The effects of El Niño on the stock market

Master Thesis: Financial Economics

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ARTICLE INFO	ABSTRACT
Keywords: *El Niño* *La Niña* *SOI-Index* *ONI-Index* *Weather* *Stock Market* *Excess Returns* *Anomalies* *Robust*	This thesis answers the question if an El Niño or a La Niña period affects the stock market of some developed countries, considering the period 1926-2016 for the USA and 1973-2016 for the others. I found no evidence of El Niño affecting stock markets, the results for La Niña are more apparent. The Australian, German, Italian and New Zealand's stock market underperform the MSCI world during La Niña. Furthermore, the deepness of El Niño or La Niña does not influence the stock markets. Overtime the effects changes, but I found no increase due to climate change and a clear response to both anomalies is not found.

Dr. L.A.P. Swinkels

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Table of Contents

List of Tables

List of Figures

1. Introduction

Within behavioural finance, a field which is more and more emerging, is the area which enquires into the effect of weather conditions on economic performance. More specific these conditions are investigated in relation to the stock markets. Nowadays many journalist write about the effects of El Niño on worldwide events. For example, after the typhoon Melor which roared through the Philippines on the fourteenth of December 2015, the New York Times wrote an article titled ‘Understanding El Niño’ (Bromwich, 2015). Not only in the media, but also in economic research the interest in El Niño is growing. A working paper of the IMF focusses on the international transmission of El Niño weather effects on macroeconomic factors (Cashin, Mohaddes, & Raissi, 2015). However, the influence of El Niño on the stock market has not yet been investigated. Within this thesis, I investigate the effect of El Niño on the stock market and the following research question will be answered:

Does El Niño have a significant effect on the returns of the stock markets of Australia, France, Germany, Italy, Japan, New Zealand, The Netherlands, and the USA?

The research of Cashin, Mohaddes, & Raissi (2015), finds different results in the effects in terms of growth, inflation, energy and non-fuel commodity prices. The paper divides the results into two groups: on the one hand, the European countries and the USA which experience positive economic effects and on the other hand Australia, New Zealand and Japan which experience mostly negative economic effects. This paper continues their research by looking at the effect on the stock markets, and ascertains a similar difference visible between those groups can be found.

Furthermore, Brunner (2002) shows the economic importance of El Niño events and argues that the Southern Oscillation (ENSO) cycle can explain about 10-20 percent of the variation in inflation and GDP growth for the G-7 economies and about 20% of real commodity price movements from 1963-1997. To investigate if investors anticipate on this fact I test the following hypothesis.

H1: The effect of an El Niño period is not visible on the stock market before the change in economic growth.

Thereafter, I check whether the differences between the two groups identified by Cashin, Mohaddes & Raissi (2015) are visible in the returns on the stock market during an El Niño period using the following hypothesis:

H2: There is not such a deviation visible on the stock markets with a positive abnormal return for France, Germany, Italy, The Netherlands and the USA on the one hand and a negative abnormal return for Australia, Japan and New Zealand.

2. Literature review

The first one to link behaviour of investors to the conditions of the weather was Saunders (1993). He examined the impact of cloudiness in New York City from 1927 to 1989 on the stock market. The stocks listed in New York City (NYC) represent claims on geographically diversified firms, so that if there is an effect it is due to local trading agents instead of productive agents of the firms. If the weather in NYC influences the moods of the traders it will influence the mood of other workers in NYC as well. This however strikes down with the rational market. Saunders collects six different weather-data types. Of these six he only uses cloud coverage. The reason for this is that cloud coverage has a high correlation with precipitation and humidity and other factors as temperature are not found to have a significant effect on the mood of people. The cloud coverage is divided in deciles, as a percentage of cloud cover from the sunrise to the sunset, in which the first decile stands for no clouds at all. The cloud-cover measures are grouped in three categories (0-30, 40-70, and 80-100). Saunders uses three different indexes to measure the market return: The Dow-Jones Industrial Average (DJIA), the NYSE/AMEX and both the equal- and value-weighted daily percentage changes. In his research, Saunders finds that less cover of clouds leads to higher returns and the difference between the least cloudy versus the cloudiest days to be statistically significant, especially comparing the two-extreme cloud-cover groups. Besides that, he finds a more pronounced effect in recent data. Even after correcting for a variety of the market anomalies, including weekend, small-firm and the January effect the results are robust. This is however a very local effect where El Niño affects the weather world-wide and therefore might influence the stock markets too.

Hirshleifer and Shumway (2003) extend the research of Saunders to 26 stock exchanges and more recent data, the research includes data from cities across the world, possessing a different climate. They calculate the averages for each week over their sample period and use the deviations of cloudiness in combination with the stock returns. For 8 out of 26 cities they find significant negative effect on returns, furthermore 25 of the 26 coefficients are negative, using an independent binomial distribution the change is only 4×10^{-7}, which gives strong results for cloudiness to affect stock returns. The results of the joint test Hirshleifer and Shumway perform are very significant and are robust after correcting for snow and rain. Hirschleifer and Shumway continue with a Britten-Jones (1999) test to see whether trading on this information can increase the Sharpe ratio. In absence of transaction costs investors can improve their Sharpe ratio by trading on the weather. However, after including transaction cost the profitability of trading on the weather differs per country since transaction cost differ per country too. Their research only pays attention to factors that change on a daily base, where El Niño measures are less fluctuating and trading on El Niño, if possible, is less affected by transaction costs.

Loughran and Schultz (2004) take a different approach; they test multiple localized trading effects, where the effect of blizzards on the companies that are located in blizzard cities is the most important for this paper. Loughran and Schultz collect the data for NASDAQ stocks, since they are smaller and for smaller companies they expect more localized trading. In case of a blizzard, they find a decline in trade volume by approximately 15% for companies in such a blizzard city versus a decline by only 3% if the company is in a non-blizzard city. After two days, the volume reverts to normal levels.

Afterwards Loughran and Schultz replicate the research of Saunders and Hirschleifer & Shumway for NYC cloudiness and find similar results, but only for the value-weighted index. The adjusted R^2 for all regressions is approximately zero, but in this research area it is a common occurrence since many things can influence the behaviour of financial markets. The effects in the research of Loughran and Schultz are again only of temporary/daily influence.

Related to this field of research is an investigation by Cao and Wei (2005). They investigate the effect of temperature on the returns of stock markets. Their idea is based on psychological evidence that temperature significantly affects mood, which consequently leads to changes in the behaviour of investors. There are two possibilities namely a high and a low temperature; a high temperature causes more aggressive trading and therefore more risk-taking or hysteria/apathy which could impede risk-taking and a low temperature causes only aggression. Their research includes eight worldwide based stock indices, to cover most of the different weather conditions. Five out of eight markets show statistically significant results for a negative correlation between a lower temperature and higher returns. Although it only is at the 10% level, if all markets are combined the results are significant at the 1% level for both equally as value-weighted indexes. Especially important are the results for Australia, since the same season covers different calendar months on the Northern and Southern Hemispheres, the results mean that temperature is a common factor to stock market returns. The results for the equally weighted index are more pronounced, meaning prices of small-cap stocks respond more to changes in investors' mood. The results are significant in both the summer and the winter season, but during summer apathy dominates aggression more than in winter, therefore the correlation is slightly stronger in summer. To test for robustness, they correct for tax-loss selling and the Monday effect. After these corrections, the results remain significant. Besides, they control for the findings of Hirschleifer & Shumway and Saunders, These adjustements do not have significant impact on the results. In comparison, this paper investigates a phenomenon that influences the weather worldwide.

Bansal & Ochoa (2012) focusses not only on the effect for the capital markets but also on the GDP growth. In the capital market part, they have a sample of 38 countries, where they find different outcomes for countries closer to the Equator. These countries have a return on the market of approximately 12%, but also 2.5 times more volatility. Their research shows that temperature is an aggregate risk factor that adversely affects economic growth. There is a positive temperature risk premium for countries closer to the equator which decreases if one moves away from the equator. The difference in temperature risk explains 51% of the differences in the risk premium across countries. Furthermore, the increase in global temperature has a negative impact on economic growth in countries closer to the equator, where the impact is negligible in countries at high latitudes. For the whole world, the one-year effect for both GDP and consumptions is close to zero, but the coefficient between ten-year growth in GDP and ten-year change in temperature is -0.63. Not only the higher levels of temperature affect GDP growth, but temperature shocks as well. The main cause why the temperature has a bigger effect on the countries closer to the equator is the part of GDP that is dependent on climate-sensitive sectors as agriculture (Bansal & Ochoa, 2012). In this thesis, I divide the sample in four periods to see if the effect of El Niño increases due to climate change.

In a later research, Robert Novy-Marx (2014) investigates the predictability of anomaly performance using a linear regression for among others things the weather in Manhattan, global warming and the El Niño phenomenon. The results are striking: the weather in Manhattan has as much predicting power as the weather in Bozeman, Montana or on Hawaii. A critic thus could say that it is not just the weather per se but picks up on strong seasonal components in the anomalies' performance. This however is not the case for global warming and the El Niño effect. The global warming effect is bad for value strategies and long-run reversal strategies but good for strategies that are based on market power. The El Niño effect is a significant predictor of good performance for the Sloan (1996) accrual based strategy. All the returns of the strategies based on earnings quality come in the months when the SOI-index is unusually high. The same applies for returns for a beta arbitrage strategy, which buys low market beta stocks, shorts high market beta stocks, and hedges the residual beta with a long market position, which comes at the peaks of El Niño. A 60-months moving average, which smoothes temperatures over the basic five-year periodicity of the phenomena and therefore measures the amplitude of the preceding El Niño, as opposed to where in the cycle the phenomena is now, predicts a strong performance for strategies based on the failure and default probability measures of Campbell, Hilscher, and Szilagyi (2008) and Ohlson (1980), gross profitability, net stock issuance, as well as strategies based on market power, Piotroski's F-score, and idiosyncratic volatility. For the one-month industry momentum of Moskowitz and Grinblatt (1999) it predicts a poor performance.

As written in the introduction, the research paper of Cashin, Mohaddes& Raissi (2015) analyses the international macroeconomic transmission of the El Niño weather shocks. Their framework comprises 21 countries/regions over the period 1979-2013, which they use to find both direct as indirect effects. In this frame work, they put the following variables: real GDP, inflation, real exchange rate, long and short-term interest rates, real energy and non-fuel commodity prices, and the Southern Oscillation index (SOI) anomalies as a measure of the magnitude of El Niño.

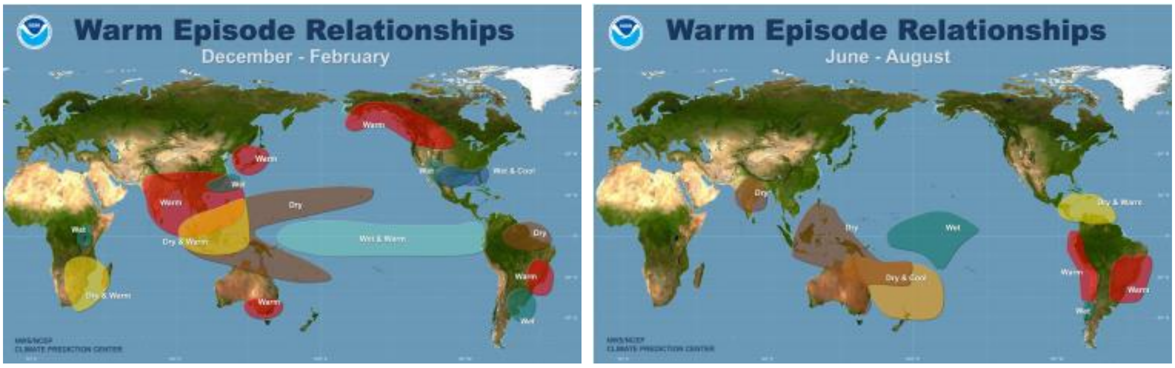
Australia, Japan & New Zealand face short-lived fall in economic activities as a response to an El Niño shock whereas the US and European countries experience growth-enhancing effects. Furthermore, most of the countries experience short-term inflationary pressure, since both energy and non-fuel commodity prices increase in El Niño periods. The higher temperatures and droughts following an El Niño event not only increases the prices of non-fuel commodities, but it also leads to a higher demand for crude oil, coal and there is less energy generated from hydroelectric dams and thermal power plants. Moreover, farmers increase their water demand for irrigation, which increases the fuel demand even further and drives up energy prices. On the other hand, the higher growth because of El Niño in the European countries and the USA increases demand and thus prices for oil as well. The faster growth in combination with the higher commodity prices leads to higher inflation in the range of 0.09 to 1.01 percent.

El Niño and La Niña

During "normal" years, a surface low pressure system builds up in northern Australia and Indonesia and a high-pressure system over the coast of Peru. This results in trade wind which moves strongly from east to west over the Pacific Ocean. Because of the relative high temperature of the water, it brings precipitation to Australia and Indonesia. Along the Peruvian coast, cold water wells up, and thereby boosts the fishing industry in South America.

However, with El Niño and La Niña this stream is disturbed. During El Niño, the area of high sea surface temperatures increases, while the atmospheric convection zones of the tropical Pacific expand and merge so that there is a tendency towards spatially homogeneous conditions and in times of El Niño, the increased release of heat to the atmosphere drives the instability. Overall, the development of an El Niño brings drought to the western Pacific (i.e. Australia), rain to the equatorial coast of South America, and hurricanes and convective storms to the central Pacific. La Niña on the other hand is associated with low sea surface temperatures near the equator, with atmospheric convergence zones that are isolated from each other, and with spatial scales smaller than those of El Niño. Also in times of La Niña when the heating of the atmosphere is lower, the compression of the convection into smaller and smaller areas permits an instability that intensifies the trade winds (Philander, 1985).

Figure 1: Climatological Effects of El Niño



Source: National Atmospheric and Oceanic Administation's (NOAA) *Climate Prediction Center.*

The changes in the weather effects due to El Niño have significant effects on construction industries, agriculture, fishing, as well as on the global commodity prices. Furthermore, the linkages of the Southern Oscillation with other climatic oscillations around the world, makes El Niño affecting the in the Pacific Ocean region and the weather worldwide too (Philander, 1985).

3. Data & Methodology

3.1 Data

To conduct this enquiry, I include eight countries in my sample (Australia, France, Germany, Italy, Japan, New Zealand, The Netherlands and the USA). This enquiry focusses on the largest developed economies in different geographical regions (Australia, Japan and the USA). I include New Zealand since its weather is highly influenced by El Niño. For Europe, I pick the three largest economies in the Euro area (France, Germany and Italy) and I include the Dutch stock market because of my own curiosity.

For the USA, I include both the total index and the S&P 500 to check if the effect for small and large companies is the same. The S&P 500 only includes the 500 largest companies of the USA and the USA total index includes all companies that are listed in the USA. For the USA, total index, the data range is from 1926 to 2016, for New Zealand and the S&P 500 the range is from 1988 to 2016 and for the other stock market the period is from 1973 to 2016. I collect the data for the stock markets via Datastream, of which I use the total return index (Ri) to prevent for a bias due to dividend pay-out. For the USA, total return index I use the market factor from the site of Kenneth French. The return of the indexes is adjusted for the USA 3-month risk-free rate, which I obtain from the Kenneth French Library. All data are expressed in the currency of the stock exchange of the country the exchange is listed in. To correct for local influences all data denominated in other currencies than US dollars are converted to US dollars. All data is on quarterly basis.

Table 1: Descriptive statistics

Index Change	S&P 500	USA	NZL	NLD	JPN	ITA	FRA	DEU	AUS
≤ -20 %	1	7	5	4	7	10	6	5	8
-20 % ≤ -10 %	8	20	8	17	16	21	19	20	15
-10 % ≤ -5 %	9	36	12	19	28	21	18	23	16
-5 % < 0 %	18	75	21	19	26	26	28	29	29
0	0	0	0	0	0	0	0	0	0
0 % ≤ 5 %	34	91	17	48	31	38	36	37	37
5 % ≤ 10 %	27	84	25	38	31	14	26	26	30
10 % < 20 %	13	40	20	23	22	23	26	26	27
20 % ≥	1	5	3	4	11	19	13	6	10
Total	**111**	**358**	**111**	**172**	**172**	**172**	**172**	**172**	**172**

This table reports descriptive statistics of the monthly return about the stock markets, the S&P 500 and the other abbreviations are for the countries total return indexes. For the USA, the data span is 1926-2016, for the S&P 500 & the NZL 1988-2016 and for the other markets the data span is 1973-2016.

To measure the effect of El Niño I take both the so called ‘Southern oscillation index (SOI)’ as the ‘Oceanic Niño Index (ONI)’. I first check whether there is a high correlation between the two, if not I will use both measures to check if a difference occurs. The Southern Oscillation Index (SOI) is measured in the following way:

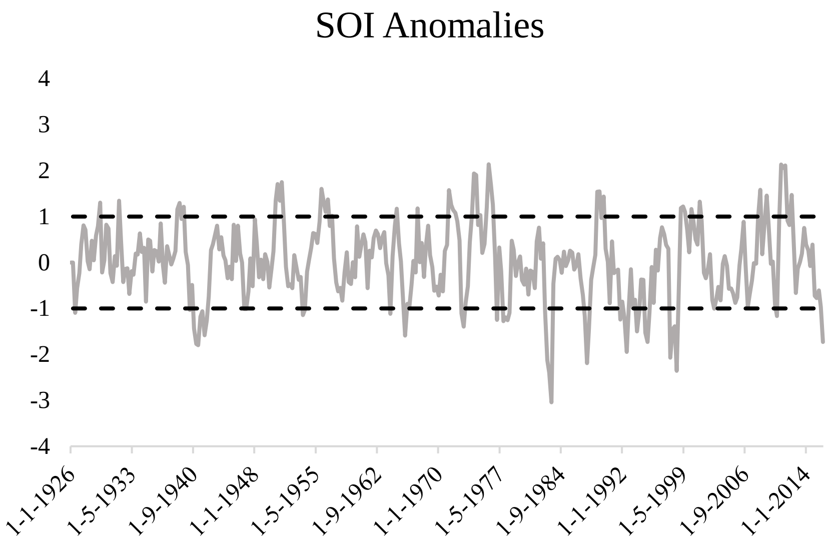
$$SOI = 10\frac{[Pdiff - Pdiffav]}{SD[Pdiff]}$$

Where Pdiff stands for the average Tahiti Mean Sea Level Pressure(MSLP) for the month minus the average Darwin MSLP for the month, Pdiffav is the long-term average of Pdiff for the month in question, and SD(Pdiff) is the long-term standard deviation of Pdiff for the month in question (Australian Government: Bureau of Meteorology). A score of -7 implies an El Niño period where a score of +7 implies a La Niña period.

To answer hypothesis one, I follow Cashin, Mohaddes & Raissi (2015) and calculate SOI anomalies. Here I calculate the effect of El Niño on the stock markets, as the deviation of the SOI index from its historical average and divide this by its historical standard deviation. If the average score of the last three months is below -1 this indicates an El Niño period, above +1 a La Niña period. The data of the SOI is available on the website of the Australian Government, from 1880 onwards.

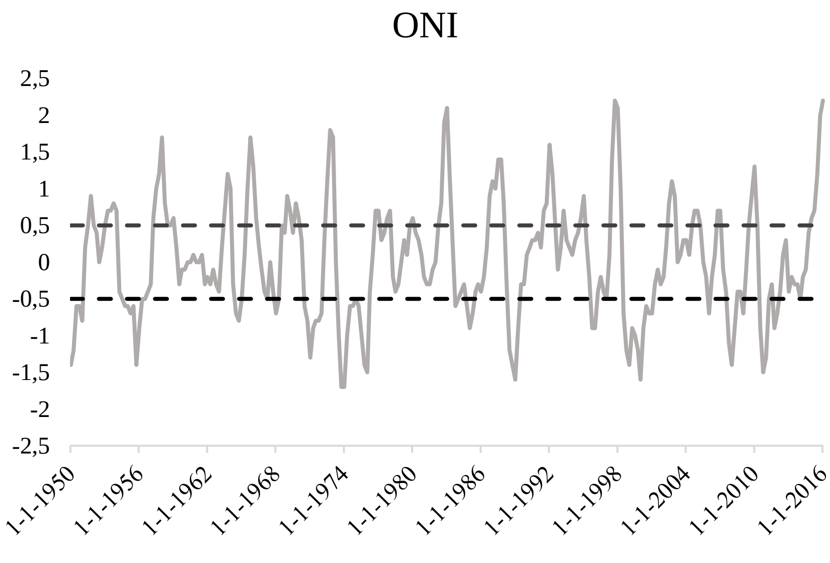
The Oceanic Niño Index (ONI), is measured as the difference between the three-month running mean of Extended Reconstructed Sea Surface Temperature Version 4 (ERSST.v4) anomalies in the Niño 3.4 region (5°N-5°S, 120°-170°W) and centred thirty-year base periods updated every 5 years. If the difference is more than +0.5 it is called an El Niño period and less than -0.5 it is called a La Niña period (National weather service, 2016). This data is available on the website of the National weather service of the USA, from 1950 onwards. Both these measures consider eventual climate change, because they adjust their base period according to the evolved time. In the two figures below the data for the SOI and ONI-index is graphically shown.

Figure 2: Southern Oscillation Index (SOI) Anomalies 1926-2016



Source: Author's construction based on data from the Australian Bureau of Meteorology. Notes: Dashed-line below -1 indicates an El Niño period, in which the dashed-line above 1 indicates a La Niña period.

Figure 3: Oceanic Niño Index (ONI) 1950-2016



S Source: Author's construction based on data from the National Weather service of the USA. Notes: Dashed-line above 0.5 indicates an El Niño period, in which the dashed-line below -0.5 indicates a La Niña period.

Table 2: El Niño & La Niña Periods

SOI		ONI	
Correlation		-0.8008	
El Niño	**La Niña**	**El Niño**	**La Niña**
Feb 26 – Apr 26	Feb 29 – Apr 29	Aug 51 – Jan 52	Feb 50 – Apr 51
Nov 39 – Jan 40	May 31 – Jul 31	Feb 53 – Jan 54	Aug 54 – Apr 56
May 40 – Jan 42	May 38 – Oct 38	May 57 – Jul 58	May 64 – Jan 65
May 46 – Oct 46	Feb 39 – Apr 39	Nov 58 – Apr 59	Feb 68 – Apr 68
May 53 – Oct 53	Feb 50 – Jan 51	Aug 63 – Apr 64	Aug 70 – Jan 72
Nov 63 – Jan 64	Aug 55 – Jul 56	Aug 65 – Apr 66	Aug 73 – Jul 74
Aug 65 – Oct 65	Nov 56 – Jan 57	Nov 68 – Jan 70	Nov 74 – Apr 76
May 72- Oct 72	Aug 64 – Oct 64	May 72 – Apr 73	Nov 83 – Jan 84
Aug 76 – Oct 76	Feb 67 – Apr 67	Nov 76 – Apr 77	Nov 84 – Jul 85
May 77 – Apr 78	Nov 70 – Oct 71	Nov 77 – Jan 78	May 88 – Jul 89
May 82 – Apr 83	Aug 73 – Apr 74	Nov 79 – Jan 80	Nov 95 – Apr 96
Feb 87 – Oct 87	Aug 74 – Oct 74	May 82 – Jul 83	Aug 98 – Apr 01
May 91 – Jul 91	May 75 – Apr 76	Nov 86 – Jan 88	Feb 06 – Apr 06
Nov 91 – Jul 92	Aug 88 – Jan 89	Aug 91 – Jul 92	Aug 07 – Jul 08
May 93 – Oct 93	May 89 – Jul 89	May 93 – Jul 93	Nov 08 – Apr 09
May 94 – Dec 94	Aug 98 – Apr 99	Nov 94 – Apr 95	Aug 10 – Apr 11
May 97 – Apr 98	Nov 99 – Jan 00	May 97 – Apr 98	Aug 11 – Apr 12
Aug 02 – Oct 02	Nov 00 – Jan 01	Aug 02 – Apr 03	
Feb 10 – Apr 10	Feb 08 – Apr 08	Aug 04 – Apr 05	
Aug 15 – Mar 16	Nov 08 – Jan 09	Nov 06 – Jan 07	
	Aug 10 – Apr 11	Aug 09 – Apr 10	
	Nov 11 – Jan 12	Jan 15 – Mar 16	

This table shows the different period of El Niño and La Niña for both the SOI as the ONI-index. For the SOI-index the data span is from 1926 to 2016 where the data span of the ONI-Index is from 1950-2016.

The table above shows different periods of El Niño and La Niña per variable. The correlation between the SOI-Index and the ONI-Index is -0.8008 which is rather high. However, the correlation is not 1 or -1 what would imply perfect correlation. This together with the difference in El Niño and La Niña periods for the indexes means that I include them both. The negative sign of the correlation is according to expectations, since a score of below -1 for the SOI-Index implies an El Niño period and a score above +0.5 implies an El Niño period for the ONI-Index.

I obtain the data of GDP growth from the website of the OECD this is available from 1980 on a quarterly basis, earlier data is obtained via Datastream on a yearly basis. The growth data of Datastream is divided by four and adjusted for compounded growth (growth on growth). For international trade, I obtain the data via the website of the World Trade Organisation (WTO), this data is available from 1948 onwards. Moreover, I collect the data of the oil price via Datastream, both for WTI & Brent oil and finally I obtain data for both an energy and a non-energy commodity index via the databank of the IMF. The energy index is based on the most important fuel commodities each with their own weight. The non-energy index is based on 38 non-fuel commodities all with their own weight, based on their value with respect to the average world export earnings. Because not all data is available on absolute basis I use percentage change for GDP growth, international trade, WTI, Brent oil, energy index and non-energy index.

3.2 Methodology

Given my interest in analyzing the stock market effects of El Niño and La Niña shocks, I include the Southern Oscillation index anomalies (SOIt) or the Oceanic Niño Index (ONIt) in the regressions. Resulting in the following regression:

1. $$Ri(t) - Rf(t) = \alpha + \beta 1 Dnino(t) + \beta 2 Dnina(t) + \varepsilon(t)$$

Where Ri is the total return of the stock market in country i, Rf is the risk-free rate, Dnino(t) takes a value of one if the absolute value of SOI is ≤ -1 or ONI score is ≥ +0.5, Dnina(t) if the value of SOI ≥ +1 or ONI score is ≤ -0.5 and t is the time subscript.

To test the first hypothesis, I run this formula and I check the effect with four lags for the dummies for El Niño and La Niña.

H1: The effect of an El Niño period is not visible on the stock market before the change in economic growth.

This demonstrates whether the stock markets react directly or with a delay to the weather effects. Afterwards I compare my results with the results of Cashin, Mohaddes & Raissi (2015) in table 3. This table demonstrates the impact on Real GDP growth during an El Niño period in the current quarter and the cumulative responses after 1,2,3 and 4 quarters in percentage. This means that the economy of Europe is on average 0,69% larger after 4 quarters after a period of El Niño, than without a period of El Niño.

Table 3: The Effects of an El Niño Shock on Real GDP Growth (in percent)

Country	Impact	1 Quarter	2 Quarters	3 Quarters	4 Quarters
Australia	-0.03	-0.18**	-0.30**	-0.37*	-0.41
Europe	0.02	0.09	0.27**	0.49**	0.69**
Japan	-0.10*	-0.12	0.01*	0.20*	0.37*
New Zealand	-0.16**	-0.29*	-0.37	-0.42	-0.43
USA	0.05*	0.10	0.23*	0.39*	0.55*

Notes: Figures are median impulse responses to a one standard deviation reduction in SOI anomalies. The impact is in percentage points and the horizon is quarterly. Symbols ** and * denote significance at 5-95% and 16-84% bootstrapped error bounds respectively. Effects are cumulated responses after 1, 2, 3 or 4 quarters. Source: Cashin, Mohaddes & Raissi (2015).

2. $$Ri(t) - Rf(t) = \alpha + \beta 1 Dnino(t) + \cdots + \beta 5 Dnino(t\text{-}4) + \beta 6 Dnina(t) + \cdots + \beta 10 Dnina(t\text{-}4) + \varepsilon(t)$$

Where Ri is the total return of the stock market in country i, Rf is the risk-free rate, Dnino(t)-Dnino(t-4) takes a value of one if the absolute value of SOI is ≤ -1 or the value of the ONI is ≥ +0.5, Dnina(t)-Dnina(t-4) takes a value of one if the absolute value of SOI ≥ +1 or ONI score is ≤ -0.5 and t is the time subscript.

This regression can also be seen as an event study (Binder 1998), but not as a regular event study, since this study is only forward-looking and there is no inside trading possible on the SOI or the ONI-Index. These measures can at most be forecasted.

There is some anecdotal evidence that SOIt and ONIt influences global commodity markets i.e. El Niño causes hot and dry summers, where hot and dry summers in southeast Australia increase the number and harshness of bush fires, this reduces Australia’s wheat exports and thereby drives up global wheat prices (Bennetton et al. 1998). Therefore, I include a commodity coefficient, but first I try to discover if the correlation between the commodity coefficients is high. The results are in table 4; the correlations of all other variables can be found in the Appendix.

Table 4: Correlation commodities

	ΔBrent	ΔWTI	ΔEnergy	ΔNon-Energy
ΔBrent	1	0.9668	0.4140	0.2336
ΔWTI	0.9668	1	0.8885	0.2846
ΔEnergy	0.4140	0.8885	1	0.3537
ΔNon-Energy	0.2336	0.2846	0.3537	1

This table shows the correlation between the coefficients, the data span is 1983-2016 due to data availability

The results above show a high correlation between the change in oil price (Brent & WTI) and the change in the energy commodity market. Since the energy commodity index is a broader index than only oil, I include this index as well as the non-energy index. Furthermore, Cashin et al (2015) shows that international trade and GDP growth are influenced by El Niño. Therefore, I include those measures too, resulting in the following formula:

3. $$Ri(t) - Rf(t) = \alpha + \beta 1 Dnino(t) + \beta 2 Dnina(t) + \beta 3 \Delta GDPi(t) + \beta 4 \Delta Energy(t) + \beta 5 \Delta Non - Energy(t) + \beta 6 \Delta Trade(t) + \varepsilon(t)$$

Where Ri is the total return of the stock market in country i, Rf is the risk-free rate, Dnino(t) takes a value of one if the absolute value of SOI is ≤ -1 or ONI score is ≥ +0.5, Dnina(t) if the value of SOI ≥ +1 or ONI score is ≤ -0.5, ΔGDPi(t) measures the effect of a percentage change in the GDP for country i, ΔEnergy(t) the percentage change in the global Energy commodity index, ΔNon-Energy(t) the percentage change in the global Non-Energy commodity index and ΔTrade(t) the percentage change in the total international trade and t is the time subscript.

With the results of regression three I test the second hypothesis, where an abnormal return is a dummy that significantly differs from zero. In this case however, I do not include transaction costs.

H2: There is not such a deviation visible on the stock markets with a positive abnormal return for France, Germany, Italy, The Netherlands and the USA on the one hand and a negative abnormal return for Australia, Japan and New Zealand.

The effect of GDP growth is a bit counterintuitive. On the one hand a higher/lower than expected GDP growth affects the stock market, but on the other hand the stock markets predict GDP growth and are half a year ahead of the normal economy (Demirgüc-Kunt, & Levine, 1996). Therefore, I run regression 3 also without GDP growth, to check if the effect stays the same.

To perform a robustness test I run regression 4 where I include the SOI and ONI index, to check if the effect of a 'deep' El Niño/La Niña (meaning a value of the SOI or ONI index far below/above the threshold of a dummy for El Niño/ La Niña) has a larger effect on the stock market.

4. $Ri(t) - Rf(t) = \alpha + \beta 1 IND(t) + \beta 2 \Delta Energy(t) + \beta 3 \Delta Non - Energy(t) + \beta 4 \Delta Trade(t) + \varepsilon(t)$

   Where Ri is the total return of the stock market in country i, Rf is the risk-free rate, Dnino(t) takes a value of one if the absolute value of SOI is ≤ -1 or ONI score is ≥ +0.5, Dnina(t) if the value of SOI ≥ +1 or ONI score is ≤ -0.5, ΔEnergy(t) the percentage change in the global Energy commodity index, ΔNon-Energy(t) the percentage change in the global Non-Energy commodity index and ΔTrade(t) the percentage change in the total international trade and t is the time subscript.

To discover if the effect of El Niño and La Niña changes overtime and increase due to climate change, I divide the data into four approximately equal periods. Period 1 is from 1926 to 1950, period 2 is from 1950 to 1973, period 3 is from 1973 to 1994 and the last period is from 1994 to 2016. The first division 1926-1973 and 1973-2016 is to compare the US total return index with the other indexes. The second division 1973-1994 and 1994-2016 is to compare the other indexes over time and to create equal periods. Furthermore, I want to compare the results for the S&P 500 with the USA total return index and since the data of the S&P 500 is only available from 1988, I compare the results in period 4. Finally, I run regression 3 without GDP again, to find if the stock markets under- or overperform versus the MSCI world. I use it without GDP, because for all indexes I use local GDP. For the MSCI I could include world GDP growth, but since this also influences the local stock markets I decide to exclude GDP from the comparison.

4. Results

This section describes the statistical results of the regressions showing if returns of stock markets are affected by El Niño and/or La Niña. The first results show the effect of including a dummy for both indexes. This gives an impression about the significance of El Niño and La Niña in explaining stock market returns. Because there is a lot of variation in individual index stock returns, I do not expect many results of this regression. To increase the power, I include some control variables in the next regression. Later, I will show the results of the regressions that include lag variables.

4.1 Dummy Results

1. $Ri(t) - Rf(t) = \alpha + \beta 1 Dnino(t) + \beta 2 Dnina(t) + \varepsilon(t)$

Where Ri is the total return of the stock market in country i, Rf is the risk-free rate, Dnino(t) takes a value of one if the absolute value of SOI is ≤ -1 or ONI score is ≥ +0.5, Dnina(t) if the value of SOI ≥ +1 or ONI score is ≤ -0.5 and t is the time subscript.

The results of the first regression, including the dummies of the SOI-index for both the El Niño and the La Niña period can be found in table 5. For both El Niño and La Niña dummies I obtained no significant results. I did find a negative adjusted R-squared, which implies that very little of the variation in return is explained by the dummy variables of the SOI-index. Moreover, the alpha implying the excess return over the risk-free rate for the USAis 1.78% per quarter and 7.12% per year which is in line with the data from the Kenneth French Library.

Table 5: Results regression 1 - SOI

Stock market	Alpha	El Niño	La Niña	Adjusted R^2
S&P	0.0171** (0.0078)	0.0075 (0.0184)	0.0113 (0.0322)	-0.0155
USA	0.0178** (0.0064)	-0.0056 (0.0149)	0.0117 (0.0148)	-0.0029
NZL	0.0208 (0.0132)	0.0012 (0.0221)	-0.0125 (0.0385)	-0.0168
NLD	0.0181* (0.0095)	0.0021 (0.0194)	-0.0208 (0.0335)	-0.0070
JPN	0.0174 (0.0106)	-0.0011 (0.0279)	-0.0348 (0.0256)	-0.0020
ITA	0.0284* (0.0163)	-0.0205 (0.0305)	-0.0372 (0.0374)	-0.0032
FRA	0.0281** (0.0126)	-0.0186 (0.0199)	-0.0297 (0.0371)	-0.0037
DEU	0.0134 (0.0117)	-0.0032 (0.0193)	-0.0106 (0.0032)	-0.0108
AUS	0.0216* (0.0120)	-0.0055 (0.0213)	-0.0111 (0.0328)	-0.0108

*significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. The data is adjusted for HAC Newey-West. The dependent variable refers to the return on the named stock market. For the USA, the data span is 1926-2016, for the S&P 500 & the NZL 1988-2016 and for the other markets the data span is 1973-2016.

Comparing the results of the SOI-index above with the ONI-index. I find different results for New Zealand and Italy. Where I do not find significant results by including the SOI-Index, Table 6 shows that when La Niña occurs, the stock market in New Zealand and Italy decrease by 6.00% and 6.09% respectively. For the other countries, the dummies for both SOI and ONI are not significant. The effect of La Niña for New Zealand differs; in northern and eastern part of the Northern Island they experience more rain, whereas the Southern Island has more frequently anticyclones and therefore drier weather (Environmental Science). La Niña leads to milder winters in Northern Europe (the UK especially) and colder winters in southern/western Europe and could lead to snow in the Mediterranean (Environmental Science). However, this effect is not likely to explain the 6.09% lower returns for Italy. In 7 of the 10 quarters that the Italian stock markets decreased by more than 20% La Niña occurred. However, this was during both the oil crisis in the seventies and the Credit & Euro crisis in that Italy suffered heavily from (Nations Encyclopaedia). Furthermore, also for the ONI-index I found a low/negative adjusted R-squared meaning that also the dummies for the ONI-Index explain little of the variation of the returns.

Latest research focusses mostly on the effects that El Niño has on economic growth, but on the other hand an article in The Telegraph was titled “La Niña is a danger to the economic recovery”. This article was generally on the effects in Asia, Australia and the USA. Thus this therefore does not explain the lower return for Italy either (White & Mason, 2011).

Table 6: Results regression 1 – ONI

Stock market	Alpha	El Niño	La Niña	Adjusted R^2
S&P	0.0230*** (0.0081)	0.0050 (0.0185)	-0.0187 (0.0145)	-0.0051
USA	0.0171*** (0.0061)	0.0010 (0.0151)	0.0051 (0.0114)	-0.0068
NZL	0.0334** (0.0138)	0.0024 (0.0208)	-0.0600*** (0.0207)	0.0450
NLD	0.0198** (0.0094)	0.0115 (0.0161)	-0.0284 (0.0187)	0.0079
JPN	0.0192 (0.0130)	-0.0060 (0.0210)	-0.0209 (0.0230)	-0.0066
ITA	0.0392** (0.0188)	-0.0195 (0.0275)	-0.0609*** (0.0217)	0.0172
FRA	0.0299** (0.0144)	-0.0066 (0.0190)	-0.0300 (0.0245)	-0.0019
DEU	0.0197 (0.0133)	-0.0044 (0.0185)	-0.0302 (0.0184)	0.0013
AUS	0.0268** (0.0124)	0.0023 (0.0227)	-0.0338 (0.0222)	0.0029

*significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. The data is adjusted for HAC Newey-West. The dependent variable refers to the return on the named stock market. For the USA, the data span is 1950-2016, for the S&P 500 & the NZL 1988-2016 and for the other markets the data span is 1973-2016.

4.2 Lead-lag results

In this section I discuss the results of regression two; the lead-lag results. Here I show the effects of an El Niño or a La Niña on the current and next four quarters. The results are shown in table 7 and 8 respectively.

2. $Ri(t) - Rf(t) = \alpha + \beta 1 Dnino(t) + \cdots + \beta 5 Dnino(t\text{-}4) + \beta 6 Dnina(t) + \cdots + \beta 10 Dnina(t\text{-}4) + \varepsilon(t)$

Where Ri is the total return of the stock market in country i, Rf is the risk-free rate, Dnino(t)-Dnino(t-4) takes a value of one if the absolute value of SOI is ≤ -1 or the value of the ONI is ≥ +0.5, Dnina(t)-Dnina(t-4) takes a value of one if the absolute value of SOI ≥ +1 or ONI score is ≤ -0.5 and t is the time subscript.

The first table shows the results for the SOI-Index. For El Niño, I only found a significant result for Australia for the fourth lag, meaning that after four quarters from an El Niño event the stock market of Australia shows a 4.06% higher return in this quarter than without an El Niño event. If La Niña occurs the effects are more apparent; the US total return index response is in total -3.14% (Qt-2-Qt-4) and the Japanese stock market shows a lower return of 4.93% in the quarter of La Niña. The Netherlands, Italy and Germany underperform with respectively 4.76%, 7.16% and 5.41% in the third quarter after La Niña. Notable is that La Niña's total effect, if occurring, is negative for all stock markets.

In Table 8 the results for the ONI-index are shown. For El Niño, only Japan & New Zealand show a significant result in the fourth lag respectively 7.73% and 5.62% higher returns. When I focus on La Niña, the effect for S&P 500 is -3.86% (based on the Qt -3.93, Qt-2 +5.76 & Qt-3- 5.69). In New Zealand, there is an almost a ten percent (9.99%) lower return in the quarter of a La Niña event. In Germany and Australia, a La Niña event also results in a lower return in the quarter of a La Niña event of respectively 5.63% and 5.10%. In Japan and Italy, a positive result is visible in the second quarter of 5.05% and 7.32%.

Research of for example Saunders (1993), Hirschleifer & Schumway (2003), Loughran & Schultz (2004) and Cao & Wei (2005), explain the effect of weather on stock markets as it influences the mood of investors. They use daily data, where I use quarterly data. Mood differs per day and over a longer time mood is approximately equal. Only the amount of sunshine may affect the mood, therefore in summertime the mood can be better Hirschleifer & Schumway (2003). El Niño and La Niña occur in all seasons, but there is no research done if there is more/less sun during those periods. Furthermore, Bansal & Ochoa (2012) and Novy-Marx (2014) and Cashin, Mohaddis & Raissi (2015) explain the effect of weather on affecting economic fundamentals and they use a large data interval period as well. Also, Cashin, Mohaddis & Raissi (2015) show the effect of El Niño on economic growth. Therefore, there is evidence that the changes can be explained by economic fundamentals and in the next part I will go deeper in the economic explanation.

Table 7: Results regression 2 - SOI

Stock market	Alpha	Niño	Niño (-1)	Niño (-2)	Nino (-3)	Nino (-4)	Niña	Niña (-1)	Niña (-2)	Niña (-3)	Niña (-4)
S&P	0.0141 (0.0108)	0.0076 (0.0257)	-0.0007 (0.0310)	-0.0101 (0.0296)	0.0355 (0.0241)	-0.0005 (0.0168)	0.0068 (0.0298)	0.0229 (0.0301)	-0.0115 (0.0317)	-0.0235 (0.0250)	0.0113 (0.0206)
USA	0.0204*** (0.0077)	-0.0035 (0.0142)	-0.0021 (0.0174)	-0.0203 (0.0160)	0.0169 (0.0127)	-0.0008 (0.0111)	0.0233 (0.0144)	0.0021 (0.0121)	-0.0247* (0.0145)	-0.0419*** (0.0116)	0.0352*** (0.0128)
NZL	0.0189 (0.0171)	0.0005 (0.0215)	0.0101 (0.0369)	-0.0255 (0.0417)	-0.0147 (0.0297)	0.0311 (0.0250)	-0.0263 (0.0374)	0.0588 (0.0369)	-0.0322 (0.0280)	-0.0322 (0.0351)	0.0299 (0.0315)
NLD	0.0213* (0.0119)	-0.0096 (0.0267)	0.0176 (0.0348)	-0.0039 (0.0329)	0.0071 (0.0262)	-0.0046 (0.0176)	-0.0052 (0.0331)	-0.0122 (0.0289)	-0.0075 (0.0382)	-0.0476* (0.0256)	0.0220 (0.0221)
JPN	0.0091 (0.0157)	0.0204 (0.0339)	-0.0482 (0.0339)	0.0174 (0.0344)	0.0197 (0.0305)	0.0275 (0.0241)	-0.0493** (0.0215)	0.0220 (0.0227)	0.0299 (0.0300)	-0.0339 (0.0334)	0.0101 (0.0289)
ITA	0.0403* (0.0223)	-0.0136 (0.0343)	-0.0342 (0.0392)	0.0026 (0.0370)	0.0386 (0.0407)	-0.0264 (0.0300)	-0.0122 (0.0322)	-0.0139 (0.0302)	-0.0231 (0.0360)	-0.0716** (0.0326)	0.0058 (0.0280)
FRA	0.0277* (0.0168)	-0.0299 (0.0280)	0.0200 (0.0411)	-0.0227 (0.0398)	0.0503 (0.0330)	-0.0071 (0.0203)	-0.0113 (0.0346)	-0.0120 (0.0331)	-0.0105 (0.0339)	-0.0541* (0.0297)	0.0225 (0.0332)
DEU	0.0137 (0.0154)	-0.0128 (0.0253)	0.0203 (0.0313)	-0.0054 (0.0305)	0.0150 (0.0320)	-0.0194 (0.0206)	0.0011 (0.0303)	-0.0007 (0.0313)	-0.0145 (0.0390)	-0.0382 (0.0288)	0.0393 (0.0283)
AUS	0.0223 (0.0160)	0.0127 (0.0316)	-0.0521 (0.0363)	0.0318 (0.0332)	-0.0190 (0.0270)	0.0406* (0.0236)	-0.0203 (0.0311)	0.0451 (0.0313)	-0.0514 (0.0329)	-0.0356 (0.0345)	0.0192 (0.0224)

*significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. The data is adjusted for HAC Newey-West. The dependent variable refers to the return on the named stock market. For the USA, the data span is 1926-2016, for the S&P 500 & the NZL 1988-2016 and for the other markets the data span is 1973-2016

Table 8: Results regression 2 - ONI

Stock market	Alpha	Niño	Niño (-1)	Niño (-2)	Nino (-3)	Nino (-4)	Niña	Niña (-1)	Niña (-2)	Niña (-3)	Niña (-4)
S&P	0.0197*	0.0171	-0.0084	-0.0074	0.0076	0.0318	-0.0393*	0.0037	0.0576*	-0.0569*	-0.0021
	(0.0119)	(0.0215)	(0.0208)	(0.0259)	(0.0204)	(0.0216)	(0.0219)	(0.0327)	(0.0316)	(0.0303)	(0.0219)
USA	0.0232***	0.0031	-0.0060	-0.0014	0.0053	-0.0134	-0.0070	0.0314**	-0.0035	-0.0312*	0.0005
	(0.0079)	(0.0132)	(0.0177)	(0.0148)	(0.0132)	(0.0133)	(0.0126)	(0.0144)	(0.0150)	(0.0156)	(0.0119)
NZL	0.0250	0.0185	-0.0045	-0.0321	0.0154	0.0562**	-0.0999***	0.0167	0.0311	-0.0143	-0.0050
	(0.0206)	(0.0228)	(0.0244)	(0.0347)	(0.0239)	(0.0278)	(0.0200)	(0.0251)	(0.0421)	(0.0350)	(0.0288)
NLD	0.0205	0.0148	-0.0043	0.0079	-0.0041	0.0071	-0.0347	0.0026	0.0435	-0.0476	-0.0042
	(0.0142)	(0.0195)	(0.0305)	(0.0338)	(0.0257)	(0.0260)	(0.0286)	(0.0379)	(0.0333)	(0.0358)	(0.0292)
JPN	0.0126	0.0033	-0.0176	0.0321	-0.0489	0.0773***	-0.0306	-0.0279	0.0505*	-0.0122	-0.0222
	(0.0170)	(0.0221)	(0.0264)	(0.0319)	(0.0308)	(0.0267)	(0.0225)	(0.0225)	(0.0289)	(0.0380)	(0.0336)
ITA	0.0454*	-0.0138	-0.0030	-0.0303	0.0300	-0.0045	-0.0511	-0.0400	0.0732*	-0.0545	-0.0123
	(0.0226)	(0.0275)	(0.0322)	(0.0376)	(0.0358)	(0.0322)	(0.0344)	(0.0444)	(0.0373)	(0.0389)	(0.0485)
FRA	0.0229	0.0044	-0.0210	0.0194	0.0104	0.0181	-0.0381	-0.0085	0.0421	-0.0410	0.0081
	(0.0207)	(0.0222)	(0.0335)	(0.0368)	(0.0315)	(0.0264)	(0.0353)	(0.0436)	(0.0354)	(0.0318)	(0.0327)
DEU	0.0050	0.0081	-0.0086	0.0088	0.0045	0.0259	-0.0563*	0.0149	0.0409	-0.0341	0.0248
	(0.0158)	(0.0181)	(0.0339)	(0.0376)	(0.0235)	(0.0296)	(0.0330)	(0.0424)	(0.0318)	(0.0345)	(0.0311)
AUS	0.0201	0.0165	-0.0255	0.0114	0.0117	0.0330	-0.0510*	0.0024	0.0323	-0.0293	-0.0032
	(0.0208)	(0.0256)	(0.0256)	(0.0329)	(0.0247)	(0.0231)	(0.0263)	(0.0309)	(0.0245)	(0.0320)	(0.0326)

*significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. The data is adjusted for HAC Newey-West. The dependent variable refers to the return on the named stock market. For the USA, the data span is 1950-2016, for the S&P 500 & the NZL 1988-2016 and for the other markets the data span is 1973-2016.

H1: The effect of an El Niño period is not visible on the stock market before the change in economic growth.

The null hypothesis is not rejected, because El Niño only affects the stock market of Australia in the same quarter as it is affected by economic growth based on the SOI-Index, but for other countries and indexes economic growth responses are visible before the responses on the stock markets. To compare my results closely with Cashin, Mohaddes & Raissi (2015) symbols ** and * denote significance at 5-95% and 16-84% bootstrapped error bounds respectively, where in other tables these symbols ** and * denote significance at 5%-level and 10%-level.

Table 9: The Effects of an El Niño Shock on Real GDP Growth (in percent) & on Stock Market under/overperformance.

Country	Measure	Impact	1 Quarter	2 Quarters	3 Quarters	4 Quarters
Australia	GDP	-0.03	-0.18**	-0.30**	-0.37*	-0.41
	SOI	0.01	-0.05*	0.03	-0.02	0.04*
	ONI	0.02	-0.03	0.01	0.01	0.03*
Europe	GDP	0.02	0.09	0.27**	0.49**	0.69**
	SOI	-0.01	0.02	-0.01	0.02	-0.02
	ONI	0.01	-0.01	0.01	0.00	0.03
Japan	GDP	-0.10*	-0.12	0.01*	0.20*	0.37*
	SOI	0.02	-0.05*	0.02	0.02	0.03*
	ONI	0.00	-0.02	0.03*	-0.05*	0.08**
New Zealand	GDP	-0.16**	-0.29*	-0.37	-0.42	-0.43
	SOI	0.00	0.01	-0.03	-0.01	0.03*
	ONI	0.02	-0.00	-0.03	0.02	0.06**
USA	GDP	0.05*	0.10	0.23*	0.39*	0.55*
	SOI	-0.00	-0.00	-0.02*	0.02*	0.00
	ONI	0.00	-0.01	-0.00	0.01	-0.01

Notes: Figures are median impulse responses to a one standard deviation reduction in SOI anomalies. The impact is in percentage points and the horizon is quarterly. Symbols ** and * denote significance at 5-95% and 16-84% bootstrapped error bounds respectively. Effects are cumulated responses after 1, 2, 3 or 4 quarters. Source: Cashin, Mohaddes & Raissi (2015) For the Europe, the results for Germany are in the table, because Germany is the largest European economy in my sample. For the USA, I have included the USA total return index since this is captures the whole period of the Cashin, Mohaddes & Raissi (2015) sample. The results for the stock markets are not cumulated.

4.3 Results Regression Three.

The outcomes of the third regression can be found in table 10 and 11. In this regression I included next to the dummy coefficient the variables; GDP growth, energy and non-energy commodity markets and international trade. This because there is some anecdotal evidence that SOIt and ONIt influences global commodity markets (Bennetton et al. 1998) and Cashin et al (2015) shows that international trade and GDP growth are influenced by El Niño.

3. $Ri(t) - Rf(t) = \alpha + \beta 1 Dnino(t) + \beta 2 Dnina(t) + \beta 3 \Delta GDPi(t) + \beta 4 \Delta Energy(t) + \beta 5 \Delta Non - Energy(t) + \beta 6 \Delta Trade(t) + \varepsilon(t)$

   Where Ri is the total return of the stock market in country i, Rf is the risk-free rate, Dnino(t) takes a value of one if the absolute value of SOI is ≤ -1 or ONI score is ≥ +0.5, Dnina(t) if the value of SOI ≥ +1 or ONI score is ≤ -0.5, ΔGDPi(t) measures the effect of a percentage change in the GDP for country i, ΔEnergy(t) the percentage change in the global Energy commodity index, ΔNon-Energy(t) the percentage change in the global Non-Energy commodity index and ΔTrade(t) the percentage change in the total international trade and t is the time subscript.

For the SOI-index no effects are found. Remarkable is the is a negative effect for the Netherlands of -0.93% for a percentage increase in worldwide trade, although this is not a subject of my research. Please note for GDP, energy, non-energy and trade the percentage change are taken. This means for example that the increase of 2.8820 (or 288.20%) for the S&P is reached when the USA economy grows by 100%.

Table 10: Results regression 3 - SOI

Stock market	Alpha	Niño	Niña	GDP#	Energy	Non-energy	Trade
S&P	0.0008 (0.0136)	-0.0022 (0.0212)	0.0107 (0.0300)	2.8820** (1.3492)	-0.0290 (0.0520)	0.2723 (0.1711)	-0.0544 (0.2954)
USA	0.0053 (0.0093)	0.0109 (0.0146)	0.0174 (0.0148)	2.2055** (0.6608)	-0.0234 (0.0365)	0.1482 (0.0995)	-0.4563** (0.2103)
NZL	0.0098 (0.0094)	0.0079 (0.0195)	-0.0010 (0.0224)	1.2503*** (0.1256)	-0.0457 (0.0682)	-0.0544 (0.1482)	-0.0473 (0.2396)
NLD	0.0279** (0.0110)	-0.0039 (0.0192)	-0.0251 (0.0327)	0.6741*** (0.2563)	0.0084 (0.0506)	0.3420** (0.1537)	-0.9253*** (0.2991)
JPN	0.0151 (0.0108)	-0.0149 (0.0223)	-0.0339 (0.0275)	0.8586*** (0.2123)	-0.0781 (0.0568)	0.1411 (0.1331)	-0.3986* (0.2276)
ITA	0.0292* (0.0165)	-0.0219 (0.0334)	-0.0319 (0.0370)	0.8433** (0.3488)	-0.0932 (0.0581)	0.4421** (0.1866)	-0.5801 (0.4135)
FRA	0.0348** (0.0168)	-0.0224 (0.0218)	-0.0287 (0.0322)	-0.1933 (0.1594)	-0.0382 (0.0598)	0.4216** (0.1933)	-0.3164 (0.4445)
DEU	0.0172 (0.0127)	-0.0106 (0.0197)	-0.0110 (0.0309)	0.6291*** (0.2208)	-0.0336 (0.0401)	0.2044 (0.1616)	-0.4923 (0.3061)
AUS	0.0211* (0.0124)	0.0101 (0.0189)	-0.0236 (0.0268)	1.3661*** (0.1423)	-0.0090 (0.0273)	0.1261 (0.1473)	-0.3898 (0.4037)

The GDP of the regression refers to origin of the stock market. *significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. The data is adjusted for HAC Newey-West. The dependent variable refers to the return on the named stock market. For the USA, the data span is 1950-2016, for the S&P 500 & the NZL 1988-2016 and for the other markets the data span is 1973-2016.

The results of the ONI-index can be found in the table below. Only the Italian stock market is affected by La Niña, the stock market underperforms by 5.39% compared with a normal period. Again, this is more likely to be explained by the oil crisis in the seventies and the Credit & Euro Crisis.

Table 11: Results regression 3 - ONI

Stock market	Alpha	Niño	Niña	GDP#	Energy	Non-energy	Trade
S&P	0.0071 (0.0143)	-0.0014 (0.0194)	-0.0230 (0.0121)	2.8823** (1.2983)	-0.0221 (0.0542)	0.2755 (0.1773)	-0.0267 (0.2831)
USA	0.0082 (0.0098)	-0.0004 (0.0116)	0.0021 (0.0098)	2.2422*** (0.6601)	-0.0197 (0.0351)	0.1469 (0.1018)	-0.4521** (0.2040)
NZL	0.0171 (0.0124)	0.0017 (0.0171)	-0.0284 (0.0178)	1.1871*** (0.1333)	-0.0339 (0.0739)	-0.0297 (0.1439)	-0.0228 (0.2211)
NLD	0.0308*** (0.0117)	-0.0042 (0.0174)	-0.0255 (0.0179)	0.6434** (0.2495)	0.0078 (0.0509)	0.3481** (0.1498)	-0.8960*** (0.2970)
JPN	0.0184 (0.0122)	-0.0206 (0.0194)	-0.0188 (0.0237)	0.8561*** (0.2132)	-0.0833 (0.0558)	0.1554 (0.1279)	-0.4307* (0.2467)
ITA	0.0421** (0.0198)	-0.0359 (0.0316)	-0.0539*** (0.0196)	0.8280** (0.3493)	-0.0900 (0.0569)	0.4632** (0.1869)	-0.5660 (0.3964)
FRA	0.0370** (0.0187)	-0.0138 (0.0199)	-0.0288 (0.0234)	-0.1710 (0.1604)	-0.0376 (0.0595)	0.4275** (0.1895)	-0.3051 (0.4358)
DEU	0.0237 (0.0145)	-0.0178 (0.0203)	-0.0247 (0.0173)	0.6174*** (0.2168)	-0.0312 (0.0393)	0.2158 (0.1583)	-0.4814 (0.2983)
AUS	0.0236* (0.0139)	0.0062 (0.0167)	-0.0240 (0.0194)	1.3413*** (0.1498)	-0.0092 (0.0265)	0.1283 (0.1462)	-0.3660 (0.3977)

The GDP of the regression refers to origin of the stock market. *significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. The data is adjusted for HAC Newey-West. The dependent variable refers to the return on the named stock market. For the USA, the data span is 1950-2016, for the S&P 500 & the NZL 1988-2016 and for the other markets the data span is 1973-2016.

H2: There is not such a deviation visible on the stock markets with a positive abnormal return for France, Germany, Italy, The Netherlands and the USA on the one hand and a negative abnormal return for Australia, Japan and New Zealand.

The second Hypotheses again is not rejected. As can been seen in the table below, there is not such a deviation that can be made. This table is formed by the results of all regressions ran in this study; considered are the significant coefficients and the signs of the coefficients. Only for Australia and Japan the results of El Niño are significant. These effects are positive, where the hypotheses suggest otherwise.

Table 12: Positive and Negative effects El Niño

Stock market	Positive	Negative
S&P	0	0
USA	0	0
NZL	0	0
NLD	0	0
JPN	1	0
ITA	0	0
FRA	0	0
DEU	0	0
AUS	1	0

Overall results of the effect of El Niño. For the USA, the data span is 1950-2016, for the S&P 500 & the NZL 1988-2016 and for the other markets the data span is 1973-2016. Only the significant coefficients at the 10% level are considered.

4.4 Small vs Big Companies

To check if the findings are similar for small and large companies, the regression is run with the S&P 500. This stock market includes only the 500 largest firms listed in the USA and the outcome is compared with the results of the total return index of the USA. I do expect the S&P 500 to be more influenced by El Niño or La Niña than the total return index of the USA, because larger companies are more international and weather and economic effects of the two phenomena are more pronounced outside the USA. Because this data for the S&P 500 is available from 1988 onwards only, I compare the results of period 4 (1993-2016).

Table 13a: Differences S&P 500 and USA

S&P 500		USA	
El Niño	La Niña	El Niño	La Niña
0.0138	0.0144	0.0198	0.0163
0.0039	-0.0184	-0.0001	-0.0114
0.0082	0.0149	0.0259	0.0199
0.0044	-0.0257	0.0002	-0.0143
0.0116	0.0060	0.0315	0.0053
0.0074	-0.0255	0.0053	-0.0138

*significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. Results are all the dummies used in the regressions; respectively regression 1 with SOI/ONI dummy, regression two SOI/ONI and the regression exc. GDP SOI/ONI.

Table 13a shows the results of the regressions in the same order as the discussed the results. The results show only minor differences in the returns for the S&P 500 and the USA total return index. For the lagged results, I only found SOI-index effects for El Niño in the third lag for the S&P 500 and in the fourth lag for La Niña for the USA total return index. For the ONI-index the results only differ in magnitude. All in all, I cannot conclude that the effects are the same for small and large companies listed in the USA or that large companies are more affected by the phenomena.

Table 13b: Differences S&P 500 and USA

SOI	Niño	Niño(-1)	Niño(-2)	Niño(-3)	Niño(-4)
S&P 500	0.0044	0.0163	-0.0370	0.0585**	-0.0027
USA	0.0300	-0.0433	0.0210	0.0196	0.0211
SOI	**Niña**	**Niña(-1)**	**Niña(-2)**	**Niña(-3)**	**Niña(-4)**
S&P 500	0.0095	0.0148	-0.0154	-0.0311	0.0078
USA	-0.0004	0.0098	-0.0289	-0.0329	0.0371*

Table 13c: Differences S&P 500 and USA

ONI	Niño	Niño(-1)	Niño(-2)	Niño(-3)	Niño(-4)
S&P 500	0.0226	-0.0100	-0.0112	0.0127	0.0435
USA	-0.0031	-0.0010	-0.0122	0.0170	-0.0062
ONI	**Niña**	**Niña(-1)**	**Niña(-2)**	**Niña(-3)**	**Niña(-4)**
S&P 500	-0.0448*	0.0060	0.0585	-0.0722**	0.0058
USA	-0.0157	0.0296	-0.0044	-0.0577**	-0.0017

4.5 GDP Effect

As discussed before, GDP might not be a good control variable. Therefore, I run regression three excluding the GDP growth. The results are shown in Table 14.

3. $$Ri(t) - Rf(t) = \alpha + \beta 1 Dnino(t) + \beta 2 Dnina(t) + \beta 3 \Delta Energy(t) + \beta 4 \Delta Non - Energy(t) + \beta 5 \Delta Trade(t) + \varepsilon(t)$$

Where Ri is the total return of the stock market in country i, Rf is the risk-free rate, Dnino(t) takes a value of one if the absolute value of SOI is ≤ -1 or ONI score is ≥ +0.5, Dnina(t) if the value of SOI ≥ +1 or ONI score is ≤ -0.5, ΔEnergy(t) the percentage change in the global Energy commodity index, ΔNon-Energy(t) the percentage change in the global Non-Energy commodity index and ΔTrade(t) the percentage change in the total international trade and t is the time subscript.

Again, no significant results are found for the SOI-index, meaning that the dummy coefficients are not affected by the inclusion of GDP.

Table 14: Results regression 3 excl. GDP - SOI

Stock market	Alpha	Niño	Niña	Energy	Non-energy	Trade
S&P	0.0166 (0.0109)	0.0045 (0.0227)	0.0077 (0.0319)	-0.0266 (0.0635)	0.3195** (0.1599)	-0.0070 (0.3040)
USA	0.0220*** (0.0082)	0.0178 (0.0143)	0.0161 (0.0163)	-0.0341 (0.0387)	0.2002* (0.1194)	-0.4873** (0.2351)
NZL	0.0254* (0.0137)	-0.0019 (0.0200)	-0.0217 (0.0385)	0.0732 (0.0773)	0.4849*** (0.1823)	-0.4174 (0.3989)
NLD	0.0306** (0.0124)	-0.0014 (0.0194)	-0.0200 (0.0310)	0.0067 (0.0558)	0.4678** (0.1810)	-0.6944** (0.2902)
JPN	0.0202 (0.0128)	-0.0065 (0.0269)	-0.0280 (0.0252)	-0.0814 (0.0530)	0.2330* (0.1294)	-0.1108 (0.2707)
ITA	0.0340* (0.0191)	-0.0238 (0.0330)	-0.0318 (0.0359)	-0.0910 (0.0647)	0.5877*** (0.1901)	-0.3329 (0.4302)
FRA	0.0343** (0.0169)	-0.0215 (0.0223)	-0.0275 (0.0334)	-0.0371 (0.0601)	0.4321** (0.1977)	-0.3627 (0.4344)
DEU	0.0187 (0.0145)	-0.0082 (0.0211)	-0.0084 (0.0300)	-0.0311 (0.0427)	0.3287* (0.1781)	-0.2973 (0.2959)
AUS	0.0318* (0.0170)	-0.0072 (0.0222)	-0.0150 (0.0318)	0.0335 (0.0535)	0.5500*** (0.1961)	-0.6408 (0.4939)

*significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. The data is adjusted for HAC Newey-West. The dependent variable refers to the return on the named stock market. For the USA, the data span is 1950-2016, for the S&P 500 & the NZL 1988-2016 and for the other markets the data span is 1973-2016.

I run the same regression but now with the ONI-index and the results can be found in Table 15. For Italy, only a change in magnitude is visible, but New Zealand and Australia show a significant negative coefficient for La Niña of respectively -6.48% and -3.81%. Thus, the inclusion of GDP influences my results.

Table 15: Results regression 3 exc. GDP - ONI

Stock market	Alpha	Niño	Niña	Energy	Non-energy	Trade
S&P	0.0219* (0.0116)	0.0027 (0.0211)	-0.0205 (0.0173)	-0.0209 (0.0659)	0.3205** (0.1610)	0.0245 (0.2969)
USA	0.0257*** (0.0087)	0.0016 (0.0120)	0.0022 (0.110)	-0.0315 (0.0371)	0.1989 (0.1211)	-0.4873** (0.2275)
NZL	0.0363** (0.0153)	-0.0008 (0.0210)	-0.0648*** (0.0214)	0.0867 (0.0802)	0.4721*** (0.1739)	-0.3090 (0.3838)
NLD	0.0333** (0.0129)	0.0015 (0.0166)	-0.0288 (0.0185)	0.0087 (0.0556)	0.4628*** (0.1763)	-0.6524** (0.2753)
JPN	0.0230 (-0.0128)	-0.0128 (0.0223)	-0.0169 (0.0230)	-0.0856 (0.0522)	0.2419* (0.1278)	-0.1307 (0.2937)
ITA	0.0458** (0.0222)	-0.0290 (0.0297)	-0.0603*** (0.0213)	-0.0852 (0.0628)	0.5990*** (0.1913)	-0.2890 (0.4011)
FRA	0.0373* (0.0187)	-0.0147 (0.0203)	-0.0300 (0.0235)	-0.0363 (0.0597)	0.4373** (0.1943)	-0.3452 (0.4237)
DEU	0.0254 (0.0164)	-0.0125 (0.0198)	-0.0303 (0.0184)	-0.0263 (0.0418)	0.3326* (0.1760)	-0.2654 (0.2804)
AUS	0.0382** (0.0173)	-0.0076 (0.0222)	-0.0381* (0.0214)	0.0389 (0.0514)	0.5492*** (0.1918)	-0.5896 (0.4719)

*significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. The data is adjusted for HAC Newey-West. The dependent variable refers to the return on the named stock market. For the USA, the data span is 1950-2016, for the S&P 500 & the NZL 1988-2016 and for the other markets the data span is 1973-2016.

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5. Robustness

5.1 results inclusive SOI/ONI index

To prove if my results are robust I run regression 4. In this regression, I include the SOI or the ONI-index, to investigate if the deepness of an El Niño or a La Niña period influences the stock markets.

4. $Ri(t) - Rf(t) = \alpha + \beta 1 IND(t) + \beta 2 \Delta Energy(t) + \beta 3 \Delta Non - Energy(t) + \beta 4 \Delta Trade(t) + \varepsilon(t)$

Where Ri is the total return of the stock market in country i, Rf is the risk-free rate, IND(t) is the adjusted SOI index or the ONI index, ΔEnergy the percentage change in the global Energy commodity index, ΔNon-Energy(t) the percentage change in the global Non-Energy commodity index and ΔTrade the percentage change in the total international trade and t is the time subscript.

Table 16 shows the results of the regression including the SOI-Index. For the inclusion of the SOI-index no significant results are found, meaning that the deepness of a period of El Niño/La Niña does not influence the stock market. The same applies when I include the ONI-index for which the results can be found in Table 17. Therefore, my results are not robust.

Table 16: Results regression 4 - SOI

Stock market	Alpha	SOI	Energy	Non-energy	Trade
S&P	0.0179 (0.0121)	-0.0040 (0.0115)	-0.0233 (0.0658)	0.3200* (0.1624)	-0.0043 (0.3087)
USA	0.0256*** (0.0075)	-0.0058 (0.0069)	-0.0259 (0.0383)	0.1886 (0.1201)	-0.4614** (0.2205)
NZL	0.0215* (0.0125)	-0.0071 (0.0114)	0.0769 (0.0794)	0.4701** (0.1830)	-0.3873 (0.4134)
NLD	0.0258* (0.0122)	-0.0132 (0.0093)	0.0122 (0.0568)	0.4497** (0.1756)	-0.6538** (0.2902)
JPN	0.0156 (0.0129)	-0.0039 (0.0103)	-0.0851 (0.0547)	0.2288* (0.1236)	-0.1177 (0.2801)
ITA	0.0242 (0.0174)	-0.0119 (0.0123)	-0.0870 (0.0673)	0.5686*** (0.1904)	-0.2899 (0.4466)
FRA	0.0267* (0.0151)	-0.0049 (0.0095)	-0.0380 (0.0620)	0.4237** (0.1931)	-0.3502 (0.4493)
DEU	0.0153 (0.0132)	-0.0050 (0.0088)	-0.0283 (0.0428)	0.3205* (0.1773)	-0.2752 (0.3002)
AUS	0.0274* (0.0150)	-0.0082 (0.0098)	0.0370 (0.0528)	0.5378*** (0.1925)	-0.6123 (0.5082)

*significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. The data is adjusted for HAC Newey-West. The dependent variable refers to the return on the named stock market. For the USA, the data span is 1950-2016, for the S&P 500 & the NZL 1988-2016 and for the other markets the data span is 1973-2016.

Table 17: Results regression 4 - ONI

Stock market	Alpha	ONI	Energy	Non-energy	Trade
S&P	0.0179 (0.0120)	0.0056 (0.0121)	-0.0242 (0.0641)	0.3218** (0.1600)	0.0165 (0.3107)
USA	0.0264*** (0.0075)	0.0003 (0.0070)	-0.0309 (0.0375)	0.1992* (0.1193)	-0.4837** (0.2270)
NZL	0.0211* (0.0126)	0.0136 (0.0121)	0.0768 (0.0783)	0.0473*** (0.1783)	-0.3305 (0.4036)
NLD	0.0273* (0.0120)	0.0105 (0.0104)	0.0075 (0.0558)	0.4564*** (0.1728)	-0.6610** (0.2908)
JPN	0.0169 (0.0126)	-0.0050 (0.0129)	-0.0912* (0.0526)	0.2409* (0.1253)	-0.1616 (0.2927)
ITA	0.0258 (0.0174)	0.0066 (0.0132)	-0.0929 (0.0672)	0.5783*** (0.1879)	-0.3114 (0.4483)
FRA	0.0280* (0.0150)	-0.0031 (0.0111)	-0.0438 (0.0616)	0.4349** (0.1886)	-0.3888 (0.4631)
DEU	0.0164 (0.0129)	-0.0008 (0.0100)	-0.0329 (0.0423)	0.3292* (0.1738)	-0.3031 (0.3024)
AUS	0.0284* (0.1448)	0.0050 (0.0118)	0.0332 (0.0515)	0.5439*** (0.1892)	-0.6247 (0.5045)

*significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. The data is adjusted for HAC Newey-West. The dependent variable refers to the return on the named stock market. For the USA, the data span is 1950-2016, for the S&P 500 & the NZL 1988-2016 and for the other markets the data span is 1973-2016.

5.2 Periodical Division

To check if the results differ overtime and due to climate change, I divide the data into four periods. Period 1 lasts from 1926 to 1950, period 2 is from 1950 to 1973, the next period takes from 1973 to 1994 and the last period start in 1994 and ends in 2016. The first division 1926-1973 and 1973-2016 is to compare the US total return index with the other indexes. The second division 1973-1994 and 1994-2016 is to compare the other indexes and to create equal periods. Table 18 shows the results of all significant dummies I found in period 3 and 4. I focus on period 3 and 4, because most indexes are available in these periods.

Table 18: Significant dummy coefficients.

SOI	El Niño	La Niña	ONI	El Niño	La Niña
Period 3	0	7	Period 3	5	6
Period 4	1	1	Period 4	4	18

This table only considers the USA total return index, Netherlands, Japan, Italy, France, Germany and Australia, because these countries/indexes have full data in both periods.

The table above shows the number of significant dummy coefficients (all other results can be found in the appendix). The number of significant coefficients increases from 18 to 24 if I move from period 3 to 4. This differs per index and also per phenomena. Therefore, I cannot conclude that the effect is more pronounced due to climate change and the results are not robust.

5.3 Deviation from MSCI World

In this part I discuss the under/overperformance of the local stock markets versus the MSCI world index. To compare thisIs run regression 3:

$$3.\quad Ri(t) - Rf(t) = \alpha(t) + \beta 1 Dnino(t) + \beta 2 Dnina(t) + \beta 3 \Delta Energy(t) + \beta 4 \Delta Non - Energy(t) + \beta 5 \Delta Trade(t) + \varepsilon(t)$$

Where Ri is the total return of the stock market in country i, Rf is the risk-free rate, Dnino(t) takes a value of one if the absolute value of SOI is ≤ -1 or ONI score is ≥ +0.5, Dnina(t) if the value of SOI ≥ +1 or ONI score is ≤ -0.5, ΔEnergy(t) the percentage change in the global Energy commodity index, ΔNon-Energy(t) the percentage change in the global Non-Energy commodity index and ΔTrade(t) the percentage change in the total international trade and t is the time subscript.

Afterwards I take the difference of the dummy coefficient of El Niño or La Niña for country i versus the dummy coefficient of El Niño or La Niña for the MSCI world. The full results can be found in the appendix. In the table below I show the difference in a period of El

Niño and La Niña. For El Niño, no significant differences occur, but for La Niña using the ONI-Index I find underperformance for the Australian, German, Italian and New Zealand's stock market. The stock markets underperform by respectively 3.95%, 3.17%, 6.17% and 6.62% per quarter. This is mostly explained by the underperformance of these stock markets in La Niña periods, rather than the MSCI index overperformance during La Niña periods. For the Australian & New Zealand's stock market, the weather effects as described before can explain the lower returns. For Italy and for Germany the weather effects are not likely to explain the lower returns. A reason could be more exposure to countries affected by La Niña, because although MSCI world is a worldwide index, the USA accounts for nearly 60% of the index (MSCI, 2017).

Table 19: (Under/Over)performance versus MSCI world.

SOI	El Niño	La Niña	ONI	El Niño	La Niña
S&P	0.0048	0.0018	S&P	0.0002	-0.0219
USA	0.0181	0.0102	USA	-0.0009	0.0008
NZL	-0.0016	-0.0278	NZL	-0.0033	-0.0662***
NLD	-0.0011	-0.0259	NLD	-0.0010	-0.0302
JPN	-0.0062	-0.0339	JPN	-0.0153	-0.0183
ITA	-0.0235	-0.0377	ITA	-0.0315	-0.0617***
FRA	-0.0212	-0.0334	FRA	-0.0172	-0.0314
DEU	-0.0079	-0.0143	DEU	-0.0150	-0.0317*
AUS	-0.0069	-0.0209	AUS	-0.0101	-0.0395*

*significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. The data is adjusted for HAC Newey-West. The dependent variable refers to the return on the named stock market. For the USA, the data span is 1950-2016, for the S&P 500 & the NZL 1988-2016 and for the other markets the data span is 1973-2016.

6. Conclusion & Discussion

This thesis contributes to the behavioral finance literature by exploring exogenous variation of stock markets of developed countries caused by El Niño and La Niña weather events, by causatively identify the effects El Niño and La Niña shocks have over a period of time. I included eight countries and ten stock markets in the period between 1926 and 2016, this differs due to data availability. To analyze the effect of La Niña and El Niño, I ran several regressions to capture financial and economic drivers that influence stock markets. I found that El Niño hardly had any influence on the stock market and the effects of La Niña where more severe. Especially after times of La Niña stock markets of Australia, Italy and New-Zealand underperform. When I compare the returns with the MSCI world index, also the German stock market underperforms. The underperformance of Italy is explained by the oil crisis in the seventies, the credit & Euro crisis rather than the effects of La Niña on Italy and one should consider that the stock listed in the USA weight for 60% in the MSCI world. Overtime results differ, but I found no increase due to climate change. Furthermore, I cannot conclude that small companies are more/less influenced by the shocks and the stock markets do not respond earlier than the real GDP growth. Lastly the deepness of El Niño or La Niña does not influence the stock markets.

This thesis can be extended in several ways. For example, one could include countries that are more influenced by shocks in El Niño or La Niña, countries like Peru & Indonesia, where this thesis focusses only on developed countries. Another possibility is to investigate if monthly data is a better predictor. One could also compare the results of small and big companies using the small sorted portfolio of the Kenneth French Library, where I decided to follow Saunders (1993) and compare with the S&P 500. Furthermore, my results show that La Niña has more significant coefficients, therefore the focus on economic and behavioural research of El Niño should also consider the effects of a La Niña.

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8. Appendix

Table 20a: Descriptive Statistics – GDP Growth

GDP Growth QoQ	USA	NZL	NLD	JPN	ITA	FRA	DEU	AUS
≤ -5 %	4	24	13	19	13	30	16	19
-5 % ≤ -2 %	11	20	17	27	23	25	18	22
-2 % ≤ 0 %	53	21	36	25	26	34	36	33
0	0	0	0	0	0	0	0	0
0 % ≤ 2 %	215	50	26	21	47	89	29	61
2 % ≤ 5 %	61	65	85	69	69	50	42	59
5 % ≥	12	39	43	59	42	35	39	31
Total	356	219	220	220	220	263	180	225

This table reports descriptive statistics of GDP growth. The data span period differs per country.

Table 20b: Descriptive Statistics – Other Independent Variables

Other independent variables	Import	Export	Non-energy commodities	Energy commodities	WTI oil	Brent oil
≤ -20 %	1	1	0	3	9	9
-20 % ≤ -10 %	1	1	2	25	33	47
-10 % ≤ -5 %	1	1	14	49	62	56
-5 % < 0 %	7	7	307	249	77	121
0	2	0	1	5	4	67
0 % ≤ 5 %	13	16	331	237	96	113
5 % ≤ 10 %	10	11	25	69	65	64
10 % < 20 %	25	23	2	27	40	58
20 % ≥	7	7	0	7	9	16
Total	67	67	682	671	395	551

This table reports descriptive statistics about the increase/decrease worldwide import and export, the (non-)energy commodities, WTI and Brent oil. The data span for import and export is 1949-2016, (non-)energy 1960-2016, WTI oil 1983-2016 and Brent oil 1970-2016

Table 21a: Correlogram

Correlation	S&P	USA	NZL	NLD	JPN	ITA	FRA	DEU	AUS
S&P	1	0.9538	0.5349	0.8072	0.4517	0.6778	0.7727	0.7613	0.6415
USA	0.9538	1	0.5300	0.7961	0.4529	0.6747	0.7646	0.7527	0.6445
NZL	0.5349	0.5300	1	0.5661	0.3520	0.5386	0.5281	0.4775	0.7416
NLD	0.8072	0.7961	0.5661	1	0.4653	0.8133	0.9033	0.8965	0.7431
JPN	0.4517	0.4529	0.3520	0.4653	1	0.4204	0.4415	0.3965	0.3676
ITA	0.6778	0.6747	0.5386	0.8133	0.4204	1	0.8198	0.7942	0.6375
FRA	0.7727	0.7646	0.5281	0.9033	0.4415	0.8198	1	0.9038	0.7128
DEU	0.7613	0.7527	0.4775	0.8965	0.3965	0.7942	0.9038	1	0.6483
AUS	0.6415	0.6445	0.7416	0.7431	0.3676	0.6375	0.7128	0.6483	1
SOI	-0.0585	-0.0664	-0.0624	-0.1202	0.0073	-0.1672	-0.0435	-0.0141	-0.0774
ΔSOI	-0.1309	-0.1309	-0.1448	-0.1037	0.0867	0.0106	-0.0946	-0.0669	-0.3180
ONI	0.0656	0.0736	0.0937	0.1109	-0.0986	0.1672	0.0061	0.0222	0.0385
ΔONI	0.0500	0.0424	-0.0078	0.0606	0.1573	0.0087	0.0064	0.0164	0.0809
GDP USA	0.2371	0.2331	0.1892	0.3105	0.2134	0.2690	0.2688	0.2432	0.2481
GDP NZL	0.1359	0.1321	0.6649	0.3458	0.1245	0.2862	0.2608	0.2524	0.5509
GDP NLD	0.0287	0.0258	0.1339	0.3288	0.0104	0.2965	0.2875	0.2793	0.3015
GDP JPN	-0.1562	-0.1540	0.0598	0.0045	-0.2892	0.0270	0.0001	-0.0679	0.0008
GDP ITA	0.0187	0.0138	0.1097	0.3230	-0.0080	0.2792	0.2969	0.2811	0.2867
GDP FRA	-0.0522	-0.0549	-0.0765	0.0125	-0.0815	-0.0915	0.0107	0.0223	-0.1025
GDP DEU	0.0051	-0.0033	0.1222	0.3378	0.0572	0.2606	0.3128	0.3058	0.2163
GDP AUS	0.2009	0.2025	0.4537	0.4647	0.1689	0.3754	0.4357	0.3784	0.7246
ΔWTI	-0.0081	-0.0089	0.0585	0.1712	0.0463	0.0418	0.0468	0.0372	0.1810
ΔBRENT	-0.0500	-0.0499	0.0758	0.1479	0.0675	0.0114	0.0308	0.0140	0.1720
ΔNon-Energy	0.2113	0.2163	0.2793	0.4454	0.1589	0.3169	0.3558	0.3564	0.5076
ΔEnergy	0.0345	0.0362	0.1870	0.2649	0.1278	0.1297	0.1593	0.1110	0.2892
ΔExport	0.0296	0.0328	-0.0165	0.0033	-0.0052	-0.0316	0.0234	0.0720	-0.0286
ΔImport	0.0321	0.0349	-0.0294	-0.0004	-0.0095	-0.0354	0.0235	0.0692	-0.0373

Table 21b: Correlogram

Correlation	SOI	ΔSOI	ONI	ΔONI	GDP USA	GDP NZL	GDP NLD	GDP JPN	GDP ITA	GDP FRA
S&P	-0.0585	-0.1309	0.0656	0.0500	0.2371	0.1359	0.0287	-0.1562	0.0187	-0.0522
USA	-0.0664	-0.1309	0.0736	0.0424	0.2331	0.1321	0.0258	-0.1540	0.0138	-0.0549
NZL	-0.0624	-0.1448	0.0937	-0.0078	0.1892	0.6649	0.1339	0.0598	0.1097	-0.0765
NLD	-0.1202	-0.1037	0.1109	0.0606	0.3105	0.3458	0.3288	0.0045	0.3230	0.0125
JPN	0.0073	0.0867	-0.0986	0.1573	0.2134	0.1245	0.0104	0.2892	-0.0080	-0.0815
ITA	-0.1672	0.0106	0.1637	0.0087	0.2690	0.2862	0.2965	0.0270	0.2792	-0.0915
FRA	-0.0435	-0.0946	0.0061	0.0064	0.2688	0.2608	0.2875	0.0001	0.2969	0.0107
DEU	-0.0141	-0.0669	0.0222	0.0164	0.2432	0.2524	0.2796	-0.0679	0.2811	0.0223
AUS	-0.0774	-0.3180	0.0385	0.0809	0.2481	0.5509	0.3015	0.0008	0.2867	-0.1025
SOI	1	-0.0823	-0.8008	-0.1272	-0.1479	-0.0637	-0.0658	-0.0113	0.0153	-0.0154
ΔSOI	-0.0823	1	0.0496	0.0269	0.0633	-0.1585	0.0257	0.1277	-0.0208	-0.0204
ONI	-0.8008	0.0496	1	0.1291	0.0410	0.0998	0.0354	-0.0440	-0.0009	0.0749
ΔONI	-0.1272	0.0269	0.1291	1	0.0980	-0.0509	0.0787	0.1686	0.0832	0.0434
GDP USA	-0.1479	0.0633	0.0410	0.0980	1	0.1565	0.0714	0.0040	0.0428	0.0921
GDP NZL	-0.0637	-0.1585	0.0998	-0.0509	0.1565	1	0.3736	0.1897	0.3481	-0.0868
GDP NLD	-0.0658	0.0257	0.0354	0.0787	0.0714	0.3736	1	0.3131	0.9659	-0.0615
GDP JPN	-0.0113	0.1277	0.0440	0.1686	0.0040	0.1897	0.3131	1	0.2870	-0.0226
GDP ITA	0.0153	-0.0208	-0.0009	0.0832	0.0428	0.3481	0.9659	0.2870	1	-0.0232
GDP FRA	-0.0154	-0.0204	0.0749	0.0434	0.0921	-0.0868	-0.0615	-0.0226	-0.0232	1
GDP DEU	-0.0429	0.0853	0.0334	0.0791	0.0577	0.3400	0.8364	0.4059	0.8426	0.0355
GDP AUS	-0.0350	-0.2498	-0.0613	-0.0270	0.2246	0.6884	0.5006	0.1370	0.5055	-0.0861
ΔWTI	0.0693	0.0169	-0.0549	-0.0887	-0.0084	0.2929	0.2045	0.1858	0.2292	-0.0778
ΔBRENT	0.0852	-0.0341	-0.0652	-0.0783	-0.0197	0.3041	0.1755	0.2007	0.2045	-0.0731
ΔNon-Energy	-0.0547	-0.1441	-0.0442	-0.0216	0.1760	0.4730	0.4361	0.1196	0.4251	-0.1073
ΔEnergy	0.1052	-0.0299	-0.0958	-0.0443	0.0749	0.3772	0.2108	0.2330	0.2440	-0.0761
ΔExport	0.1337	0.0802	-0.1553	0.1308	0.0868	0.0276	0.1534	0.1349	0.1426	0.0389
ΔImport	0.1388	0.0767	-0.1644	0.1326	0.0905	0.116	0.1464	0.1314	0.1375	0.0418

Table 21c: Correlogram

Correlation	GDP DEU	GDP AUS	WTI	Brent	Non-energy	Energy	Export	Import
S&P	0.0051	0.2009	-0.0081	-0.0500	0.2113	0.0345	0.0296	0.0321
USA	-0.0033	0.2025	-0.0089	-0.0499	0.2163	0.0362	0.0328	0.0349
NZL	0.1222	0.4537	0.0585	0.0758	0.2793	0.1870	-0.0165	-0.0294
NLD	0.3378	0.4647	0.1712	0.1479	0.4454	0.2649	0.0033	-0.0004
JPN	0.0572	0.1689	0.0463	0.0675	0.1589	0.1278	-0.0052	-0.0095
ITA	0.2606	0.3754	0.0418	0.0114	0.3169	0.1297	-0.0316	-0.0354
FRA	0.3128	0.4357	0.0468	0.0308	0.3558	0.1593	0.0234	0.0235
DEU	0.3058	0.3784	0.0372	0.0140	0.3564	0.1110	0.0720	0.0692
AUS	0.2163	0.7246	0.1810	0.1720	0.5076	0.2892	-0.0286	-0.0373
SOI	-0.0429	-0.0350	0.0693	0.0852	-0.0547	0.1052	0.1337	0.1388
ΔSOI	0.0853	-0.2498	0.0169	-0.0341	-0.1441	-0.0299	0.0802	0.0767
ONI	0.0334	-0.0613	-0.0549	-0.0652	-0.0442	-0.0958	-0.1553	-0.1644
ΔONI	0.0791	-0.0270	-0.0887	-0.0783	-0.0216	-0.0443	0.1308	0.1326
GDP USA	0.0577	0.2246	-0.0084	-0.0197	0.1760	0.0749	0.0868	0.0905
GDP NZL	0.3400	0.6884	0.2929	0.3041	0.4730	0.3772	0.0276	0.0116
GDP NLD	0.8364	0.5006	0.2045	0.1755	0.4361	0.2108	0.1534	0.1464
GDP JPN	0.4059	0.1370	0.1858	0.2007	0.1196	0.2330	0.1349	0.1314
GDP ITA	0.8426	0.5055	0.2292	0.2045	0.4251	0.2440	0.1426	0.1375
GDP FRA	0.0355	-0.0861	-0.0778	-0.0731	-0.1073	-0.0761	0.0389	0.0418
GDP DEU	1	0.4279	0.2650	0.2478	0.3906	0.2488	0.1451	0.1390
GDP AUS	0.4279	1	0.2862	0.2805	0.6503	0.4004	0.0347	0.02293
ΔWTI	0.2650	0.2862	1	0.9702	0.3118	0.8925	0.1570	0.1547
ΔBRENT	0.2478	0.2805	0.9702	1	0.3217	0.8890	0.1494	0.1465
ΔNon-Energy	0.3906	0.6503	0.3118	0.3217	1	0.3961	0.2664	0.2543
ΔEnergy	0.2488	0.4004	0.8925	0.8890	0.3961	1	0.2093	0.2057
ΔExport	0.1451	0.0347	0.1570	0.1494	0.2664	0.2093	1	0.9989
ΔImport	0.1390	0.0229	0.1547	0.1465	0.2543	0.2057	0.9989	1

This table shows the correlation between all coefficients used in this paper. The data span period differs per variable

Table 22: Results Regression 1 Periodical Division - SOI

Stock market	Period#	El Niño	La Niña
S&P	4	0.0138	0.0144
USA	1	-0.0646**	0.0085
	2	0.0016	0.0276
	3	0.0141	-0.0083
	4	0.0198	0.0163
NZL	4	-0.0212	-0.0063
NLD	3	0.0123	-0.0426
	4	-0.0134	0.0006
JPN	3	0.0088	-0.0615*
	4	-0.0241	-0.0076
ITA	3	-0.0553	-0.0960*
	4	0.0201	0.0184
FRA	3	-0.0166	-0.0733
	4	-0.0285	0.0123
DEU	3	0.0153	-0.0232
	4	-0.0274	0.0025
AUS	3	0.0093	-0.0433
	4	-0.0315	0.0192

the periods are 1: 1926-1950, 2: 1950-1973, 3: 1973-1994 and 4: 1994-2016 *significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. The data is adjusted for HAC Newey-West. The dependent variable refers to the return on the named stock market.

Table 23: Results Regression 1 Periodical Division - ONI

Stock market	Period#	El Niño	La Niña
S&P	4	0.0039	-0.0184
USA	2	-0.0132	0.0289**
	3	0.0179	-0.0032
	4	-0.0001	-0.0114
NZL	4	0.0024	-0.0690***
NLD	3	0.0033	-0.0221
	4	0.0186	-0.0353*
JPN	3	0.0052	-0.0359
	4	-0.0135	-0.0032
ITA	3	-0.0764*	-0.0702*
	4	0.0384	-0.0487**
FRA	3	-0.0234	-0.0245
	4	0.0098	-0.0337
DEU	3	-0.0084	-0.0246
	4	-0.0021	-0.0380*
AUS	3	0.0003	-0.0337
	4	0.0015	-0.0371*

the periods are 1: 1926-1950, 2: 1950-1973, 3: 1973-1994 and 4: 1994-2016 *significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. The data is adjusted for HAC Newey-West. The dependent variable refers to the return on the named stock market.

Table 24: Results Regression 2 Periodical Division - SOI

Stock market	Per#	Niño	Niño (-1)	Niño (-2)	Nino (-3)	Nino (-4)	Niña	Niña (-1)	Niña (-2)	Niña (-3)	Niña (-4)
S&P	4	0.0044	0.0163	-0.0370	0.0585**	-0.0027	0.0095	0.0148	-0.0154	-0.0311	0.0078
USA	1	-0.0308	-0.0422	-0.0557	0.0382	0.0389**	0.0523	-0.0211	-0.1284***	-0.0848*	0.1005***
	2	-0.0048	-0.0032	0.0286	-0.0029	0.0029	0.0310	0.0143	-0.0004	-0.0448**	0.0338*
	3	0.0019	0.0328	-0.0394	0.0172	-0.0179	0.0061	-0.0275	0.0087	-0.0219	0.0028
	4	0.0300	-0.0433	0.0210	0.0196	0.0211	-0.0004	0.0098	-0.0289	-0.0329	0.0371*
NZL	4	-0.0227	0.0082	-0.0541	0.0091	0.0071	-0.0033	0.0266	-0.0252	-0.0506	0.0058
NLD	3	-0.0030	0.0204	0.0243	-0.0327	0.0026	-0.0470	0.0031	0.0446	-0.0570*	0.0138
	4	-0.0374	0.0306	-0.0469	0.0502	0.0065	0.0113	-0.0322	-0.0423	-0.0434	0.0119
JPN	3	0.0202	-0.0343	0.0488	-0.0212	0.3510	-0.0700*	0.0246	0.0512	-0.0805	0.0283
	4	0.0127	-0.0688	-0.0535	0.0775**	0.0124	-0.0292	0.0188	0.0221	-0.0020	-0.0130
ITA	3	-0.0381	-0.0493	-0.0018	-0.0076	-0.0119	-0.0811	-0.0109	0.0154	-0.0966*	-0.0030
	4	0.0067	0.0002	-0.0024	0.0864	-0.0557	0.0314	-0.0105	-0.0314	-0.0519	-0.0021
FRA	3	-0.0135	0.0043	-0.0243	0.0469	0.0001	-0.0519	0.0056	0.0137	-0.0881**	0.0315
	4	-0.0580	0.0532	-0.0321	0.0473	-0.0166	0.0242	-0.0147	-0.0234	-0.0314	0.0057
DEU	3	0.0065	0.0116	0.0224	-0.0310	-0.0046	-0.0280	-0.0084	0.0430	-0.0423	0.0424
	4	-0.0587	0.0536	-0.0441	0.0691	-0.0189	0.0094	-0.0032	-0.0559	-0.0361	0.0195
AUS	3	0.0322	-0.0504	0.0568	-0.0385	0.0556	-0.0564	0.0985*	-0.0558	-0.0557	0.0283
	4	-0.0273	-0.0299	-0.0059	-0.0016	0.0285	0.0134	0.0087	-0.0437	-0.0303	0.0041

the periods are 1: 1926-1950, 2: 1950-1973, 3: 1973-1994 and 4: 1994-2016 *significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. The data is adjusted for HAC Newey-West. The dependent variable refers to the return on the named stock market.

Table 25: Results Regression 2 Periodical Division - ONI

Stock market	Per#	Niño	Niño (-1)	Niño (-2)	Nino (-3)	Nino (-4)	Niña	Niña (-1)	Niña (-2)	Niña (-3)	Niña (-4)
S&P	4	0.0226	-0.0100	-0.0112	0.0127	0.0435	-0.0448*	0.0060	0.0585	-0.0722**	0.0058
USA	2	0.0019	-0.0094	-0.0175	0.0187	0.0097	-0.0130	0.0526**	0.0100	-0.0139	-0.0069
	3	0.0146	-0.0064	0.0223	-0.0164	-0.0364*	0.0067	0.0088	-0.0198	-0.0063	0.0024
	4	-0.0031	-0.0010	-0.0122	0.0170	-0.0062	-0.0157	0.0296	-0.0044	-0.0577**	-0.0017
NZL	4	0.0273	-0.0199	-0.0445	0.0290	0.0666	-0.1188***	0.0351*	0.0079	-0.0370	0.0187
NLD	3	-0.0051	0.0195	0.0348	-0.0034	-0.0226	-0.0046	-0.0449	0.0448	0.0159	0.0005
	4	0.0391	-0.0221	-0.0279	0.0101	0.0515	-0.0656	0.0291	0.0427	-0.0894**	-0.0051
JPN	3	-0.0012	-0.0019	0.0817*	-0.0744	0.0446	-0.0312	-0.0372	0.0421	0.0124	-0.0080
	4	0.0157	-0.0321	-0.0093	-0.0344	0.1235***	-0.0395	-0.0160	0.0571	-0.0313	-0.0259
ITA	3	-0.0644	-0.0163	-0.0253	0.0491	-0.0483	-0.0226	0.1408**	0.1246***	-0.0315	-0.0046
	4	0.0428	0.0198	-0.0440	0.0300	0.0621	-0.0905**	0.0341	0.0430	-0.0556	-0.0185
FRA	3	-0.0174	-0.0257	0.0399	0.0186	-0.0108	0.0091	-0.0805	0.0312	0.0155	0.0106
	4	0.0264	-0.0006	-0.0176	0.0182	0.0648	-0.0812*	0.0392	0.0481	-0.0674	0.0072
DEU	3	0.0009	0.0069	0.0261	0.0034	-0.0061	-0.0379	-0.0145	0.0378	0.0495	0.0294
	4	0.0224	-0.0213	-0.0112	0.0202	0.0817	-0.0825*	0.0226	0.0477	-0.0939**	0.0266
AUS	3	0.0041	-0.0211	0.0547	0.0062	0.0056	-0.0174	-0.0668*	0.0661*	-0.0037	-0.0060
	4	0.0173	-0.0024	-0.0715*	0.0596*	0.0525*	-0.0935***	0.0616	-0.0043	-0.0286	-0.0129

the periods are 1: 1926-1950, 2: 1950-1973, 3: 1973-1994 and 4: 1994-2016 *significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. The data is adjusted for HAC Newey-West. The dependent variable refers to the return on the named stock market

Table 26: Results Regression 3 Periodical Division - SOI

Stock market	Period#	Niño	Niña	GDP#	Energy	Non-energy	Trade
S&P	4	0.0082	0.0149	2.7415*	0.0409	0.2310	-0.0237
USA	3	0.0017	0.0122	1.2344	-0.0562	-0.0037	-0.5004
	4	0.0259	0.0199	4.5088***	0.0376	0.2696**	-0.2760
NZL	4	-0.0168	-0.0147	1.1981***	0.0242	-0.0659	0.0314
NLD	3	-0.0008	-0.0122	1.1534***	-0.0240	0.0605	-1.1431***
	4	-0.0123	-0.0285	0.4028	0.1308	0.7031***	-0.5625
JPN	3	-0.0087	-0.0146	1.3630***	-0.1452*	-0.1072	-0.6138*
	4	-0.0300	-0.0291	0.4121*	0.1952**	0.1661	-0.1577
ITA	3	-0.0538	-0.0475	1.0542	-0.1457**	0.3773	-0.6821
	4	0.0306	-0.0073	0.6895*	0.1244	0.3796*	-0.5132
FRA	3	-0.0191	-0.0545	-0.01795	-0.0773	0.1126	-0.0578
	4	-0.0318	-0.0109	-0.1275	0.0978	0.6469***	-0.3553
DEU	3	0.0055	0.0065	0.8345***	-0.0574	-0.0558	-0.8237*
	4	-0.0344	-0.0186	0.3293	0.0416	0.6077***	-0.0674
AUS	3	0.0217	-0.0012	1.5370***	-0.0354	0.2182	-0.7966
	4	-0.0157	-0.0275	1.2309***	0.0965	0.0733	-0.2124

the periods are 1: 1926-1950, 2: 1950-1973, 3: 1973-1994 and 4: 1994-2016 *significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. The data is adjusted for HAC Newey-West. The dependent variable refers to the return on the named stock market.

Table 27: Results Regression 3 Periodical Division - ONI

Stock market	Period#	Niño	Niña	GDP#	Energy	Non-energy	Trade
S&P	4	0.0044	-0.0257	2.5787*	0.0571	0.2263	-0.0036
USA	3	0.0186	0.0137	1.2636	-0.0550	-0.0357	-0.4596
	4	0.0002	-0.0143	4.4133***	0.0437	0.2780**	-0.2871
NZL	4	0.0062	-0.0365**	1.1221***	0.0514	-0.0691	0.0629
NLD	3	-0.0098	0.0032	1.2000***	-0.0269	0.0811	-1.5257***
	4	0.0164	-0.0403**	0.3564	0.1553*	0.6685***	-0.4534
JPN	3	-0.0032	0.0105	1.3769***	-0.1498**	-0.0953	-0.6940**
	4	-0.0166	-0.0190	0.4195	0.1972**	0.1469	-0.1420
ITA	3	-0.0930**	-0.0436	1.2526*	-0.1441**	0.4929*	-0.9552
	4	0.0359	-0.0543**	0.6108*	0.1612**	0.3531*	-0.3834
FRA	3	-0.0262	-0.0083	-0.1927	-0.0880	0.1749	-0.2438
	4	0.0128	-0.0393	-0.1274	0.1263*	0.6065***	-0.2682
DEU	3	-0.0186	-0.0026	0.8583***	-0.0558	-0.0379	-0.8754**
	4	-0.0052	-0.0395**	0.3017	0.0612	0.5863***	-0.0143
AUS	3	0.0022	-0.0097	1.5210***	-0.0357	0.2234	-0.8089
	4	0.0130	-0.0315*	1.1928***	0.1190*	0.0516	-0.1348

the periods are 1: 1926-1950, 2: 1950-1973, 3: 1973-1994 and 4: 1994-2016 *significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. The data is adjusted for HAC Newey-West. The dependent variable refers to the return on the named stock market.

Table 28: Results Regression 3 exc. GDP Periodical Division - SOI

Stock market	Period#	Niño	Niña	Energy	Non-energy	Trade
S&P	4	0.0116	0.0060	0.0591	0.2746*	-0.0052
USA	3	0.0067	0.0186	-0.0661	0.0379	-0.5759
	4	0.0315	0.0053	0.0675	0.3413**	-0.2456
NZL	4	-0.0272	-0.0225	0.1407	0.4404**	-0.3289
NLD	3	0.0066	-0.0209	-0.0340	0.0675	-0.5839
	4	-0.0146	-0.0252	0.1273	0.8549***	-0.5590
JPN	3	0.0029	-0.0288	-0.1523***	0.0731	-0.1891
	4	-0.0309	-0.0194	0.2029**	0.1851	-0.0521
ITA	3	-0.0582	-0.0714	-0.1501**	0.3458	0.0351
	4	0.0243	-0.0026	0.1250	0.6422***	-0.5599
FRA	3	-0.0195	-0.0566	-0.0755	0.1217	-0.1277
	4	-0.0301	-0.0073	0.1017	0.6486***	-0.3590
DEU	3	0.0116	-0.0065	-0.0582	-0.0577	-0.2094
	4	-0.0360	-0.0158	0.0423	0.7360***	-0.0839
AUS	3	0.0071	-0.0337	-0.0156	0.2085	-0.2940
	4	-0.0315	-0.0080	0.1803**	0.8118***	-0.6816

the periods are 1: 1926-1950, 2: 1950-1973, 3: 1973-1994 and 4: 1994-2016 *significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. The data is adjusted for HAC Newey-West. The dependent variable refers to the return on the named stock market.

Table 29: Results Regression 3 exc. GDP Periodical Division - ONI

Stock market	Period#	Niño	Niña	Energy	Non-energy	Trade
S&P	4	0.0074	-0.0255	0.0738	0.2604*	0.0280
USA	3	0.0195	0.0157	-0.0642	0.0028	-0.5322
	4	0.0053	-0.0138	0.0723	0.3364**	-0.2329
NZL	4	0.0045	-0.0748***	0.1799**	0.3805**	-0.2151
NLD	3	-0.0001	-0.0060	-0.0387	0.0852	-0.6526
	4	0.0206	-0.0409*	0.1552*	0.8010***	-0.4425
JPN	3	0.0054	-0.0142	-0.1573***	0.0872	-0.2313
	4	-0.0119	-0.0096	0.2042**	0.1736	-0.0426
ITA	3	-0.0848**	-0.0615*	-0.1528**	0.4619	-0.1024
	4	0.0435	-0.0541**	0.1668*	0.5821***	-0.4103
FRA	3	-0.0272	-0.0123	-0.0858	0.1865	-0.3144
	4	0.0126	-0.0384	0.1299*	0.6112***	-0.2772
DEU	3	-0.0071	-0.0112	-0.0589	-0.0423	-0.2412
	4	-0.0029	-0.0415*	0.0645	0.7025***	-0.0246
AUS	3	-0.0061	-0.0305	-0.0194	0.2377	-0.3391
	4	0.0041	-0.0438**	0.2073***	0.7772***	-0.6128

the periods are 1: 1926-1950, 2: 1950-1973, 3: 1973-1994 and 4: 1994-2016 *significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. The data is adjusted for HAC Newey-West. The dependent variable refers to the return on the named stock market.

Table 30: Results Regression 4 Periodical Division - SOI

Stock market	Period#	SOI	Energy	Non-energy	Trade
S&P	4	-0.0101	0.0683	0.2753*	-0.0108
USA	3	-0.0097	-0.0555	-0.0088	-0.4274
	4	-0.0135	0.0768	0.3422***	-0.2543
NZL	4	-0.0110	0.1530*	0.4193**	-0.2957
NLD	3	-0.0109	-0.0328	0.0526	-0.5538
	4	-0.0194	0.1456*	0.8300***	-0.5235
JPN	3	-0.0004	-0.1594***	0.0955	-0.2931
	4	-0.0045	0.2096**	0.1681	-0.0232
ITA	3	-0.0014	-0.1620**	0.3731	-0.0575
	4	-0.0250	0.1459	0.6328***	-0.5550
FRA	3	-0.0034	-0.0857	0.1471	-0.2412
	4	-0.0084	0.1140*	0.6375***	-0.3414
DEU	3	-0.0070	-0.0564	-0.0696	-0.1838
	4	-0.0075	0.0535	0.7194***	-0.0564
AUS	3	-0.0118	-0.0170	0.2008	-0.2995
	4	-0.0095	0.1940**	0.7997***	-0.6624

the periods are 1: 1926-1950, 2: 1950-1973, 3: 1973-1994 and 4: 1994-2016
*significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. The data is adjusted for HAC Newey-West. The dependent variable refers to the return on the named stock market.

Table 31: Results Regression 4 Periodical Division - ONI

Stock market	Period#	ONI	Energy	Non-energy	Trade
S&P	4	0.0090	0.0645	0.2732*	0.0258
USA	3	0.0049	-0.0591	0.0117	-0.4997
	4	0.0076	0.0685	0.3424**	-0.2250
NZL	4	0.0197	0.1559*	0.4098**	-0.2116
NLD	3	0.0077	-0.0357	0.0712	-0.6194
	4	0.0172	0.1383	0.8258***	-0.4533
JPN	3	-0.0017	-0.1605***	0.1002	-0.3096
	4	-0.0086	0.1990**	0.1761	-0.0631
ITA	3	-0.0228	-0.1746**	0.4231	-0.2337
	4	0.0344*	0.1452	0.6187***	-0.4102
FRA	3	-0.0137	-0.0950	0.1855	-0.3765
	4	0.0087	0.1117	0.6348***	-0.3054
DEU	3	-0.0027	-0.0622	-0.0426	-0.2792
	4	0.0055	0.0498	0.7187***	-0.0346
AUS	3	0.0054	-0.0217	0.2269	-0.3918
	4	0.0086	0.1904***	0.7976***	-0.6272

the periods are 1: 1926-1950, 2: 1950-1973, 3: 1973-1994 and 4: 1994-2016
*significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. The data is adjusted for HAC Newey-West. The dependent variable refers to the return on the named stock market.

Table 32: Results Regression 3 exc. GDP - SOI

Stock market	Alpha	Niño	Niña	Energy	Non-energy	Trade
MSCI	0.0328*** (0.0102)	-0.0003 (0.0146)	0.0059 (0.0203)	-0.0378 (0.0368)	0.2805 (0.1728)	-0.6063* (0.3178)
S&P	0.0166 (0.0109)	0.0045 (0.0227)	0.0077 (0.0319)	-0.0266 (0.0635)	0.3195** (0.1599)	-0.0070 (0.3040)
USA	0.0220*** (0.0082)	0.0178 (0.0143)	0.0161 (0.0163)	-0.0341 (0.0387)	0.2002* (0.1194)	-0.4873** (0.2351)
NZL	0.0254* (0.0137)	-0.0019 (0.0200)	-0.0217 (0.0385)	0.0732 (0.0773)	0.4849*** (0.1823)	-0.4174 (0.3989)
NLD	0.0306** (0.0124)	-0.0014 (0.0194)	-0.0200 (0.0310)	0.0067 (0.0558)	0.4678** (0.1810)	-0.6944** (0.2902)
JPN	0.0202 (0.0128)	-0.0065 (0.0269)	-0.0280 (0.0252)	-0.0814 (0.0530)	0.2330* (0.1294)	-0.1108 (0.2707)
ITA	0.0340* (0.0191)	-0.0238 (0.0330)	-0.0318 (0.0359)	-0.0910 (0.0647)	0.5877*** (0.1901)	-0.3329 (0.4302)
FRA	0.0343** (0.0169)	-0.0215 (0.0223)	-0.0275 (0.0334)	-0.0371 (0.0601)	0.4321** (0.1977)	-0.3627 (0.4344)
DEU	0.0187 (0.0145)	-0.0082 (0.0211)	-0.0084 (0.0300)	-0.0311 (0.0427)	0.3287* (0.1781)	-0.2973 (0.2959)
AUS	0.0318* (0.0170)	-0.0072 (0.0222)	-0.0150 (0.0318)	0.0335 (0.0535)	0.5500*** (0.1961)	-0.6408 (0.4939)

*significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. The data is adjusted for HAC Newey-West. The dependent variable refers to the return on the named stock market. For the USA, the data span is 1950-2016, for the S&P 500 & the NZL 1988-2016 and for the other markets the data span is 1973-2016.

Table 33: Results Regression 3 exc. GDP - ONI

Stock market	Alpha	Niño	Niña	Energy	Non-energy	Trade
MSCI	0.0378*** (0.0104)	0.0025 (0.0167)	0.0014 (0.0142)	-0.0362 (0.0351)	0.2775 (0.1746)	-0.5973* (0.3231)
S&P	0.0219* (0.0116)	0.0027 (0.0211)	-0.0205 (0.0173)	-0.0209 (0.0659)	0.3205** (0.1610)	0.0245 (0.2969)
USA	0.0257*** (0.0087)	0.0016 (0.0120)	0.0022 (0.110)	-0.0315 (0.0371)	0.1989 (0.1211)	-0.4873** (0.2275)
NZL	0.0363** (0.0153)	-0.0008 (0.0210)	-0.0648*** (0.0214)	0.0867 (0.0802)	0.4721*** (0.1739)	-0.3090 (0.3838)
NLD	0.0333** (0.0129)	0.0015 (0.0166)	-0.0288 (0.0185)	0.0087 (0.0556)	0.4628*** (0.1763)	-0.6524** (0.2753)
JPN	0.0230 (-0.0128)	-0.0128 (0.0223)	-0.0169 (0.0230)	-0.0856 (0.0522)	0.2419* (0.1278)	-0.1307 (0.2937)
ITA	0.0458** (0.0222)	-0.0290 (0.0297)	-0.0603*** (0.0213)	-0.0852 (0.0628)	0.5990*** (0.1913)	-0.2890 (0.4011)
FRA	0.0373* (0.0187)	-0.0147 (0.0203)	-0.0300 (0.0235)	-0.0363 (0.0597)	0.4373** (0.1943)	-0.3452 (0.4237)
DEU	0.0254 (0.0164)	-0.0125 (0.0198)	-0.0303 (0.0184)	-0.0263 (0.0418)	0.3326* (0.1760)	-0.2654 (0.2804)
AUS	0.0382** (0.0173)	-0.0076 (0.0222)	-0.0381* (0.0214)	0.0389 (0.0514)	0.5492*** (0.1918)	-0.5896 (0.4719)

*significant at the 10%-level; **significant at the 5%-level; ***significant at the 1%-level. The data is adjusted for HAC Newey-West. The dependent variable refers to the return on the named stock market. For the USA, the data span is 1950-2016, for the S&P 500 & the NZL 1988-2016 and for the other markets the data span is 1973-2016.