES	-0.57	4.02**
East Caribbean Financial Holding Company Ltd	ECFH	0.50	11.29**
Grenada Electricity Services Limited	GESL	-0.59	5.62**
Grenreal Property Corporation Ltd	GPCL	-1.63	2.17**
GraceKennedy	GKC	-2.96**	-0.68
Republic Bank (Grenada) Ltd	RBGL	1.57	1.71
St Kitts-Nevis-Anguilla National Bank Ltd	SKNB	-2.81**	0.45
St Lucia Electricity Services Ltd	SLES	0.81	1.81
S L Horsford & Company Ltd	SLH	1.55	2.97**
Trinidad Cement Ltd	TCL	-2.30**	8.95**
St Kitts-Nevis-Anguilla Trading and Development Company Ltd	TDC	1 1 1	5 41**

Table 3 provides results of the runs test before and after adjusting for thin trading using the methodology of Miller, et. al. (1994). The adjustment reduces bias in the runs test due to infrequent returns. The third and fourth columns give test statistics for the runs test for raw and adjusted returns. \*\* denotes significance at the 5% level

Finally, Table 4 shows the results of our day-of-the-week tests in Panels 1, 2, and 3. Panel 1 shows the results of tests of Monday vs. non-Monday returns. For all ten companies we fail to reject the null hypothesis of weak-form market efficiency at a significance level of .05. Panel 2 shows the results of tests of Friday vs. non-Friday returns. In all cases except for the Bank of Nevis, we fail to reject the null hypothesis of weak-form market efficiency at a significance level of .05. Finally, Panel 3 of Table 2 shows the results of tests of Monday vs. Friday mean returns. For all cases except the Bank of Nevis, we fail to reject the null hypothesis of weak-form market efficiency at a significance level of .05. Finally, Panel 3 of Table 2 shows the results of tests of Monday vs. Friday mean returns. For all cases except the Bank of Nevis, we fail to reject the null hypothesis of weak-form market efficiency at a significance level of .05. The results suggest that returns are spread out evenly across trading days. Rejecting the null hypothesis of weak-form efficiency in only two out of 30 tests provides support for the conclusion that the ECSE is weak-form efficient. Therefore, the results are consistent with weak-form efficiency of the ECSE.

### **CONCLUDING COMMENTS**

Though many studies have been conducted on the efficiency of developed stock markets, relatively little research has been done concerning the efficiency of emerging stock markets. Given the massive amounts of capital being invested in emerging markets, 26 percent of total 2009 global equity invested, there is a need for empirical research on emerging markets.

This is the first study of the weak-form efficiency of the stocks that trade on the Eastern Caribbean Stock Exchange (ECSE). This study conducts tests of the weak-form efficiency of the ECSE, which is characterized by very thin trading, using runs tests and day-of-the-week tests on thirteen of the fourteen individual stocks trading on the ECSE as of December 2010. In twenty five of thirty nine total runs tests (including up, down, and flat runs), and in all but two cases out of thirty day-of-the-week tests, we fail to reject the hypothesis that the market for the stocks on the ECSE is weak-form efficient. Thus we do not conclude that the ECSE itself is weak-form inefficient in general. The few companies trading on the

ECSE combined with the extremely thin trading on the ECSE present major methodological challenges. However, the fact that the results of the more sophisticated runs tests which use returns adjusted for thin trading to adjust for bias due to thin trading find rejection of weak-form efficiency in fourteen of thirty nine tests. This suggests that as both the number of companies traded on the ECSE and the number of trading days available for analysis continue to increase, future tests of the efficiency of securities traded on the ECSE will be of substantial interest.

Table 4: Mean Daily P	ercentage Returns
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Panel 1: Monday vs. Non-Monday				
Company	Ticker	Monday Return	Non-Monday Return	Test Statistic
Bank of Nevis	BON	0.07	0.02	0.96
Cable and Wire St Kitts & Nevis Ltd	CWKN	0.62	-0.14	0.96
Dominica Electricity Services Ltd	DES	0.18	-0.02	1.39
East Caribbean Financial Holding Company Ltd	ECFH	-0.09	0.08	-1.27
GraceKennedy	GKC	-0.02	-0.07	0.38
St Kitts-Nevis-Anguilla National Bank Ltd	SKNB	0.09	-0.03	1.68
St Lucia Electricity Services Ltd	SLES	0.13	0.05	1.23
S L Horsford & Company Ltd	SLH	0.04	-0.02	0.25
Trinidad Cement Ltd	TCL	0.02	0.08	-0.30
St. Kitts-Nevis-Anguilla Trading and Development Co. Ltd.	TDC	-0.01	-0.15	0.34
Panel 2: Friday vs. Non Friday				
Company	Ticker	Friday Return	Non-Friday Return	Test Statistic
Bank of Nevis	BON	-0.08	0.05	-2.40**
Cable and Wire St Kitts & Nevis Ltd	CWKN	0.62	-0.14	0.93
Dominica Electricity Services Ltd	DES	0.10	-0.03	0.93
East Caribbean Financial Holding Company Ltd	ECFH	0.11	0.04	0.52
GraceKennedy	GKC	-0.27	-0.01	-1.86
St Kitts-Nevis-Anguilla National Bank Ltd	SKNB	-0.07	0.00	-0.90
St Lucia Electricity Services Ltd	SLES	0.00	0.08	-1.08
S L Horsford & Company Ltd	SLH	-0.32	0.07	-1.85
Trinidad Cement Ltd	TCL	-0.08	0.10	-0.90
St. Kitts-Nevis-Anguilla Trading and Development Co. Ltd.	TDC	-0.08	-0.13	0.12
Panel 3: Monday vs. Friday Returns				
Company	Ticker	Monday Return	Friday Return	Test Statistic
Bank of Nevis	BON	0.07	-0.08	2.07**
Cable and Wire St Kitts & Nevis Ltd	CWKN	0.62	0.62	0.00
Dominica Electricity Services Ltd	DES	0.18	0.10	0.48
East Caribbean Financial Holding Company Ltd	ECFH	-0.09	0.11	-1.45
GraceKennedy	GKC	-0.02	-0.27	0.96
St Kitts-Nevis-Anguilla National Bank Ltd	SKNB	0.09	-0.07	1.81
St Lucia Electricity Services Ltd	SLES	0.13	0.00	1.51
S L Horsford & Company Ltd	SLH	0.04	-0.32	1.59
Trinidad Cement Ltd	TCL	0.02	-0.08	1.25
St. Kitts-Nevis-Anguilla Trading and Development Co. Ltd.	TDC	-0.01	-0.08	0.70

Table 4 provides results of the day-of-the-week tests. Panel 1 shows the results of Monday vs. non-Monday tests, Panel 2 shows Friday vs. non-Friday test, and Panel 3 shows Monday vs. Friday results. \*\* denotes significance at the 5% level.

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### BIOGRAPHY

Kirwins Charles earned a B.A. in Finance and a Masters in Public Administration from the University of Wisconsin Oshkosh. He is currently a doctoral student in Public Policy at Carleton University. His primary research area is the effectiveness of policies towards the improvement of quality of life. Kirwins can be reached at Carleton University, School of Public Policy and Administration, 5224 River Building, Ottawa, ON K15 5B6, KirwinsCharles@cmail.carleton.ca.

Dr. Bruce Niendorf earned his B.S. from the University of Wisconsin Madison, his M.B.A. from the University of Wisconsin Oshkosh and his Ph.D. from Florida State University. His areas of teaching and research include: Financial Management, Investments, International Finance, and Financial Modeling using distributed artificial intelligence. Dr. Niendorf taught at the University of Montana prior to joining the University of Wisconsin Oshkosh. He can be reached at Department of Finance and Business Law, College of Business, University of Wisconsin Oshkosh, Oshkosh, Wisconsin 54901, niendorf@uwosh.edu.

Dr. Kristine Beck earned a B.S. in Economics from California Polytechnic State University San Luis Obispo and a Ph.D. in Finance from Florida State University. Dr. Beck taught at the University of Denver and worked in the banking industry prior to joining the faculty at the University of Wisconsin Oshkosh. Professor Beck is also the Director of the Wisconsin Financial Services Institute. Her research interests include international finance, investments, and methodological issues. She can be reached at Department of Finance and Business Law, College of Business, University of Wisconsin Oshkosh. Oshkosh, Wisconsin 54901, beck@uwosh.edu.