Political areas of competition in Southwest Finland: A cluster analysis of parliamentary election data from three levels of aggregation

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Abstract

This research utilizes the methods of geography, mathematics and political ecology to outline the political areas and to define the profiles of political competition within the region of Southwest Finland using parliamentary election results from the 2010s.

Additionally the research investigates the areal concentration and dispersion of support for the parliamentary parties and the effect of the regional level of aggregation to the concentration of the political support.

Our research questions are: (1) are there distinctive political areas in Southwest Finland? And (2) can political areas of stable and unstable competition patterns be identified by investigating election results over time?

Using cluster analysis and map visualizations we show that there are distinctive political areas of competition to be found in contemporary Southwest Finland and that the map of political support changes significantly at the municipal and polling district levels.

Keywords: electoral geography, cluster analysis, parliamentary elections, political areas

Introduction

This study has both theoretical and practical aims: (1) we test cluster analysis as a means of describing the competition constellations between parties, and (2) through cluster analysis and studying electoral support on different levels of aggregation we provide information about the diversity of party support. This information can be used, for example, to decide at which geographical area it would be useful to allocate campaign resources for maximum impact, and what kinds of candidates a party should recruit to increase its support in areas of low support.

The political map of Finland has changed during the past decades and so have the political competitive constellations of parties. The heyday of electoral geography was in the 1960s and 1970s (Vuoristo 1997, 81). The most comprehensive classifications of the political areas of Finland date back to those times. Onni Rantala (1970) studied the support of four political groups in multiple elections. His work provides fundamental information about the classification of political regions and suggests that in addition to the

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party that receives the most votes, the support of the second and third parties should also be looked at when characterizing the level of competition. Risto Sänkiaho (1968, 20–21) used ecological correlations, factor and transformation analysis to study parliamentary elections. He also pointed out the need for grid based statistics on census data and recognized the value of analyzing polling district level data. Yet another study of electoral ecology from the late 1970s was done by Pertti Laulajainen (1979). He studied regional political differentiation in eastern Finland. Since then, there has been very little research in Finland in the field of political ecology and even less on the spatial variation of electoral support (Wuori & Wiberg, 2012, 215). A notable exception is the study by Paloheimo and Sundberg (2005). They studied the factors that influence the long-term support for parties. Using statistical classification analysis to form municipality groups they compared the results with Rantala's work in 1970.

The emergence of the True Finns (later the Finns Party) as a serious rival in the political competition has aroused scholarly interest. An article by Westinen (2013) focuses on the success of The Finns party (PS) and studies the support for PS from 2007 to 2011 parliamentary elections at a municipal level. It also identifies the stronghold areas of parties other than PS and provides an overview of the previous parliamentary elections.

The research traditions of electoral geography in Europe have focused on survey methods while in the United States the usage of ecological data has been more common (Johnston & Pattie 2008, 369). One reason for this – at least at the polling district level – might be that even though the electoral results of the sub-municipal polling districts have been available in Finland for decades, it has been impossible to draw exact geographical boundaries for the areas. This is because the information has been associated with buildings and the building data has only been openly available for the past few years.

In this research we compare two consecutive elections, 2011 and 2015. It is quite common that municipalities rearrange the geographical boundaries of their polling districts. If the modifications are not done by simply merging polling districts, the possibility to evaluate the election results from one election to another at that particular level of aggregation is lost. In this research we try to overcome this problem by presenting the municipal level comparisons of parliamentary elections between 1962 and 2015. We use and aggregate these data fully cognizant of the potential pitfall known as the ecological fallacy (Johnston, 2005; Robinson, 1950).

In Finland there are three levels of reporting the sub-national level voting data. The largest area unit is the electoral district, next is the municipal level, and municipalities are further divided into one or more polling districts. Current economic circumstances encourage municipalities to merge into larger units. This process reduces the resolution provided by a municipal level examination of political support. One of the aims of this paper is to show how the regional level of aggregation changes the political map and the concentration of political support.

It is easy to draw a map indicating the party with the largest electoral support. Likewise, it is simple to measure the competition between the party with the greatest electoral support and the party that gained the second largest number of votes. However, the visualization and classification of support profiles of an area becomes more complicated when we add more parties to our analysis. In this research, we use cluster analysis to classify the electoral support profiles of the parties with the four largest shares of votes at the municipality and polling district levels in Southwestern Finland. Our cluster analysis aims at highlighting typical settings of party competition in terms of the relative support sizes of parties. The research area and the area divisions are shown in Figure 1. With the clustering method, we aim at shedding light on the competitive constellations of political parties and on the changes in these constellations at different regional levels.

The parliamentary elections in Finland are proportional and direct. The votes cast directly to the candidates are first allocated to the political parties or electoral alliances that the candidates represent. The number of candidates that a party or alliance is allocated in a given district is determined, according to d'Hondt's rule, by the sum total of votes cast for each candidate of the party or alliance. If party or alliance A is entitled to n seats, the n largest vote-getters of A are elected. In a sense, the electoral system

used in the Finnish parliamentary elections is a mixture of a party-list system and a direct person election. Deviations from strict proportionality in seat allocation stem from the fact that the country is divided into electoral districts and these are considered separately from each other.

Dividing the electoral districts into smaller units with a seat allocation and candidate setting of their own would lead, at the municipal level for example, to a situation where some municipalities would have no seats at all.
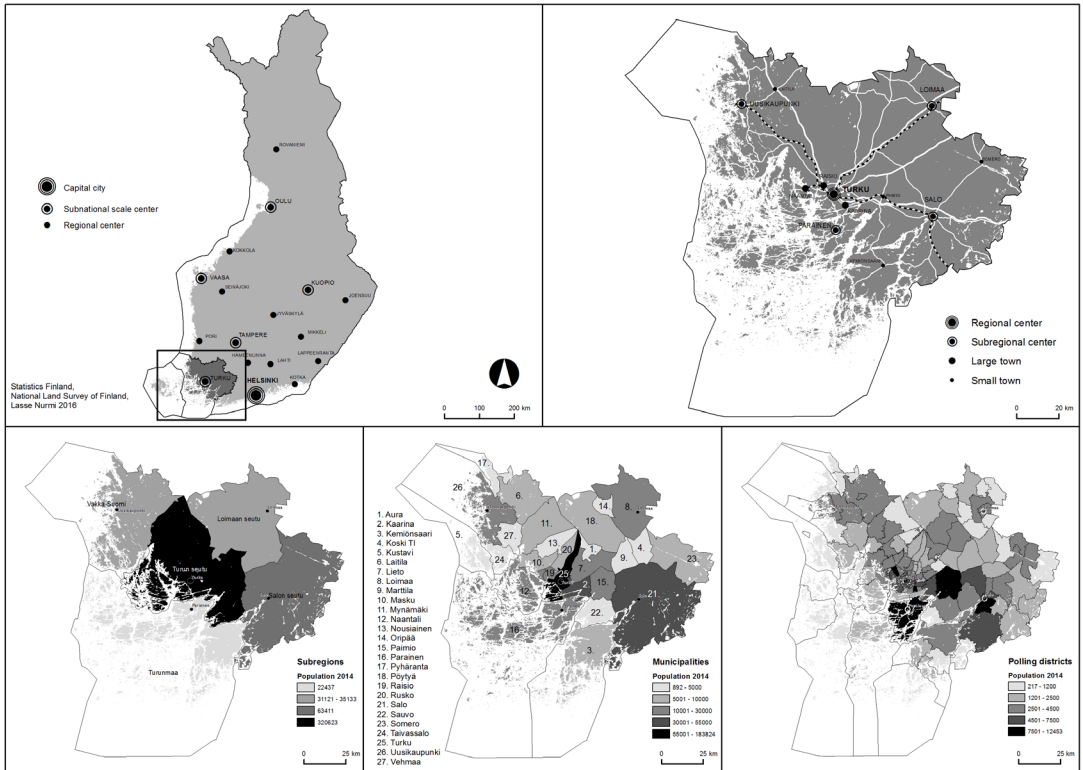

Figure 1. The location of the research area and the population of sub-regions, municipalities and polling regions in SW Finland.

Source: National Land Survey of Finland 2016, Statistics Finland 2016a.

Hypotheses and assumptions related to political competition and political support areas

The main foci of this study are (1) the political competition settings of the parties, (2) the geographical distribution of support and the stronghold areas of parliamentary parties, and (3) the concentration and dispersion of support among the parties in the area of Southwest Finland. In addition, changes between the parliamentary elections 2011 and 2015 are scrutinized. Moreover, a map-based examination of the parliamentary elections from 1962 to 2015 is presented in order to offer a comparative perspective on the earlier studies.

Our basic research questions are: (1) can political areas of stability and instability be identified in Southwestern Finland by studying the political dominance, competition and fragmentation of electoral

support? And (2) are there distinctive political areas in contemporary Southwestern Finland? In other words, are there groups of areal units where the distribution of support for political parties (as measured by their electoral support) differs markedly from other groups?

The cluster analysis provides considerable information about the competition arrangements that might interest parties in political competition – for example, when planning funding for forthcoming elections. In the cluster analysis part of this research it can be seen that there are areas where the leading party has not changed for a long period of time, but the competition is still quite severe between the parties.

On the other hand, the customary way of looking at the parties that have received the largest number of votes connects this research to the tradition of Finnish research on political areas and political ecology. By examining the election results at the polling district level, we can better understand the diversity of voting behavior whereas the picture gets blurred when the election results are shown at the municipal level. This might also be interesting from the viewpoint of rearranging the electoral districts and avoiding any tactical re-drawing of district boundaries to one party's advantage.[1]

The hypotheses that we seek to evaluate in this research are the following. We base our assumptions on the Downs' model of a rational voter (Downs, 1957, 138), where the voter compares his/her preferences and the policy platforms of the parties and then votes for the party that is closest to his/her own opinions.

- *The political competition in urban areas is stronger than in sparsely populated areas and there are no dominant parties.* This idea is suggested by the observation that urban areas have so much diversity in the population and the background of voters that personal preferences differ substantially. This leads to a situation where there is no single party that could gain the dominant status.
- *The Swedish-speaking areas have one clearly dominant party.* This we base on the assumption that the status of the Swedish People's Party in Finland (RKP, SFP in Swedish) as a party promoting the interests of the Swedish-speaking population and Swedish language overrides other political issues at least in the Swedish-speaking archipelago. The agenda of defending the bilingual status of Finland is also clearly expressed in the program of the party (Svenska Folkpartiet, 2016).
- *The rural areas have two, in some areas three, competing parties while other parties are in the minority.* This we base on an assumption that KESK is the most supported party in rural areas, but either the PS with its legacy from the Finnish Rural Party (SMP) (Arter, 2010, 485) or the National Coalition Party (KOK) as a promoter of the interests of entrepreneurs (The National Coalition Party, 2016) or both, challenge KESK.

The assumptions related to the political support areas of the parties are the following. We base these on the survey results conducted by the unit of Economic Sociology at the University of Turku in 2014 (Koivula et al., 2015). The survey contains information about the party identification of the respondents and their backgrounds.

Firstly, the leftist parties – the Left Alliance (VAS) and the Finnish Social Democratic Party (SDP) – have strong support among working-class people in those suburbs dominated by apartment buildings, housing areas near industrial areas, and in areas of increased unemployment. The support areas of the VAS also overlap with the areas of the Green League (VIHR). These assumptions we justify by the survey findings that the respondents of the SDP, VAS and VIHR were typically living in population centers. The overlap of the support areas of the VAS and VIHR is related to their partially shared goals, such as basic income and a positive response to immigration, equality, maintaining social security at a high level and supporting the diversity of nature.

Secondly, the PS has support in areas of increased unemployment, in working class housing neighborhoods and in sparsely populated rural areas. This assumption we base on the strong status of the PS as a working class party and on the fact that the PS was founded by members of the former SMP, which promoted the interests of small farmers. The PS is seen as the successor of the SMP since many of the party members and candidates, at least in the early days, were former SMP members (Arter, 2010, 485). The support for the PS in the 2011 election can also be seen as a protest against the political elite (Ruostetsaari,

2011, 114). In a similar way, it has been argued that working-class voters have felt that the left-wing parties have failed to stand up for their interests; thus, the votes for the PS in working class and high unemployment areas have the nature of a proletarian protest (Westinen, 2013).

Thirdly, KESK is the party with the highest support in agrarian areas, but it has also made inroads into some more densely populated areas. This we justify by political socialization. Even though Finnish society has changed significantly over the past decades, the political socialization process in families still passes the political views of parents down to their offspring, thus affecting the formation of the political personality of the younger generation (see Elo, 2012, 77; Wass, 2007, 2).

Fourthly, the KOK has its support in areas where average incomes exceed the national average, i.e. in city centers and in suburban areas around cities with higher living standards, but also to some extent in rural areas. We base our assumption on the idea that the policies of the KOK aim at encouraging and rewarding entrepreneurial activities e.g. through lower taxes (The National Coalition Party, 2016).

Fifthly, RKP has strong support in the Swedish-speaking archipelago, where it also has a dominant position. This assumption we base on the fact that the party has a strong status because it promotes the interests of the Swedish-speaking minority in Finland and support for the RKP has traditionally been strong in these areas (Statistics Finland, 2016b).

Sixthly, the support for the VIHR we assume to be centered in the cities and in student dominated housing areas. The support areas of the VIHR overlap with the support areas of the VAS. This is due the values of the VIHR, which appeal to younger voters who support environmental conservation, organic and ethical food production and energy-saving means of transportation. Although the VIHR is reluctant to be associated politically with either the right or the left parties, there are similarities with the aims of the SDP and the VAS on multiple issues such as reducing poverty (Raunio, 2015).

The concentration measure

In order to characterize the degree of areal concentration of a party's support, we need an appropriate measure that is independent of the size of the population and of the nature of the property under study. In such contexts the Herfindahl-Hirschman index (HHI) is a widely used index. When applied to measure the concentration of political support the formula is

$$HHI = \sum_{i=1}^{n} p_i^2$$

where p_i is the share of votes of the party inside the area (i) compared to the total votes of the party. In this research we use the HHI to measure the areal concentration of support for the Finnish parliamentary parties separately at the polling district, municipality, and sub-regional levels in the 2011 and 2015 parliamentary elections. When support is more concentrated, the index values are higher (with a maximum of 1 when all the votes for a party are given in one area). When support is more evenly distributed among the areas, the value is smaller (approaching 0 as the number of areas with largely equal support grows).

The hypotheses related to the HHI are the following. We base our hypotheses on the assumed behavior of the index when calculating it at different levels of aggregation.
- We assume that the HHI of all the parties increases from the polling district level to the municipality level and further to the sub-regional level (e.g., Taagepera & Grofman, 1981, 66).
- We also hypothesize that parties that appeal to voters in rural areas (KESK, PS and KOK) receive lower HHI values than parties that have platforms primarily addressed to city dwellers.
- In addition, the support for the RKP is assumed to be concentrated in the area of the Swedish-speaking archipelago and thus the party most likely achieves high HHI values.
- We also assume that there are some changes in the HHI values of those parties that have markedly

gained or lost support between the 2011 and 2015 elections. Therefore, we assume that the greatest changes in the HHI values are in the cases of the PS, KESK, KOK and SDP.

In all the cases the scale is in focus. The map visualizations are conducted at three levels of aggregation: the polling area, municipality and sub-regional levels. In the cluster analysis, the categorization is performed at the polling district and municipality level, and the concentration index is computed at sub-regional, municipality and polling district level. This is done to discover (1) if the results at one level of aggregation differ systematically from the results obtained at another level, and (2) how much descriptive information is lost due to the generalization of the resolution.

We suppose that changes in political support and competition at the polling district level will have been more substantial than the municipal level examination indicates. We hypothesize that the changes in political competition will vary more at the polling area level and the diversity of areas belonging to different clusters of competition will be higher. We believe that the rise of the PS will have brought about changes in party competition especially in areas around the cities. Furthermore, we expect that the more detailed view of the polling regions will also highlight the fact that a clear domination of one party in the cities and around the cities is quite unusual, apart from the Swedish-speaking areas where the dominance of the RKP will be apparent.

Data

High quality data about election results are available at all the levels: the electoral, municipal and polling districts. In this research, the main data sources are the statistics provided by Statistics Finland and the election website of the Ministry of Justice Finland (Oikeusministeriö, 2016). The sub-regional level information can easily be derived by merging the municipal level statistics. Population data are available at the polling district level.

The challenge with the polling district level information is that there are no unambiguous territorial boundaries for polling districts. We have solved this by creating polling district boundaries by using building data which contain the information about polling districts. The building data are available as open datasets. By adding the buildings to the map and creating Thiessen polygons the polling districts can be created with fairly good precision.[2] The building data, which were used to create the boundaries of the polling districts, were provided by the Population Register Center in Finland and are available in avoindata.fi open data and interoperability tools website.

The political map of Southwest Finland over time

Looking back at the post World War II elections, class-based voting used to be strong in the Scandinavian countries but it has been in decline since the 1970s (Nieuwbeerta & Ultee, 1999, 137–138). It has also been observed that some people have abandoned party loyalty and voted according to those political issues they consider important regardless of the party (Denver & Hands, 1990, 20–22, 32). This raises the question of whether there still are distinctive political areas, or have we stepped into a new era of shifting loyalties and the transformation of the party-electorate nexus. We have scrutinized this question using Southwest Finland as a test area.

Rantala (1970) and Sänkiaho (1968) studied the Finnish parliamentary elections at a municipal level from 1907 to the late 50's and early 60's. Paloheimo and Sundberg (2005) examined the 2003 parliamentary elections. We have tried to connect this research with earlier works by looking at which parties won the largest share of votes in the elections between 1962 and 2015 in Southwest Finland. We have used, to the extent it was possible, the municipal structure of 1962. This means that if an old municipality has survived as a polling district, the boundaries of the old municipality have been used, and if not, the area has been
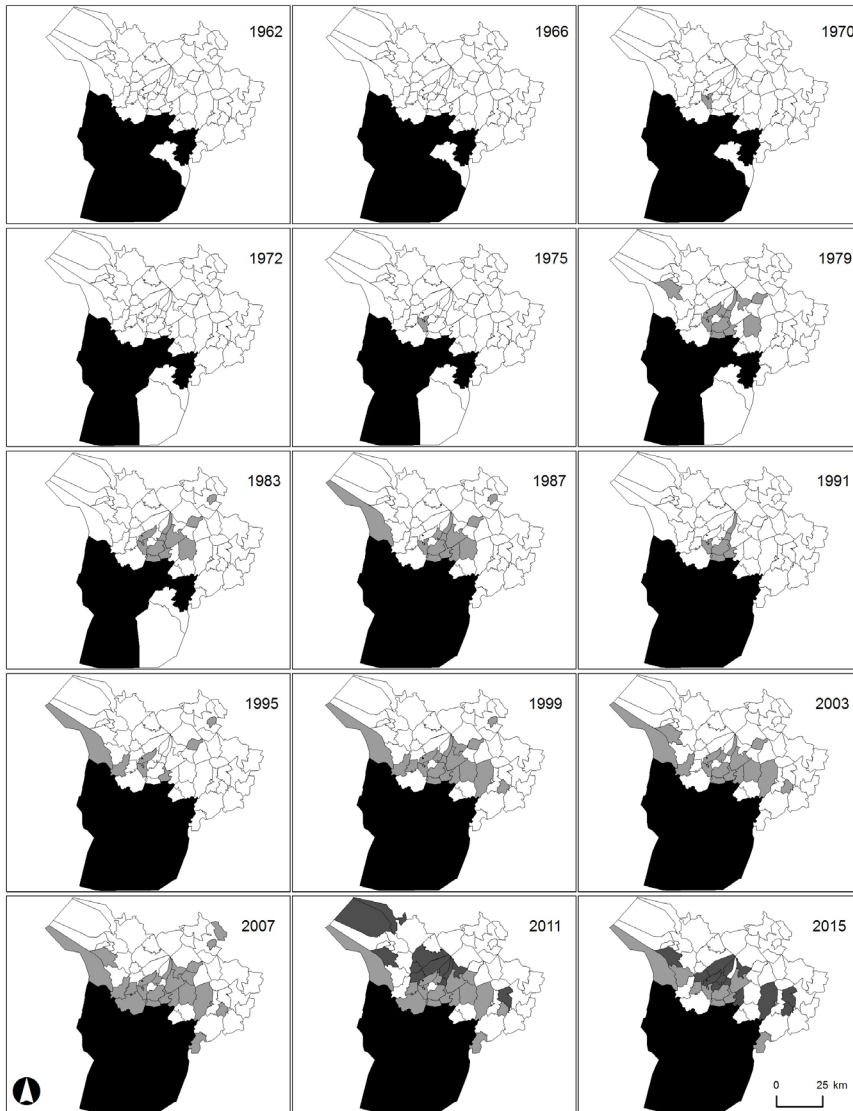
merged into the present municipality.

Figure 2. The municipalities or polling districts in SW Finland where right wing parties – KOK (light grey), People's party of Finland KP (light grey and only in 1962 elections), RKP (black) and PS (dark grey) – were the largest parties in the Parliamentary elections 1962–2015.
Source: National Land Survey of Finland 2016, Statistics Finland 2016b.

Rantala classified the parties in the following manner: the Agrarian League, which in 1965 became the KESK (Keskustapuolue, 2016), other bourgeoisie parties (such as the KOK and RKP), the social democrats, and the communists. Figure 2 presents the areas where the parties which belong to the class "other bourgeoisie parties" have reached the status of the largest party in parliamentary elections 1962–2015. When comparing these areas with the areas that Rantala defined as the core support areas of the parties, it can be seen that the support has stayed high in the Swedish-speaking archipelago areas and that geographically the support for these parties has actually increased even more in the direction that Rantala visualized

(Rantala, 1970, 68), if we take the later success of the PS into account.

The support for the SDP and more leftist SKDL (Finnish People's Democratic League) has gone through major changes from the early 60's to the present day. The strong support areas of these parties spread steadily around the regional cities of Turku, Salo and Uusikaupunki during the 60's and 70's. The support for the SKDL declined in the 80's and it seems likely that at least some of the supporters started to vote for the SDP at that point. There is a ten-year period when the support of the SDP did not increase, but in the 1995 parliamentary elections the party once more gained support.

Paloheimo and Sundberg (2005, 188–189) define the core support area of the SDP in Southwest Finland to range as a strip ranging from Salo to Uusikaupunki via the areas north of Turku. Since that time, support for the SDP has declined dramatically and the core areas of support that are still left are small areas near the centers of Uusikaupunki and Salo.

The KESK has strong support in the rural municipalities of Southwest Finland (excluding the Swedish-speaking archipelago), but the PS took over the status of the largest party from the KESK in the parliamentary elections in the 2010's.

Due to space limitations, other maps showing the support areas of the SDP in the parliamentary elections between 1962 and 2015 cannot be presented here but are available from the authors upon request.

The stronghold areas of the parties in Southwest Finland in 2010s

We obtain merely a crude idea of the election results if we list the parties with the largest share of votes. More information about the status of a single party can be obtained by looking at the neighboring areas and a sequence of elections. Figure 3 shows that larger areas of party hegemony can clearly be found in Southwest Finland. The smaller scale areas and their party dominations can be seen in the polling region level maps in Figures 3 and 4, but the support features are so scattered that generalizing them cartographically into larger areas is not worthwhile. Probably the most striking change in the parliamentary elections from 2011 to 2015 within the Turku urban area is the decline in SDP support (see Figure 4). This party lost the status of the largest party in 17 polling districts, most of them located in the Turku urban area. The winning party in these polling districts in the 2015 parliamentary election was mainly the PS.

The KESK has its roots in promoting the interests of the rural population. The party has adopted issues like promoting a clean environment, innovations, and education, but still stands for keeping the rural areas inhabited and supporting a vibrant countryside (Centre Party Election Platform, 2015; Keskustan tavoiteohjelma 2010-luvulle, 2010). In addition, the Election Platform in 2015 for the KESK party included objectives that appeal especially to entrepreneurs, for example, tax cuts and de-regulative policies (Centre Party Election Platform, 2015). The 2015 parliamentary election was a success for the KESK (see Figure 3). It replaced the KOK in a number of polling districts and even managed to overtake the SDP in parts of the suburban rim around the sub-regional center of Salo that was previously a stronghold area of the SDP. KESK even won back the status of the largest party from the PS in the rural area north of Turku. In the 2015 parliamentary election, the horn-shaped support area of the KESK thrust into the areas between Turku and the sub-regional centers Salo and Parainen. The support area of the KESK even penetrated the KOK support area ranging from Turku to Salo causing a division in the continuous support area of the KOK.

The larger continuous area with the KOK as the party with largest support forms a semi-circle around Turku center (Figure 3, the light grey area at the top left). The areas close to the sea near Turku are residential areas with high real estate prices. These areas are largely only within the reach of wealthy people. The policy principles of the KOK promote entrepreneurship for example by lowering taxation (The National Coalition Party, 2016). Progressive taxation means that wealthier people have higher tax rates than people with moderate or low incomes. Thus, one can expect that the support of the KOK is high in areas where the income level is above average.

The larger support area of the KOK, visualized in the top left map of Figure 3, does not tell the complete truth about the support for the KOK, since most of Turku city area polling regions are also mostly dominated by KOK supporters and the population density in those areas is significantly greater than in the rural and outer archipelago areas. The magnitude of KOK support in the Turku urban area is shown in Figure 4 with the lightest gray color.
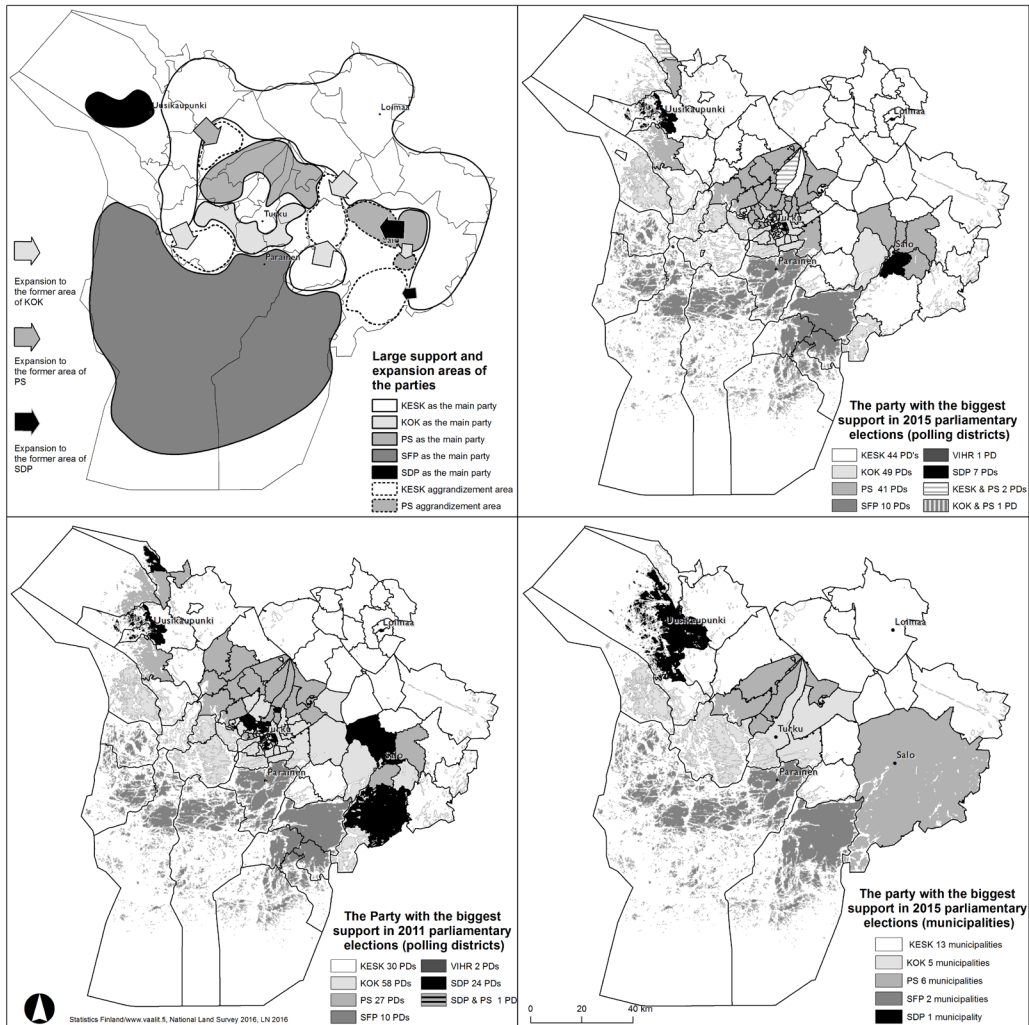

Figure 3. The large generalized stronghold areas of the parties in the 2011 parliamentary election and the stronghold expansion areas in the 2015 parliamentary election, the largest parties in polling districts in the 2011 and 2015 parliamentary elections and the largest parties in municipalities in the 2015 parliamentary election.
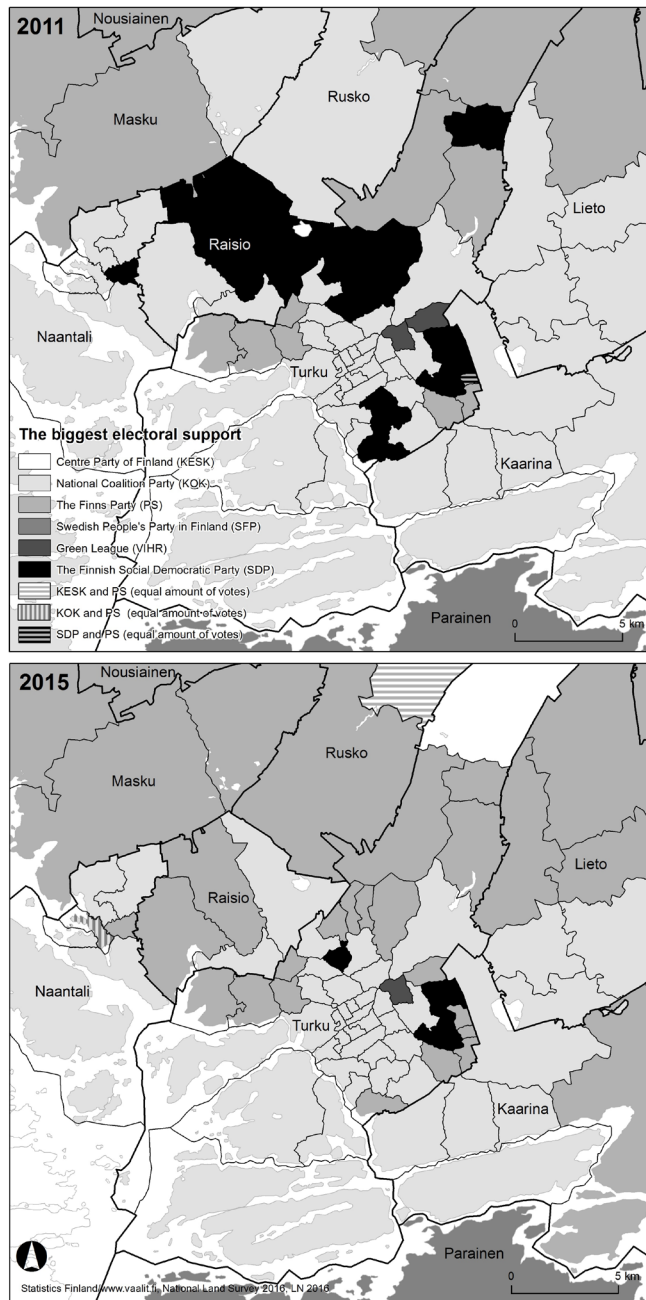Source: National Land Survey of Finland 2016, Statistics Finland 2016b

Figure 4. The largest parties in polling districts in the 2011 and 2015 parliamentary elections in the Turku urban area.
Source: National Land Survey of Finland 2016, Statistics Finland 2016b.

If KOK has its large support area in Turku and in the south side of Turku, the PS is the largest party north of Turku and in a semicircular area around the inner city area of Salo (Figure 3, the medium gray area top left). As the offspring of the anti-establishment mainly rural-based SMP, the status of the PS as the largest party seems to be geographically located in those areas where urban areas merge into rural

surroundings. These areas are also the commuting belts of Turku and Salo, which means that a number of the residents living in these areas have their jobs in the city center.

In the area north of Turku, the PS managed to maintain the status of the largest party in both the 2011 and 2015 parliamentary elections, with the exception of a small area in the northwestern part of the support area. In this area, the KESK succeeded in becoming the largest party in the 2015 election. In Salo, the PS has expanded its support area at the expense of the SDP and KOK. Salo has suffered from the economic depression Finland experienced during the 2010s. For example, a massive loss of jobs occurred when Nokia (later Microsoft) decided to close the Salo factory, leaving thousands of people unemployed. Disappointment at losing jobs may have led many people to protest against the political elite and a surge in support for the PS.

The SDP has traditionally had its greatest support in urban and suburban areas among working and middle class voters. The change in the parliamentary elections from 2011 to 2015 was devastating: the party lost the status of the largest party in 17 polling districts and thus became the largest loser. The larger support areas disappeared from the Turku urban area and Salo leaving a part of Uusikaupunki the only area with multiple polling districts forming a sizeable unit where the SDP was the biggest party (Figure 3). Most of the areas were lost to the PS.

The majority of inhabitants in the Turunmaa sub-region are Swedish speaking. As mentioned earlier, the RKP has the promotion of the Swedish language as a key issue on its agenda (Svenska Folkpartiet, 2016). Therefore, it is not surprising that in these municipalities the RKP also has a strong and steady support from election to election (Figure 3, the darkest gray area top left).

The map-based examination of the largest party may not give a very sophisticated view of political support, but by looking at the results on the map and at different aggregation levels (municipality and polling district level) it can be seen that the municipality level scrutiny of the election results gives a narrow and crude picture of the actual political behavior of voters when compared to the polling region level. Furthermore, larger unbroken political areas for different parties can be formed at the polling region level and they do not necessarily follow the municipal borders.

Cluster analysis

In this study, we measure party support from two perspectives: we look at the parties with the largest support within the areas and we categorize the political support profiles of the four parties with the highest share of votes within the areas using cluster analysis. In other words, we only look at the largest shares of votes, not the parties that have received the largest shares in each area. This is done at the municipal and polling district level. Figure 5 illustrates the fact that even though there are areas of political stability in terms of both the leading party and the support profile, there are also areas undergoing considerable changes even when observing a small part of Finland and using the results of only two consecutive elections as data. The areas that have witnessed the largest change are marked with dark grey and the light gray areas are the most stable ones. In the following section our aim is to cast some light on the changes that have occurred in the competitive arrangements of the leading parties within the polling areas and municipalities.

Cluster analysis seeks to find pieces of data that are, to a certain extent, similar to each other when compared with the whole dataset and then combine them into clusters. One of the most important purposes of cluster analysis is that it can assist in the classification design of complicated data (Mirkin, 1996, 24).

Another important issue in clustering is that the classification should be done in such a way that as little as possible of the information in the data is lost in the clustering process. The cluster analysis in this study aims at finding patterns of political competition settings through analyzing the support intensity of the first, second, third and fourth largest number of votes at the municipal and polling district level. In other words, in this analysis we focus solely on the political competition arrangements based on the share of votes and therefore omit the names of the political parties.
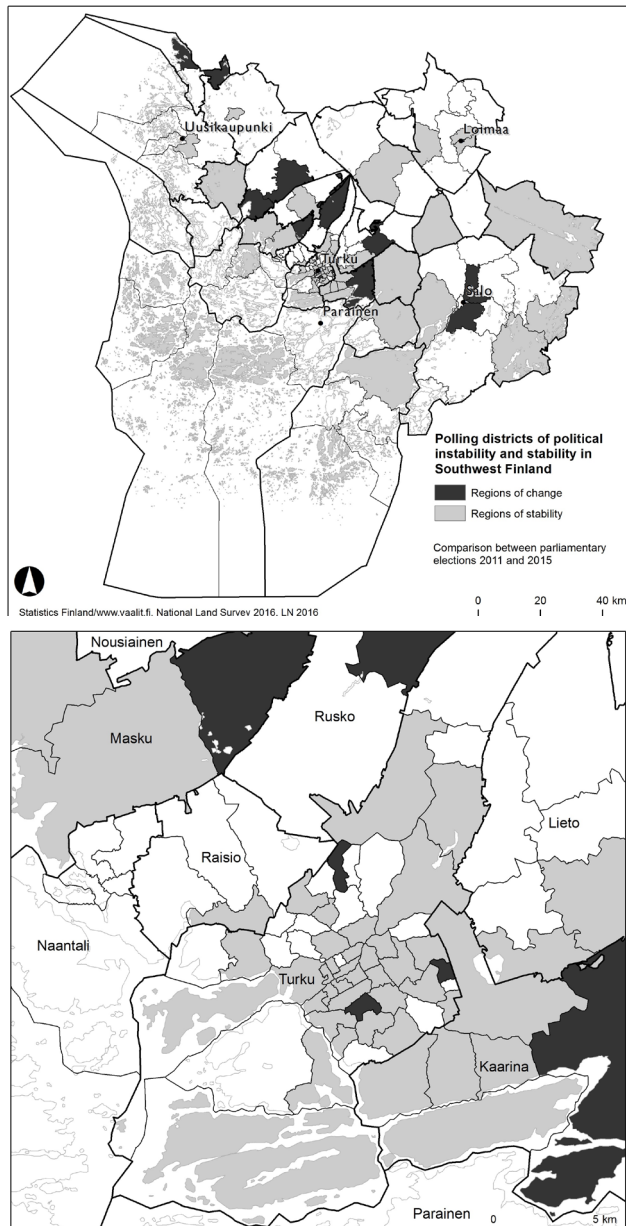
Figure 5. A polling district level comparison between the 2011 and 2015 parliamentary elections. The regions of change are the ones where the party with the largest electoral support and the support profile defined by cluster analysis has changed between the elections. In the regions of political stability the party with the largest support has maintained its position and the support profile has remained the same in both of these elections.
Source: National Land Survey of Finland 2016, Statistics Finland 2016b.

Cluster analysis has seldom been used to analyze election results. Nevertheless, Aleskerov and Nurmi (2008) have studied Finnish municipal and British general election results using the curves and slopes of the party support to cluster the data, however, the values used in the analysis were not absolute but relative.

The curves were presented in coordinates so that party support is represented by the y-axis, while the three parties with the largest number of votes are represented in decreasing order along the x-axis. In the case of the Finnish municipality elections, the timespan covered the years from 1976 to 2000, and included seven election results. The clustering measured the dynamics of the municipalities concluding that most municipalities in Finland were classified as semi-stable, when focusing on the cluster changes between the elections (Aleskerov & Nurmi, 2008, 17–18).

In this research, we use cluster analysis that is based on an algorithm that Aleskerov and Nurmi (2008) used. This allows us to include the slopes of the support curves in the cluster analysis. Instead of the three parties used by Aleskerov and Nurmi, in this paper, we use four parties.

For the clustering, we considered the four largest shares of votes in each area. We disregarded the names of the largest parties within each area and focused only on the four largest shares, which we arrange in a decreasing order. The share of votes of the i:th largest party is denoted by s_i. For each area, we drew a graph with three line segments to connect the four data points. The constants a_i and b_i can be chosen such that the equation of the line segment between points (i, s_i) and $(i + 1, s_{i+1})$ is $y = a_i + b_i x$ for all $i=1,2,3$.

Each voting area can now be described as a vector $V = (a_1, b_1, a_2, b_2, a_3, b_3)$. The Euclidean distance between two areas, V and V', is

$$d(V, V') = \sqrt{\sum_{i+1}^{3} \left((a_i - a_i')^2 + (b_i - b_i')^2 \right)}$$

At the beginning of our clustering algorithm every area forms its own cluster. This is the initial clustering. In each round, we combine the two clusters with the average vectors closest to each other. On each iteration round we acquire a new clustering and each new clustering has one cluster less than the previous one. The iteration process continues combining clusters until there are only two clusters left.

The number of clusterings thus found is one less than the number of areas. It is then necessary to define which clustering is the best. We used the formula

$$E(V, V') = e^{-\alpha d(V,V')}$$

to define a function that depends on the distance between two areas. The distance $d(V, V')$ is as defined above and e is the basis of the natural logarithm. The a in the equation is a constant that can be chosen as desired. A different a results in different quality values. The quality value of a clustering with n clusters G_i, $i=1, ..., n$ is defined by

$$\sum_{i=1}^{n} \frac{\sum_{V,V' \in G_i} E(V, V')}{\sum_{V \in G_i, V' \in G_j, i \neq j} E(V, V')}$$

Here the numerator depends on the distances of all the areas inside one cluster and the denominator depends on the distances between areas in the cluster and areas outside the cluster. The final clustering to be chosen is the one with the greatest quality value.

The criterion in this cluster analysis is internal (Mirkin, 1996, 119) and utilizes only the data from the research area – in our case the attribute data from the region of Southwest Finland. If the cluster analysis was applied to a different area, it would affect the clustering and the set of clusters would most likely be different.

Our cluster analysis is based on the electoral results of 27 municipalities[3] and 151 polling districts[4] of Southwest Finland, and the results from these areas are from the elections of 2011 and 2015. This should be noted when inspecting the descriptions of these clusters in Table 1. To make the verbal description of the clusters clearer, the support types of the clusters needed to be visualized in some exact manner. This was done by calculating the averages for the largest proportional share of the votes in the areas belonging to the same cluster, then the averages for the second biggest proportional share of votes in the areas belonging to

that cluster, and so on (Figure 6).

Table 1. The descriptions of the clusters for political competition in Southwest Finland.

Cluster	N	Description
1	214	Cluster of three party competition for the second place and one weakly dominant party
2	28	Cluster of competition for the second place with one dominant party
3	21	Cluster of competition of the second place
4	14	Cluster of intensive competition for the second and third place with one dominant party
5	4	Cluster of competition for the second place and inferior competition for the third place with one significantly dominant party
6	6	Cluster of overwhelming dominance of one party with intensive low level competition for the second and third place
7	7	Cluster of one slightly dominant party with one contender party
8	1	Cluster of shared third place and clear hierarchy
9	43	Cluster of two equally dominant parties with inferior competition for the third place
10	8	Cluster of intensive competition for the second place with one significantly dominant party
11	5	Cluster of significantly dominant party with low level competition for the second and third place
12	2	Cluster of two equal parties in second and third place with one weakly dominant party
13	4	Cluster of competition for the third place with clear hierarchy

The clustered areas of political competition in Southwest Finland

The cluster analysis clearly shows that the most common cluster is 1, where there is a clear ordering among the four largest parties, but none of these parties has a strong domination in the area. The following analysis is based on Figures 6 and 7. Between 2011 and 2015 there has been a decline in the number of areas belonging to cluster 1 when examining the phenomenon at the municipal level. At the polling district level, it can be noticed that the total number of districts with a competitive constellation represented by cluster 1 has remained the same, but the polling districts belonging to cluster 1 are not the same.

The most common change in competitive arrangements from the 2011 to 2015 elections has been the shift from a cluster 1 type to a cluster 9 support profile, and this phenomenon is noticeable both in and an examination of the municipal and polling district levels. The changes from a cluster 1 type support profile to a cluster 9 type have mostly taken place in a semi-circle shaped area some 30 kilometers north of Turku. This indicates that the competition has shifted from a four-party competition for the place of the leading party to a two-party competition. Another larger area involved with a similar cluster change is located north-east of the Salo center. The cluster shift in the Salo area does not appear at all when examining the phenomenon at the municipal level. There is also a clear shift from the cluster 9 type support profile to cluster 1 type. This phenomenon is only registered when examining the polling districts.

Cluster 1 and cluster 9 seem to have a connection and most of the changes in support profiles are located in areas belonging to those clusters – both at the municipal and the polling region level. In addition, a third cluster – cluster 3, which is characterized by intense competition for second place – seems to have a connection with cluster 1. There has been a similar two-way cluster shift process between areas in clusters 1 and 3 as with clusters 1 and 9, however although this shift is less common it can be recognized at the

municipal level as well. In addition, there have also been shifts from cluster 3 to 9 which indicates that the competition for third place has changed to a competition for second place. One of the larger support profile change areas from 2011 to 2015 is located in the western coastal area of Vakka-Suomi and the western Turku sub-region. This area has undergone a support profile change from a three-party competition for second place and one weakly dominant party to a little more obvious one dominant party support profile.
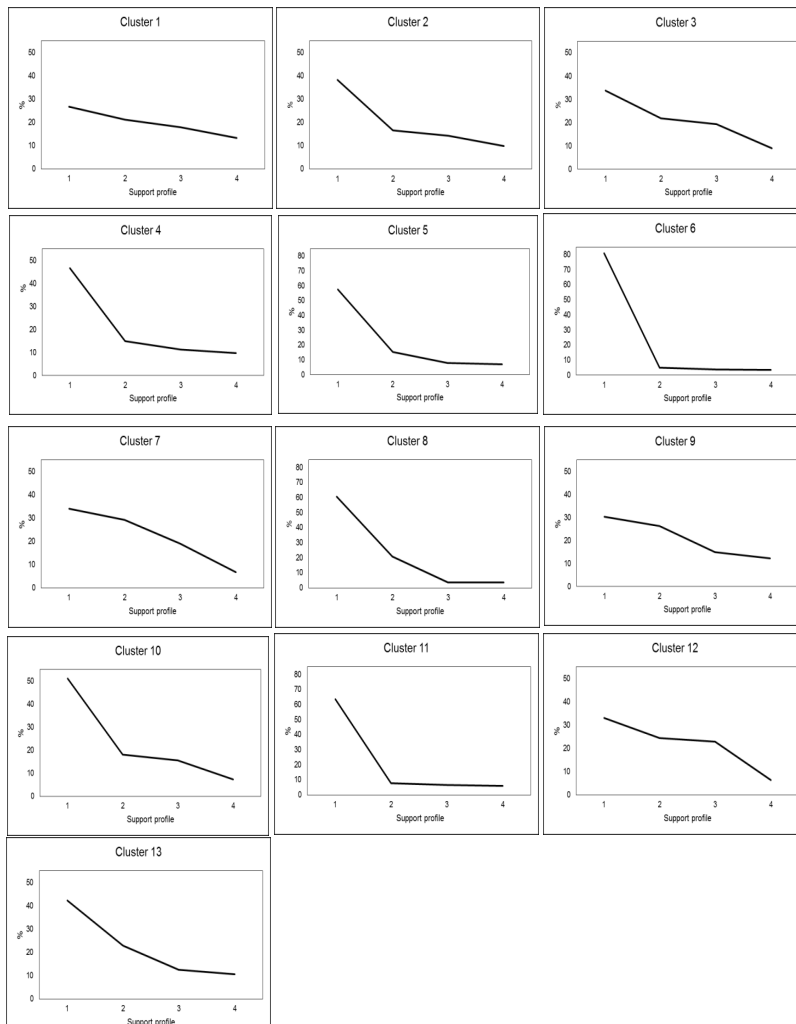

Figure 6. The profile curves for the clusters of political competition in Southwest Finland in the 2011 and 2015 parliamentary elections. Notice the difference in scale for clusters 5, 6, 8 and 11.

The cluster 9 type support profile has moved south from the northern parts of the Vakka-Suomi sub-region towards Turku when comparing the 2011 to 2015 elections at the polling district level; this cluster has overtaken areas which have previously mostly been cluster 1 type. The northern areas of Vakka-Suomi sub-region have been replaced by cluster 13, which is a support profile that was not present at all in the 2011 election. These areas which have moved from a cluster 1 to a cluster 13 type of competition have shifted from a four-party competition to a support profile where there is only one party holding the status of the largest party. Meanwhile, the political competition profiles in the larger area of cluster 13, located in the

northern parts of Vakka-Suomi sub-region, and in parts of Turku, the support profiles have shifted in a direction where the competition between the first and the second largest party has grown tighter.

Focusing on the areas of stability between the elections of 2011 and 2015 in terms of the competitive constellations we see that the larger ensemble of areas is located in the southern part of Salo, and in the urban areas surrounding Turku. Stable areas are also located in three other areas: a narrow but long northwestern area near the coastal area of Vakka-Suomi; in the Turku sub-region next to the cluster 9 type support profile area referred to above; and in the Swedish-speaking archipelago areas. The first three areas have stable cluster 1 type support profiles, while the Swedish-speaking areas have remained in clusters 6 or 11 where there is one significantly dominating party.
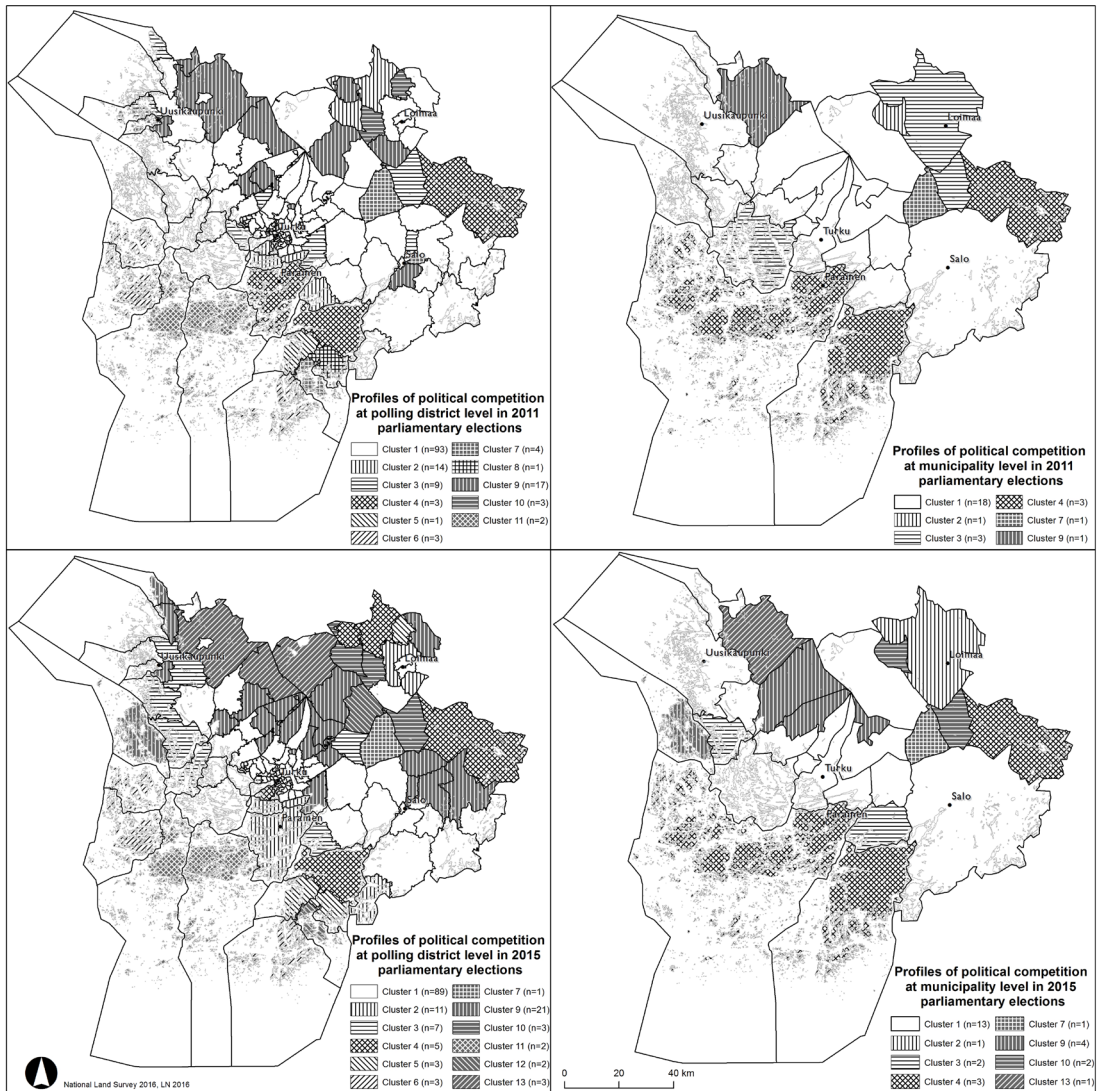

Figure 7. The profiles of political competition in the 2011 and 2015 parliamentary elections in Southwest Finland according to the cluster analysis at the polling district level and the municipality level.
Source: National Land Survey of Finland 2016.

The Herfindahl-Hirschman Index (HHI) analysis

Maps can visualize the regional support for the political parties. The image they provide can be augmented with a set of indices to measure the fragmentation of political support and to determine the correlation between the vote and seat distributions. In this research, we used an HHI concentration index to give more depth to the findings from the map-based and cluster analysis introduced earlier. The features of the HHI were presented above.

The HHI values increase when moving from the polling district level to the municipality level and to the sub-region level for all the parties in both elections (Table 2). The values of the KESK were the lowest in all cases and this is an indication of an even distribution of support. The VIHR is an example of party support which was strongly concentrated. Further, the support for the PS was intensely concentrated in both the 2011 and 2015 elections at the polling district and municipality level – there were municipalities where the PS received the majority of votes and some municipalities where the support was almost non-existent.

Table 2. *Herfindahl-Hirschman index values of the parliamentary parties calculated at different regional levels in Southwest Finland. The lowest HHI values in each level of aggregation in both 2011 and 2015 elections are marked with italics and the highest HHI values are in bold.*

| | Polling district | | | Municipality | | | Sub-region | | |
Party	2011	2015	Change	2011	2015	Change	2011	2015	Change
Centre Party	0.00960	*0.01010*	+	*0.0767*	*0.0858*	+	*0.3033*	*0.3505*	+
National Coalition Party	*0.00933*	0.01064	+	0.1971	0.2189	+	0.5615	0.5865	+
The Finns Party	0.00829	**0.05733**	+	0.1497	**0.8943**	+	0.4746	0.4880	+
Social Democratic Party	0.00937	0.01117	+	0.1908	0.1823	−	0.5018	0.4884	−
Green League	0.01383	0.01322	−	**0.3864**	0.3686	−	**0.7063**	**0.7013**	−
The Left Alliance	0.01017	0.01086	+	0.2844	0.3411	+	0.6305	0.6640	+
Swedish People's Party	**0.05809**	0.05425	−	0.2857	0.2854	−	0.4655	0.4669	+
The Christian Democrats	0.01038	0.01058	+	0.2073	0.2097	+	0.5561	0.5361	−

Discussion

The aim of this study was to discover whether there are distinctive political areas in Southwest Finland and if political areas of stability and instability can be identified by investigating the political dominance and competition of the parties. In both these questions, the interest was on the impact of the scale of the results in the elections, and for this we analyzed data from the sub-regional, municipal and polling district levels. To measure the change in political areas and competition arrangements we studied the 2011 and 2015 parliamentary elections, and compared this research with previous studies on the topic by looking at the results of the parliamentary elections between 1962 and 2015.

When considering the geographical distribution of support and the stronghold areas of the parties we found that there are larger areas crossing municipality borders that are stronghold areas of certain parties. We also noticed that these areas do not necessarily follow municipality borders. Therefore, the polling region data gives a more precise picture of the support distribution. In very large municipalities especially, the municipality level data does not give a very good indication of the magnitude of differences in party support within the area. We also discovered that between the two elections studied, the changes in the

largest parties within the areas have been substantial; the only major area for political stability of the same party in both the elections was the Swedish-speaking archipelago. The cluster analysis showed that the Swedish-speaking areas were also overwhelmingly dominated by one party, this also being something that we hypothesized.

Some of the parties have very strong support in some areas, while in others the support is marginal. Conversely, for some parties the support is weaker but spread more broadly over the whole electoral district. Some parties, like the RKP, have traditionally been seen dominant in some areas, while in others their support has been virtually non-existent. In contrast, the KESK is often thought to be a party of largely uniform support. We used the Herfindahl-Hirschman Index to study the fragmentation of support for the parliamentary parties and hypothesized that the parties having their support in the rural areas would have higher HHI values. In addition, in this context, we were interested in how the degree of fragmentation varied within each party. It transpired that the most uniform support at the polling district, municipality, and sub-region levels in both elections was for the KESK, with considerably more variation among the other parties. The level of aggregation seemed to markedly affect the concentration index values, as we assumed in our hypotheses, and there were significant changes between the two elections. High HHI values reveal that the support for some of the parties is quite concentrated, indicating that the support for the party is highly localized. A low HHI value, in turn, reflects a more homogenous support distribution for the party.

The competition settings between the political parties were studied using cluster analysis. In this analysis, we were interested in the vote share distributions of the four largest parties within the region. The names of the parties that got these votes were irrelevant; the focus was only on the general support distribution pattern. The results from the polling region level and the municipality level were all included in the analysis. We hypothesized that in the densely populated areas the political competition would be tighter and that seems to be so; however, there were also large numbers of sparsely populated areas where there was no clear dominant party.

We found that the use of the relatively uncommon method of cluster analysis together with a map and curved visualization to be a workable tool for describing the competition settings of parties.

Acknowledgements

Endnotes

[1] In the literature this kind of redistricting is often called gerrymandering. The term refers to governor Elbridge Gerry who in 1812 accepted a salamander-shaped district to secure the electoral victory of his own party. Gerrymandering is very commonly resorted to in the United States where strategic redistricting has had, from the first half of the 19th century, a marked effect on electoral outcomes (see Engstrom, 2013).

[2] For the creation of Thiessen polygons, see Brassel & Reif (1979).

[3] There were 26 municipalities in 2015 election, since Tarvasjoki has merged with Lieto municipality.

[4] The municipality of Somero is processed as one unit, since the polling districts of the municipality were redefined by completely new borders between the elections of 2011 and 2015 making the comparison impossible.

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