Scottish independence referendum: Risky or not?

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Abstract

On September 18th, 2014, with a historic 84.7% turnout, Scottish voters declared their wish to stay as part of the UK with 55.3% No versus 44.7% Yes votes. During the period that leads to the referendum both sides made financial and economic claims that effected the actual outcome. Even the European Union, afraid of a contagious independence bid, supported this fear campaign. Financial markets reflect changes in risk. We provide evidence that Scottish independence referendum played a part in sending markets lower. However, evidence is clear that market risk is lower during and after the campaign and actual referendum periods. The referendum, according to the empirical financial evidence, not only did not increase financial risk, it actually lowered it.

Keywords: Scotland, referendum, market volatility, market risk

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1 Introduction

Scotland as part of the United Kingdom of Great Britain (UK) had a referendum for independence on September 18th, 2014. The recent referendum witnessed a special argument about economic consequences of Scottish independence. At the time, UK was part of the European Union even though it was never part of the Eurozone, along with Denmark, through formal agreements. UK is a NATO member and holds a seat at the United Nations Security Council (UNSC).

Opponents of the Scottish independence, “Better Together” campaign, emphasized the possibility of financial and economic threats of such separation. They also pointed out that a Yes vote may trigger more calls for independence in other parts of the UK, i.e. Wales. Possible spillovers may further erode the UK’s standing on international stage. As a result, the UK may not be able to retain its seat at UNSC (Chikhoun, 2015; Mullen, 2014; Antunes, 2015; McGarvey, 2015; Flamini, 2013).

From the economic perspective, it was argued that the revenues from North Sea’s oil and gas would not be sufficient for independent Scotland. Scottish economy would be fragile and volatile. For the UK, similar economic threats existed. Kirshner (2014) argues that UK would lose tax revenues, especially from oil sales originating from Scotland. Both sides would end up in a financially and economically worse situation. Accordingly, social services such as NHS would be at risk. A few financial institutions supported these financial catastrophe claims and threatened to move their headquarters to England (i.e. Bank of Scotland and Lloyds Bank).

“Yes Scotland” campaign argued that Scotland would continue using the British pound, retain its membership to EU and NATO. All of these arguments were swiftly rejected by the “Better Together” campaign. Even the deposit insurance scheme was called to question for independent Scotland which would actually increase the banking risk not only for Scotland but also for the remaining UK. “Better Together” campaign found support from EU member countries who quickly set forth the requirements for independent Scotland to “apply” to the EU for a new membership. Isolation of independent Scotland was voiced from all international fronts.

We posit that the Scottish independence referendum was influenced by economic and financial and political fear campaign that was lead by the “Better Together” and supported by the EU member countries that face similar independence calls, such as Catalonia in Spain, Walloons and Flemish in Belgium. We further argue that if the economic and financial worries were justified then the financial markets would reflect this increase in risk during the referendum, especially at times when “Yes Scotland” gained momentum. It would be natural to expect an increase in risk for financial markets to reflect the risk Scottish independence posed for the entire United Kingdom.

Evaluating the volatility of equities traded in the UK and the volatility of the British pound for the period before, during and after the Scottish independence referendum, we find that risk actually is lower during the referendum period. While
the risk is lower after the referendum (compared to before), indicating some relief because of the outcome, risk was lower during the referendum compared to before and after. This evidence is contrary to the claims that independent Scotland posed a significant danger to the financial wellbeing of the UK.

The study is presented through following sections. Next section provides the historical background of the referendum as well as the important events and arguments about the referendum. Data definition and sources are provided in the third section. Econometric model and empirical results are provided in the fourth section. Concluding remarks finalize the study. Appendix includes the figures and tables to provide estimation results.

2 Scottish independence and the referendum

History witnessed many ebbs and flows in Scotland’s status as an independent state. Scotland made its appearance in international stage as an independent state in early middle ages. It maintained its status as an independent state until the Act of Union, 1707 (McGarvey, 2015; Mullen, 2014; Flamini, 2013; Campbell, 2013). With this act, Scotland and England emerged as United Kingdom of Great Britain. The treaty abolished Scottish Privy Council. A new parliament was established to which representatives from Scotland would join. Scotland started to pay taxes to the English. In the meantime, the treaty allowed Scotland to keep its separate legal system, educational institutions, the Church of Scotland and its local governing systems intact (McGarvey, 2015; Mullen, 2014; Flamini, 2013). So, even though the Act of Union legally united two separate kingdoms into one, by keeping these institutions, Scotland succeeded to develop its own civic society which eventually led the way for a distinct political system. The Scottish Office which was founded in 1885, further strengthened Scotland’s administrative powers (McGarvey, 2015; Mullen, 2014; Flamini, 2013).

Founded in 1934, Scottish National Party (SNP) primarily aimed to gather diverse groups for independence under one umbrella. Independence movements in Scotland, Wales and Northern Ireland, got their fair share from the rise of nationalism all around the world. This development led SNP to win its first parliamentary seat in 1967 elections (Mullen, 2014). Conservative UK government responded to SNP’s win by establishing the Kilbrandon Commission (Mullen, 2014). Conservative government did act on the commission’s final report. 1970s witnessed the discovery of oil in the North Sea which is labeled as “Scotland’s oil” by SNP. In 1974 general elections, SNP increased its one seat to seven seats (McGarvey, 2015). Labor government answered to the rise of SNP’s electoral support by legislating a bill to establish a new Scottish parliament and devolution of more power, subject to a referendum. Referendum was held on March 1, 1979 resulting 51.6% Yes vote in support. However, Yes vote failed to meet the threshold which requires 40% of the registered voters to
vote Yes (Antunes, 2015; Mullen, 2014; Tierney, 2015; McGarvey, 2015). When the Conservative Party came to power in 1979, they revoked the Labor Government’s bill and shelved the idea of devolution. Conservative government’s total dismiss of more devolution for Scotland resulted the erosion of electoral support for the Conservative Party in Scotland between 1979 and 1997 (Mullen, 2014; McGarvey, 2015).

A Scottish Constitutional Convention (SCC) was founded in 1989 by major Scottish political parties and several institutions which were produced by Scottish civic society which has been cultivating since the 1707 Act of Union. SNP did not take a part in the Convention and all other Scottish parties joined in SCC (Mullen, 2014; McGarvey, 2015). SCC called for the establishment of a Scottish Parliament. Their call is answered when the Labor Party won a landslide victory in UK General Elections in 1999. After the Labor Party formed the government, Labor majority parliament passed the Scotland Act 1998. It is decided that the Scottish electorate should be asked in a referendum whether they wish to see the establishment of a new Scottish Parliament (Mullen, 2014; McGarvey, 2015). The three major Scottish parties’ close cooperation, unlike first referendum in 1979, reflected on the numbers of voter turnout and Yes vote. Referendum was held in September 1997. This time Yes vote for the establishment of a Scottish parliament won by a decisive 74.3% with a voter turnout 60.2%. A Scottish Parliament with more legislative powers and tax varying powers came to life in 1999 (Flamini, 2013; Cairney, 2015; Antunes, 2015; Mullen, 2014; McGarvey, 2015).

SNP became the largest party in the Scottish Parliament after winning the largest number of seats in May 2007 elections (Mullen, 2014; McGarvey, 2015). As a result, SNP formed a minority government. SNP’s gain of overall majority of seats in the Scottish Parliament (69 out of 129 seats) in 2011 elections gave SNP a chance to put its demand for independence on a ballot (Mullen, 2014). In November 2009, SNP government issued a White Paper, declaring their intention for a referendum (Tierney, 2015). Cairney (2015) argues that the referendum was the result of SNP’s ability to evolve and adapt over time. He argues that SNP adjusted well to the gradually changing electoral landscape. First, it used Devolution as a stepping stone to widen its electoral support. Then, forming a minority government it showed that its ability and capability to govern. Cairney (2015) argues that SNP’s 2011 victory, winning the majority in the Scottish Parliament, was the result of “how ’mainstream’ the SNP has become” (pp.190). The British government accepted SNP government’s referendum proposal. Negotiations regarding issues such as i) whether the Scottish government has the power to call for a referendum, or ii) whether the 16 years olds should be given right to vote started between Scottish First Minister Alec Salmond and the British Prime Minister David Cameron. Negotiations resulted in the Edinburgh Agreement in October 2012 (Mullen, 2014). After long discussions about the wording, it is agreed upon that i) there should be one simple question “Should Scotland be an independent country” and ii) proposed referendum should be held before
the end of 2014 (Campbell, 2013; Chikhoun, 2015; Tierney, 2015; Flamini, 2013; Mullen, 2014; McGarvey, 2015; Antunes, 2015).

The official referendum campaign started in April, 2014. However, both “Yes Scotland” and “Better Together” campaigns were launched in May 2012 and June 2012, respectively (Mullen, 2014; Antunes, 2015; McGarvey, 2015). Yes Scotland and Better Together campaigns portrayed different pictures in terms of the opportunities and the risks that an independent Scotland’s future might hold. Several issues were debated at length by two campaigns. However, the revenues from the North Sea Oil and Gas, membership to the EU, the continuation of pound as their currency and the financial stability of an independent Scotland remained as the core issues. Yes campaign developed into a social movement by mobilizing the 16 and 17 year olds who were given the right to vote for the first time. Meanwhile, Better Together campaign relied more on the political elite of Westminster (Antunes, 2015). Yes Scotland campaign argued that the North Sea Oil and Gas revenues would support the economy of an independent Scotland. Moreover, an independent Scotland would move nuclear weapons from its soil and would reduce its military spending. These funds would be used for better education and health services. Better Together campaign insisted that other than a short term relief, these revenues would not be able to support a sustainable economy. Kirshner (2014) argues that Scottish economy may become “heavily dependent on this investment-intensive and volatile industry”. The rest of the UK, meanwhile, would lose its tax revenues from oil sales (Kirshner, 2014). From the early stages of the campaign, SNP announced their intention of keeping the pound as the currency of independent Scotland through a formal monetary union with the UK. All three major, also unionist, parties in Westminster voiced their opposition to this idea. SNP’s proposition created a dilemma (Antunes, 2015; Campbell, 2013).

First, as the currency regulator for pound, Bank of England would be involved in the independent Scotland’s currency if they were to keep the pound. “However, as the Bank of England is an institution of the UK, this would require the full support and the participation of the rest of the UK” (Antunes, 2015, pp. 53). In a similar line, Campbell (2013) also questions the submission of financial affairs of Scotland to UK, from which Scotland is voting to part.

Secondly, if independent Scotland would be able to retain its membership to the EU, it would have to adopt Euro as its currency as all new members are required to do so. UK and Denmark were allowed to opt out in the past. However, EU officials were clear about EU’s unwillingness for future opt-outs. Campbell (2013) argues that SNP’s insistence on keeping pound as independent Scotland’s currency while retaining its EU membership which requires new members to adopt Euro resulted an inconsistency for their bid for independence. In turn, this inconsistency damaged Yes votes.

In terms of EU membership, Yes Scotland campaign expected that independent Scotland should preserve its membership to the EU. Nicola Sturgeon, Scotland’s first
deputy minister at the time, said “we are going to be simply arguing for a transition from membership as a part of the UK membership as an independent country” (Flamini, 2013, pp. 60). Worrying about the spillover effects of independent Scotland over other parts of Europe, Catalonia in Spain, Wallons and Flemish in Belgium, EU officials made it clear that automatic transition was not an option. In case of independence, Scotland would have to go back in the line to start over by making an official application. Even if automatic transition were technically possible, that transition would require an approval from all EU members, including the rest of the UK and Spain that has been under the pressure for Catalan and Basque independence for decades (Flamini, 2013; Antunes, 2015; ?; Campbell, 2013). Chikhoun (2015) concludes “Thus, the political position was clear in Brussels; a newly independent Scottish state would have to undergo, in the best case scenario, a long and quite complex application process…” (pp. 206).

In terms of the financial stability of an independent Scotland, Kirshner (2014) argues “it seems that a decision to secede would have a complicated and undesirable financial impact” for both Scotland and the rest of the UK. An Independent Scotland would have to establish a new financial regulatory office and a central bank. A possible currency crisis would increase the risk of capital flight. Also, questions about the division of UK public debt between independent Scotland and the rest of the UK, increased credit risk and investor risk would threaten public services such as pensions and NHS. As a result, an independent Scotland may end up in a worse financial position. On the whole, however, Kirshner (2014) argues that the break-up of the union would hurt Scotland, financially and politically.

Chikhoun (2015) makes a different argument. Accordingly, it was absolutely vital for the UK to keep Scotland in the union. An independent Scotland would further diminish the UK’s declining status in international politics. Maintaining its vetoing seat at UNSC would become questionable. In sum, McGarvey (2015) argues “in a sense, Yes Scotland were outlining the benefits of a divorce -a fresh start, and the possibility of redefining the relationship- while Better Together were outlining its negatives - cost, finality, pain”.

Yes vote, for Independent Scotland, took the lead in You.gov polls for the first time, albeit for a short time, on September 5th (Antunes, 2015; McGarvey, 2015; Cairney, 2015). Bank of Scotland and Lloyds Bank announced1 that they would remove their headquarters to London in case of a Yes victory, on September 11th (Chikhoun, 2015). Yes vote’s short-lived lead resulted in three unionist parties in Westminster, announcing “the Wow” on September 16th, two days before the referendum. The Wow was a pledge signed by the leaders of three parties, to devolve even more powers to the Scottish parliament on taxing, spending and welfare (Mullen, 2014; McGarvey, 2015; Antunes, 2015; Chikhoun, 2015; Tierney, 2015; Cairney, 2015). On

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September 18th, 2014, with a historic 84.7% turnout, Scottish voters declared their wish to stay as a part of the UK with 55.3% No votes versus 44.7% Yes votes.

Data

The purpose of the study is to evaluate the the impact of the Scottish independence referendum on the financial markets, especially on the financial risk. For this purposes several financial securities are tested including FTSE index, EWU exchange traded fund (ETF), S&P-500 index, VIX index, BPVIX index, GBP index and GBP/USD foreign exchange rate. FTSE refers to the “Financial Times Stock Exchange 100 Index”, EWU refers to the “iShares MSCI United Kingdom ETF” and S&P-500 refers to the “Standard and Poor’s 500 index”. Daily values (opening, closing, high and low) for FTSE, EWU and S&P-500 are obtained from Yahoo! Finance and confirmed with Google finance. VIX refers to the “CBOE Volatility Index” (implied volatility) for the S&P-500 index and BPVIX refers to the “CBOE/CME FX British Pound Volatility Index” (implied volatility) for the GBP/USD foreign exchange rate. Both VIX and BPVIX daily values are obtained from Chicago Board Options Exchange. GBP index refers to the trade weighted British pound and obtained from Bank of England. GBP/USD refers to the foreign exchange rate for the number of US dollars to one British pound and obtained from Federal Reserve Bank of St. Louis. Variables and their notations used throughout this study are provided in Table 1.

Since we are comparing the financial risk before and after the referendum, dates that are considered to be the referendum period are important. Accordingly, referendum period is taken to be between May 1st, 2012 and September 18th, 2014. Sample period is restricted to start from May 1st, 2009 to ensure balanced comparisons. Two binary variables are created. Before is assigned a value of one for trading dates that are before the referendum period and zero otherwise. After is assigned a value of one for trading dates that are after the referendum period and zero otherwise. Trading days that fall “during” the referendum period is left to be controlled with the constants in the estimations to avoid dummy variable trap.

Figure A.1 provides the charts for daily closing values for FTSE index, EWU ETF, GBP index and GBP/USD foreign exchange rate. Each chart includes a vertical marker line to show the beginning and the end of the referendum period. We note that while equities (FTSE and EWU) are on an increasing course, currency value of

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2Available via http://finance.yahoo.com
3Available via http://google.com/finance
5Available via http://www.bankofengland.co.uk/
6Available via https://fred.stlouisfed.org/series/DEXUSUK
the GBP is decreasing. Although the drop in the value of the trade weighted GBP index (part c) appear to be much later than the referendum ending date, the drop in the GBP/USD exchange rates corresponds to the end of the referendum period.

Econometric models and empirical results

The econometric analysis is done in two parts. First, we analyze the daily returns and monthly standard deviations using simple unpaired t-tests. This is primarily to test whether what we perceived on the charts have any statistical merit. Differences in daily returns would show us that the overall markets were impacted positively or negatively by the referendum. Differences in monthly standard deviations would show us that the market overall became riskier or less risky after the referendum.

The second step in our analysis is more formal and controls for variables that are likely to effect the results of the simple t-tests. If there is no evidence of difference in t-tests then there is no need to estimate the formal models. However, if there is evidence in t-tests and the evidence may be because of other variables, not necessarily the referendum, and therefore require further analysis. With the second step, we control for the effect of S&P-500 (in returns and in risk) as well as British equities and pound. Multiple risk measure provide further robustness to the results.

Table A.1 provides the simple unpaired t-test results for comparison of daily returns before, during and after the referendum period. There is not enough statistical evidence to differentiate daily returns for periods before, during and after the referendum. This is the case for all four variables tested: equities as well as the British pound value. While we note the apparent drop in British pound value versus the US dollar after the referendum period, this is not evident on daily returns based on statistical analysis.
Unpaired t-test results for monthly standard deviations of daily returns are provided in Table A.2. Interestingly, we find that the monthly standard deviations are greater for periods before and after the referendum period compared to the referendum period itself. In other words, FTSE, EWU and GBP were all less risky during the referendum period compared to the periods before and after the referendum. In fact, evidence points to lower risk for equities (FTSE and EWU) after the referendum. While the risk is lower during the referendum for GBP, it is virtually the same after the referendum as it was before the referendum. This result is important because it provides evidence for our hypothesis that the Scottish independence referendum had a positive effect on financial markets by lowering volatility (risk).

At this point, given the t-test evidence, we feel the need to test the effect of the referendum using an econometric model where we can control for relevant variables that may otherwise explain the lower risk after the referendum. Since the variable of interest is risk, a common GARCH model is estimated following Engle (1982) and Bollerslev (1986). Hansen and Lunde (2005) is followed for the ARCH and GARCH lag lengths and accordingly chosen to be one.

The GARCH(1,1) model is estimated for the implied volatility index for the British pound (BPVIX) as follows:

\[
\Delta BPVIX_d = \beta_0 + \beta_1 \text{Before}_d + \beta_2 \text{After}_d + \beta_3 \Delta \text{SP500}_d + \beta_4 \Delta \text{VIX}_d + \epsilon_d
\]

\[
\sigma^2_d = \alpha_0 + \alpha_1 \epsilon^2_{d-1} + \alpha_2 \sigma^2_{d-1} \text{ where } \epsilon_d | \delta_{d-1} \sim N(0, \sigma^2_d)
\]

With this model, we control for the S&P500 daily returns as a general market model as well as for the implied volatility index for the S&P-500 index. As S&P-500 is one of the most influential international equity index, its effect on the British pound and its implied volatility is expectedly significant. Thus, we control for the return as well as its implied volatility within the model for the British pound implied volatility.

The results of the estimation of Equation 1 are provided in the first data column (with the column heading $\Delta BPVIX_d$) of Table A.3. The two binary variables, before and after, are statistically insignificant. Similar to the t-test results, referendum did not have an impact on the risk levels of the British pound. While the pound may have gone lower, its risk is not effected by the referendum in a statistically significant manner. As expected, S&P-500 has a statistically significant effect on the British pound, both in terms of returns (at 10%) and of implied volatility (at 1%).

The second estimation for the financial risk depends on a measure that utilizes daily high and low values. The intraday range, notated here as $\Phi$, is the ratio of daily high value over the daily low value. It is based on the high-low ratio used by Alizadeh et al. (2002). High-low ratio provides an efficient volatility estimate that is on a daily frequency instead of the monthly standard deviation we previously calculated. Thus, it contains much more information compared to a monthly standard deviation of daily returns. It is quite popular in financial technical analysis and forecasting models.
The second GARCH model is estimated for $\Phi_{FTSE}$ as follows:

$$\Phi_{FTSE_d} = \beta_0 + \beta_1 Before_d + \beta_2 After_d + \beta_3 \Delta SP500_d + \beta_4 \Phi_{SP500_d}$$
$$+ \beta_5 \Delta FTSE_d + \epsilon_d$$
$$\sigma^2_d = \alpha_0 + \alpha_1 \epsilon^2_{d-1} + \alpha_2 \sigma^2_{d-1} \text{ where } \epsilon_d|\delta_{d-1} \sim N(0, \sigma^2_d)$$

The same GARCH model is estimated for $\Phi_{EWU}$ as follows:

$$\Phi_{EWU_d} = \beta_0 + \beta_1 Before_d + \beta_2 After_d + \beta_3 \Delta SP500_d + \beta_4 \Phi_{SP500_d}$$
$$+ \beta_5 \Delta EWU_d + \epsilon_d$$
$$\sigma^2_d = \alpha_0 + \alpha_1 \epsilon^2_{d-1} + \alpha_2 \sigma^2_{d-1} \text{ where } \epsilon_d|\delta_{d-1} \sim N(0, \sigma^2_d)$$

For both of the Equations 3 and 5, the effect of S&P-500 is controlled by including daily S&P-500 returns and daily S&P-500 high-low ratio as independent variables. We also control for the daily corresponding market returns for each of the models. The results for Equations 3 and 5 are provided in Table A.3 in the second and third data columns, respectively. Both models have statistically significant (at 1%) Before and After binary variables. This important result is interesting as the coefficient is higher for Before compared to After for both models. Thus, the high-low range for FTSE and EWU is lower after the referendum period compared to the period before the referendum. The sample is divided into three parts: before, during and after. Each model omits the period in which referendum is taking place (debates and the actual referendum) which we refer to as during. Thus, the coefficient for Before and After variables are their effects on high-low range compared to During. It is quite evident that Before is greater than After which points to higher high-low range (higher volatility) before the referendum (or lower high-lo range after the referendum). We further confirm the effect of S&P-500 on British equities through daily returns as well as daily high-low range. It is interesting to note that the effect of S&P-500 returns is negative for EWU and positive for FTSE. We speculate that this sign change is due to the time zone difference between FTSE and EWU as FTSE is an index traded in UK and EWU is an ETF traded in the US.

As a final robustness check for our results, we further test another daily volatility estimate: intraday standard deviation of daily high, low, opening and closing values. Several studies use intraday high, low, opening and closing values as a volatility estimator (i.e. Parkinson, 1980; Garman and Klass, 1980; Rogers and Satchell, 1991; Rogers et al., 1994). Intraday standard deviation uses four intraday values compared to two that are used by the high-low ratio. Thus, it incorporates more information compared to the high-low range.

The GARCH(1,1) model for the intraday standard deviations for FTSE and EWU are as follows:
\[
\sigma_{FTSE_d} = \beta_0 + \beta_1 \text{Before}_d + \beta_2 \text{After}_d + \beta_3 \Delta SP500_d + \beta_4 \sigma SP500_d \\
+ \beta_5 \Delta FTSE_d + \epsilon_d 
\]  
(7)

\[
\sigma^2_d = \alpha_0 + \alpha_1 \epsilon^2_{d-1} + \alpha_2 \sigma^2_{d-1} \text{ where } \epsilon_d|\delta_{d-1} \sim N(0, \sigma^2_d) 
\]  
(8)

\[
\sigma_{EWU_d} = \beta_0 + \beta_1 \text{Before}_d + \beta_2 \text{After}_d + \beta_3 \Delta SP500_d + \beta_4 \sigma SP500_d \\
+ \beta_5 \Delta EWU_d + \epsilon_d 
\]  
(9)

\[
\sigma^2_d = \alpha_0 + \alpha_1 \epsilon^2_{d-1} + \alpha_2 \sigma^2_{d-1} \text{ where } \epsilon_d|\delta_{d-1} \sim N(0, \sigma^2_d) 
\]  
(10)

Final two columns of the Table A.3 provide the results for the Equations 7 and 9, respectively. The results for these estimations provide further confirmation to the hypothesis that after the referendum financial risk has gone down. The coefficients for After for both models are lower than the coefficients for Before. They are all statistically significant at 1%. In fact, for the EWU, the coefficient for After is negative.

**Concluding remarks**

The 2014 referendum for the independence of Scotland from the UK was cause of campaign for about two years. During this time, both sides of the referendum argued cultural, political, military, economic and financial reasons for separation and for staying together. It is interesting however that “Better Together” campaign resorted to economic and financial fear tactics. It was argued that Scotland in specific and UK in general would be worse off financially if they were to separate. EU, worried about contagion of independence demands, supported the fear campaign. EU membership, use of British pound, losing large national banks to England, tax revenues, oil revenues all played part in this fear campaign.

In this study, we posit that this fear campaign was targeted towards voters and it was baseless. If it had any foundation, financial markets would reflect such risk and volatilities would increase. The financial risk however is lowest during the referendum campaign compared to before and after periods. It can be argued that the financial markets never really believed that the referendum could favor independent Scotland. Nevertheless, the polls before the actual referendum were all very close to call. At times, the Yes campaign was leading the No side. Also, the risk actually went down during the referendum campaigns. It is hard to believe that financial markets had the certainty about the referendum result.

It is interesting to note that risk is actually lower after the referendum compared to before. Thus, whatever anxiety existed because of the referendum was relieved after the referendum result. However, the fact that the financial risk was lower during
the referendum points to unjustified nature of the financial fear campaign conducted by the “Better Together” side.

Based on our results, it would be interesting to explore the impact of Scottish independence referendum on the countries that have their own independence demands such as Spain and Belgium.

References


A Tables and Figures

(a) FTSE

(b) EWU

(c) GBP index

(d) GBP/USD

Figure A.1: Daily closing values for FTSE index, EWU ETF, GBP index and GBP/USD foreign exchange rate.

Table A.1: T-test of equality \((x - y \neq 0)\) results for daily returns. Daily returns for the period before, during and after the Scottish independence referendum are compared. Referendum period is between May 1st, 2012 and September 18th, 2014. Sample is restricted to start from May 1st, 2009 to ensure balanced comparisons. FTSE refers to the “Financial Times Stock Exchange 100 Index”. EWU refers to the “iShares MSCI United Kingdom ETF”. GBP-Ind refers to the trade weighted British pound. GBP/USD refers to the foreign exchange rate for the number of US dollars to one British pound. *, ** and *** refer to statistical significance at the 10%, 5% and 1% respectively.

<table>
<thead>
<tr>
<th></th>
<th>x</th>
<th>t</th>
<th>x Mean</th>
<th>x SD</th>
<th>N_x</th>
<th>t-stat</th>
<th>x &lt; 0</th>
<th>x \neq 0</th>
<th>x &gt; 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\Delta FTSE) Before</td>
<td>0.0002</td>
<td>1.0441</td>
<td>739</td>
<td>0.0158</td>
<td>0.5321</td>
<td>586</td>
<td>0.2611</td>
<td></td>
<td></td>
</tr>
<tr>
<td>During</td>
<td>0.0212</td>
<td>0.9822</td>
<td>685</td>
<td>0.0158</td>
<td>0.7321</td>
<td>586</td>
<td>0.1099</td>
<td></td>
<td></td>
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<tr>
<td>After</td>
<td>0.0302</td>
<td>1.1641</td>
<td>739</td>
<td>0.0212</td>
<td>0.9822</td>
<td>685</td>
<td>0.1572</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\Delta EWU) Before</td>
<td>(-0.0080)</td>
<td>1.1986</td>
<td>675</td>
<td>0.0344</td>
<td>0.8541</td>
<td>578</td>
<td>0.6931</td>
<td></td>
<td></td>
</tr>
<tr>
<td>During</td>
<td>(-0.0080)</td>
<td>1.1986</td>
<td>675</td>
<td>0.0344</td>
<td>0.8541</td>
<td>578</td>
<td>0.6931</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After</td>
<td>(-0.0080)</td>
<td>1.1986</td>
<td>675</td>
<td>0.0344</td>
<td>0.8541</td>
<td>578</td>
<td>0.6931</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\Delta GBP) Before</td>
<td>(-0.0094)</td>
<td>0.6066</td>
<td>739</td>
<td>0.0081</td>
<td>0.3284</td>
<td>588</td>
<td>0.0144</td>
<td></td>
<td></td>
</tr>
<tr>
<td>During</td>
<td>(-0.0094)</td>
<td>0.6066</td>
<td>739</td>
<td>0.0081</td>
<td>0.3284</td>
<td>588</td>
<td>0.0144</td>
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<tr>
<td>After</td>
<td>(-0.0094)</td>
<td>0.6066</td>
<td>739</td>
<td>0.0081</td>
<td>0.3284</td>
<td>588</td>
<td>0.0144</td>
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<tr>
<td>(\Delta GBP/USD) Before</td>
<td>(-0.0245)</td>
<td>0.6679</td>
<td>666</td>
<td>0.0116</td>
<td>0.3958</td>
<td>577</td>
<td>0.0868</td>
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<tr>
<td>During</td>
<td>(-0.0245)</td>
<td>0.6679</td>
<td>666</td>
<td>0.0116</td>
<td>0.3958</td>
<td>577</td>
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<tr>
<td>After</td>
<td>(-0.0245)</td>
<td>0.6679</td>
<td>666</td>
<td>0.0116</td>
<td>0.3958</td>
<td>577</td>
<td>0.0868</td>
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Figure A.2: Monthly standard deviations of daily returns for FTSE index, EWU ETF, GBP index and GBP/USD foreign exchange rate.

Table A.2: T-test of equality \((x - y \neq 0)\) results for monthly standard deviation of daily returns.

Monthly standard deviations of daily returns for the period before, during and after the Scottish independence referendum are compared. Referendum period is between May 1st, 2012 and September 18th, 2014. Sample is restricted to start from May 1st, 2009 to ensure balanced comparisons. FTSE refers to the “Financial Times Stock Exchange 100 Index”. EWU refers to the “iShares MSCI United Kingdom ETF”. GBP-Ind refers to the trade weighted British pound. GBP/USD refers to the foreign exchange rate for the number of US dollars to one British pound. *, ** and *** refer to statistical significance at the 10%, 5% and 1% respectively.
Table A.3: **GARCH(1,1) estimation results.** Sample is restricted to start from May 1\(^{st}\), 2009 to ensure balanced comparisons. Referendum period is between May 1\(^{st}\), 2012 and September 18\(^{th}\), 2014. Before\(_d\) refers to the trading days before the Scottish independence referendum period. After\(_d\) refers to the trading days after the Scottish independence referendum period. Δ refers to the log difference of daily closing values. Φ refers to the log difference of daily high and daily low. σ refers to the intraday standard deviation of daily high, low, open and close values. SP500 refers to the S&P-500 index. FTSE refers to the “Financial Times Stock Exchange 100 Index”. EWU refers to the “iShares MSCI United Kingdom ETF”. VIX refers to the implied volatility index for the S&P-500 index. BPVIX refers to the implied volatility index for the GBP/USD foreign exchange rate. *, ** and *** refer to statistical significance at the 10%, 5% and 1% respectively.

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<th>ΔBPVIX(_d)</th>
<th>ΦFTSE(_d)</th>
<th>ΦEWU(_d)</th>
<th>σFTSE(_d)</th>
<th>σEWU(_d)</th>
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<td>0.296 ***</td>
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<td>(0.218)</td>
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<td>(0.021)</td>
<td>(0.783)</td>
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<tr>
<td>After(_d)</td>
<td>-0.160</td>
<td>0.182 ***</td>
<td>0.088 ***</td>
<td>3.154 ***</td>
<td>-0.023 ***</td>
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<td>(0.023)</td>
<td>(0.021)</td>
<td>(0.755)</td>
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<tr>
<td>ΔSP500(_d)</td>
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<td>-0.052 ***</td>
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<td>0.692 ***</td>
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<td>(0.008)</td>
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<td>σSP500(_d)</td>
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<td>0.013 ***</td>
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<td>(0.047)</td>
<td>(0.000)</td>
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<td>(0.288)</td>
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<td>ΔEWU(_d)</td>
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<td>0.004 **</td>
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<td>(0.009)</td>
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<td>ΔVIX(_d)</td>
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<td></td>
<td>(0.019)</td>
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<td>(0.154)</td>
<td>(0.020)</td>
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<td>(0.781)</td>
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**ARCH**

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<tr>
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<td>0.009 ***</td>
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<td>(0.017)</td>
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<td>χ(^2)</td>
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<td>N</td>
<td>1900</td>
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