Could the result of the Brexit vote be explained by changes in economic variables?

An analysis of economic variables by NUTS 2 regions

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Instructor: Gylfi Zoega

Faculty of Economics

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Thesis for a BS degree in Economics

Instructor: Gylfi Zoega

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School of Social Sciences at the University of Iceland

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This thesis is a 12 credit thesis in my final assignment for a BS degree in Economics at the Faculty of Economics, School of Social Sciences of the University of Iceland.

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Preface

The thesis *Could the result of the Brexit vote be explained by changes in economic variables?* is a 12 ETCS credit project as a final assignment for the author's BS degree in Economics at the Faculty of Economics of the University of Iceland.

The instructor for this thesis was Gylfi Zoega, economics professor at the University of Iceland. The author wants to use this opportunity to express gratitude to the instructor for helpful input and feedback on this thesis and valuable guidance. Also, the author wants to extend gratitude to Agust Arnorsson for advice on data collection on economic and demographic variables and to her parents for proof-reading and advice.
Abstract

On June 23rd 2016, the British electorate voted to leave the European Union in a referendum on the United Kingdom’s membership of the EU, nicknamed Brexit for a British exit. I analysed economic variables by NUTS 2 regions in a quest to answer the question “Could the result of the Brexit vote be explained by changes in economic variables?”. Using OLS regressions on regional economic variables, I found that variables like development of unemployment during 2006 to 2015, disposable income of private households during 2004 to 2013 and GDP per capita from 2006 to 2015 certainly had a varying effect on the share of votes for leaving the EU in NUTS 2 regions. Growth of disposable income had a significant effect on share of votes cast in support of leaving the EU. Development of GDP per capita in NUTS 2 regions had a slight effect, while GDP per capita in 2015 had a significant effect. However, the development of the unemployment rate had only a minor effect. Furthermore, demographic and social variables like the age of voters and their level of education were influential in determining the share of votes cast for leaving the EU. Also, geographical factors and national identity had a substantial effect on voters’ choices.
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1 Introduction

On June 23\textsuperscript{rd} 2016, the British electorate voted to leave the European Union (EU) in a referendum on the countries membership in the EU, nicknamed Brexit for a British exit. The United Kingdom’s (UK) relationship with the European Union has been a special one, and the country has been a longstanding member of the union joining the European Economic Community (EEC) the precursor of the EU in 1973. Over the last couple of decades, the relationship between the UK and the EU has grown apathetic. However, in the final days running up to the referendum, many analysts and pollsters predicted the results to be for remaining in the EU.

In the time before the referendum two opposite sides emerged, the Leave camp and the Remain camp, who campaigned for either leaving or remaining in the EU. The Leave camp’s basic argument for leaving the EU was that the UK is being held back by Europe, unshackled it could prosper as an open economy that continued to trade with the EU and other countries of the world. On the other side, the Remain camp’s main arguments for staying in the EU was that the position of UK as a leading economy is stronger in the EU than alone. By leaving the EU, the UK would forego influence and power in politics and business. Furthermore, the Remain side argued that the EU would have a strong incentive to impose a harsh settlement to discourage other countries from leaving the union.

Numerous researches have been conducted on the results of the Brexit referendum and the following are a few examples. Dhingra, Ottaviano, Sampson and Reenen (2016) explored the consequences of Brexit for UK trade and living standards and concluded that the economic consequence of Brexit will depend on what policies the UK adopts following the UK leaving the EU. Becker, Fetzer and Novy (2017) researched who voted for Brexit with a comprehensive district-level analysis and found that areas with deprivation in terms of education, income and employment were more likely to vote for leaving the EU. Ashcroft (2016) surveyed approximately 12,000 voters to help explain the result, who voted for which outcome, and what reasons lay behind their decision. Dorling (2016) published findings showing amongst other how the different social classes voted, with 59% of the middle-class voting for leaving the EU and 41% of the working class voted for leaving the EU. Furthermore, research conducted by Colantone
and Staning (2016) shows that support for the leaving the EU was higher in regions of the UK that were hit harder by economic globalisation. The research focuses on the shock of surging imports from China over the past three decades. Also, Darvas (2016) found with regression analyses that income inequality and poverty boosted share of votes for leaving the EU. In addition to geographical differences and larger shares of less educated and older people in UK regions.

The primary purpose of this thesis is to seek an answer to the question “Could the result of the Brexit vote be explained by changes in economic variables?” with data acquired from Eurostat, the statistical office of the European Union and data provided by Agust Arnorsson and Gylfi Zoega. Empirical econometrics methods were used to calculate results and draw conclusions. Furthermore, this thesis is organised as follows. Section 2 introduces theoretical components and methods used in the analysis. Section 3 presents an overview of the economic environment in the UK. Section 4 shows the results of the EU referendum by geographical regions of the UK. Section 5 provides regressions with both economic, demographic and geographic variables. Section 6 introduces a regional comparison of economic variables and the results of the EU referendum. Section 7 provides a summary comparison of economic variables and referendum results. Finally, section 8 presents conclusions drawn from the empirical evidence and the referendum results.
2 Theoretical components and methods

This thesis is based on some fundamental economics and econometrics methods. The primary analysis in this thesis is based on three economic variables and ordinary least squares econometric regressions, to interpret the economic variables. The data for the analysis are derived from Eurostat, the European Commission database.

Unemployment is often viewed as a certain characteristic of a market economy. The problem of unemployment is a matter of constant concern and debate. High unemployment means that fewer individuals are working, so productivity of the market is lower than it could be. Unemployment is a source of poverty and inequality. Unemployment is measured as a percentage of the labour force, called unemployment rate (Gottfried, 2013).

When comparing standards of living between areas, it would make sense to compare disposable income per capita. In practice GDP per capita is the most common measure used to compare income levels in different areas. We should be aware that GDP per capita measure production rather than income, so it might be a misleading measure of income when there is substantial primary income or transfer to or from the rest of the world (Gottfried, 2013).

Households receive primary income in the form of wages, interest payments and dividends. From these income households pay taxes to the government and receive transfers from the government such as pensions, sickness benefits and welfare. What remains is the household’s disposable income (Gottfried, 2013).

The Gini coefficient is a measure of inequality derived from the Lorenz curve, usually applied to income or wealth inequality. The Gini coefficient is convenient in that it summarises the level of inequality in a single number between 0 and 1. Under perfect equality, the Gini coefficient is equal to zero, and with perfect inequality, the coefficient is equal to 1. Most developed countries have Gini coefficients in the range of 0,25 to 0,40 (Nechyba, 2011).

The ordinary least squares estimator chooses the regression coefficient so that the estimated regression line is a close as possible to the observed data where closeness is measured by the sum squared mistakes made in predicting Y, given X. The estimators of
the intercept and slope that minimise the sum of squared mistakes are calls the ordinary least squares estimators (Stock and Watson, 2014).

Variance inflation factors (VIF) measure how much the variance of the estimated regression coefficients are inflated as compared to when the predictor variables are not linearly related. The method is used to describe how much multicollinearity, the correlation between predictors, exists in a regression analysis. Multicollinearity is problematic because it can increase the variance of the regression coefficients, making them unstable and difficult to interpret (Minitab 17, n.d.).

The $R^2$ of the regression of $Y$ on the single repressor $X$ is the square of the correlation coefficient between $Y$ and $X$ and ranges between 0 and 1. In general, the $R^2$ does not take on the extreme values of 0 and 1 but falls somewhere in between. An $R^2$ near 1 indicates that the repressor is good at predicting $Y$, while an $R^2$ near 0 indicates that the repressor is not very good at predicting $Y$ (Stock and Watson, 2014).

The p-value can be used to make the decision for a hypothesis test by noting that if the p-value is less than the significance, $\alpha$, the value of the test statistic must be in the rejection region. Similarly, if the p value is greater than or equal to $\alpha$, the value of the test statistic is not in the rejection region (Anderson, Sweeney and Williams, 1990).
3 Overview of the economic environment in the United Kingdom

The United Kingdom has been a longstanding member of the European Union (EU). Before the United Kingdom’s (UK) referendum on the countries European Union membership held June 23rd 2016, on whether or not the UK should remain in or leave the EU, opinion polls showed that the general public was divided on the topic of the UK’s membership of the EU. Figure 1 depicts the development of opinion polls before the election and shows the shifting views of the general public over time and up until the referendum on whether or not to maintain the membership in the EU.

![Figure 1: Opinion polling for the United Kingdom European Union membership referendum (Agust Arnorsson and Gylfi Zoega, 2016)](image)

To make an analysis of the results of the Brexit vote, it would prove useful to gain an understanding of the economic environment of the UK before the election and view how the country’s economic situation has developed over time.

The United Kingdom comprises of four geographic areas: Scotland, Northern Ireland, Wales and England, each of these areas have a somewhat strong national identity. During the last decades and centuries, the UK has evolved from being an empire with many colonies to being a modern economy with the financial capital of Europe, London.
3.1 Comparison to France and Germany

3.1.1 Gini coefficients

To understand the current economic environment in the UK, it is important to view the economic development which has occurred in the country over the last decades. A useful way to do so would be to inspect the development of the Gini coefficient for the UK and measure the development in comparison to other countries. Especially it is useful to compare the performance of the UK economy to the ones of France and Germany since the three countries are the largest economies in the EU.

![Figure 2: Development of Gini coefficients for France, Germany, Italy, Spain, the United Kingdom and the EU average (Eurostat)](image)

Figure 2 depicts the development of Gini coefficients for the EU nations France, Germany, Italy, Spain, United Kingdom and the EU average over the period 2005 to 2015. The purpose of viewing the Gini coefficient is that inequality in societies can have negative effects and can even lead to public distress. Interestingly, the Gini coefficient for the UK is considerably higher than France, Germany and the EU average and the coefficient for the UK is in closer proximity to the Gini coefficients for Italy and Spain, where inequality is more widely acknowledged. The Gini coefficient for the United Kingdom is the highest out of the Gini coefficients for France, Spain, Italy, Germany and the EU Average in 2005 to 2008. From 2008 to 2013 wealth and income inequality in the
UK decreased, but has sharply risen from 2013 until now. From 2013 inequality in the UK has increased whereas it has declined in most of the EU member states.

To calculate the EU average Gini coefficient, I used the Gini coefficients for single member states of the EU. The EU member states are currently the following: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom.

3.1.2 Comparison of economic variables

During 2005 to 2013 disposable income of private households in the UK has been subject to much change, first falling considerable in 2007 to 2009 to bumpy growth from 2009 to 2013. During the same period disposable income of private households in France and Germany grew at a steadier pace. In 2013 the average UK household had a lower disposable income than households in France or Germany.

![Figure 3: Disposable income of private households, 2005 to 2013 in the UK, France and Germany (Eurostat)](image)

During 2006 to 2015 GDP per capita in the UK has also been subject to changes. Rising from 2006 to 2007 and falling from 2007 to 2009. During 2009 to 2015 GDP per capita has grown at a somewhat inconsistent rate between years. During 2006 to 2015 GDP per capita in France and Germany has risen at a steady pace without dramatic
changes. Clearly, the growth rate in the UK has not as steady as in France and Germany.

![GDP per capita in the UK, France and Germany in million euro (Eurostat)](image)

*Figure 4: GDP per capita in the UK, France and Germany in million euro (Eurostat)*

From 2006 to 2008 the unemployment rate in the UK remained almost unchanged until it grew in 2009 until 2013 when it fell again until 2015. The unemployment rate in Germany fell continuously from 2006 to 2015. However, the unemployment rate in France remained high during 2006 to 2015 and grew from 2008 to 2015.

![Unemployment rate in the UK, France and Germany during 2006 to 2015 (Eurostat)](image)

*Figure 5: Unemployment rate in the UK, France and Germany during 2006 to 2015 (Eurostat)*
4 The EU referendum results by NUTS 2 regions

The outcome of the EU referendum varied considerably between regions of the UK. Most NUTS 2 regions voted to leave the EU while a minority of regions voted to remain in the EU. Table 1 shows the results of the vote in regions of the United Kingdom, visibly nine of the regions below voted to leave against three regions voting to remain.

<table>
<thead>
<tr>
<th>REGIONS</th>
<th>LEAVE %</th>
<th>REMAIN %</th>
<th>LEAVE VOTES</th>
<th>REMAIN VOTES</th>
<th>VOTER Turnout</th>
<th>VALID VOTES</th>
<th>PERCENTAGE OF TOTAL VOTE IN REFERENDUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORTH EAST ENGLAND</td>
<td>58%</td>
<td>42%</td>
<td>778,103</td>
<td>562,595</td>
<td>69,30%</td>
<td>1,340,698</td>
<td>4%</td>
</tr>
<tr>
<td>NORTH WEST ENGLAND</td>
<td>54%</td>
<td>46%</td>
<td>1,966,925</td>
<td>1,699,020</td>
<td>70,00%</td>
<td>3,665,945</td>
<td>11%</td>
</tr>
<tr>
<td>YORKSHIRE AND THE HUMBER</td>
<td>58%</td>
<td>42%</td>
<td>1,580,937</td>
<td>1,158,298</td>
<td>70,70%</td>
<td>2,759,235</td>
<td>8%</td>
</tr>
<tr>
<td>EAST MIDLANDS</td>
<td>59%</td>
<td>41%</td>
<td>1,475,479</td>
<td>1,033,036</td>
<td>74,20%</td>
<td>2,508,515</td>
<td>7%</td>
</tr>
<tr>
<td>WEST MIDLANDS</td>
<td>59%</td>
<td>41%</td>
<td>1,755,687</td>
<td>1,207,175</td>
<td>72,00%</td>
<td>2,962,862</td>
<td>9%</td>
</tr>
<tr>
<td>EAST OF ENGLAND</td>
<td>56%</td>
<td>44%</td>
<td>1,880,367</td>
<td>1,448,616</td>
<td>75,70%</td>
<td>3,328,983</td>
<td>10%</td>
</tr>
<tr>
<td>LONDON</td>
<td>40%</td>
<td>60%</td>
<td>1,513,232</td>
<td>2,263,519</td>
<td>69,70%</td>
<td>3,776,751</td>
<td>11%</td>
</tr>
<tr>
<td>SOUTH EAST ENGLAND</td>
<td>52%</td>
<td>48%</td>
<td>2,567,965</td>
<td>2,391,718</td>
<td>76,80%</td>
<td>4,959,683</td>
<td>15%</td>
</tr>
<tr>
<td>SOUTH WEST ENGLAND</td>
<td>53%</td>
<td>47%</td>
<td>1,669,711</td>
<td>1,503,019</td>
<td>76,70%</td>
<td>3,172,730</td>
<td>9%</td>
</tr>
<tr>
<td>WALES</td>
<td>53%</td>
<td>47%</td>
<td>854,572</td>
<td>772,347</td>
<td>71,70%</td>
<td>1,626,919</td>
<td>5%</td>
</tr>
<tr>
<td>SCOTLAND</td>
<td>38%</td>
<td>62%</td>
<td>1,018,322</td>
<td>1,661,191</td>
<td>67,20%</td>
<td>2,679,513</td>
<td>8%</td>
</tr>
<tr>
<td>NORTHERN IRELAND</td>
<td>44%</td>
<td>56%</td>
<td>349,442</td>
<td>440,707</td>
<td>62,70%</td>
<td>790,149</td>
<td>2%</td>
</tr>
</tbody>
</table>

Table 1: Results of the European Union membership referendum (The Electoral Commission)

The last column of the table shows how large of a percentage the regions vote was out of the total votes cast in the election. Votes cast in England counted for 85% of total votes, 11% were votes cast in London while 74% of votes were cast in England excluding London. Votes cast in Wales counted for 5% of the total votes. Votes cast in Scotland counted for 8% of total votes while votes cast in Northern Ireland counted for 2% of the total votes. It can therefore be said with full certainty that votes cast in England, excluding London, heavily influenced the results of the referendum. Furthermore, the only regions that collectively voted to remain in the European Union: Northern Ireland, Scotland and London were among the bottom four regions when considering voter turnout.
4.1 North East and North West

The regions in North East and North West voted to leave the European Union with 2,745,028 votes for leaving the EU against 2,261,615 votes for remaining in the EU, or 54.8% of votes for Leave against 45.2% of votes for Remain. In the region of North East and North West, there are six areas: Tees Valley and Durham, Northumberland and Tyne and Wear, Cumbria, Greater Manchester, Lancashire, Cheshire and Merseyside.

Tees Valley and Durham voted most significantly to leave the EU out of the North East and North West regions with approximately 61% of voters voting to leave the EU against 39% voting to remain in the EU. Northumberland and Tyne and Wear voted to leave the EU with 55.7% of the region backing leaving the EU against 44.3% wanting to remain in the EU. Cumbria voted to leave the UK with 56.4% of votes in support of leaving the EU against 43.6% of votes in favour of remaining in the EU. Greater Manchester voted to leave the EU with 53.5% of votes supporting leaving the EU against 46.5% of votes supporting to remain in the EU. Lancashire voted to leave the EU with 59% of votes supporting leaving the EU and 41% of votes supporting remaining in the EU. Cheshire voted to leave the EU with 51.7% of votes supporting leaving the EU against 48.3% of votes supporting remaining in the EU. Merseyside was the only region of the North East and North West regions to vote for remaining in the EU, with 51.2% of voters supporting remaining in the EU against 48.8% of voters supporting leaving the EU.

Figure 6: Referendum results in North East and North West (Agust Arnorsson and Gylfi Zoega, 2016)
4.2 Yorkshire and the Humber

All of the regions of Yorkshire and the Humber in England voted to leave the European Union with 1,580,937 votes for leaving the EU against 1,158,298 votes to remaining in the EU, or 57.71% of votes for Leave against 42.29% of votes for Remain. In the region of Yorkshire and the Humber are four areas: East Yorkshire and Northern Lincolnshire, North Yorkshire, South Yorkshire and West Yorkshire.

East Yorkshire and Northern Lincolnshire voted most significantly to leave the EU of the Yorkshire and Humber regions with 65.75% of votes in support of leaving the EU against 35.25% of votes in support if remaining in the EU. North Yorkshire voted to leave the EU with 51.9% of votes in favour of leaving the EU against 48.1% of votes in support of remaining in the EU. South Yorkshire voted to leave the EU with 61.6% of votes in support of leaving the EU against 38.4% of votes in favour of remaining in the EU. West Yorkshire voted to leave the EU with 54.8% of votes in support of leaving the EU against 45.2% of votes in support of remaining in the EU.

![Referendum results in Yorkshire and the Humber](Agust Arnorsson and Gylfi Zoega, 2016)

Figure 7: Referendum results in Yorkshire and the Humber (Agust Arnorsson and Gylfi Zoega, 2016)
4.3 East Midlands and West Midlands

All of the regions in the East and West Midlands voted to leave the European Union with 3,231,166 votes for leaving the EU against 2,240,211 votes to remaining in the EU, or 59,06% of votes for Leave against 40,94% of votes for Remain. In the region of East Midlands and West Midlands, there are six areas: Derbyshire and Nottinghamshire, Leicestershire, Rutland and Northamptonshire, Lincolnshire, Herefordshire, Worcestershire and Warwickshire, Shropshire and Staffordshire and West Midlands.

Derbyshire and Nottinghamshire voted to leave the EU with 58,6% of votes in support of leaving the EU against 41,4% in support of remaining in the EU. Leicestershire, Rutland and Northamptonshire voted to leave the EU with 59% of votes in favour of leaving the EU against 41% votes in support of remaining in the EU. Lincolnshire voted to leave the EU with 65,2% of votes in support of leaving the EU against 34,8% of votes in support of remaining in the EU. Herefordshire, Worcestershire and Warwickshire voted to leave the EU with 56,6% of votes in support of leaving the EU against 43,4% of votes in support of remaining in the EU. Shropshire and Staffordshire voted to leave the EU with 62,5% of votes in support of leaving the EU against 37,5% of votes in support of remaining in the EU. The West Midlands voted to leave the EU with 58,6% of votes in support of leaving the EU against 37,5% of votes in support of remaining in the EU.

Figure 8: Referendum results in East Midlands and West Midlands (Agust Arnorsson and Gylfi Zoega, 2016)
4.4 East of England

All of the regions in the East of England voted to leave the European Union with 1,880,367 votes for leaving the EU against 1,448,616 votes to remaining in the EU, or 56,48% of votes for Leave against 43,52% of votes for Remain. The region of East of England has three areas: East Anglia, Bedfordshire and Hertfordshire and Essex.

   East Anglia voted to leave the EU with 55,45% of votes in support of leaving the EU against 44,55% is favour of remaining in the EU. Bedfordshire and Hertfordshire voted to leave the EU with 51,9% of votes in favour of leaving the EU against 48,1% of votes in support of remaining in the EU. Essex voted to leave the EU with 62,34% of votes in support of leaving the EU against 37,66% of votes in support of remaining in the EU.

Figure 9: Referendum results in East of England (Agust Arnorsson and Gylfi Zoega, 2016)

4.5 South East and South West

Most of the regions in South East and South West voted to leave the European Union with 4,237,676 votes for leaving the EU against 3,894,737 votes to remaining in the EU, or 52,11% of votes for Leave against 47,89% of votes for Remain. In the region of South East and South West, there are eight areas: Berkshire, Buckinghamshire and Oxfordshire, Surrey, East and West Sussex, Hampshire and Isle of Wight, Kent, Gloucestershire, Wiltshire and Bristol/Bath area, Dorset and Somerset, Cornwall and Isles of Scilly and Devon.
Berkshire, Buckinghamshire and Oxfordshire voted to remain in the EU with 53.16% of votes in support of remaining in the EU against 46.84% of votes in favour of leaving the EU. Surrey, East and West Sussex voted to remain in the EU with 50.71% of votes in support of staying in the EU against 49.29% of votes in support of leaving the EU. Hampshire and Isle of Wight voted to leave the EU with 54.58% of votes in support of leaving the EU against 45.42% of votes in support of remaining in the EU. Kent voted to leave the EU with 59.25% of votes in support of leaving the EU against 40.75% of votes in support of remaining in the EU. Gloucestershire, Wiltshire and Bristol/Bath area voted to remain in the EU with 50.88% of votes in support of staying in the EU against 49.12% of votes in support of leaving the EU. Dorset and Somerset voted to leave the EU with 56.2% of votes in support of leaving against 43.8% of votes in support of remaining in the EU. Cornwall and Isles of Scilly voted to leave the EU with 56.46% of votes in support of leaving the EU against 43.54% of votes in support of remaining in the EU. Devon voted to leave the EU with 55.34% of votes in support of leaving the EU against 44.66% of votes in support of remaining in the EU.

Figure 10: Referendum results in South East and South West (Agust Arnorsson and Gylfi Zoega, 2016)
4.6 London

London voted to remain in the European Union with 2,263,519 of votes in support of remaining in the EU against 1,513,232 of votes for leaving the EU, or 59.93% of votes for Remain against 40.07% of votes for Leave. London is commonly divided into inner London and outer London.

Inner London voted to remain in the EU with 71.91% of votes in support of remaining in the EU against 28.09% of votes in favour of leaving the EU. Outer London voted to remain in the EU with 56.03% of votes in support of remaining in the EU against 43.97% of votes in favour of leaving the EU.

4.7 Wales

Wales voted to leave the European Union with 854,572 votes in support of leaving the EU against 772,347 votes for remaining in the EU, or 52.53% of votes for Leave against 47.47% of votes for Remain. The region of Wales is divided into two areas: West Wales and the Valleys and East Wales.

West Wales and the Valleys voted to leave the EU with 53.89% of votes in support of leaving the EU against 46.11% of votes in favour of remaining in the EU. East Wales voted to leave the EU with 50.25% of votes supporting leaving the EU against 49.75% of votes in support of remaining in the EU.

4.8 Scotland

Scotland voted to remain in the European Union with 1,661,191 of votes in support of remaining in the EU against 1,018,322 of votes for leaving the EU, or 62.00% of votes for Remain against 38.00% of votes for Leave. The region of Scotland is divided into four areas: Eastern Scotland, South Western Scotland, North Eastern Scotland and Highlands and Islands.

Eastern Scotland voted to remain in the EU with 63.18% of votes in support of staying in the EU against 36.82% of votes in support of leaving the EU. South Western Scotland voted to remain in the EU with 63.22% of votes in support of remaining in the EU against 36.78% of votes in support of leaving the EU. North Eastern Scotland voted to remain in the EU with 57.53% of votes in support of remaining in the EU against 42.37% in support of leaving the EU. Highlands and Islands voted to stay in the EU with
56.04% of votes in support of remaining in the EU against 43.96% of votes in support of leaving the EU.

### 4.9 Northern Ireland

Northern Ireland voted to stay in the European Union with 440.707 of votes in favour of remaining in the EU against 349.442 of votes for leaving the EU, or 55.78% of votes for Remain against 44.22% of votes for Leave.

![Referendum results in London, Wales, Scotland and Northern Ireland](image)

*Figure 11: Referendum results in London, Wales, Scotland and Northern Ireland (Agust Arnorsson and György Zoega, 2016)*
5 Regressions of economic variables in NUTS 2 regions

Economic variables are useful instruments to gain an understanding of the economic environment of a region and can serve as an indicator of the conditions of private households and the general public of a particular region. To gain a feel for the economic situation of each NUTS 2 region in the United Kingdom I chose economic variables well suited for such an explanation. The economic variables I chose for the analysis were the growth of unemployment during 2006 to 2015, the growth of GDP per capita during 2006 to 2015 and growth of disposable income during 2004 to 2013.

The reasoning behind choosing these economic variables are simple. Disposable income of private households determines the economic wellbeing of inhabitants. The regional growth of disposable income over a decade shows how the residents of a region are faring compared to other areas. The same argument lies behind choosing to use the regional growth of unemployment. The unemployment rate is a direct indicator of how inhabitants in a region are faring. GDP per capita is a measure of average income per person in a region and is a useful tool to understand the average living standard in a particular region.

In section 5.1 is a regression of the economic variables to view their effects on a vote for leaving the EU in the referendum. Section 5.2 shows a regression of both economic and demographic variables on a vote for leaving the EU in the referendum. However, in section 5.3 we explore the effect of geography and national identity on voters’ choices in the EU referendum by viewing regression results with dummy variables to determine the regional effects. Utilizing the development of the economic variables in each NUTS 2 regions, it is possible to make a comparison between regions and the result of the EU referendum. Section 5.4 shows a comparison of goodness of fit of individual variables on the share of votes for leaving the EU and displays how well variables explain the share of votes cast for leaving the EU.

The p-value of an analysis determines the significance level of a coefficient. In the following analysis a significance level of 1% is symbolized with ***, a significance level of 5% is symbolized with ** and a significance level of 10% will be symbolized with *.
5.1 Regression of economic variables

5.1.1 Regression of the development of economic variables over 10 years

The purpose of viewing these economic variables is to make a comparison of the development of these economic variables and the results of the EU referendum in each NUTS 2 region. Utilizing ordinary least square regression to interpret the effect of each economic variable on the dependent variable, Leave, yields the results shown in table 2.

**OLS Regression**

*Dependent variables: Leave*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth of unemployment during 2006 to 2015</td>
<td>-4,12</td>
<td>6,52</td>
<td></td>
</tr>
<tr>
<td>Growth of GDP per capita during 2006 to 2015</td>
<td>-2,18</td>
<td>18,43</td>
<td></td>
</tr>
<tr>
<td>Growth of disposable income during 2004 to 2013</td>
<td>-70,10</td>
<td>21,18</td>
<td>***</td>
</tr>
</tbody>
</table>

$R^2 = 0,248$

**Table 2: Results of OLS regression with development of economic variables on dependent variable, Leave (Eurostat)**

Table 2 shows a regression where the dependent variable is the share of votes cast for leaving the EU. The results of the regression show that the statistically significant variable in the regression was the growth of disposable income of private households. However, the variables growth of GDP per capita and the growth of unemployment in regions were statistically insignificant. The regression implies that the growth of disposable income had a negative impact on the dependent variable and therefore the growth of disposable income encouraged remaining in the EU.

In a regression as this one multicollinearity might prove to be a problem. Multicollinearity problems arise when one of the repressors is highly correlated with another repressor. The existence of multicollinearity would prove problematic since the regression coefficients could be estimated imprecisely. Using Variance Inflation Factors test to check for multicollinearity in the regression shows the absence of such problem.
5.1.2 Regression of the most recent values for economic variables

Although, the purpose of this thesis to make a comparison of the development of these economic variables and the results of the EU referendum in each NUTS 2 region it would also prove useful to analyse the effect the most current value of the economic variables on voters voting patterns.

**OLS Regression**

**Dependent variables: Leave**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>The unemployment rate in NUTS 2 regions in 2015</td>
<td>-58.78</td>
<td>90.20</td>
<td></td>
</tr>
<tr>
<td>GDP per capita in NUTS 2 regions in 2015</td>
<td>-0.00064</td>
<td>0.00018</td>
<td>***</td>
</tr>
<tr>
<td>Disposable income of private households in NUTS 2 regions in 2013</td>
<td>0.00044</td>
<td>0.00052</td>
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</tbody>
</table>

\( R^2 = 0.32 \)

**Table 3 : Results of OLS regression with most recent values for economic variables on dependent variable, Leave (Eurostat)**

The regression in table 3 shows the effects of the unemployment rate in 2013, GDP per capita in 2015 and disposable income of private households in 2015 on share of votes for leaving the EU. The regression reveals that only GDP per capita in 2015 is statistically significant and had a negative effect on share of votes for leaving the EU, hence encouraging remaining. However, the unemployment rate in 2013 and disposable income of families in 2015 had no statistically significant effect on shares of votes for leaving the EU.
5.2 Regression of economic and demographic variables

The purpose of this thesis is to examine the relationship between economic variables and the result of the EU referendum. However, it is quite clear that the result of the referendum will not be explained solely by the development of regional economic variables. Other variables, like demographic, had a significant effect on the result of the EU referendum.

**OLS Regression**

**Dependent variables: Leave**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth of unemployment during 2006 to 2015</td>
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<td></td>
</tr>
<tr>
<td>Growth of GDP per capita during 2006 to 2015</td>
<td>15,89</td>
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<td></td>
</tr>
<tr>
<td>Growth of disposable income during 2004 to 2013</td>
<td>−50,71</td>
<td>25,78</td>
<td>*</td>
</tr>
<tr>
<td>Percentage of population with less than primary, primary and lower secondary education</td>
<td>102,26</td>
<td>33,31</td>
<td>***</td>
</tr>
<tr>
<td>Percentage of population 65 years old and older</td>
<td>154,30</td>
<td>58,89</td>
<td>**</td>
</tr>
<tr>
<td>Percentage of population born in a foreign country</td>
<td>22,37</td>
<td>28,87</td>
<td></td>
</tr>
</tbody>
</table>

\( R^2 = 0,527 \)

Table 4: Results of OLS regression with economic and demographic variables on dependent variable, Leave (Eurostat)

The variables in the dataset that are statistically insignificant are the growth of unemployment in a region, the growth of GDP per capita in a region and the percentage of population born in a foreign country, here used as a measurement of the level of immigration in a region. While the variables that are statistically significant are growth of disposable income, the percentage of the population with less than primary, primary and lower secondary education and population of 65 years old and older. Therefore, it is clear that the growth of disposable income of private households, the percentage of the population with less than primary, primary and lower secondary educational level and the proportion of seniors in regions all have a significant effect on the results of EU
referendum in each region. At the same time growth of unemployment, the growth of GDP per capita and the proportion of the population born another country than the UK in each region did not have a significant effect on the referendum results.

Furthermore, the regression in table 4 shows that the statistically significant independent variables in the model had different effects on the dependent variable, Leave. The results confirm that disposable income had a negative effect on the variable Leave, so people with higher disposable income less likely to vote Leave. Contrary, the percentage of the population with low educational level and the proportion of the population of elderly citizens living in a region both had a positive effect on shares of votes for leaving the EU, so an increase in any of these variables would increase the votes for leaving the EU.

A possible problem with this kind of OLS regression is the possibility of multicollinearity, a problem that might arise from the fact that the variables for the percentage of seniors and educational level might be correlated. Intuition might suggest that an elder person would be more likely to have less formal education than a younger person and therefore, a region with a significant percentage of the population being seniors that the same region would have a large population with less than primary, primary and lower secondary education. To assess this possible problem, I conducted a Variance Inflation Factors test to test for collinearity. The VIF test result was that the data does not have a collinearity problem.
5.3 Regression comparison with regional dummy variables

As confirmed in regressions in section 5.1 of economic variables and in section 5.2 of economic and demographic variables, socio-economic factors played a major role in voters’ choices. In this section we explore the effect of geographical factors and national identity on voters’ choices in the EU referendum.

<table>
<thead>
<tr>
<th></th>
<th>Model A</th>
<th>Model B</th>
<th>Model C</th>
<th>Model D</th>
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<td>income</td>
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<td>[67.03]</td>
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<td>older</td>
<td></td>
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<td>2013</td>
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<td>4.04E-04</td>
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<tr>
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<td>2.6-04</td>
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<tr>
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<td>−14.00</td>
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<td>[2.82]</td>
<td>[3.33]</td>
<td>[2.93]</td>
<td>[1.99]</td>
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<td>−15.01</td>
<td>−18.61</td>
<td>−13.87</td>
<td>−12.05</td>
</tr>
<tr>
<td></td>
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<td>[2.68]</td>
<td>[3.54]</td>
<td>[1.22]</td>
<td>[0.97]</td>
</tr>
<tr>
<td>London</td>
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<td>−6.11</td>
<td>−10.28</td>
<td>−2.76</td>
<td>−16.23</td>
</tr>
<tr>
<td></td>
<td>[2.48]</td>
<td>[6.32]</td>
<td>[7.13]</td>
<td>[5.14]</td>
<td>[0.97]</td>
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<td>Wales</td>
<td>−6.10</td>
<td>−4.83</td>
<td>−6.41</td>
<td>−6.20</td>
<td>−4.23</td>
</tr>
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<td>[1.56]</td>
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<td>[1.69]</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.68</td>
<td>0.78</td>
<td>0.82</td>
<td>0.75</td>
<td>0.64</td>
</tr>
</tbody>
</table>

Table 5 : Results of regression comparison with regional dummy variables (Eurostat)
Table 5 shows the findings of five ordinary least squares regressions of economic, social and geographical dummy variables for the NUTS 2 regions. Each variable in the table has two values. The upper shows coefficient value for the variable, but the lower demonstrates the standard deviation of the coefficient.

The results allow for some conclusions to be drawn about factors that influenced the share of votes for leaving the EU. The dependent variable in the regression was the proportion of votes for leaving the EU in each NUTS2 region. In the regression, four geographical dummy variables interpret the regional effects on the share of votes for leaving the EU in each region after controlling for social and economic characteristics. The geographical dummy variables are Scotland, Northern Ireland, London and Wales. When using dummy variables in an analysis like this, it is necessary to drop one region from the analysis, here the region of England excluding London was dropped from the analysis.

The parameter in the analysis for Scotland was generally the largest in the regression models, ranging from -13,5 to -20. The parameter implies that the share of votes for Leave in Scotland was 13,5 to 20 percentage points lower than in England outside London. The same parameter for London was approximate – 15 to -16, implying that the share of votes for Leave in London was 15 to 16 percentage points lower than in England outside London. The same parameter for Northern Ireland was -12 to -19, implying that the share of votes for Leave in Northern Ireland was 12 to 19 percentage points lower than in England outside London. The parameter for Wales the parameter was -4 to -6,5, implying that the share of votes for Leave in Wales was 4 to 6,5 percentage points lower than in England outside London.

In regression model A, the growth of unemployment was statistically significant and had positive effects share of leave votes. The growth of GDP per capita and growth of disposable income of private households were statistically insignificant. The dummy variables were all statistically significant with the parameter for Scotland being -20, the same parameters for Northern Ireland were -17, London -15 and Wales -6. In regression model B the percentage of the population with less than primary, primary and lower secondary education in regions was statistically significant and had a positive
effect on the share of votes for leaving the EU. Percentage of people 65 years old and older and percentage of the population born in foreign countries were both statistically insignificant. Out of the geographical dummy variables, only London was statistically insignificant. The geographic parameters were -13.5 for Scotland, -15 for Northern Ireland and -5 for Wales.

In regression model C out of economic and social variables used in the regression, only percentage of the population with less than primary, primary and lower secondary education was significant and had a positive effect on the share of votes for leaving the EU. However, only London was not statically significant of the geographical dummy variables. The parameter for Scotland was -18, for Northern Ireland was -19 and the parameter for Wales was -6.

Regression model D consists of only most recent values for the economic variables in for each region. The regression shows effect of the unemployment rate in each region in 2015, disposable income of families in 2013 and GDP per capita in each region in 2015 on the share of votes cast in favour of leaving the EU. Also the regression shows the effects of the geographical variables. Only GDP per capita in 2015 was statistically significant out of the economic variables and had a negative effect on the proportion of votes for leaving the EU, hence encouraged remaining in the EU. The unemployment rate in 2015 and disposable income in 2013 were not statistically significant in the analysis. The dummy geographical variables were all significant except for London. The parameter for Scotland was -14, for Northern Ireland it was -14 and for Wales -6.

Regression model E consists only of the geographical dummies and shows their effect on votes cast in favour of leaving the EU. All of the geographical dummies were statistically significant and the parameter for Scotland was -16, the same parameter for Northern Ireland was -12, for London it was -16 and for Wales -4.

In conclusion from viewing the regressions in this chapter, it is clear that economic and social variables had a vast effect on votes for leaving the EU in each NUTS 2 regions. Furthermore, it is clear that beyond socio-economic factors geographical and national identity had a profound effect on voters voting patterns. The parameter for the geographical dummies implied that voters outside of England excluding London had an inclination for voting for remaining in the EU based only on their geographical position.
5.4 Goodness of fit of variables on the dependent variable Leave

A variety of variables had an effect on the proportion of votes cast in favour of leaving the EU in the referendum on the UK membership in the EU. However, some socio-economic variables had a more profound effect on the likelihood of a voter voting for leaving the EU. A useful way of judging how well a variable explains shares of votes for leaving is viewing the goodness of fit, measured as $R^2$.

Figure 12 shows the goodness of fit of single variables in separate OLS regressions explaining the share of the vote for leaving the EU in each NUTS 2 region. In these regressions, the share of votes for leaving the EU was the dependent variable, and the single independent variables were the ones in figure 12.

The most influential factor for encouraging voters to vote for leaving the EU was GDP per capita in 2015. The second most prominent factor was the growth of disposable income of families. The third most influential factor was the proportion of the population with less than primary, primary and lower secondary education. The fourth strongest factor was disposable income of families in 2013. The fifth most influential variable was the proportion of the population aged 65 years old and older. The sixth most prominent factor was the percentage of population born in a foreign country. The three least influential variable were in correct order the growth of GDP per capita, growth of unemployment and the unemployment rate in 2015 and had relatively low explanation power of share of votes cast in favour of leaving the EU.

![Figure 12: Goodness of fit of variables on the dependent variable Leave (Eurostat)](image-url)
6 Regional comparison of variables and result of EU referendum

6.1 North East and North West

6.1.1 Tees Valley and Durham
Tees Valley and Durham voted to leave the EU most significantly out of the regions in North East and North West with 60,89% of votes for leaving the EU. The unemployment rate in Tees Valley and Durham was the highest out of the areas in North East and North West during 2011 to 2015 and was higher than the national unemployment average during the last 10 years. Tees Valley and Durham had the lowest GDP per capita in the region during 2006-2015 and was below national average. Furthermore, Tees Valley and Durham had the lowest disposable income of private households in the region of North East and North West from 2007 to 2013 and the second lowest in the year 2004-2007, second to Merseyside. Disposable income of private households was below national average throughout 2004 to 2013.

6.1.2 Northumberland and Tyne and Wear
Northumberland and Tyne and Wear voted to leave the EU with 55,71% of votes supporting leaving the EU. The unemployment rate in the area was higher than the national average throughout 2006 to 2015 and was the second highest in 2015 out of the areas in North East and North West. GDP per capita in Northumberland and Tyne and Wear was lower than national average during 2006 to 2015. Disposable income in Northumberland and Tyne and Wear was below the national average throughout 2004 to 2013 and was among lowest in the region of North East and North West in 2013.

6.1.3 Cumbria
Cumbria voted to leave the EU with 56,43% of votes in support of leaving the EU. The area of Cumbria had low unemployment throughout the period of 2006 to 2015 and was below the national average during the period. In 2015 Cumbria had the second lowest unemployment rate in the region of North East and North West. GDP per capita in the area of Cumbria was below the national average during 2006 to 2015 but grew by roughly 30% during the period. Furthermore, although disposable income of private households was relatively high in Cumbria in relation to the regions in the North East
and North West the disposable income of private households in Cumbria was below the national average throughout 2004 to 2013.

6.1.4 Greater Manchester
Greater Manchester voted to leave the EU in the referendum with 53.46% of votes in support of leaving the EU. In the Greater Manchester area, unemployment rate remained above average through the period of 2006 to 2015 and was the third highest out of all areas in the North East and North West in 2015. The Greater Manchester area had relatively high GDP per capita in relation to the areas in North East and North West and had the third highest GDP per capita in 2015. However, GDP per capita in Greater Manchester remained below national average during 2006 to 2015. Disposable income of private households in Greater Manchester was the third highest of the areas in the region during 2004 to 2013 but remained lower than national average throughout the period.

6.1.5 Lancashire
Lancashire voted to leave the EU with 59.03% of votes cast in support of leaving the EU. The unemployment rate in Lancashire remained similar to the national unemployment rate throughout the period of 2006 to 2015. Lancashire’s GDP per capita was lower than the national average at all times during 2006 to 2015. Also, disposable income of private households remained lower than the national average at all times from 2004 to 2013 and in 2013 families in Lancashire had one of the lowest disposable incomes out of the areas in the North East and North West.

6.1.6 Cheshire
Cheshire voted to leave the EU with 51.67% of votes cast in support of leaving the EU. Cheshire had the lowest unemployment rate in the region of North East and North West in 2014 and 2015, and the area's unemployment rate was lower than national average at all times in 2006 to 2015. Cheshire’s GDP per capita was the highest out the areas in the North East and North West during 2006 to 2015 and grew by 17% during the period. Disposable income of private households in Cheshire was the highest in all of the regions in North East and North West during 2004 to 2013 and was considerably higher than the national average of disposable income of private households.
6.1.7 Merseyside

Merseyside was the only area in the North East and North West to vote to remain in the EU, with 51.18% of votes cast in support of remaining in the EU. The unemployment rate in Merseyside declined sharply from 2010 to 2015, and went from being the highest in all of the regions of North East and North West in 2010 to just above national average in 2015. Merseyside’s GDP per capita was one of the lowest out of the areas in the North East and North West and was the second lowest in 2015. GDP per capita in Merseyside was below the national average during 2006 to 2015. Private households in Merseyside had one of the lowest disposable incomes during 2004 to 2013 out of the areas in North East and North West and the disposable income of families in Merseyside remained far below the national average during the same period.
Figure 13: Unemployment rate in North East and North West (Eurostat)

Figure 14: GDP per capita in North East and North West (Eurostat)

Figure 15: Disposable income of private households in North East and North West (Eurostat)
6.2 Yorkshire and the Humber

6.2.1 East Yorkshire and Northern Lincolnshire
East Yorkshire and Northern Lincolnshire voted to leave the EU with 64.75% of votes cast in support of leaving the EU. The unemployment rate in East Yorkshire and Northern Lincolnshire remained relatively high and above national average for most of 2006 to 2015. The area’s GDP per capita was the second lowest of the areas in Yorkshire and the Humber during 2006 to 2015 and remained below national average throughout the period. Disposable income of private households in East Yorkshire and Northern Lincolnshire was the second lowest in the region of Yorkshire and the Humber throughout 2004 to 2013 and was below national average.

6.2.2 North Yorkshire
North Yorkshire voted to leave the EU with 51.89% of votes cast in support of leaving the EU. The unemployment rate in North Yorkshire was the lowest in the region of Yorkshire and the Humber and below national average throughout 2006 to 2015. GDP per capita in North Yorkshire was the highest of the areas in Yorkshire and the Humber during 2006 to 2015 but remained below national average during the period. Private households in North Yorkshire had the highest disposable income of all the areas in the region of Yorkshire and the Humber throughout 2004 to 2013. The disposable income of families in North Yorkshire was above national average during the period and North Yorkshire was the only area in Yorkshire and the Humber to have disposable income over national average.

6.2.3 South Yorkshire
South Yorkshire voted to leave the EU with 61.56% of votes cast in support of leaving the EU. South Yorkshire had the highest unemployment rate of all the areas in the region of Yorkshire and the Humber for most of 2006 to 2015. GDP per capita in South Yorkshire was the lowest of the areas in Yorkshire and the Humber during 2006 to 2015 and was below national average during the period. Furthermore, private household’s in South Yorkshire had the lowest disposable income in the region of Yorkshire and the Humber and disposable income of families living in South Yorkshire was well below the national average.
6.2.4 West Yorkshire

West Yorkshire voted to leave the EU with 54.78% of votes cast in support of leaving the EU. Unemployment rate in West Yorkshire was above national average at all times during 2006 to 2015, but still close to the unemployment rate in East Yorkshire and Northern Lincolnshire and South Yorkshire. West Yorkshire had the second highest GDP per capita of the regions in Yorkshire and the Humber during 2006 to 2015. However, GDP per capita in West Yorkshire was below national average during the period. Private households in West Yorkshire had the second highest disposable income in the region of Yorkshire and the Humber during 2004 to 2013. However, disposable income of the households in West Yorkshire was still under national average at all times during the period.
Figure 16: Unemployment rate in Yorkshire and the Humber (Eurostat)

Figure 17: GDP per capita in Yorkshire and the Humber (Eurostat)

Figure 18: Disposable income of private households in Yorkshire and the Humber (Eurostat)
6.3 East Midlands and West Midlands

6.3.1 Derbyshire and Nottinghamshire

Derbyshire and Nottinghamshire voted to leave the EU with 58.53% of votes cast in support of leaving the EU. The unemployment rate in Derbyshire and Nottinghamshire rose above national average in 2009. From 2009 to 2015 the unemployment rate continued to slowly descend to the national average unemployment rate, in 2015 unemployment in the area of Derbyshire and Nottinghamshire was just below national average. GDP per capita in Derbyshire and Nottinghamshire was relatively low in relation to the areas in the region of East- and West Midlands during 2006 to 2015 and GDP per capita was lower than national average during the period. Private households in Derbyshire and Nottinghamshire had the second lowest disposable income of the areas in East Midlands and West Midlands during 2004 to 2013 and were below national average for the disposable income of households during the period.

6.3.2 Leicestershire, Rutland and Northamptonshire

Leicestershire, Rutland and Northamptonshire voted to leave the EU with 59.03% of votes cast for leaving the EU. The unemployment rate in Leicestershire, Rutland and Northamptonshire was throughout the period of 2006 to 2015 almost parallel to national average. However, unemployment rate in 2015 was lower than national average. The GDP per capita in the area of Leicestershire, Rutland and Northamptonshire was slightly below national average during 2006 to 2015 and was the second highest of the areas in East Midlands and West Midlands in 2015. Disposable income of private households in the area was higher than national average until 2008 when it became almost the same as the national average, in 2013 the rate was just below national average.

6.3.3 Lincolnshire

Lincolnshire voted to leave the EU with 65.16% of cast votes in support of leaving the EU. The unemployment rate in Lincolnshire was in line with national average until 2008 when unemployment rate in the area became more volatile and fell considerably only to rise greatly and then fall again. In 2015 unemployment rate in Lincolnshire was just below national average. The area of Lincolnshire had the lowest GDP per capita from 2006 to 2013 and in 2015 Lincolnshire had the second lowest GDP per capita of the
areas in East Midlands and West Midlands. Furthermore, GDP per capita in Lincolnshire was at all times during 2006 to 2015 below national average. Disposable income of private households in Lincolnshire was lower than national average throughout 2004 to 2013 and families living in Lincolnshire were the only ones to have a positive growth in their disposable incomes during the period.

6.3.4 Herefordshire, Worcestershire and Warwickshire
Herefordshire, Worcestershire and Warwickshire voted to leave the EU with 56,56% of votes cast for leaving the EU. The unemployment rate in the area in Herefordshire, Worcestershire and Warwickshire was the lowest of all of the regions in East Midlands and West Midlands for most of the period 2006 to 2015. Furthermore, the unemployment rate in the area was below national average. GDP per capita in Herefordshire, Worcestershire and Warwickshire was the second highest of the areas in East Midlands and West Midlands from 2007 until 2012. Since then GDP per capita in the area was the highest of the areas in the region. Disposable income of private households in Herefordshire, Worcestershire and Warwickshire was the highest of all of the areas in the region of East Midlands and West Midlands and above national average at all time during 2004 to 2013.

6.3.5 Shropshire and Staffordshire
Shropshire and Staffordshire voted to leave the EU with 62,53% of votes cast for leaving the EU. The unemployment rate in Shropshire and Staffordshire followed the national average but was below the average from 2011 to 2015. GDP per capita for the area of Shropshire and Staffordshire was one of the lowest of the areas in the East Midlands and West Midlands during 2006 to 2015 and was the lowest of all the areas in 2015. Furthermore, GDP per capita in Shropshire and Staffordshire was below national average during the period. Disposable income of private households in Shropshire and Staffordshire was below national average during 2004 to 2013.

6.3.6 West Midlands
West Midlands voted to leave the EU with 58,64% of votes cast in support of leaving the EU. The unemployment rate in the West Midlands was the highest of all the areas in East Midlands and West Midlands during 2006 to 2015 and was at all times higher than national average during the period. GDP per capita in the region of West Midlands was
the third highest of the areas until 2011 when it became the third lowest of the areas. Also, GDP per capita in the West Midlands was below national average during the period. Disposable income of families in the area of West Midlands was the lowest by a considerable amount and below national average at all times during 2004 to 2013. Furthermore, the area of West Midlands had the most decline in disposable income of families in the UK during 2004 to 2013 but disposable income of private households declined by approximately -10% in the area.
Figure 19: Unemployment rate in East Midlands and West Midlands (Eurostat)

Figure 20: GDP per capita in East Midlands and West Midlands (Eurostat)

Figure 21: Disposable income of private households in East Midlands and West Midlands (Eurostat)
6.4 East of England

6.4.1 East Anglia

East Anglia voted to leave the EU with 55.45% of votes cast in support of leaving the EU. The unemployment rate in East Anglia was below national average during 2006 to 2015. GDP per capita was the second highest of the areas in the region of East of England and was just below national average during 2007 to 2015. Disposable income of private households in East Anglia was the lowest of the areas in the region of East of England and was almost parallel to national average during 2004 to 2013.

6.4.2 Bedfordshire and Hertfordshire

Bedfordshire and Hertfordshire voted to leave the EU with 51.93% of votes cast for leaving the EU. The unemployment rate in Bedfordshire and Hertfordshire was below national average at all times during 2006 to 2015 and was the lowest of the areas in East of England from 2012 to 2015. GDP per capita in Bedfordshire and Hertfordshire was the highest of the area in East of England during 2006 to 2015 and was the only area to be above national average during the period. Disposable income of private households in Bedfordshire and Hertfordshire was the highest of the areas in the region of East of England by a good amount and was well above national average.

6.4.3 Essex

Essex voted to leave the EU with 62.34% of votes cast in support of leaving the EU. The unemployment rate was below national average for most of the time during 2006 to 2015. GDP per capita in Essex was the lowest of the areas in East of England during 2006 to 2015 and was below national average at all times during the period. Disposable income of private households in Essex was the second highest of the areas in the region of East of England and was above national average at all times during 2004 to 2013.
Figure 22: Unemployment rate in East of England (Eurostat)

Figure 23: GDP per capita in East of England (Eurostat)

Figure 24: Disposable income of private households in East of England (Eurostat)
6.5 London

London voted to remain the EU with 59.93% of votes cast in support of remaining the EU. The area of London is commonly divided into Inner London, and Outer London and those divisions voted quite differently with 71.91% of voters in Inner London voted for remaining while 56.03% of electors in Outer London voted for remaining. Inner London voted most significantly of the areas in the UK for remaining.

London, and especially Inner London, is in many ways different from the rest of the UK with significantly higher disposable income of private households and notably greater GDP per capita than other areas in the UK. Furthermore, a significant share of the residents of Inner London has a university degree, and London has the greatest non-UK born population of any UK areas, in 2011 36.82% of the population living in London were born in a foreign country.

The unemployment rate in London was above national average unemployment rate during 2006 to 2015. GDP per capita in London was considerably higher than national average during 2006 to 2015. Disposable income of private households in London was significantly greater than those of the average homes in the UK during 2004 to 2013.
Figure 25: Unemployment rate in London (Eurostat)

Figure 26: GDP per capita in London (Eurostat)

Figure 27: Disposable income of private households in London (Eurostat)
6.6 South East and South West

6.6.1 Berkshire, Buckinghamshire and Oxfordshire

Berkshire, Buckinghamshire and Oxfordshire voted to remain in the EU with 53.16% of votes cast in support of remaining in the EU. The unemployment rate in Berkshire, Buckinghamshire and Oxfordshire was below national average during 2006 to 2015. In 2015 the unemployment rate was the lowest of the areas in South East and South West. GDP per capita in Berkshire, Buckinghamshire and Oxfordshire was the highest of the areas in South East and South West during 2006 to 2015 and was above national average during the period. Furthermore, GDP per capita in Berkshire, Buckinghamshire and Oxfordshire grew the most of the areas in South East and South West during the period, by 17.27%. Disposable income of private households in Berkshire, Buckinghamshire and Oxfordshire was the highest of the areas in South East and South West and well above national average.

6.6.2 Surrey, East and West Sussex

Surrey, East and West Sussex voted to remain in the EU with 50.71% of votes cast in favour of remaining in the EU. The unemployment rate in Surrey, East and West Sussex was below national average during the period of 2006 to 2015 and was one of the lowest in the areas in South East and South West in 2015. GDP per capita in Surrey, East and West Sussex was the one of highest of the areas in South East and South West and from 2012 it was the second highest of the areas in the region. Also, during 2006 to 2015 GDP per capita was and well above national average. Disposable income of private households in Surrey, East and West Sussex was the second highest of the areas in South East and South West during 2004 to 2013 and was above national average during the period. Furthermore, families in Surrey, East and West Sussex were the only families in South East and South West that had a positive growth of disposable income during the period.

6.6.3 Hampshire and Isle of Wight

Hampshire and Isle of Wight voted to leave the EU with 54.58% of votes cast in support of leaving the EU. The unemployment rate in Hampshire and Isle of Wight was below
national average during 2006 to 2015, and in 2015 the unemployment rate was the third highest of the areas in South East and South West. GDP per capita in Hampshire and Isle of Wight was above national average during 2006 to 2015. In 2015 the GDP per capita in Hampshire and Isle of Wight was the fourth highest of the areas in South East and South West. Disposable income of private households in Hampshire and Isle of Wight was above national average during 2004 to 2013 but families living in Hampshire and Isle of Wight had the most declines in disposable income during the period of the areas in South East and South West.

6.6.4 Kent

Kent voted to leave the EU with 59.25% of votes cast for leaving the EU. The unemployment rate in Kent was one of the highest of the areas in the South East and South West during 2006 to 2015 and was almost parallel to national average during the period. GDP per capita for Kent was below national average during 2006 to 2015 and was the third lowest of the areas in South East and South West in 2015. Disposable income of private households in Kent was above national average during 2004 to 2013 and was the fourth lowest during most of the period.

6.6.5 Gloucestershire, Wiltshire and Bristol/Bath area

Gloucestershire, Wiltshire and Bristol/Bath area voted to remain in the EU with 50.88% of votes cast in favour of remaining in the EU. The unemployment rate in the area of Gloucestershire, Wiltshire and Bristol/Bath was below national average during 2006 to 2015. GDP per capita in Gloucestershire, Wiltshire and Bristol/Bath was the third highest in the areas in the region of South East and South West during 2006 to 2015 and grew by 17% during the period. Also, GDP per capita in the area was above national average at all times during the same period. Disposable income of private households in Gloucestershire, Wiltshire and Bristol/Bath was the third and fourth highest for the period of 2004 to 2013 and was above national average during the period.

6.6.6 Dorset and Somerset

Dorset and Somerset voted to leave the EU with 56.20% of votes cast in support of leaving the EU. The unemployment rate in Dorset and Somerset was below national
national average during 2006 to 2015. GDP per capita in Dorset and Somerset was below national average during 2006 to 2015 and in 2015 GDP per capita in Dorset and Somerset was the fourth lowest out of the areas in South East and South West. Disposable income of private households in Dorset and Somerset was almost parallel to the national average and was the third and fourth highest out of the areas in the region of South East and South West during 2004 to 2013.

6.6.7 Cornwall and Isles of Scilly

Cornwall and Isles of Scilly voted to leave the EU with 56.46% of votes cast for leaving the EU. The unemployment rate in Cornwall and Isles of Scilly was quite volatile during 2006 to 2015. The rate began below the national average in 2006 and rose above the national average in 2008, then dipped in 2009 under the average only to increase again in 2010 above the national average. Since 2010 the unemployment rate has been well below national average. GDP per capita in Cornwall and Isles of Scilly was the lowest of the areas in South East and South West and was below national average during 2006 to 2015. Disposable income of private households in Cornwall and Isles of Scilly was the lowest of the areas in the region of South East and South West during 2004 to 2013 and was below national average during the period.

6.6.8 Devon

Devon voted to leave the EU with 55.34% of votes in support of leaving the EU. The unemployment rate in Devon was more volatile than national average, with more drastic rises and falls in the rate during 2006 to 2015 than the average, but remained under national average during the same period. GDP per capita was the second lowest in Devon of the areas in the region of South East and South West during 2006 to 2015 and was below national average at all times during 2006 to 2015. Disposable income of private households in Devon was the second lowest of the areas in South East and South West during 2004 to 2013 and was below the national average during the same period.
Figure 28: Unemployment rate in South East and South West (Eurostat)

Figure 29: GDP per capita in South East and South West (Eurostat)

Figure 30: Disposable income of private households in South East and South West (Eurostat)
6.7 Wales

6.7.1 West Wales and the Valleys
West Wales and the Valleys voted to leave the EU with 53.89% of votes cast in support of leaving the EU. The unemployment rate in West Wales and the Valleys was above national average during 2006 to 2015 and rose considerably from the national average during 2008 to 2013. Furthermore, the unemployment rate in West Wales and the Valleys was the highest and the second highest of the areas in Wales, Northern Ireland and Scotland during the period. GDP per capita in West Wales and the Valleys was the lowest of the areas in Wales, Northern Ireland and Scotland during 2006 to 2015 and was below national average during the period. Disposable income of private households in West Wales and the Valleys was the lowest of the areas in Wales, Northern Ireland and Scotland and were below national average during 2004 to 2013.

6.7.2 East Wales
East Wales voted to leave the EU with 50.25% of votes cast in support of leaving the EU. The unemployment rate in East Wales was near national average during 2006 to 2015. GDP per capita in East Wales was below national average during 2006 to 2015 and in 2015 GDP per capita in East Wales was the third lowest of the area in Wales, Northern Ireland and Scotland. Disposable income of private households in East Wales was below national average during 2004 to 2013. In 2013 disposable income of families in East Wales was the third highest out of the areas in Wales, Northern Ireland and Scotland.

6.8 Northern Ireland
Northern Ireland voted to remain in the EU with 55.78% of votes cast for remaining in the EU. The unemployment rate in Northern Ireland was near national average, in 2015 the unemployment rate in Northern Ireland was approximately 1% higher than national average. GDP per capita in Northern Ireland was the second lowest of the areas in Wales, Northern Ireland and Scotland during 2006 to 2015 and was below national average during the period. Disposable income of private households in Northern Ireland was the second lowest of the areas in Wales, Northern Ireland and Scotland during 2004 to 2013 and was below national average.
6.9  Scotland

6.9.1  Eastern Scotland
Eastern Scotland voted to remain in the EU with 63,18% of votes cast in favour of remaining in the EU. The unemployment rate in Eastern Scotland was in close proximity to the national average during the period of 2006 to 2015. GDP per capita in the area was the almost parallel to the national average during 2006 to 2015 and was just below the national average in 2015. Disposable income of families living in Eastern Scotland was the second highest of the areas in Wales, Northern Ireland and Scotland and was almost parallel to but just above the national average.

6.9.2  South Western Scotland
South Western Scotland voted to remain in the EU with 63,22% of votes cast in favour of remaining in the EU. The unemployment rate in South Western Scotland was above the national average during 2006 to 2015. Furthermore, during 2009 to 2013 the unemployment rate in South Western Scotland was well above the national average. The GDP per capita in South Western Scotland was below the national average during 2006 to 2015 and was very close to the GDP per capita in Eastern Scotland and the Highlands and Islands in Scotland during the period. Disposable income of private households in South Western Scotland was below national average during 2004 to 2013.

6.9.3  North Eastern Scotland
North Eastern Scotland voted to remain in the EU with 57,63% of votes in support of remaining against 42,37% of votes supporting leaving the EU. The unemployment rate in North Eastern Scotland was at all times during 2006 to 2015 below the national average by a good amount. Also, the unemployment rate in North Eastern Scotland was the lowest the areas in Wales, Northern Ireland and Scotland in 2015. GDP per capita in the area was at all times during 2006 to 2015 the highest of the areas in Scotland and above the national average. Also, GDP per capita grew the most out of all the areas in the UK during 2006 to 2015, by approximately 35%. Disposable income of private households in North Eastern Scotland was at all times the highest in Scotland and above the national average. Disposable income of families in North Eastern Scotland also grew the most out of all the areas in the UK during 2004 to 2013, by 16%.
6.9.4 Highlands and Islands

Highlands and Islands voted to remain in the EU with 56.04% of votes cast in support of remaining in the EU. The unemployment rate in Highlands and Islands was considerably lower than national average during most of 2006 to 2015, the only year that the unemployment rate was higher in the Highlands and Islands than the national average was 2012. GDP per capita in Highlands and Islands was lower than the national average during 2006 to 2015 and was close to GDP per capita in East Wales and South Western Scotland. Disposable income of private households in Highlands and Islands was below the national average at all times during 2004 to 2013. The Highlands and Islands was one of two areas in Wales, Northern Ireland and Scotland that had a positive growth in disposable income of private households over the period 2004 to 2013, by approximately 9%.
Figure 31: Unemployment rate in Scotland, Northern Ireland and Wales (Eurostat)

Figure 32: GDP per capita in Scotland, Northern Ireland and Wales (Eurostat)

Figure 33: Disposable income of private households in Scotland, Northern Ireland and Wales
7 Comparison of variables and referendum results

A useful way of comparing effects of economic variables on the results of the UK’s EU membership referendum is to view how the best and worst off areas in the UK voted in regards to the unemployment rate, disposable income and GDP per capita. In the following figures blue columns represent areas that voted to leave the EU while green columns represent areas that voted to remain in the EU.

The areas in the UK with the highest unemployment rate in 2015 were in descending order: Tees Valley and Durham, Northumberland and Tyne and Wear, South Yorkshire, South Western Scotland and West Yorkshire. The only of these to vote for remaining in the EU was South Western Scotland. The areas in the UK with the lowest unemployment rate in 2015 were in ascending order: North Yorkshire, North Eastern Scotland, Herefordshire, Worcestershire and Warwickshire, Berkshire, Buckinghamshire and Oxfordshire and Cheshire. Only two of these areas voted for remaining in the EU in the referendum, North Eastern Scotland and Berkshire, Buckinghamshire and Oxfordshire. Therefore, there does not appear to be an apparent relationship between living in areas on either extreme levels concerning unemployment rates and voting patterns.

The areas in the UK with the highest GDP per capita in 2015 were in descending order: London, North Eastern Scotland, Berkshire, Buckinghamshire and Oxfordshire.
Cheshire and Surrey, East and West Sussex. Of these areas, only Cheshire voted to leave the EU. The areas in the United Kingdom with the lowest GDP per capita in 2015 were in ascending order West Wales and The Valleys, Tees Valley and Durham, South Yorkshire, Cornwall and Isles of Scilly and Shropshire and Staffordshire. None of these areas voted for remaining in the EU. In conclusion, there appears to be a relationship between being on either extreme of low or high GDP per capita in areas and voting for leaving or remaining in the EU. Furthermore, this relationship between GDP per capita in 2015 and voters voting pattern is implied in section 5.4 where GDP per capita in 2015 had a relatively high explanation power over share of votes in regions for leaving the EU. This was furthermore examined in section 5.1.2.

Figure 35: Regions with highest and lowest GDP per capita in 2015 (Eurostat)

The areas with highest disposable income of private households in 2013 were in descending order: London, North Eastern Scotland, Berkshire, Buckinghamshire and Oxfordshire, Surrey, East and West Sussex and Bedfordshire and Hertfordshire. The four highest areas voted for remaining in the EU while the fifth highest area voted for leaving the EU. The regions with the lowest disposable income of private households in 2013 were in ascending order: West Midlands, West Wales and The Valleys, Tees Valley and Durham, South Yorkshire, Lancashire, Merseyside and Northern Ireland. The five areas with the lowest disposable income voted for leaving the EU while the sixth and seventh most moderate disposable income areas voted for remaining in the EU. The conclusion can be drawn that the areas with the highest disposable income voted generally for
remaining in the EU on the contrary to the areas with the lowest disposable income who generally voted for leaving the EU.

Furthermore, according to the OLS regression results in chapter 5.1 growth of disposable income was statistically significant while the growth of GDP per capita and the growth of unemployment were insignificant. According to the regression results the growth of disposable income of private households had adverse effects on the proportion of votes for leaving the EU, hence encouraging remaining in the EU. These results imply that an increase in disposable income of workers would lead to a decrease in votes for leaving the EU.

Figure 36: Regions with highest and lowest disposable income in 2013 (Eurostat)
8 Conclusion

Economic variables are a helpful tool to explain the economic environment people live and work in. When drawing a conclusion of the results of the Brexit referendum it’s necessary to remember that people behave and vote according to their incentives. Therefore, the answer to the question “Could the result of the Brexit vote be explained by changes in economic variables?” is a resounding yes. However, some variables explain the results of the Brexit vote better than others.

Growth of disposable income of private households was one of the most influential variables on the share of votes cast in favour of leaving the EU according to regressions in section 5.1 and 5.2 and goodness of fit analysis in section 5.4. Disposable income is a direct indicator of how well-off families are and the growth of disposable income is a measure of how much more prosperous people are today than they were earlier. Therefore, voters living in areas that had the lowest growth of disposable income during 2004 to 2013 tended to vote for leaving the EU which intuitively would fit their incentives of challenging the status quo.

Growth of GDP per capita during 2006 to 2015 tended to be statistically insignificant in OLS regressions preformed in this analysis. However, GDP per capita in 2015 had a significant effect on the outcome of the referendum according to the OLS regression in section 5.1.2 and the goodness of fit analysis in section 5.4. This result might also seem intuitive since voters are people not companies and how the GDP was in recent years might be more tangible to voters than its growth over 10 years. Interestingly, GDP per capita has grown during the 10 years in the data whilst the disposable income of private households has for most areas shrunk over the 10 years. While GDP was growing, the incomes of most Britons were stagnating at the same time. This evolution leads to more inequality.

Growth of unemployment during 2006 to 2015 had a slight effect on the results of the Brexit referendum. Both the growth of unemployment during 2006 to 2015 and the unemployment rate in 2015 were statically insignificant in the regression of economic variables in section 5.1. Furthermore, the goodness of fit analysis in section 5.4 indicated that both the growth of the unemployment rate and the unemployment rate in 2015 only had a minor effect on share of votes cast in favour of leaving the EU.
However, generally, the unemployment rate and the growth of the unemployment rate in regions is a variable that is strongly felt by people.

Furthermore, other variables than economic ones had an effect on the share of votes cast in support of leaving the EU. Demographic variables like level of education and age of voters had an impact on votes for leaving the EU, confirmed in the OLS regression in section 5.2 and further established by Becker, Fetzer and Novy (2017). Geographical factors also had a substantial impact on voting patterns. Voters in Scotland, London, Wales and Northern Ireland were more likely to vote for remaining in the EU than voters in England excluding London according to the dummy variables regression in section 5.3 and further established by Darvas (2016). This result might also seem intuitive since, for an example, due to the fact that both the UK and Ireland are member states of the EU and currently do not have a systematic custom checks, since 1993 Northern Ireland and Ireland share a common labour market.

We can also draw conclusions from voting results by NUTS 2 regions in section 4. Most voters in England voted to leave the EU. Only London, areas in close proximity to the capital like Berkshire, Buckinghamshire and Oxfordshire and Surrey, East and West Sussex and then two areas farther from the capital: Gloucestershire, Wiltshire and Bristol/Bath area and Merseyside voted for remaining in the EU. Areas like Scotland and Northern Ireland also voted for remaining in the EU. Interestingly, the areas that voted for remaining in the EU are not homogeneous as stated in section 7 where areas with low disposable income and high unemployment still voted for remaining the EU.

To summarize, I found that economic variables had an effect on the results of the EU membership referendum and the result of the referendum can be explained, in a significant part, by economic variables. Furthermore, my findings suggest that disposable income of families and GDP per capita had an effect on voters voting patterns while unemployment rate had a less of an effect. The economic variables had an effect because they describe the economic environment people live in and people behave and vote according to their incentives and expectation for the future.
Bibliography


