Can Canadian Stock market provide complete hedge against Inflation ?

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ABSTRACT

This study empirically assesses the relationship between inflation and stock return in Canadian stock market. The study has covered data for the period **1999 :M1−2018 :M4** of canadian economy. Inflation has been decomposed to predicted and unpredicted phase by MA filter. **First** it has tested three hypothesis within **static model** : Fisher hypothesis, Fama and Schwert approach, and Fama's proxy effect framework. These investigations support Fisher Hypothesis. It has showed that Canadian stock **market *provides a complete hedge against Inflation***. **Second**, since relationships between Stock price and inflation may not be correctly specified in the static linear regression, linear and non linear autoregressive **dynamic** specification have been tested. ARDL and NARDL model with Expected inflation as regressor conclude that Stock **price *cannot be used as a hedge* against inflation**. Finding of NARDL precise that only partial sum of the *negative* changes in *Expected inflation* have significant effect on canadian stock market. Then i***nefficiency*** of the canadian stock market suggests that information on past values of inflation could provide opportunities for abnormal gains from the canadian stock market.

Key words : Static model ; Fisher hypothesis ; Stock price ; Expected inflation, cointegration, Dynamic model, ARDL, NARDL, symmetrie, asymmetrie.

JEL classification : G1, G12, G14 , C32.

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Introduction

In an informationally efficient market, price fully and instantly reflects available information in such a way that there are no opportunities for the agents to predict prices and make excess profits.

The correlation between stock price and inflation has been explored intensively in literature ; see for example Fisher (1930), Fama (1981), Phylaktis & Ravazzolo (2005), Eita (2012), Ibrahim & Agbaje (2013), Tripathi & Kumar (2014) , Hunjra, Chani, Shahzad & Khan (2014), and Boonyanam (2014). The remarkable hypothesis is the Fisher proposition, which essentially proposes a positive relationship between the stock price and inflation (Fisher (1930)).
Stock market plays a vital role in any country's economic growth. A healthy stock market is considered relevant for economic growth by channelizing capital toward investors and entrepreneurs.

Inflation may eat out the future nominal cashflow of the companies and reduce their value. If a company is going to grow quickly in the future, investors will be willing to pay up for that growth. Paying up for growth means buying stock with high price/earnings ratios. Now, if inflation is going to erode the value of that growth then nobody will be willing to pay much for the growth because it will be worth less in a high in flationary environment. That implies fall in price/earnings ratios. Therefore, lower inflation may lead to higher price/earnings ratios and vice a versa.

Fisher (1930) hypothesis states that the *expected real rate of return* **is independent** of *expected inflation*. Fisher hypothesis, therefore, predicts a **positive** homogenous relationship between *stock returns and inflation*. In other words, Fisher hypothesis implies that *stocks offer a hedge against inflation*.[3]

In accordance with Fisher (1930), Fama and Schwert (1977) argued that the *expected nominal return* of an asset is the sum of the *expected real return* of the asset and the *expected inflation* rate (see also Wohlwend and Goller (2011)).

This study will investigate in first stage the following issues :
-Is Fisher hypothesis applicable on Canadian stock market or is the stock market of the country provides a good hedge against inflation ?
-Is Fama and Schwert (1977) approach applicable on Canadian stock market ?
-Does Fama's proxy hypothesis explain the real stock returns-inflation relationship for the Canadian stock market ?

The second objective of this paper is to analyze the asymmetries of the stock return-inflation tradeoff in the canadian stock market. Concerning the research method, the nonlinear

[3] Fisher (1930) hypothesis, in its most familiar version, states that "the *expected nominal rate of return* on *stock* is equal to *expected inflation* **plus** the *real rate of return*".

autoregressive distributed lag (NARDL) model has been utilized since ARDL or NARDL approach can be applied regardless of whether the series are I (0), I (1) or fractionally integrated (Pesaran and Pesaran (1997) and Bahmani-Oskooee and Ng (2002)).

The new contribution of this article to the existing literatures can be categorized into three main points : (i) the possibility of an symmetric or asymmetric impact of exogenous; (ii) the monthly data instead of annual data were used in order to better capture the short-term effects ; and (iii) separating the effect of expected and unexpected inflation from actual inflation. Therefore this study has been organized as follows. Section 2 reviews the published literature pertinent to the topic. Section 3 mentioned the required data and their sources. Section 4 outlines the methodology used. Section **5** provides the empirical results and analysis and finally concluding remarks are given in section 6.

1. Empirical Review

A vast empirical review of studying the hypothetic relationships between Stock price and inflation (in the static or dynamic linear models) is given at Table 12 (see Annexe). Different methods have been employed to test the relationships between inflation and stock prices (existance, direction, sign, etc). We sum up results of 46 references in the following table :

	30	for negative relation	29	for positive relation	1 for Instable relation
with		5 in SR	with	3 in SR	2 for no effect
		2 in LR		7 in LT	2 for causal relation
					1 for relation exist

Note : SR : short run, LR : long run.

This mean that probality to get positive relationship is almost equal to probality to get the opposite result. But, these results depend heavely on period of study and on methodology adopted.

2. Data

2.1. Description

In this paper, The study use log-changes in the consumer price index (CPI) of Canada as a proxy for inflation.[4] Real activity in the economy will be measured by Index of Industrial Production (IIP). Monthly data covering period from 1999 :01 to 2018 :04 of CPI, IIP and Stock price (SP), will be taken for analysis. All data are collected form OCDE (Organisation de Cooperation et de Developpement Economique).
We denote by

[4] The CPI represents the price of a typical basket of goods consumed by a private person. Consumer Price Index (CPI) can be used as inflation measure (see Kumari (2011), Schwert (1989), Alagidede (2009) and Samiran (2013)). This is not the case for this paper.

$$R_t = \log(SP_t/SP_{t-1}) = \log(SP_t) - \log(SP_{t-1}) = LSP_t - LSP_{t-1} = \Delta\ LSP_t, \quad (3.1)$$

$$I_t = \log(CPI_t/CPI_{t-1}) = \log(CPI_t) - \log(CPI_{t-1}) = LCPI_t - LCPI_{t-1} = \Delta\ LCPI_t \quad (3.2)$$

and

$$RA_t = \log(IIP_t/IIP_{t-1}) = \log(IIP_t) - \log(IIP_{t-1}) = LIIP_t - LIIP_{t-1} = \Delta\ LIIP_t \quad (3.3)$$

The return of stock price, inflation, and real activity of t th period respectively. The difference between R_t and I_t ($R_t - I_t$) represents the real stock return at t th period, where LSP_t and LSP_{t-1} are the t and $t-1$ th months price Stock in log, $LCPI_t$ and $LCPI_{t-1}$ are the consumer price index of t and $t-1$ period in log, and $LIIP_t$ and $LIIP_{t-1}$ are the t and $t-1$ th months Index of Industrial Production in log, t = 1, …, T = 232.

Fama and Schwert (1977) developed a common approach to determine *inflation hedging abilities*. In accordance with Fisher (1930) they argued that the *expected nominal return* of an asset is the **sum** of the *expected real return* of the asset and the *expected inflation rate* (see also Wohlwend and Goller (2011). Hence, it is necessary to make a distinction between unexpected and expected inflation. As Fama and Gibbons (1982) and Hartzell, Hekman, and Miles (1987), we apply movingaverage processes to estimate expected inflation. The decomposition of actual inflation was done by inferring the expected inflation at period t with the following *MA filter*

$$EI_t = (1/5) * [1 * x\,(t\ - 2) + 1 * x\,(t\ - 1) + 1 *\ x\,(t) + 1 *\ x\,(t\ + 1) + 1 * x\,(t + 2)];$$

where $x(t) = I_t$. By decomposing the inflation *It* into its trend (expected inflation ; EI_t) and unexpected deviations from the trend : unexpected inflation ; UEI

$$UEI_t = I_t - EI_t,$$

we will have then three type of inflation.[5] We consider also EI^+ partial sums of positive changes in EI defined as

$$EI_t^+ = \sum_{j=1}^{t} \Delta\, EI_j^+ = \sum_{j=1}^{t} max\ (\Delta\, EI_j, 0),$$

and EI^- : partial sums of negative changes in EI defined as

$$EI_t^- = \sum_{j=1}^{t} \Delta\, EI_j^- = \sum_{j=1}^{t} min\ (\Delta\, EI_j, 0).$$

Figure 1 illustrate 2 type of inflation ; (a) actual inflation (I_t) and expected inflation (EI_t) as well as (b) partial sums of positive changes in EI (EI_t^+) and partial sums of negative changes in EI (EI_t^-.)[6]

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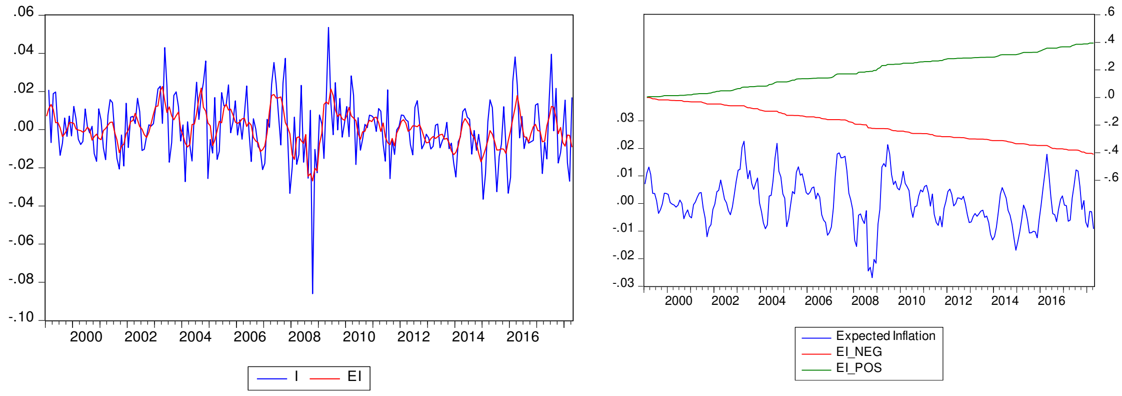
[5] Auto-Regressive Moving Average (ARMA) model is applicable on the inflation data I_t [because auto-correlation is dying exponentially (Gujarati (1995))], see figure 1. We can also decompose the series of I_t into trend and cyclical components by using Hodrick–Prescott (HP) filter (Hodrick and Prescott, 1997) :

$$Min_{\{gI_t\}_{t=1}^{T}} \left\{ \sum_{t=1}^{T} (I_t - gI_t)^2 + \lambda\ \sum_{t=1}^{T} [(gI_{t+1} - gI_t) - (gI_{t-1} - gI_{t-2})]^{\,2} \right\},$$

Where gI_t and cI_t ($I_t - gI_t = cI_t$) are the growth component (trend) and the cyclical component of I_t (for t = 1, . . ., T), respectively. The cyclical part here, cI_t, is the unexpected change in the I_t. $\lambda = 14400$ for monthly data.

[6] This is done by STATA version 15.



(a) I_t and EI_t (b) EI, EI_t^+ and EI_t^-

Figure 1. Canadian time series from 1999 : 10 to 2018 : 4.

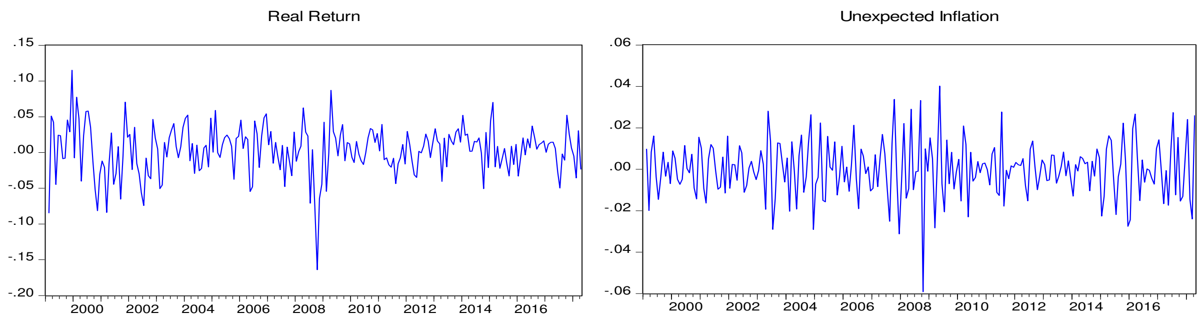
2.2. Descriptive Analysis

During the whole time period of the research stock return and inflation rates, Expected inflation, and unexpected inflation in Canada were extremely low and fluctuated around zero ; see **Table 1** and Figure 1and **Figure 2.**

Table 1: Descriptive statistics, T=232

Variables	Mean	Std. Dev	Min	Max
LSP	4.5085	0.27011	3.9306	4.9036
LCPI	4.4777	0.1102	4.2755	4.6655
LIIP	4.6033	0.0879	4.4361	4.7655
R=ΔLSP	0.0035	0.0379	-0.2499	0.1118
I=ΔLCPI	0.0006	0.0162	-0.0860	0.0535
EI	0.0006	0.0085	-0.0268	0.0226
EI_t^+	0.193335	0.119974	0.003940	0.395137
EI_t^-	-0.199829	0.121752	-0.411368	0.000000
UEI	0.0000	0.0133	-0.0591	0.0401
RA=ΔLIIP	0.0014	0.0081	-0.0291	0.0222
RmI=R-I	0.0029	0.0340	-0.1639	0.1151

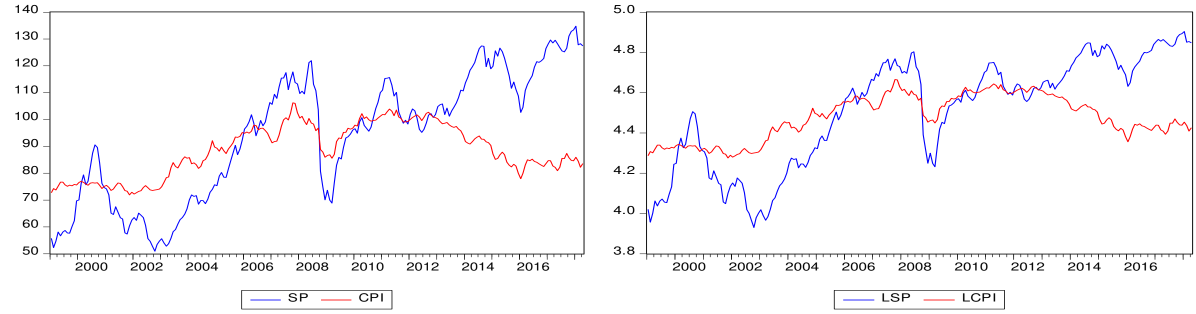
Note : EI_t^+ and EI_t^- are partial sums of positive and negative changes in EI.



(a) R_t- I_t **(b)** UEI_t

Figure 2 : (a) Canadian Real stock return and (b) Unexpected inflation from 1999 : 10 to 2018 : 4.

It is clear from **Figure 3** that stock price (SP) and Consumer Price Index (CPI) show steadily rising trends with stock price growing at a faster rate than Consumer Price Index till 2011.[7] Canadian stock price constantly **fluctuated although** the Consumer Price Index (CPI) ; see **Figure 3**. Due to the world financial crisis (2008M01−2009M08) and the euro crisis (2009*M*08 and after), the canadian stok price is affected and hit a peak around these dates. From figure 3, we can see also that stock price (SP) has an asymmetric relationship with Consumer Price Index (CPI) to be explained for canadian economics since 2011. Indeed, after **2011, the stock price increased but did not follow the decreasing trend of the Consumer Price Index (CPI). Prior to deciding on the appropriate model, the stationary of the variables have to be tested using unit root testing. In this study, Augmented Dickey Fuller (ADF) and Phillip and Perron (PP) test will be used to investigate the stationary.**



(a) In level (b) In log

Figure 3 : Canadian Stock proce and Consumer price index : SP_t (LSP) and CPI_t (LCPI) from 1999 : 10 to 2018 : 4

2.3. Order of Integration

Data needs to be stationary before using for **static** regression analysis (Pankratz (1983), Harvey (1990) and Gujarati (1995)). For dynamic ARDL or NARDL models, data are useful irrespective of whether they are purely I (0), purely I (1), or mutually cointegrated. For NARDL model, none of the considered variable is I (2).

Table 2 shows the Augmented Dickey Fuller (ADF) test result and philip-Perron (PP) test results for considered periods for : stock price in log (*LSP*), consumer price index in log (*LCPI*), inflation rate ($I = \Delta LCPI$), Expected inflation (*EI*), UnExpected inflation (*UEI*), and real return of *SP* ($R{-}I$), and real activity ($RA = \Delta LIIP$) : increase in industrial production index. LSP, LCPI, and LIIP arte non stationary while the rest of considered variables are stationary. These results are in chord with correlograms of autocoorelation of these variables (see Figure 4 given in Annexe)

[7] Before 2011, when the Consumer Price Index increases, the stock price will increase and vice versa. This explain, at least initially, way a linear trend should be included in the stock price equations 4.15 and 4.22. Also the application of unit root tests to several variables, perhaps not surprisingly, yields mixed results with strong evidence in favour of the unit root hypothesis only in the cases of stock price and Consumer Price Index (see section 3.3).

Table 2: Unit root tests.

Variables	ADF	p-value	PP	p-value	Conclusion
LSP	-1.3196	0.6206	-1.7304	0.4145	Non stationary
LCPI	-1.7544	0.4025	-1.7114	0.4241	Non stationary
LIIP	-1.1136	0.7107	-0.8393	0.8056	Non stationary
ΔLSP=R	-6.3179***	0.0000	-11.6937***	0.0000	Stationary
ΔLCPI=I	-12.0238***	0.0000	-11.6937***	0.0000	Stationary
EI	-3.9268***	0.0022	-5.1784***	0.0000	Stationary
EI_t^+	-0.025241	0.9544	0.170370	0.9702	Non stationary
EI_t^-	0.300759	0.9779	0.270889	0.9763	Non stationary
UEI	-10.2308***	0.0000	-66.7448***	0.0001	Stationary
ΔLIIP=RA	-10.3849***	0.0000	-9.7838***	0.0000	Stationary
R-I	-11.8526***	0.0000	-12.0544***	0.0000	Stationary
Δ^2LSP=ΔR	-13.0583***	0.0000	-50.1952***	0.0001	Stationary
ΔI	-14.91028	0.0000	-90.87281	0.0001	Stationary

Note : *** designe lenvels of significance of 1%. EI_t^+ and EI_t^- are partial sums of positive and negative changes in EI.

3. Methodology

3.1. Static models

In this section we discuss how do a static research regarding the inflation hedging abilities. The inflation hedging abilities of stock price can be tested using Fisher hypothesis, the approach of Fama and Schwert (1977), and the Fama's proxy hypothesis. In the next subsections, we explain respectively how to validate each of these hypothesis : Fisher hypothesis, the approach of Fama and Schwert (1977), and Fama's proxy hypothesis in static models.

3.1.1. Fisher Hypothesis

To test the relationship of the real stock return with each type of inflation, we formulate three econometric models. The first model represent relation between real stock returns, $R_t - I_t$, and actual inflation, I_t, (see Graham (1996), Chatrath et al. (1997), and Samiran (2013)) ;

$$R_t - I_t = \beta_0 + \beta_1 I_t + u_t \qquad (4.4)$$

where Rt and It are defined respectively in equation (3.1) and (3.2).

The second model, presented the relation between **real stock returns** and the **expected inflation**,[8] EI,

$$R_t - I_t = \beta_0 + \beta_2 EI_t + v_t, \qquad (4.5)$$

while, the third model give the relationship between stock returns and unexpected inflations,[9] UEI,

$$R_t - I_t = \beta_0 + \beta_3 UEI_t + w_t, \qquad (4.6)$$

where $\beta_0, \beta_1, \beta_2,$ and β_3 are real parameters and u_t, v_t, and w_t are the error terms.

[8] See Gultekin (1983), Solnik (1983), Leonard and Solt (1986), Wahlroos and Berglund (1986), Kaul (1987), Chatrath et al. (1997), and Samiran (2013).

[9] See Gultekin (1983a and 1983b), Chatrath et al. (1997) and Samiran (2013).

Fisher hypothesis will be *proved* if β_1, β_2, and β_3 are respectively equal to *zero* (not significant) in respective regresson (4.4), (4.5) and (4.6).

3.1.2. Fama and Schwert approach

In accordance with Fisher (1930), Fama and Schwert (1977) argued that the *expected nominal return* of an asset is the sum of the *expected real return* of the asset and the *expected inflation* rate (see also Wohlwend and Goller (2011)). They developed a common approach to determine inflation hedging abilities. After providing the values for expected and unexpected inflation, Fama and Schwert (1977) analyzed the inflation hedging abilities with two-factor model. The asset return is the dependent variable and the expected and unexpected inflation are the independent variables. Then equation (4.7) has to be conducted ;

$$R_t = \beta_1 + \beta_2 EI_t + \beta_3 UEI_t + u_t. \qquad (4.7)$$

According to the theory of Fisher (1930), the beta coefficient for expected inflation (β_2) should be equal to one. If $\beta_2 = 1$, an asset is said to be a *complete hedge* against expected inflation. An asset is called a *complete hedge* against unexpected inflation if $\beta_3 = 1$. If $\beta_2 = \beta_3 = 1$, then an asset is said to provide a *complete hedge* against inflation. One would expect all assets to be a complete hedge against expected inflation ($\beta_2 = 1$) but only some assets to provide a complete, if any, hedge against unexpected inflation ($\beta_3 = 1$).

3.1.3. Fama's Proxy Hypothesis

Fama's proxy hypothesis states that real *stock returns and inflation rates* are **independent** once the impact of real economic activity on inflation was *controlled for.* Fama's proxy hypothesis is based on two propositions. The **first proposition** of Fama's proxy hypothesis states that there is a *negative* relationship between *inflation and real economic activity*. The **second** one say that there is *a positive* association between *stock returns and real activity.*[10] This hypothesis states that real stock returns and inflation rates are **independent** once the impact of real economic activity on inflation was *controlled for.*

Fama's proxy Hypothesis is based on an **indirect** relationship between *real stock returns* and *inflation* explained by a **negative** *inflation-real activity* relationship (first proposition) and a **positive** *real activity-stock returns* relationship (second proposition). These hypotheses can be individually be tested.
To test the *first proposition*, we consider one of the three following equation

$$I_t = \alpha_0 + \sum_{i=-k}^{k} \alpha_i RA_{t+i} + \varepsilon_{4t}, \qquad (4.8)$$

$$EI_t = \alpha_0 + \sum_{i=-k}^{k} \alpha_i RA_{t+i} + \varepsilon_{5t}, \qquad (4.9)$$

[10] Since Fama's proxy effect explanation is based on an **indirect** relationship between *real stock returns* and *inflation*, we will use *two-step ordinary least square procedure* followed by Chatrath et al. (1997) and Samiran (2013).

$$UEI_t = \alpha_0 + \sum_{i=-k}^{k} \alpha_i RA_{t+i} + \varepsilon_{6t}, \qquad (4.10)$$

Where α_0 , α_i are real parameters, RA_{t+i} are leading, contemporaneous and lagging variables of real activity, and ε_{4t}, (ε_{5t}, ε_{6t}) is the error term (free of real activity effect), EI_t is the expected inflation, and *UEIt* is the unexpected inflation. *RA* is the real activity as defined in equation (3.3).

This part of Fama proposition will be *proved* if some of α_i are ***significantly negative*** in equation (4.8), (4.9) and (4.10) (see Chatrath et al. (1997)).

We test then the *second postulat* within the following model :

$$R_t - I_t = \delta_0 + \sum_{i=-k}^{k} \delta_i RA_{t+i} + \varepsilon_{7t}, \qquad (4.11)$$

Where $R_t - I_t$ is the real stock return, RA_{t+i} are leading, contemporaneous, and lagging variables of real activity, δ_0 and δ_i are real parameters, and, ε_{7t} is the error term [$\varepsilon_{7t} \sim WN(0, \sigma_7^2)$]. The second part of second hypothesis of *Fama's proposition*, will be *proved* if some δ_i of equation (4.11) **are *significantly positive*.**

Since Fama's proxy effect explanation is based on an **indirect** relationship between *real stock returns* and *inflation*, we can rather use *two-step ordinary least square procedure* followed by Chatrath et al. (1997) and Samiran (2013). Three models are presented in the following equations :

$$R_t - I_t = \delta_0 + \lambda_4 \hat{\varepsilon}_{5t} + \sum_{i=-k}^{k} \delta_i RA_{t+i} + \varepsilon_{9t}, \qquad (4.12)$$

$$R_t - I_t = \delta_0 + \lambda_5 \hat{\varepsilon}_{5t} + \sum_{i=-k}^{k} \delta_i RA_{t+i} + \varepsilon_{11t}, \qquad (4.13)$$

$$R_t - I_t = \delta_0 + \lambda_6 \hat{\varepsilon}_{6t} + \sum_{i=-k}^{k} \delta_i RA_{t+i} + \varepsilon_{13t}, \qquad (4.14)$$

Where $\hat{\varepsilon}_{4t}$, $\hat{\varepsilon}_{5t}$, and $\hat{\varepsilon}_{6t}$ (residuals from regression (4.8), (4.9) and (4.10))[11] give successively the inflation variable that is purged of the relationship between inflation and real economic activity, and $\varepsilon_{jt} \sim BB(0, \sigma_j^2)$, $j = 9, 11, 13$.

The *zero coefficients* of $\hat{\varepsilon}_{4t}$($\hat{\varepsilon}_{5t}$, and $\hat{\varepsilon}_{6t}$) in equations (4.12) [(4.13) and (4.14)] will ensure the *Fama's proxy* hypothesis stating that real stock returns and inflation rates are **independent** once the impact of real economic activity on inflation was *controlled for*.

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[11] $\hat{\varepsilon}_{4t} = I_t - \widehat{I_t}$,

$\hat{\varepsilon}_{5t} = EI_t - \widehat{EI_t}$,
$\hat{\varepsilon}_{6t} = UEI_t - \widehat{UEI_t}$,

And

$\widehat{I_t}$, $\widehat{EI_t}$, and $\widehat{UEI_t} \equiv \widehat{\alpha_0} + \sum_{i=-k}^{k} \widehat{\alpha_i} RA_{t+i}$

3.2. Dynamic specifications

Understanding the dynamics that explain the volatility of stock prices is an important issue in the financial economics literature, since it is critical while formulating investment decisions by market practitioners as well as policy makers. The relationships between Stock price and inflation may not be correctly specified in the static linear regression. Different methods have been employed to test the relationships between inflation and stock prices. In this section, we explain how to modeling linear and non linear autoregressive dynamic models ; ARDL and NARDL.

3.2.1. ARDL model

Prior to deciding on the appropriate model, the stationary of the variables have to be tested using unit root testing. In this study, Augmented Dickey Fuller (ADF) and Phillip and Perron (PP) test will be used to investigate the stationary. Unlike the residual-based Engle and Granger (1987) and maximum likelihood based Johansen (1988,1991) and Johansen and Juselius (1990) cointegration tests approaches, the ARDL approach can be applied irrespective of the stationarity properties of the variables under consideration. To explore the long- and short-run linear relationships between stock market returns and inflation (expected inflation or unexpected infltion), the following equation in the ARDL form will be used :

$$\Delta LSP_t = R_t = C_1 + C_2 t + \sum_{i=1}^{p} \alpha_i \Delta\, LSP_{t-i} + \sum_{i=1}^{p} \beta_i \Delta X_{t-i} + \gamma_1 LSP_{t-1} + \gamma_2 X_{t-1} + \varepsilon_t, \qquad (4.15)$$

$$X_t = I_t, EI_t \ or\ UEI_t,$$

C_1 is the intercept of the equation, t is the trend, α_i and β_i represent chort-term relationship, γ_1, and γ_2 represent long-term relationship (all are real parameters), p is the maximum lag to be used, $\Delta = 1-B$, B is the lag operator, and $\varepsilon_t \sim BB\ (0, \sigma^2)$. Theoretically, negative relationship in short run ($\beta_i < 0$)[12] is in tandem with *Fama* (1981) *proxy hypothesis* (and the standard stock valuation model which predict a negative relationship between inflation and stock market returns). The positive relationship between inflation and stock market returns in long run (γ_2>0) is the *Fisher hypothesis*. It suggests that as inflation rises investors on stock market are compensated for it in the long run.

Pesaran & Shin (2001) provide bound test [with two sets of critical values (lower and upper)] to resolve null hypothesis of no cointegration in the ARDL framework based on *F* type statistic (noted by F_{PSS}). An other bount test based on *t* type statistic (noted by t_{BDM}) is proposed by Benarjee, Dolado and Mestre in 1998 is also neaded to resolve hypothesis of no cointegration. Bound test is applied regardless of whether the series are I (0), I (1) or fractionally integrated [(Pesaran and Pesaran (1997)) and Bahmani-Oskooee and Ng (2002))].[13] The lower critical bound assumes that all the variables are I (0), meaning that there is no cointegration among the variables, while the upper bound assumes that all the variables are I (1). If the F_{PSS} is greater

[12] Or $\sum_{i=1}^{p} \beta_i < 0$.

[13] Bound test F_{PSS}.is proposed by Pesaran & Shin (2001) and t_{BDM} is proposed by Benarjee, Dolado and Mestre in (1998)

than the upper critical bound, then the null hypothesis is rejected, suggesting that there is a cointegrating relationship between the variables under consideration. If the observed F_{PSS} lies within the lower and upper bounds, then the test is inconclusive. If the F_{PSS} falls below the lower critical bounds value, it suggests that there is no cointegrating relationship (we do not reject null hypothesis). The presence of cointegration between variables suggests causal relationship between them but the direction of causality is unknown. If cointegrating relationship is established between stock returns and inflation, Granger causality test will be done in the following error correction model :[14]

$$\Delta LSP_t = C_1 + C_2 t + \delta_1 ECT_{1,t-1} + \sum_{i=1}^{p} \alpha_i \Delta LSP_{t-i} + \sum_{i=1}^{p} \beta_i \Delta X_{t-i} + \varepsilon_t \qquad (4.17)$$

$$X_t \equiv I_t, EI_t \; or \; UEI_t,$$

$ECT_{t,1}$ is the error correction term representing the long-run relationship between stock returns and inflation, δ_1 captures the sensitivity of the error correction term. A *negative* and significant coefficient of the error correction term, δ_1, indicates that there is a *long-run causal relationship* between stock returns and inflation. Precisely, δ_1 indicates a *causality from inflation to stock market returns* that implying that inflation drives stock returns toward long-run equilibrium and that stock price cannot be used as a hedge against inflation.[15] In other words, the *unidirectional causality* from inflation to stock returns hints an *inefficiency* of the stock market which suggests that information on past values of inflation could *provide opportunities* for abnormal *gains* from the SP.

3.2.2. NARDL model

The relationships between Stock price and inflation may not be correctly specified in ARDL model.[16] The nonlinear autoregressive distributed lag (NARDL) model is useful to model asymmetric response of stock prices from inflation. In the setting of an unrestricted error correction model, the NARDL model allows for joint investigation of nonstationarity and nonlinearity. Recent developments proved the effectiveness to asses both long run and short run asymmetries test, irrespective of the integration order of considered variables (Shin et al. (2014)) in NARDL model.[17] The NARDL model investigate the asymmetric relationship

[14] And

$$\Delta X_t = C_1' + C_2' t + \delta_2 ECT_{2,t-1} + \sum_{i=1}^{p'} \alpha_i' \Delta LSP_{t-i} + \sum_{i=1}^{p'} \beta_i' \Delta X_{t-i} + \varepsilon_t' \qquad (4.16)$$

Where δ_2 indicates a causality from stock market returns to inflation.

[15] If the coefficient of $ECT_{i,\,t-1}$ is negative and significant in both equations it means there is a bi-directional causality.

[16] Long-run relationship may be represented as a symmetric linear combination of stationary and nonstationary stochastic regressors.

[17] The logic behind these approaches is that even if the stock price and/or inflation themselves are non-stationary the linear/nonlinear combination of both might be. If this is true the two variables are cointegrated. Very little research effort has been devoted to the analysis of nonlinear cointegration.

between variables by introducing the short run and long run nonlinearities in the positive and negative partial sum decompositions of the independent variables. Before developing the full representation of the NARDL model, let's start with the *asymmetric* long run regression of the stock price (LSP_t)− inflation tradeoff :

$$LSP_t = \beta^+ X_t^+ + \beta^- X_t^- + u_t \qquad (4.18)$$

Where X_t^+ and X_t^-: partial sums of positive and negative changes in $X_t \equiv I_t$, EI_t or UEI_t, are

$$X_t^+ = \sum_{j=1}^{t} \Delta X_j^+ = \sum_{j=1}^{t} max\,(\Delta X_j, 0), \qquad (4.19)$$

$$X_t^- = \sum_{j=1}^{t} \Delta X_j^- = \sum_{j=1}^{t} min\,(\Delta X_j, 0), \qquad (4.20)$$

and β^+ and β^- are the related asymmetric *long run* cointegration coefficients to be estimated. β^- capture the long-run relation between stock price and its exogenous reduction ; I_t^- , EI_t^- or UEI_t^-. According to Shin et al. (2011), the asymmetric impact of exogenous (I_t, EI_t or UEI_t) on the endogenous variable (LSP_t) exists if the magnitude of exogenous increase (I_t^+ , EI_t^+or UEI_t^-) has a significant different than the magnitude of exogenous reduction (I_t^- , EI_t^- or UEI_t^-). Thus, if the findings show that $\beta^+ = \beta^-$ then the asymmetric pass-through effects from I_t, EI_t or UEI_t to stock price will not hold.

The stationary linear combination of the partial sum components could be defined as :[18]

$$z_t = \beta_0^+ LSP_t^+ + \beta_0^- LSP_t^- + \beta^+ X_t^+ + \beta^- X_t^-.$$

LSP_t and X_t are *asymmetrically cointegrated* only if z_t is stationary. The linear *symmetric cointegration* can only be obtained when $\beta_0^+ = \beta_0^-$ and $\beta^+ = \beta^-$. Thus Equation (4.18) can be outlined in an ARDL (p, q) context along the line of Pesaran et al. (2001) as :

$$\Delta LSP_t = \sum_{j=i}^{p} \emptyset_i LSP_{t-j} + \sum_{j=0}^{q} (\theta_j^+ \Delta X_{t-j}^+ + \theta_j^- \Delta X_{t-j}^-) + \varepsilon_t \qquad (4.21)$$

Where $\emptyset_i$ is the autoregressive parameter, θ_j^+ and θ_j^- are the *asymmetric distributed-lagged parameters*, and ε_t is the innovation,

$$LSP_{t-j} = B^j LSP_t, X_{t-j}^+ = B^j X_t^+, X_{t-j}^+ = B^j X_t^-,$$

$$\varepsilon_t \sim WN(0, \sigma^2)$$

Based on the Shin et al. (2011), the equation (4.18) was extended in an Unrestricted Nonlinear ARDL regression in order to analyze the asymmetric long and short-run cointegration effects. The error correction form of equation (4.21) can then be written as :

$$\Delta LSP_t = C_1 + C_2 * trend + \rho LSP_{t-1} + \theta^+ X_{t-1}^+ + \theta^- X_{t-1}^- + \sum_{j=1}^{p-1} \varphi_j LSP_{t-j}$$

[18] Granger and Yoon (2002) advance the idea of 'hidden cointegration', where cointegrating relationships may be defined between the positive and negative components of the underlying variables.

$$+\sum_{j=0}^{q^+} \pi_j^+ \Delta X_{t-j}^+ + \sum_{j=0}^{q^-} \pi_j^- \Delta X_{t-j}^- + \varepsilon_t \qquad (4.22)$$

Where

$$ECT_{1,t-1} = LSP_{t-1} + (\beta^+ X_{t-1}^+ + \beta^- X_{t-1}^-),$$

ρ, θ^+ and θ^- are the *long run coefficients*, π_j^+ and π_j^- are *the short run coefficients* are the *asymmetric long run parameters*, where all variables are described as above, and the p, q^+, and q^- are lag orders selected **based on the Hendry (1979) general-to-specific approach**. $\sum_{j=0}^{q^+} \pi_j^+$ and $\sum_{j=0}^{q^-} \pi_j^-$ represent the short-run increase and reduction impact of I_t , EI_t or UEI_t respectively.

Shin et al. (2014) refer to (4.22) as the NARDL model. The NARDL model is valid regardless of the integration orders of the **regressors**.

In order to observe the effects of the world financial crisis and the euro crisis, two dummy variables are created and included in the above model [model (4.22)],

$$D_{1t} = \begin{cases} 1 \text{ if the date } t \text{ is equal or greater than } 2008M01 \\ 0 \text{ otherwise} \end{cases}$$

$$D_{2t} = \begin{cases} 1 \text{ if the date } t \text{ is equal or greater than than } 2009M08 \\ 0 \text{ otherwise} \end{cases}$$

for drift instability (C_1), and two other dummy D_{1t} **trend* and D_{2t} **trend* to take account of possible trend instability ($C2$).[19]

Equation (4.22) can be estimated as following. Firstly, the regression was estimated with a standard Ordinary Least Squares (OLS). Secondly, the optimal lag p, q^+, and q^- were selected based on the Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (SBC) and Hendry (1979) general to specific procedure. Thirdly, the long-run relationship between the levels of the underlying variables LSP_t, and I_t, EI_t or UEI_t were examined using modified F-test, while using the bounds-testing procedure advanced by Pesaran et al. (2001) and Shin et al. (2011), which refers to the *joint hypothesis* as :

$$H_0: \rho = \theta^+ = \theta^- = 0 \qquad (4.24)$$

against

$$H_a: \rho \neq 0 \cup \theta^+ \neq \theta^- \neq 0 \qquad (4.25)$$

Banerjee, Dolado and Mestre (1998) propose the use of the t-statistic testing individual hypothesis

$$H_0: \rho = 0 \text{ against } H_a: \rho < 0$$

in (4.22).These statistics will we denoted by F_{PSS} and t_{BDM} respectively. The asymptotic distributions of these statistics are all non-standard. Pesaran et al. (2001) propose the use of the pragmatic 'bounds-testing' approach.[20] If the computed F_{PSS} ($t_{\mathbf{BDM}}$) falls below the lower bound

[19] Thus D_1 equals 1, if the date t is equal or greater than 2008M01, otherwise $D_1 = 0$.

[20] Two extreme cases can be identified, one in which the level regressors (4.22) are all I(1), and the other in which they are all I(0). It follows that critical values tabulated for these two scenarios provide critical value bounds for all classifications. The associated critical values of F_{PSS} and t_{BDM} statistics are available from Pesaran et al. (2001) or by Eviews output.

critical value, the null hypothesis of no-cointegration cannot be rejected. On the other hand, if the computed F_{PSS} ($t_{\mathbf{BDM}}$) exceeds the upper bound critical value, the null hypothesis is rejected (implying a long-run cointegration asymmetric relationship among the variables in the model). However, if the computed F_{PSS} ($t_{\mathbf{BDM}}$) value falls within the bounds, the test is inconclusive.
If the cointegration null hypothesis is rejected in third steps, then **Wald test** will be applied to test asymmetric long-run and shrt run coefficient. The long run and short run symmetries can be examined by testing respectively

$$H_{0,LR}\colon \theta^{+} = \theta^{-} \tag{4.26}$$

for long run symmetry, and

$$H_{0,SR}\colon \sum_{j=0}^{q^{+}} \pi_j^{+} = \sum_{j=0}^{q^{-}} \pi_j^{-} \tag{4.27}$$

for short run weak-form (additive) symmetry. Strong-form (pair-wise) symmetry consist to test

$$H_{0,SR}\colon \pi_j^{+} = \pi_j^{-} \; \forall\, j \tag{4.28}$$

if $q^{+} = q^{-}$.[21] We denote Wald statistics by $W_{LR}(X)$ and $W_{SR}(X)$ for long run and short run symmetries respectively, with X = I, EI or UEI. If the null hypothesis is rejected, asymmetry is confirmed.
Only when both the long- and short-run symmetry restrictions cannot be rejected, restricted linear ARDL model replace non lineaire ARDL (NARDL).
The asymmetric dynamic multiplier effects of one unit change in X_t^{+} and X_t^{-} individually on LSP_t can be derived from equation (4.22). They are defined as :

$$m_h^{+} = \sum_{j=0}^{h} \frac{\partial LSP_{t+j}}{\partial LCPI_t^{+}} \;\; and \;\; m_h^{-} = \sum_{j=0}^{h} \frac{\partial LSP_{t+j}}{\partial LCPI_t^{-}} \;\; for\ h = 0, 1, 2 \ldots \tag{4.29}$$

$m_h^{+} \to \beta^{+}$ and $m_h^{-} \to \beta^{-}$ if $h \to \infty$, where β^{+} and β^{+} denote the asymmetric long run coefficients.
These dynamic multipliers represent the transition between the initial equilibrium, short run disequilibrium after a shock, and the new long run equilibrium.
This approach has a number of **advantages** over the existing class of *regime-switching models*. First, once the regressors, X_t, are decomposed into X_t^{+} and X_t^{-}, NARDL equation (4.22) can be estimated simply by standard OLS. Second, the null hypothesis of no long-run relationship between the levels of Y_t, X_t^{+} and X_t^{-} (i.e. $\rho = \theta^{+} = \theta^{-}$) can be easily tested using the bounds-testing procedure advanced by PSS and SYG, which remains valid irrespective of whether the regressors are I(0), I(1) or mutually cointegrated. Third, NARDL equation (4.22) nests the following two special cases : (i) long-run symmetry where $\theta^{+} = \theta^{-} = \theta$, and (ii) short-run symmetry in which $\pi_j^{+}$and π_j^{-} for all $j = 0, \cdot \cdot \cdot, q$.

[21] Given that we will employ general-to-specific lag selection which is likely to include different lags of the positive and negative partial sum in the model, it follows that we limit our attention to the weak-form restrictions.

Moreover, this study adopted various diagnostic tests namely, the Breusch-Gofrey Serial Correlation LM test, **Jarque-Bera** (JB) test for normality, and the White test statistic for heteroskedasticity, to check the adequacy of model specification.

To further investigate the nexus between X_t (X_t^+ and X_t^-; partial sums of positive and negative changes in X_t) and the stock market return, $\Delta LSP_t \equiv Y_t$, we tests the direction of causality between the series using Granger causality test (1988). This test infers that if two series are cointegrated, then there must be Granger-causation in at least one direction. A variable *X* Granger causes *Y*, if *Y* can be predicted with better accuracy by using past values of *X* with other factors held constant. The Granger causality test involves estimating the following model

$$Y_t = \mu_t + \sum_{i=1}^{p} \alpha_i Y_{t-i} + \sum_{i=1}^{p} \beta_i X_{t-i} + \varepsilon_t \qquad (4.30)$$

where μ_t denotes the deterministic component and ε_t is white noise. The null hypothesis of noncausality from *X* to *Y* in Equation (4.30) can be stated as :

$$H_0: \beta_i = 0, \forall\, i.$$

Rejecting the null suggests there is Granger causality. The null hypothesis can be tested by using the F-test. If the p-value < α = 5%, then, this implies that the first series Granger-causes the second series (null is rejected).

4. Empirical results

4.1. Validity of Static models

This section will answer the following questions :

1. Is Fisher hypothesis applicable on Canadian stock market or is the stock market of the country provides a good hedge against inflation ?

2. Is Fama and Schwert (1977) approach applicable on Canadian stock market ?

3. Does Fama's proxy hypothesis explain the real stock returns-inflation relationship for the Canadian stock market ?

To have answers to these questions, our study seek to

i. examines the relationship between *real stock returns and inflationary trends* in the Canadian stock market,

ii. test Fama and Schwert (1977) approach, which states *expected nominal return* of an asset is the sum of the *expected real return* of the asset and the *expected inflation* rate.

iii. tests Fama's proxy hypothesis, which states that **negative** real *stock returns-inflation* relationship is *indirectly* explained by a **negative** *inflation-real activity* relationship (first proposition) and a **positive** *real activity-stock returns* relationship (second proposition).[22]

[22] All considered variables in these models are stationnary ; see

4.1.1. Validity of Fisher Hypothesis

In order to test the validity of the Fisher's hypothesis, inflation, expected inflation and unexpected inflation has been regressed on real stock return (regressions (4.4), (4.5) and (4.6)). **Table 3** (and *Figure 4*) represents the estimation results by OLS and Hildreth-Lu (HL) procedure. Real return, ($R_t - I_t$), is *negatively* associated with inflation *I*,[23] and unexpected inflation *UEI*, and *positively* associated with expected inflation *EI*. With OLS, *DW* statistics indicates misspecification problem, $u_t \nsim WN$. This misspecification is corrected by HL procedure.

But respective coefficients β_1, β_2, and β_3 in respective regressons (4.4), (4.5) and (4.6) are **not significant** (equal to *zero*).[24] Fisher hypothesis is then well *proved.* Candian stock market provides *a complete hedge against Inflation*.[25]
This result is in line with Gultekin (1983) on US, Australia, France, Norway, Peru and Sweden for the period from June 1947 to December 1979, with Samiran (2013) for Indian Stock Index return for the Pre reforms period.which support Fisher Hypothesis. This result do not supports the findings of Adam, and Frimpong (2010) on Ghana stock market and Spyrou (2001) and Floros (2004) on Grecee stock market.

The values for R-squared of these regressions are extremely low. All coefficients are not significant at standard levels. This is an indicator of poor fit of these Fisher's models.

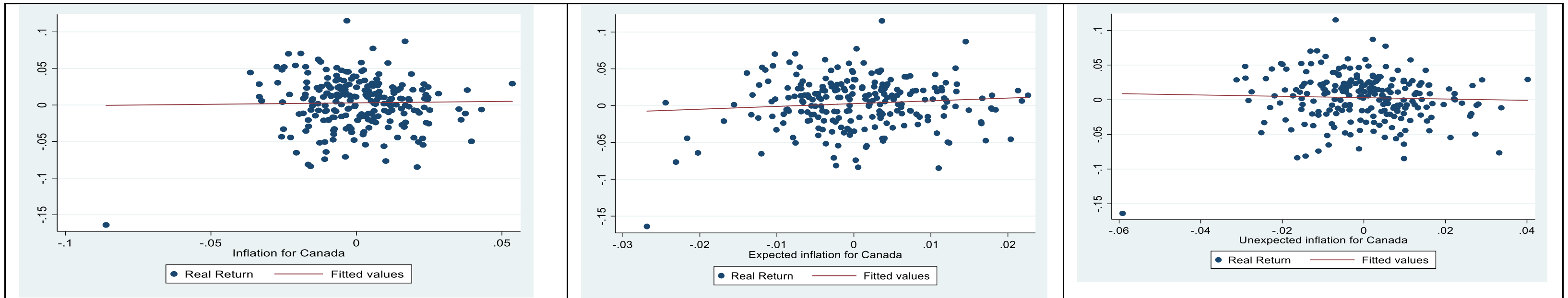
Table **2**.

[23] The negative sign of the beta coefficient of real returns for actual inflation would actually suggest that Canada stock return acts as a "reverse" hedge against inflation.
[24] p-values are greater than 5%. Models are estimated olso by Hidruth-Lue (HL) procedure. The same results are obtained by Cochrane-Orcutt (CORC) procedure. All coefficients are not significant at standard levels. The values for R-squared are extremely low. This is an indicator of poor fit of our model.
[25] The negative sign of the beta coefficient actual inflation would actually suggest that canadian indirect real estate acts as a "reverse" hedge against inflation.

Table 3 : Results for Fisher Hypothesis for ($R_t - I_t$) in (4.4), (4.5) and (4.6).

Hypothesis	**Fisher** Model (4.4)		Model (4.5)		Model (4.6)		**Fama_Schwert** Model (4.7)	
Dependent variable	R-I		R-I		R-I		R	
Method	OLS	HL	OLS	HL	OLS	HL	OLS	HL
I	.03933988	**-.03539165**						
EI			.37766886	**.3993208**			1.3876405***	1.3986291***
UEI					-.09660974	**-.13198341**	.88908722***	.86919864***
_cons	.00295073	.00346572	.00275557	.00324426	.00297682	.00344841	.00275247	.00324527
N	231	230	231	230	231	230	231	230
R^2	.00035328	.00029713	.00900321	.00696604	.00143549	.00338792	.20631904	.18951079
rho		.25485732		.25095146		.25681025		.25095146
DW=2(1-rho)	1.474045	**1.968535**	1.484451	**1.987313**	1.460242	**1.969106**	1.477976	**1.979568**

Note : HL is the Hildreth-Lu procedure. Legend: * p<.1; ** p<.05; *** p<.01



Model (4.4)	Model (4.5)	Model (4.6)

Figure 4: Real stock return and fitted lines by OLS. Real return, ($R_t - I_t$), is negatively associated with unexpected inflation UEI, and positively associated with expected inflation EI and inflation I.

4.1.2. Validity of Fama and Schwert (1977) approach

According to the theory of Fisher (1930) presented earlier in this paper, the beta coefficient for expected inflation should be one for Canadian assets in equaion (4.7). Regression by OLS and HL leads to the results in Table 3. The present results cannot reject hypothesis

$$H_0\colon \beta_2 = 1$$

(p-value= 0.1413). Then canadian stock price is a complete hedge against expected inflation. The beta coefficient for unexpected inflation is positive (not a "reverse" hedge), and is significant. Hypothesis

$$H_0\colon \beta_3 = 1,$$

is also not rejected (p-value= 0.5104). Then canadian stock price is also a hedge against unexpected inflation. Since

$$H_0\colon \beta_2 = \beta_3 = 1,$$

is not rejected (p-value= 0.2870), then canadian stock price provide a **complete hedge** against inflation.

Again, the values for R-squared is extremely low. This is also an indicator of poor fit of Fama and Schwert's model.[26]

4.1.3. Validity of Fama's Proxy Hypothesis

Fama's proxy hypothesis states that **negative** real *stock returns-inflation* relationship is *indirectly* explained by a **negative** *inflation-real activity* relationship (first proposition) and a **positive** *real activity-stock returns* relationship (second proposition). So what about the **First** proposition of Fama's proxy hypothesis ? Is there a **negative** relationship between *Inflation and real economic activity* for the canadian economy ? **Table 4** sum up results of estimated equations (4.8), (4.9) and (4.10) i.e. regression result of inflation (expected inflation or unexpected inflation) on real economic activity (RA), which is being proxied by *increase* of Index of Industrial Production (IIP). Several leading, contemporaneous, and several lagging values of real activity have been considered as independent variables. [27]

From (4.8), actual inflation, *I*, and *real activity* are significantly and *negatively* related at contemporaneously stage, in lag 6 and lag 9.[28] From (4.9), expected inflation, *EI*, is also significantly and *negatively* related to 7 th lag of *real activity*.[29] And finally from (4.10), Unexpected inflation, *UEI−real activity* relation **is also *negatively*** significant at

[26] By OLS, $DW = 1.477976$ indicates misspecification problem, $u_t \nsim BB$. This misspecification is corrected by HL procedure.
[27] Selection is based on AIC information criteria.
[28] It is *positively* related at first lag (and 7 th and 9 th leads). But the overall effect is negative.
[29] But *positively* related at 7 th, 10 th, and 11 th leads.

contemporaneous stage.[30] Fama's **first proposition** is then applicable and **valid** with the three type of inflation ; *I*, *EI*, and *UEI*.

Now what about the **second** proposition of Fama's proxy hypothesis ? Is there a **positive** relationship between *real stock return and Real economic activity* ?

This question is treated with **two approaches**. **First** one is based on equation (4.11). Again several leads and lags, and contemporaneous values of real activity, RA_{t+i}, (increase in index of industrial production ; IIP) has been considered as independent variable for $(R-I)_t$. Table 4 shows also the regression results of equation (4.11). At 4 th and 8 th lag of RA_t, the data is *negatively* and significantly related to real return (p-value < 5%). At contemporaneously stage and in lead 2 and 3, relationship is positive and significant. But the overall effect is **positive**. Therefore, we can say that **second proposition** of *Fama's proxy hypothesis* **is valid**.[31]

The **second approache** to test the second proposition of Fama's proxy hypothesis consist to introduce a *two step estimation to control for the inflation and real economic activity* relationship. So, we investigate rather the relationship between real return $(R-I)$ and real activity, *RA*, if error terms, approximated from regression (4.8), (4.9) and (4.10)) has been included.[32] **Table 5** shows the estimated result of equations (4.12), (4.13) and (4.14) by OLS and Cochrane-Orcutt procedure (CORC). These *error terms are not significant* ($p-$value < 5%).

This implies that Fama's proxy hypothesis is applicable for *the three type of inflation.* It **ensure** that the Fama's proxy hypothesis which states that real stock returns and inflation rates are **independent** once the impact of real economic activity on inflation was *controlled for*.

Again, the values for R-squared of these regressions are extremely low. This is also an indicator of poor fit of these models.

[30] It is *positively* and significantly related to real activity at first lag and second one and 11 th leads. But again, the overall effect is negative.

[31] There is no evidence of independance between *real stock return and inflation* in Canadian economy

Table 4 : Results for Fama's Proxy Hypothesis : First proposition (regression results estimation of equations (4.8), (4.9), and (4.10) and Results for Fama's Proxy Hypothesis : Second proposition [equation 4.11]

Dependent Variable	I		EI		UEI		R-I
Model Lags/Lead	Model (4.8) OLS	$I_t=f(RA_{t+i})$ HL	Model (4.9) OLS	$EI_t=f(RA_{t+i})$ HL	Model (4.10) OLS	$UEI_t=f(RA_{t+i})$ HL	Model (4.11) OLS
RA_t							
0	-.85245044***	-.84437846***			-.69623646***	-.66110276***	1.028867***
-1.	.2863725**	.24595876*			.30355698***	.30413618***	
-4.							-.63440556**
-6.	-.28104803**	-.25645958**					
-7.			-.19490874***	.04128425			
-8.							-.61665501**
-9.	-.32619647***	-.29259356**					
1.	.37237165***	.33844412***					
2.					.36155762***	.19532831**	.88594784***
3.							.62189092**
7.	.3101026**	.30278804**	.15147909**	**-.0381693**			
8.			.2526236***	.05172505			
9.	.43122901***	.36618499***					
10.			.27269642***	.06530573*			
11.			.18528305***	.05225671	.20148977**	.37472576***	
_cons	.00067508	.00079586	-.0003784	.00031938	-.00029731	-.000294	.00162947
N	213	212	213	212	219	218	220
R^2	.25343584	.25837692	.24607724	.02800632	.20071731	.19387064	.23383544
F	4.04***	.26931372	13.51***	.84575153	13.44***	13.44***	13.06***
DW	1.468282	**1.932191**	.5018661	**1.507038**	2.262264	**2.125668**	**1.606412**

legend: * p<.1; ** p<.05; *** p<.01

Table 5 : Results for Fama's Proxy Hypothesis : Second proposition with error terms [equation (4.12), (4.13) and (4.14)]

Dependent Variable	Model (4.12)		Model (4.13)		Model (4.14)	
Lags/Lead	CORC	OLS	CORC	OLS	CORC	OLS
RA						
-8.	-.59449327**	-.55642448**	-.5362147**	-.53212082**	-.56455343**	-.57162409**
-4.	-.68062948**	-.6645809***	-.63163828**	-.64432483**	-.63835973**	-.66332385***
0	.99278348***	.9597274***	.96945665***	.92459728***	.96916933***	.90643683***
2.	.99912184***	1.1407031***	1.0222744***	1.1804502***	1.0022103***	1.1645411***
$\hat{\varepsilon}_{4t}$	**.2054063**	.23718426				
$\hat{\varepsilon}_{5t}$			**.32080121**	.37046201		
$\hat{\varepsilon}_{6t}$					**.22266385**	.2154384
_cons	.00200095	.00208548	.00232525	.00238829	.00238418	.00250667
N	212	213	211	212	211	212
R^2	.19217419	.22320833	.17560155	.21307316	.17659048	.21203936
DW	**1.997955**	1.647818	**2.013990**	1.640998	**2.021147**	1.618081
F	9.80***	11.90***	8.73***	11.16***	8.79***	11.09***

Note : CORC is the Cochrane-Orcutt procedure.

4.2. Dynamic specifications

Static models are generally considered as oversimplified. Furthermore, the static model (in all its form) is criticized because it does not reflect possible non-stationarity in the variables (**Goetzmann and Valaitis (2006).**[33] To solve this lacune, cointegration techniques have been practiced. The regression of those two variables would therefore be meaningful (Ganesan and Chiang (1998)) and we can apply a short-term and a long-term sensitivity measurement (Wohlwend and Goller (2011)) via ARDL or NARDL models.

Following the methodology explained in section 4.2, it is possible to test for the existence of a stock price equation involving the levels of all variables irrespective of whether they are purely I(0), purely I(1), or mutually cointegrated.

4.2.1. ARDL model

Having established that the variables under consideration are I (1) or I (0) variables,[34] ARDL approach is used to determine cointegrating relationship. The results of the cointegration test using ARDL approach are presented in **Table 6**. As can be observed, the F-statistic and *t*-statistic (F_{PSS} and t_{BDM}) exceeds the upper critical bound value at 5% significance level for only the Expected inflation, **EI**. We therefore, conclude that there is a long-run relationship between Expected Inflation and stock market price. The presence of cointegrating relationship between stock price and expected inflation implies that equations (4.15) and (4.17) can be estimated for **EI**.

[33] Researcher might reject the tested hypotheses too often.

[34]

Table 2 displays the results of the ADF and PP unit root tests. As can be observed, stock market price (LSP) is *not stationary*, stock market returns and Inflation, Expected Inflation, and Unexpected Inflation are *stationary*.

Table 6 : Bound tests for ARDL specification

	F_{PSS}		Conclusion	t_{BDM}		Conclusion
I	9.5144		Cointegration	-4.3720		No cointegration
EI	90.0250		Cointegration	-1.9335		Cointegration
UEI	6.1461		No cointegration	-3.1971		Cointegration
Significance	**I(0) Bound**	**I(1) Bound**		**I(0) Bound**	**I(1) Bound**	
5% Level	5.59	6.56		-3.41	-3.69	
10% Level	6.26	7.3		-3.13	-3.4	

Source : Author's calculations

The short run and long-run relationships between stock market returns and *Expected* Inflation are given in equation (4.15) and equation (4.17) here after in **Table 7**,[35] where

$$\Delta EI_t = EI_t - EI_{t-1}$$
$$\Delta LSP_t = R_{t,} \, \Delta LSP_{t-j} = R_{t-j,} = B^j R_t.$$

In the **short run**, *Expected inflation* has a **negative** statistically significant relationship with stock market returns ($\sum_{i=1}^{p} \widehat{\beta_i^*} < 0$). The **negative short run** relationship between Expected inflation and stock returns implies that a rise in Expected inflation results in a fall of stock return.[36] However, in **the *long-run*** this negative relationship becomes significantly **positive** ($\widehat{\delta}_1$ **= 1.424761**). Since the Fisher effect is valid only in the long run, the positive long run relationship between *Expected* inflation and stock market price is in a chord with *Fisher hypothesis*. It suggests that as Expected inflation rises, investors on the canadian stock market are compensated for it in the long run.
The *negative and statistically significant* coefficient of the *Error Correction Term* (ECT_{t-1}) in the (ECM version) following equation (4.17) suggests that there is a *unidirectional causality* running from *Expected* inflation to stock market returns.[37]

In other words, *Expected* inflation drives stock market price towards equilibrium in the long run. However, as can be observed, the speed of adjustment to long-term equilibrium is slow ($\widehat{\delta}_1$**= 0.034323**). This mean again that investors on the canadian stock market are compensated **for *Expected* inflation and that Stock price *cannot be used as a hedge* against inflation**.[38] Moreover, this unidirectional causality from *Expected* inflation to stock returns hints of

[35] Selected model by AIC criteria is an ARDL (7, 6) ; see Figure 7 given in Annexe.
[36] These findings confirm those of Akbar et al. (2012), Dasgupta (2012), Naik and Padhi(2012), Sohail and Hussain (2009), Bhattarai and Joshi (2009), Hussain et al. (2009), Gunasekarage et al(2004), Bhattarai and Joshi(2009) in Nepal, Issahaku et al (2013) and Samiran (2013) in Ghana.
[37] Granger Causality Tests contradict this result. Null hypothesis : EI does not Granger Cause LSP is not rejected (F-Statistic= 0.51693, p-value=0.5971). While Null hypothesis : LSP does not Granger Cause EI is rejected (F-Statistic= 4.98574, p-value=0.0076).
[38] This contradicts the Efficient Market Hypothesis which postulates that capital markets are efficient.

inefficiency of the canadian stock market which suggests that information on past values of inflation could provide opportunities for abnormal gains from the stock market.

Table 7: Results of ARDL specification : Model (4.15) and Model (4.17) for EI

Model (4.15)			Model (4.17)		
Variable	**Coefficient**	**P-value**	**Variable**	**Coefficient**	**P-value**
C	0.13953	0.0587	C	0.139537	0.0000
TREND	0.000142	0.0337	TREND	0.000142	0.0035
LSP_{t-1}	-0.034323	0.0545	ΔLSP_{t-1}	0.283646	0.0000
EI_{t-1}	1.424761	0.0026	ΔLSP_{t-2}	0.054954	0.4198
ΔLSP_{t-1}	0.283646	0.0000	ΔLSP_{t-3}	0.031658	0.6414
ΔLSP_{t-2}	0.054954	0.4325	ΔLSP_{t-4}	-0.018835	0.7756
ΔLSP_{t-3}	0.031658	0.6477	ΔLSP_{t-5}	0.131351	0.0473
ΔLSP_{t-4}	-0.018835	0.7802	ΔLSP_{t-6}	-0.160125	0.0119
ΔLSP_{t-5}	0.131351	0.0527	ΔEI_{t}	**-0.439639**	**0.4541**
ΔLSP_{t-6}	-0.160125	0.0151	ΔEI_{t-1}	0.134460	0.8094
ΔEI_{t}	-0.439639	0.4705	$\boldsymbol{\Delta EI_{t-2}}$	**2.064265**	**0.0003**
ΔEI_{t-1}	0.134460	0.8162	$\boldsymbol{\Delta EI_{t-3}}$	**-2.155852**	**0.0002**
$\boldsymbol{\Delta EI_{t-2}}$	**2.064265**	**0.0005**	ΔEI_{t-4}	-1.020174	0.0701
$\boldsymbol{\Delta EI_{t-3}}$	**-2.155852**	**0.0003**	ΔEI_{t-5}	-1.093844	0.0793
ΔEI_{t-4}	-1.020174	0.0781	CointEq(-1)	-0.034323	0.0000
ΔEI_{t-5}	-1.093844	0.0818			

EC = LSP - (41.5109*EI)

R^2=0.985960 χ^2_{LM} =1.474055 (0.4785)

χ^2_{ARCH} = 0.3660 (0.5452)

F=7.561016 DW=1.952411

Note : ARCH(.) is the ARCH test for autoregressive conditional heteroskedasticity up to the lag order given in the parenthesis. LM (.) is the Breusch-Gofrey Serial Correlation LM test for error autocorrelation up to the lag order given in the parenthesis.

Diagnostic tests (in **Table 7**) suggest adequate specifications as the models show free autocorrelation errors and free conditianal heteroskedasticity. Additionally, we can say that the CUSUM statistics show stable relations in the long run ; see Figure 8 **and** Figure 9 **given in Annexe.**[39]

4.2.2. NARDL model

One of the purpose of this section is to develop a coherent modelling strategy which provides for the simultaneous analysis of asymmetry in both the underlying long-run relationship and the patterns of dynamic adjustment.

[39] But that is not the case using the CUSUMSQ statistics. For EI, instability is local.

An other extension of section 5.2.1 can be examining the effect of CPI shocks on stock price (SP) by considering the presence of structural breaks that have directly affected SP.[40] Considering the structural breaks in the model could add value to the analysis, and this will be one of the objectives of the following investigation.

To carry out the nonlinear ARDL methodology, we need to apply the following steps. **First step** is done in section **5.2.1**, but we have to run a unit root test to check that none of considered variable is I (2), see also Table 2. As can be observed, stock market price (LSP) is *not stationary*, while stock market returns, Inflation, Expected Inflation, Unexpected Inflation, and Real activity are *stationary*. Then, we estimate Equation (4.22) using the standard OLS method incorporating the significant number of lags to capture the most reliable representation of the NARDL model. In order to observe the effects of the world financial crisis **(between 2008M01 and 2009M08**) and the euro crisis (since 2009M08), two dummy variables are created and included in considered model (4.22), D_{1t} and D_{2t} for drift instability (C_1), and two other dummy D_{1t} $*trend$ and D_{2t} $*trend$ to take account of possible trend instability (C_2)**.**

Second, after estimation of the NARDL model, we test for existence of a long run relationship among the variables (cointegration) by conducting an F_{PSS} (and $t_{\mathbf{BDM}}$) test for the joint significance (individual) of the coefficients of the lagged level variables.[41] The null hypothesis of no cointegration

$$H_0:\ \rho = \theta^+ = \theta^- = 0 \tag{5.3}$$

is tested against the alternative of cointegration

$$H_a: (\rho \neq 0) \cup (\theta^+ \neq 0) \cup (\theta^- \neq 0) \tag{5.4}$$

F_{PSS} (and $t_{\mathbf{BDM}}$ for $H_0: \rho = 0$) values and the bounds of F_{PSS} (and of $t_{\mathbf{BDM}}$) of the nonlinear ARDL models (critical points) are reported in **Table 8**. The findings document a long run relationship (cointegration) between Inflation (Expected inflation at 10% level) and canadian stock price.[42]

The estmated long run coefficients are given in the following results :

$$ECT_t = LSP_t - (17.2452\ I_t^+ + 17.0020\ I_t^-), \tag{5.5}$$

$$ECT_t = LSP_t - (\mathbf{9.908}\ EI_t^+ - \mathbf{5.1363}\ EI_t^-), \tag{5.6}$$

and

$$ECT_t = LSP_t - (10.2010\ UEI_t^+ + 9.8002\ UEI_t^-), \tag{5.7}$$

[40] The structural breaks could be a reason for not finding a long run relationship or could be a reason to cause the long-run relationship to change.

[41] Testing cointegration in the NARDL methodology is valid irrespective of whether the variables are I(0) or I(1).

[42] If the computed F_{PSS} ($t_{\mathbf{BDM}}$) falls below the lower bound critical value, the null hypothesis of no-cointegration cannot be rejected. On the other hand, if the computed F_{PSS} ($t_{\mathbf{BDM}}$) exceeds the upper bound critical value, the null hypothesis is rejected (implying a long-run cointegration relationship among the variables in the model). However, if the computed F_{PSS} ($t_{\mathbf{BDM}}$) value falls within the bounds, the test is inconclusive.

It is obvious from equation (5.5) and (5.7) that for I and for UEI, the long-run coefficients associated with the positive and negative partial sums are *remarkably similar*. But from **Table 9**, the Wald tests reject longrun symmetry with respect to UEI and I.[43] On the other hand, Wald test fail to reject long-run symmetry with respect to EI (see **Table 9**,) while coefficients associated with its positive and negative partial sums are different with opposite sign.

Table 8 : Bound test for NARDL specification with trend and dummy variables for EI and With only a trend for I and UEI. Critical value (5% and 10% level)

	F_{PSS}		**Conclusion**	t_{BDM}		**Conclusion**
I	7.6654		**Cointegration**	-2.3995		Cointegration
EI	5.3924*		**Cointegration**	-2.8691		Cointegration
UEI	4.9873		**inconclusive**	-3.2195		Cointegration
Significance	**I(0) Bound**	**I(1) Bound**		**I(0) Bound**	**I(1) Bound**	
5% Level	4.87	5.85		-3.41	-3.95	
10% Level	4.19	5.06		-3.13	-3.63	

Source : Author's calculations

Table 9 : Wald test Resultats for symmetric effects.

	Long run Asymmetrie			Short run Asymmetrie		
Statistics	W_{LR}(I)	W_{LR} (EI)	W_{LR} (UEI)	W_{SR}(I)	W_{SR} (EI)	W_{SR} (UEI)
(4.22)	7.142168	0.173222	9.593929		2.711264	
p-value	0.0075	0.6777	0.0020		0.0073	
Conclusion	LRA	LRS	LRA		SRA	

Note : With regressor *I*, *UEI* or *EI*, optimal model for ΔLSP are respectively ARDL (3, 0, 1), ARDL (3, 0, 1), and ARDL(7, 0, 4). LRA mean long run Asymmetrie, **LRS** mean long run symmetrie, and SRA mean Short run Asymmetrie.

Once cointegration is established, we test also the *short run asymmetrie* between stock price and X: Inflation, expected inflation or Unexpected inflation :

$$H_{0,SR}\colon \sum_{j=0}^{q^+} \pi_j^+ = \sum_{j=0}^{q^-} \pi_j^- \qquad (5.10)$$

In short run, there is statistical evidence to support the theory that the *Expected inflation* has a Asymmetric impact on stock price, as the Wald test statistic reject the null hypothesis of symmetric relationship (**Table 9**).[44] For unexpected inflation and actual inflation, thers is no significant effects (short run effects are null).

[43] The true models for UEI and I are, in fact, non linear in the long-run.

[44]In this case $\sum_{j=0}^{q^+} \pi_j^+ = 0$

The short run and long-run relationships between stock market returns and *Expected* Inflation are given in **Table 10** here after.

Table 10: Short run and long-run relationships between stock market returns and Expected Inflation.

Variable	Coefficient	P-value	Variable	Coefficient	P-value
C	0.289373	0.0031	C	0.289373	0.0001
TREND	-0.001340	0.0805	TREND	-0.001340	0.0004
LSP_{t-1}*	-0.067206	0.0045	ΔLSP_{t-1}	0.334940	0.0000
EI_t^+**	**0.665872**	**0.0902**	ΔLSP_{t-2}	0.036069	0.5713
EI_t^- **(-1)**	**-0.345189**	**0.5452**	ΔLSP_{t-3}	0.025101	0.6986
ΔLSP_{t-1}	0.334940	0.0000	ΔLSP_{t-4}	0.026053	0.6907
ΔLSP_{t-2}	0.036069	0.5981	ΔLSP_{t-5}	0.102942	0.1182
ΔLSP_{t-3}	0.025101	0.7053	ΔLSP_{t-6}	-0.118953	0.0632
ΔLSP_{t-4}	0.026053	0.6958	$\Delta\, EI_t^-$	-0.737250	0.3651
ΔLSP_{t-5}	0.102942	0.1252	$\Delta\, EI_{t-1}^-$	1.232006	0.1331
ΔLSP_{t-6}	-0.118953	0.0676	$\Delta\, EI_{t-2}^-$	**4.562914**	**0.0000**
$\Delta\, EI_t^-$	-0.737250	0.3882	$\Delta\, EI_{t-3}^-$	**-2.210213**	**0.0120**
$\Delta\, EI_{t-1}^-$	1.232006	0.1681	DUM1	0.358883	0.0739
$\Delta\, EI_{t-2}^-$	**4.562914**	**0.0000**	DUM2	-0.040846	0.0960
$\Delta\, EI_{t-3}^-$	**-2.210213**	**0.0229**	DUMT	-0.003377	0.0522
DUM1	0.358883	0.0845	DUMT2	0.003366	0.0553
DUM2	-0.040846	0.2028	**CointEq(-1)***	**-0.067206**	**0.0001**
DUMT	-0.003377	0.0635			
DUMT2	0.003366	0.0682			

EC = LSP - (9.9080* EI_t^+ **-5.1363*** EI_t^- **)**
R^2=0.986098
DW=1.979836
F-statistic=811.8033

In the **short run**, partial sum of the *negative* changes in *Expected inflation* has a **positive** statistically significant relationship with stock market returns in *2 months*.[45] While partial sum of the *positive* changes in *Expected inflation* has **no effect** on stock market returns. In **long run**, partial sum process of the *positive* changes in *Expected inflation* has **significative positive** effect. While partial sum of the *negative* changes in *Expected inflation* has **insignificant *negative*** effect.

The *negative and statistically significant* coefficient of the *Error Correction Term* (ECT_{t-1}) in Table 11 suggests that there is a *unidirectional causality* running from *Expected* inflation to stock market returns.[46] In other words, *Expected* inflation drives stock market returns towards equilibrium in the long run. However the speed of adjustment to long-term equilibrium is slow

[45] But this relationship is negative into 3 months. The overall effect of partial sum of the *negative* changes is **positive**

[46]Granger Causality Tests confirm this result. Null hypothesis : EI^+ does not Granger Cause LSP is rejected (F-Statistic= 6.36506, p-value=0.0020). Null hypothesis: EI^- does not Granger Cause LSP is rejected (F-Statistic= 15.4437, p-value=5.E-075.E-07.

($\hat{\delta}$= **0.067206**). This mean again that investors on the canadian stock market are compensated for *Expected* inflation (via partial sum of the *negative* changes in *Expected inflation*). And so, **stock price *cannot be used as a hedge* against inflation**. Moreover, this unidirectional causality from *Expected* inflation to stock returns hints **of *inefficiency* of the canadian stock** market which suggests that information on past values of inflation could provide opportunities for abnormal gains from the stock market. This result is coherent with finding of ARDL model. But with NARDL model, we know precisely that only partial sum of **the *negative*** *dynamic* changes in *Expected inflation* have significant effect on canadian stock market.

These results are more ullustrated by the dynamic multipliers for the corresponding model ; see Figure 5.

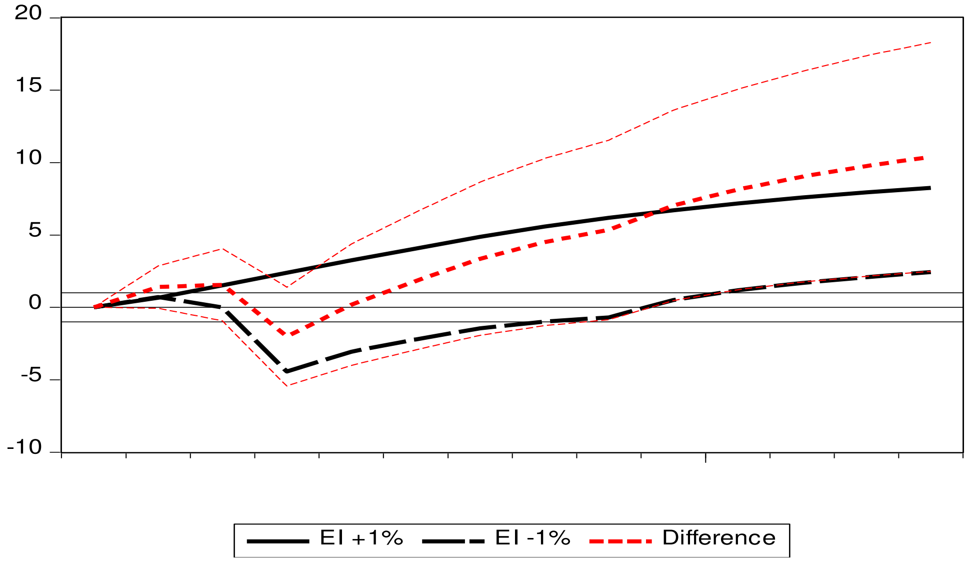


Figure 5. Dynamic multipliers for EI : asymmetrie in short run and in long run.

The results of the diagnostic tests of estimated model suggest adequate specifications as the models show free autocorrelation errors (χ^2_{LM}= 0.397656, p-value= 0.8197) and free heteroskedasticity (χ^2_{White}= 198.6663, p-value = 0.0530). Then,

$$\varepsilon_t \sim WN\,(0, \sigma^2).$$

and is gaussian since Jarque-Bera statistic is equal to 3.935 with p-value= 0.1397. Additionally, the CUSUM statistics and CUSUM of Squares statistics show that the parameters in the estimated regression were structurally stable ; see Figure 10 and Figure 11 given in Annexe.[47]

[47] Results of the short run and long-run relationships between stock market returns and *Unexpected* Inflation and actual inflation are given in Table 11**,** see Annexe.

5. Conclusion

In order to test the efficiency and strength at which inflation is related to real stock returns, in this study we decompose the inflation into expected and unexpected components using an MA filter. We seek to see if the effect of both Fisher and Fama hypothesis on long time horizon hold for Canadian Stock market. The study has covered data for the period 1999 : 1−2018 : 4. Results with static model support Fisher Hypothesis**. Canadian stock market provides a complete hedge against Inflation.** Fama's first proposition is **valid** with the three type of inflation ; actual inflation, expected inflation, and unexpected inflation. The hypothesis that canadian stock price is a hedge against unexpected inflation is not rejected (hypothesis of Fama and Schwert approach). While second Fama's proxy proposition is validated (real stock returns and inflation rates are **independent**). The consistency of Fama's proxy hypothesis was retested by introducing a twostep estimation controlling for the inflation and real economic activity relationship.

Results are not maintained with dynamic models. With ARDL specification, positive long run relationship between *Expected* inflation and stock market price is in a chord with *Fisher hypothesis*. It suggests that as Expected inflation rises, investors on the canadian stock market are compensated for it **and that Stock price *cannot be used as a hedge* against inflation** in the long run.

Results with NARDL model are coherent with finding of ARDL model. But with NARDL model, we know precisely that only partial sum of the *negative* changes in *Expected inflation* have significant effect on canadian stock market. Stock price *cannot be used as a hedge* against inflation.

Moreover, this unidirectional causality from *Expected* inflation to stock returns hints of *inefficiency* of the canadian stock market which suggests that information on past values of inflation could provide opportunities for abnormal gains from the stock market.

Many researchers have used many other modern econometric tools to prove the validity of Fischer hypothesis on various markets. More research works on Canada data may provide full idea on this. Considering more exogenous variables in the NARDL model could add also value to the analysis. Studying, the long-run and short-run asymmetric impact of other **exogenous variables**, such exhange rate and unemployment rate can be analyzed in subsequent researchs.

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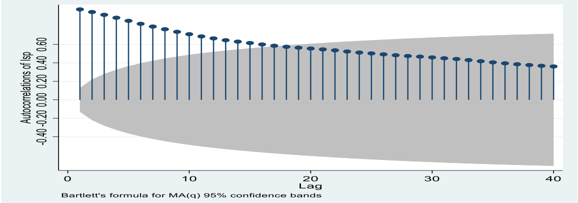
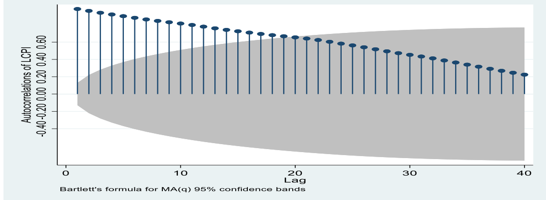
Annexe

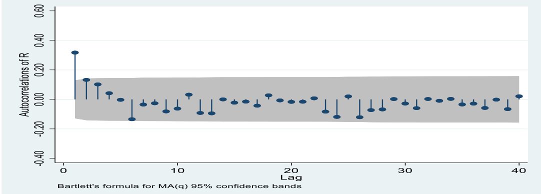
Figures



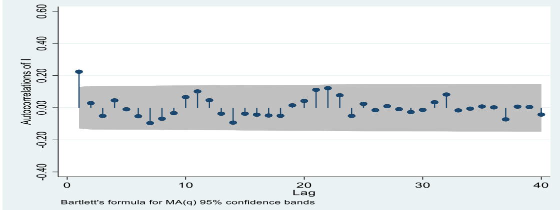
(a) Correlogram for LSP



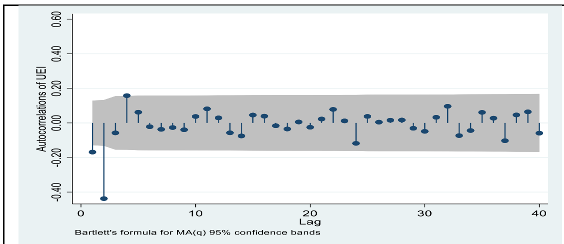
(b)) Correlogram for LCPI



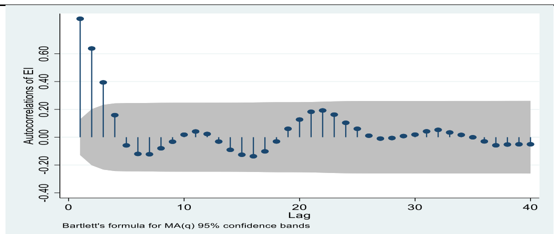
(c)) Correlogram for R



(d)) Correlogram for I



(e) Unexpected inflation



(f) Expected inflation

Figure 6 : Autocorrelation function of canadian time series from 1999:10 to 2018:4 (a) LSP, (b) LCPI, (c) R, (d) I, (e) UEI, and (f) EI.

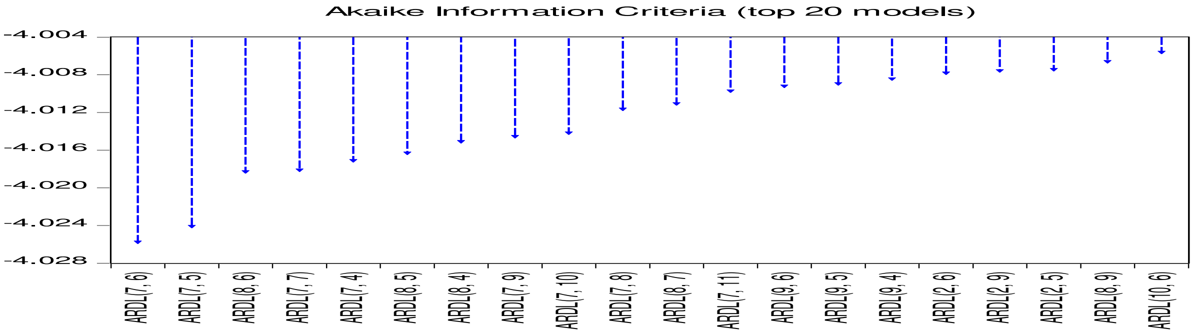


Figure 7: AIC criteria of selected ARDL(7, 6) model for EI.

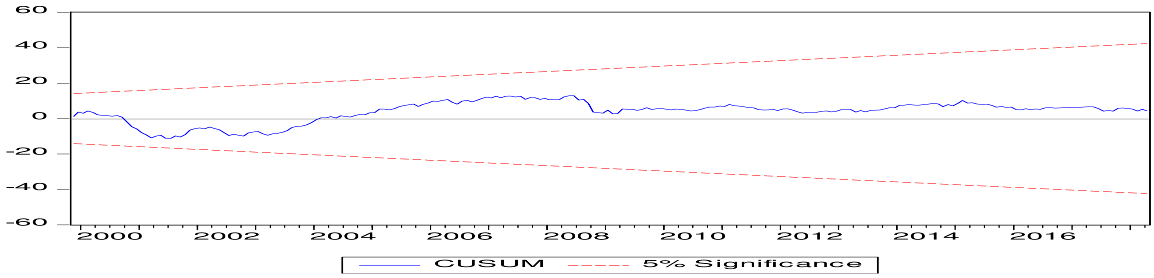


Figure 8. CUSUM test for ARDL model ; Xt ≡ EI.

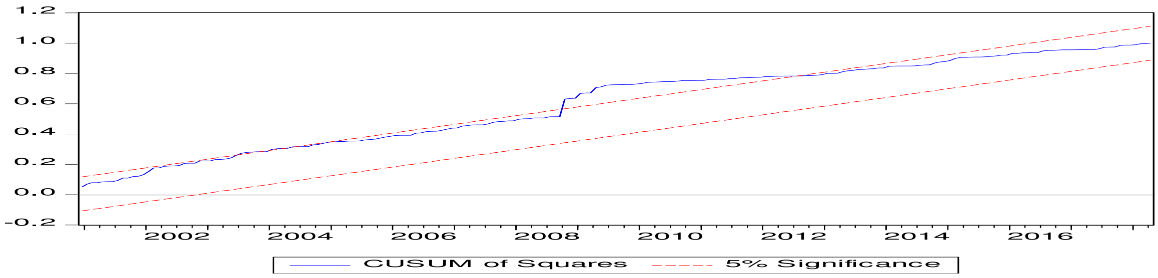


Figure 9. CUSUM of Squares test for ARDL model ; Xt ≡ EI.

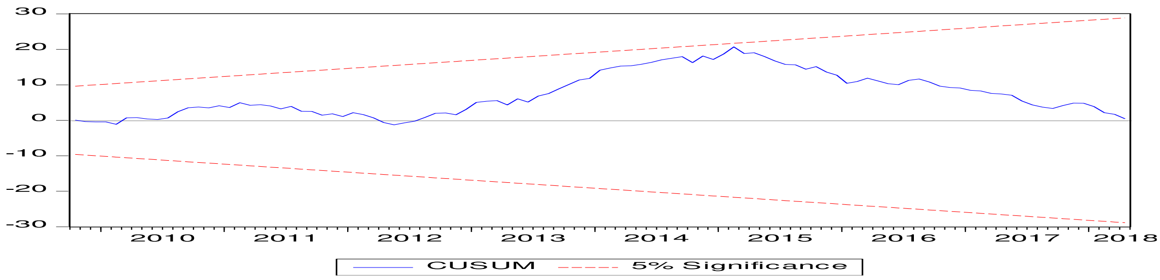


Figure 10. CUSUM Test for NARDL model ; Xt ≡ EI .

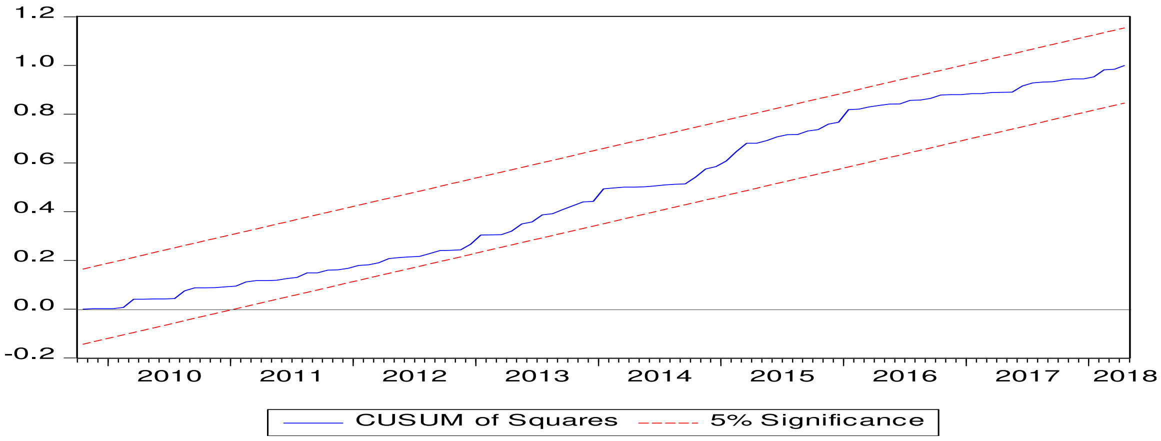


Figure 11. CUSUM of Squares for NARDL model ; Xt ≡ EI.

Tables

Table 11 : Results of model (4.22) and for Unexpected Inflation and actual Inflation, UEI and I.

	I			UEI	
Variable	Coefficient	Prob.	Variable	Coefficient	Prob.
C	0.171954	0.0070	C	0.216970	0.0008
TREND	6.10E-05	0.8419	TREND	2.22E-05	0.9375
LSP(-1)*	-0.037074	0.0172	LSP(-1)*	-0.049247	0.0017
I_POS**	**0.639346**	**0.0002**	**UEI_POS****	**0.499303**	**0.0265**
I_NEG(-1)	**0.630330**	**0.0003**	**UEI_NEG(-1)**	**0.482299**	**0.0323**
D(LSP(-1))	0.245294	0.0001	D(LSP(-1))	0.297185	0.0000
D(LSP(-2))	0.108171	0.0729	D(LSP(-2))	0.139505	0.0259
D(I_NEG)	**1.214526**	**0.0000**	**D(UEI_NEG)**	**1.227756**	**0.0000**
EC = LSP - (17.2452*I_POS + 17.0020*I_NEG)			EC = LSP - (10.1387*UEI_POS + 9.7935*UEI_NEG)		

Table 12: Empirical review.

Authors	Variables	Model	Sample	Results
Fisher (1930)	-stock market returns -real interest rate -expected inflation rate -inflation rate			-A positive relationship between stock market returns and inflation. -The real interest rate and the expected inflation rate are independent.
Fama and Schwert (1977)	-**CPI** -Inflation rate -Expected inflation rate -nominal stock market return -nominal yields on real estate, bonds and treasury bills.	-Simple regression	**-Period :** 1953-1971 **-Country :** United States **-**Monthly, quarterly and half-yearly data.	-Returns on common stocks are **negatively** correlated with expected and unexpected inflation rates. -Expected nominal returns on real estate, bonds and treasury bills are directly related to the expected rate of inflation. -Government bonds and bills have full protection against expected inflation.
Gultekin (1983)	-Nominal stock market returns -**Inflation rate** -Expected and unexpected inflation rates -Short-term interest rates	-OLS -Cross-section -ARIMA	**-Countries :** 26 countries **-Period :**1947-1979 **-**Quarterly and monthly data.	-Time series results indicate a **negative** relationship or absence of a positive relationship between stock returns and inflation over time in most countries. - Cross-sectional regression coefficients are not significant.
Kaul (1987)	-Real stock returns, -**expected inflation,** **-unexpected inflation** -real activity	-OLS	**-Countries :** United States, Canada, United Kingdom and Germany **-Period :**1951-1983 **-**Monthly, quarterly and annual data.	- A **negative** relationship between real equity returns and inflation. - Real stock market returns are positively (and significantly) related to future real activity in all countries in the monthly, quarterly and annual regressions. - A significant negative relationship exists between inflation and current and future real activity variables in all countries in the monthly, quarterly and annual post-war regressions.
Lee (1992)	-Actual asset returns -Real interest rate -Industrial production growth **-Inflation rates**	-VAR -Granger's Causality	**-Country :** United States **-Period :** 1947-1987 -Monthly data	-**Negative** relationship between equity returns and inflation rates in the post-war period. -Positive relationship between equity returns and industrial production growth. -A positive correlation between nominal interest rates and inflation.

				-A negative correlation between nominal interest rates and industrial production growth.
Graham (1996)	-Real rate of return on common shares **- inflation rate** -growth rate of the monetary base -unemployment rate.	-OLS -Granger causality test	**-Period :**1953-1990 **-Country :** Unit-stated **--**Monthly data.	-The relationship between real return and inflation is unstable over the period 1953-1990. -When monetary policy is sufficiently pro-cyclical the negative relationship between real equity returns and inflation disappears, or even becomes positive.
Chatrath (1997)	-CPI **-Inflation rate** **-Expected and unexpected inflation rates** -Actual stock market returns -Industrial production index	-OLS -ARMA	**-Period :**1984-1992 **-Country :** India **-**Monthly data.	-A **negative** relationship between real returns and inflationary trends. -A negative relationship between real equity returns and unexpected inflation. -Real returns and expected inflation are independent. (Fisher's hypothesis is verified). -A negative relationship between the rate of inflation and real activity. -A positive relationship between real returns and real activity.
Adranbgi and al. (2000)	-Stock market returns -**Inflation rates** -Real economic activity (presented by the industrial production index)	-Johansen's cointegration	**-Country :** Brazil **-Period :** 1986-1997 -Monthly data.	-A positive relationship between real return and real activity. -A negative relationship between inflation and real economic activity. -A long-term **negative** relationship between real returns and inflation.
Kolari and Anari (2001)	-Share price index **-CPI**	-Johansen cointegration test -VAR	**-Countries :** United States, Canada, United Kingdom, France, Germany and Japan **-Period :** 1953-1998 -Monthly data	-**Negative** short-term relationship between equity price indices and inflation. -Positive long-term relationship between equity price indices and inflation.
Wongbanpo and Sharma (2002)	-Stock market prices -GNP -M1 -**CPI** -Exchange rates -Interest rates	-Johansen cointegration -VECM -Granger's Causality	**-Countries :** Indonesia, Malaysia, Philippines, Singapore, Thailand. **-Period :** 1985-1996 -Monthly data.	In the long term ; -A positive relationship between stock prices and GNP. -A **negative** relationship between stock prices and inflation. -Share prices are negatively affected by the interest rate in the Philippines, Singapore and Thailand, and positively in Indonesia and Malaysia.

				- Share prices are positively affected by the exchange rate in Indonesia, Malaysia and the Philippines, and negatively in Singapore and Thailand.
Al Khazali (2003)	Share prices **-CPI** -Industrial production index	-Johansen cointegration test -GARCH	**-Countries :** 21 emerging countries **-Period :** 1980-2001 -Monthly data.	-**Negative** short-term relationship between stock market returns and inflation. -Positive long-term relationship between stock market returns and inflation.
Gunasekarage and al. (2004)	-Stock market index -Money supply -Treasury Bill rate (as a measure of interest rates) -**Consumer price index** (as a measure of inflation) -Exchange rate	-Johansen cointegration test -VECM	**-Country :** Colombo **-Period :** 1985-2001 -Monthly data.	-A **negative** impact of inflation on stock prices. -The money supply has a positive effect on share prices. -A negative impact of the interest rate on stock market indices. -The exchange rate has no effect on share prices.
Patra (2006)	-Share price -**Consumer Price Index (CPI)** Money supply -Exchange rates -Volume of transactions.	-Granger's Causality -Johansen's integration -Engle-Granger test -ECM	**-Country :** Greek **-Period :** 1990-1999 -Monthly data.	-**Causal** relationship is from the inflation rate, money supply and transaction volume to the general price index. -Inflation, money supply and trading volume have a equilibrium relationship with stock prices in the short and long term.
Ratanapakorn and Sharma (2007)	-S&P500 -The interest rate -Money supply -Industrial production -**Inflation (CPI)**	-VAR -Granger's Causality	**-Country :** United States **-Period :** 1975-1999 -Monthly data	-Negative relationship between the stock market index and the interest rate. -Positive relationship between the stock market index and the money supply. **-Positive** relationship between the stock market index and inflation.
Akmal (2007)	-Stock market prices **-CPI** -Subterranean economy.	-ARDL -ECM	**-Country :** Pakistan **-Period :** 1971-2006 -Monthly data	-**Positive** and non-significant short-term relationship between share prices and inflationary pressure (CPI). -Positive and significant short-term relationship between share prices and the subterranean economy. -Positive and significant long-term relationship between stock prices and inflation (CPI).
Adam and Tweneboah (2008)	-Stock market index (DSI) **-Inflation rates**	-Johansen's integration -VECM	**-Country :** Ghana **-Period :** 1991-2006 -Quarterly data	-A **positive** relationship between stock market indices and the inflation rate.

	-Exchange rates -Interest rates			-A negative relationship between stock market indices and the exchange rate.
Humpe and Macmillan (2009)	-S&P500 **-CPI** -M1 -Real industrial production Long-term interest rates.	-Johansen's integration -VECM	**-Country :** United States and Japan **-Period :** 1965-2005 -Monthly data.	-Positive relationship between US stock prices and industrial production. -US equity prices are **negatively** correlated with both the consumer price index (CPI) and the long-term interest rate. -Positive relationship between Japanese stock prices and industrial production. -Negative relationship between Japanese stock prices and money supply.
SOHAIL and HUSSAIN (2009)	- LSE25 index **-CPI** -Rreal effective exchange rate -Three-month treasury bill rate -Industrial production index -Money supply (M2)	-Johansen's integration -VECM	**-Country :** Pakistan **-Period :** 2002-2008 - Monthly data.	-In the long term, inflation **negatively** affects stock prices, while the exchange rate and money supply have a positive impact on stock returns.
Bhattarai and Joshi (2010)	-Share return -**Inflation rates** -Money supply (M1) -Three-month treasury bill rate.	-Johansen's cointegration -VECM	**-Country :** Nepal **-Period :** 1995-2006 - Monthly data.	-Unidirectional causal relationship from the stock market index to the treasury bill rate. -Unidirectional, positive and short-term **causal** relationship from inflation to nominal returns.
Adam and Frimpong (2010)	-Stock market index -**Inflation rate (CPI)**	-Johansen's cointegration	**-Country :** Ghana **-Period :** 1991-2007 - Monthly data.	-The Ghanaian stock market offers long-term complete inflation **hedging.** (Fisher's Hypothesis is verified).
Omotor (2010)	-Stock market index -Actual share price -**CPI** -M2 -GDP	-Johansen's cointegration -Granger's Causality	**-Country :** Nigeria **-Period:** 1985-2008 -Monthly and quarterly data.	-A significant and **positive** relationship between stock market returns and inflation.
Alagidede and Panagiotidis (2010)	-Stock market returns -**Inflation rates**	-Johansen's cointegration -VECM	**-Countries :** Egypt, Kenya, Morocco, Nigeria, South Africa, Tunisia	-**A positive** long-term relationship between stock market returns and inflation.

			-Period : 1980-2007 -Monthly data.	-The evolution over time of the reaction of stock prices to a consumer price shock shows a first **negative** reaction in Egypt and South Africa, which becomes **positive** in the long term.
Geetha and al. (2011)	-Share prices -Interest rates -**Inflation (CPI)** -Exchange rates -GDP	-Johansen cointegration test -ECM	**-Countries :** United States, Malaysia and China **-Period :** 2000-2009 -Monthly data	-A **negative** long-term relationship between stock market returns and expected and unexpected inflation. -A short-term relationship between Chinese stock market returns and inflation.
Eita (2012)	-The ratio of market capitalization to GDP -Namibian Global Exchange Rate Index -The money supply (M2) -**Inflation (CPI)**	-VAR -VECM	**-Country :** Namibia **-Period :** 1998 to 2009 -Quarterly data.	- **Negative** relationship between stock prices and inflation. - Negative relationship between share prices and interest rates. -Positive relationship between share prices and economic activity.
NAIK and PADHI (2012)	-Stock market index (BSESensex) -Industrial production index Wholesale price index (**inflation)** -The money supply -Treasury bill rates -Exchange rates.	-Johansen cointegration test -VECM	**-Country :** India **-Period :** 1994-2011 -Monthly data	- In the **long term,** stock prices are positively related to money supply and industrial production, and **negatively** related to inflation. -The exchange rate and the short-term interest rate do not have a significant effect on stock prices.
Dasgupta (2012)	- BSE SENSEX index - **Inflation** (Wholesale Price Index) -Industrial production index -Exchange rates -Interest rate (Call Money Rate)	-Johansen's cointegration -Granger's Causality	**-Country :** India **-Period :** 2007-2012 -Monthly data	-In the long term, stock prices (presented by BSE SENSEX index) are positively related to interest rates (represented by CMR) and real economic activity (represented by IIP). -In the long term, stock prices (presented by BSE SENSEX index) are **negatively** related to the inflation rate (presented by Wholesale Price Index) and the exchange rate.
Kuwornu (2012)	-Stock market index (ASI) -**Inflation rates** -Interest rates	- Johansen's multivariate cointegration -ECM	**-Country :** Ghana **-Period :** 1992-2008 -Monthly data	-The inflation rate has a **negative** impact on stock market returns in the **short term**, but a **positive** impact in the **long term**. -A positive relationship between stock market returns and interest rates in the short and long-term.

	-Exchange rates -Oil prices			-The oil price negatively affects stock market returns in the long-term. -A positive link between stock market returns and the exchange rate.
Alagidede and Panagiotidis (2012)	-Stock returns -**Inflation rates**	- Quantile regression	**-Countries :** Canada, France, Germany, Italy, Japan, United Kingdom and United States. **-Period :** 1970-2008 -Monthly data	-**Positive** relationship between equity returns and the inflation rate for most cases.
Khumalo (2013)	-Share prices -Exchange rates -Money supply -**Inflation (CPI)** -GDP -Interest rates	-ARDL -ECM -VAR	**-Country :** South Africa **-Period :** 1980-2010 -Quarterly data	-A **negative** relationship between stock prices and inflation. -The money supply and the exchange rate have a negative impact on share prices.
Ibrahim and Agbaje (2013)	- Stock Index (ASI) -**CIP**	-ARDL	**-Country :** Nigeria **-Period :** 1997-2010 -Monthly data	-**Positive** relationship between real stock market returns and inflation in the short and long term.
Olufisayo (2013)	-Share price index -**Inflation (CPI)** -Interest rates -GDP	-VAR -VECM	**-Country :** Nigeria **-Period :** 1986-2010 -Quarterly data.	-Share prices have a positive relationship with interest rates and GDP. -**Positive** relationship between stock prices and the inflation rate in the short and long-term.
Khan and Youssef (2013)	-Stock market index (DSI) -Interest income -Exchange rates **-CPI** -Crude oil prices -Money supply (M2)	-Johansen's cointegration -VECM	**-Country :** Bangladesh **-Period :** 1992-2011 -Monthly data	-In the long term : -Interest rates, crude oil prices and money supply are positively related to equity prices. -A negative link between share prices and the exchange rate. -Inflation has **no effect** on stock prices.
Emenike and Solomon (2013)	-Share price index -**Consumer Price Index (CPI)**	-Engle and Granger cointegration method -ECM	**-Country :** Nigeria **-Period :** 1985-2011 -Monthly data	-Fluctuations in inflation have a **positive** but insignificant influence on short-term equity returns. -**Positive** relationship between stock market returns and inflation.
Issahaku and al. (2013)	-Share prices -Exchange rates -Treasury bill rate	-Johansen's cointegration -VECM -Granger's Causality	**-Country :** Ghana **-Period :** 1995-2010 -Monthly data	-In the long term ; -The money supply negatively affects stock returns.

	Money supply -Money supply **-CPI**			-The inflation rate and the exchange rate have a **positiv**e impact on stock market returns. -In the short term ; -The inflation rate, money supply and treasury bill rate have a negative impact on equity returns.
Boonyanam (2014)	-Stock market index -**CPI** -Interest rates -Narrow currency (M1) -Repurchase rates over 14 days	-VECM	**-Country :** Thailand **-Period :** 1999-2012 -Monthly data	- **Positive** relationship between the stock market index and inflation (CPI). -Limited effect of currency and short-term interest rates on the stock market index.
Hunjra and al. (2014)	-Share prices -Interest rates -Exchange rates -GDP rate -**Inflation rates**	-VAR -Causality and Granger cointegration tests	**-Country :** Pakistan **-Period :** 2001-2011 -Monthly data	-A **negative short-term** impact of exchange rate, GDP, inflation rate and interest rate on equity prices. -A **positive long-term** relationship between macroeconomic variables, including inflation and equity prices.
Tripathi and Kumar (2014)	-Stock market index -**Inflation rates**	-Pedroni cointegration test -Johansen cointegration test	**-Country :** BRICS **-Period :** 2000-2013 -Monthly data	-A **negative** and significant relationship between the stock market index and the inflation rate for Russia. -A **positive** relationship between the equity price index and inflation for India and China.
Adusei (2014)	-Ghana Stock Exchange Index (GSE) -**Inflation rates**	-ARDL -Granger's Causality -ECM	**-Country :** Ghana **-Period :** 1992-2010. -Monthly data	-Unidirectional relationship goes from the inflation rate to stock market returns. -A **negative short-term** relationship between inflation and stock market returns. -A **positive long-term** relationship between inflation and stock market returns.
ZOA and al. (2014)	-Stock market index (Nikkei 225) -**Inflation rates** -Exchange rates -Interest rates -Industrial production index - Public debt	-Johansen's integration -VECM -Granger's Causality	**-Country :** Japan **-Period :** 2000-2012 -Monthly data.	-The inflation rate, interest rate and public debt have a significant negative long-term effect on the Nikkei 225 stock market index. -The exchange rate and the industrial production index have a positive long-term effect on Japan's stock market indexes.

Uwubanmwen and Eghosa (2015)	-Stock market returns **-CPI**	-ARDL	**-Country :** Nigeria **-Period :** 1995-2010 -Monthly data	-Inflation has a **negative** effect on stock market returns.
Jareno and Negrut (2016)	-Stock market prices **-CPI** -IPI -The interest rate -The unemployment rate GDP	-Pearson correlation coefficients	**-Country :** United States **-Period :** 2008-2014 -Quarterly data	- Positive relationship between stock prices and GDP. -Negative relationship between stock prices and unemployment rate. -Negative relationship between stock prices and interest rate.
Emeka and Aham (2016)	-Share price index -**Inflation rates** -Exchange rates	-Johansen's integration -AR (1) GARCH-S (1.1) - GARCH-X	**-Country :** Nigeria **-Period :** 1986-2012 -Quarterly data	-**Negative** relationship between stock price volatility and inflation rate. -Negative relationship between equity price volatility and the exchange rate.
Saha, S. (2017)	- Share prices - Exchange rates - **Inflation rate (CPI)** -The money supply (M2) - IPI	-ARDL -NARDL	**-Countries :** Brazil, Canada, Chile, Indonesia, Indonesia, Japan, Korea, Malaysia, Mexico, United Kingdom and United States **-Period :** 1973-2015 -Monthly data	-Long-term effect of the IPI on Canadian equity prices. -Significant **long-term effects** of the IPC on share prices. -Significant long-term effects of M2 on stock prices for Korea, Malaysia and Mexico. -Asymmetric effects of exchange rate movements on equity prices in the short-term and long-term.
Bin and Celis (2017)	-Share performance -GDP -The price of oil -**The inflation rate** The short-term interest rate -The exchange rate	-Johansen's cointegration -VECM -Granger's Causality	**-Countries :** Brazil, Russia, India and China **-Period :** 1996-2013 -Quarterly data	-The inflation rate has **no effect** on equity returns. -A cointegrating relationship between the variables and a long-term equilibrium relationship between stock market performance, economic growth, inflation, exchange rates, risk-free rates and oil prices.
Areli Bermudez Delgado et al. (2018)	- Stock market index - Nominal exchange rate -Oil prices **-CPI**	-Johansen cointegration test -VAR -Granger causality	**-Country :** Mexico **-Period :** 1992-2017 -Monthly data	- The exchange rate has a negative and statistically significant effect on the stock market index. - The Consumer Price Index (CPI) has a positive effect on the exchange rate and a **negative** effect on equity prices.
Njogo et al. (2018)	-Stock market index **-CPI**	-Pearson Correlation -Johansen cointegration test	**-Country :** Nigeria **-Period :** 1995-2014 -Annual data	-There is a significant **negative** relationship between stock market returns and inflation rates in Nigeria.

		-VAR -Granger causality		-There is a long-term relationship between stock market returns and inflation rates.