APPLICATIONS OF NETWORK SEGREGATION MEASURES

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Date……03.06.2016....……..…..

A B S T RA C T

Applications of Network Segregation Measures

In this thesis, the main purpose is to measure the political segregation level of main four party voter groups in Turkey. Political segregation is the degree to which political groups live apart. The segregation index is a kind of probability which shows this apartness level. It is crucial to understand the general situation of the counties in terms of the segregation of different party voters who reside in the country, because segregation might have different effects on socioeconomic variables such as crime level, education level and real estate prices. In order to conduct this analysis, main networks for two big cities of Turkey (Istanbul and Ankara) are constructed. The segregation levels of the voters are measured in the neighborhood base analysis. In addition, correlation between the segregation values are measured for the last three elections of Turkey. Finally I check whether the segregation indices are meaningful measures in terms of predicting the real estate prices in Istanbul.

ÖZET

Ağ Tabanlı Segregasyon Ölçüm Uygulamaları

Bu çalışmada Türkiye'deki en büyük dört siyasal parti seçmeninin politik segregasyon seviyesini ölçmek esas amaçtır. Politik segregasyon en basit anlamıyla farklı politik grupların birbirinden ne kadar ayrık yaşadığının ölçütüdür. Bu analizi yaparken Istanbul ve Ankara illeri baz alınmıştır ve ölçümler mahalle bazlı data oluşturularak yapılmıştır. Bu iki ilin her ilçesi için ayrı ayrı mahalle ağları oluşturulmuş ve mahallelerden ilçelere doğru geçerek dört büyük seçmen grubunun segregasyon seviyesi ölçülmüştür. Segregasyon seviyesi, hem ülkenin seçmen gruplarının dağılımını incelemede önemliyken hem de birçok sosyo-ekonomik faktöre etkisi olan bir değişkendir. Örnek olarak, bir mahalledeki eğitim seviyesi, suç işleme oranı ve emlak fiyatları verilebilir. Bu bağlamda çalışmada, Istanbul'un tüm mahalleleri için segregasyon seviyesinin emlak fiyatlarını tahmin gücünü arttırıcı bir ölçüt olup olmadığı test edilmiştir.

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Special thanks are due my family; my mother,my father and my dear brother for their confidence in me.

DEDICATION

I dedicate my work to my beloved father...

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CHAPTER 1

INTRODUCTION

Classifying individuals according to socioeconomic characteristics such as income level, political preference is an interesting topic around the world. A large literature explores the causes and consequences of residential segregation. This subject has long been a significant research area in the economic and social policy environment, because segregation could have impacts on public policies. In this paper, my objective is to measure the political segregation of the voters located in Istanbul and Ankara. After measuring political segregation, I investigate the correlation between these segregation values. Political segregation is the degree which political groups live apart based on their political preferences. In Turkey, the number of active political parties varies from year to year. But in terms of understanding the general political picture in the society, main four political views are selected to investigate. In this paper, the relation between the real estate prices and segregation level of voters is going to be analyzed.In order to measure segregation, I utilize from a neighborhood base analysis. In this analysis, our agents are the voters of four political groups in Turkey. They are AKP(Justice and Development Party); CHP(Republican People's Party) ; MHP(Nationalist Movement Party) and HDP(The Democratic Party of The Communities). There are residential units(census tracts) that the voters are located. They are named as nodes. (Ballester & Vorsatz, 2014) Nodes are connected each other with links. If there is a link between two nodes, then they are adjacent. In our study, two census tracts (neighborhood) are connected if they are adjacent geographically.

CHAPTER 2

LITERATURE REVIEW

Massey & Denton (1988) accomplished a systematic analysis on more than 15 segregation indices which they extracted from the literature. They claimed that segregation has not one dimensional structure. Within this concept, they worked about five dimensions of segregation which are evenness, exposure, concentration, centralization, clustering.

Currarini & Jackson & Pin (2008) studied the segregation and homophily indices. They developed an economic model of friendship for homophily, minorities and segregation. Their friendship model clarifies segregation patterns observed in social and economic networks. They analyzed the steady state equilibrium in these networks and defined homophily index as a tendency of various types of individuals to associate with others who are similar to themselves. They took a high school as an observation group and identified the students according to their race. Then they investigated how people from different race get along or live apart from each other. According to the findings, Currani et al.(2008) developed a friendship model formation. If an agent's preferences are insensitive to type regarding the friendship formation, then the agents only give importance to the total number of friends. Then under any matching process, all agents would have the same number of networks in terms of friendship. They examine if agents see high return of connecting with people from the same race.

Echenique & Fryer (2006) proposed three specific properties that any segregation measure should have and they defined spectral segregation index. They

used this index in order to measure the connectedness of individuals. In order to derive spectral segregation index, a graph theory algorithm is used. The social interaction framework is basicly studied with the assumption of agents spend their time with the agents who are from the same group. All agents have to divide their time with the decision of time allocation between the other agents(Echenique & Fryer, 2006). After deriving SSI they used this index to measure the schooling and residential segregation. The residential segregation is the separation of different groups into different neighborhoods physically. They computed the segregation level of major cities in the US, then compared their findings with the other common measures of segregation in the literature.

Ballester & Vorsatz (2014) used the data of Spain in their empirical analysis. They found that the Mediterranean coast is the most segregated region. Also they discussed about the discontinuity of spectral segregation index. They built a game theoretical model in which they measure the index of segregation. In this model the utilities of agents depend on if they meet the agents from the same social group or not.

Jahn, Schmid & Schrag (1947) developed some indices to measure segregation. One of them is dissimilarity index which is a measure of evenness. In order to calculate the index of dissimilarity, in the first place the ratio of black who live in neighborhood i to the total number of blacks is calculated, afterwards, the ratio of non-black residents who live in neighborhood i to the number of total non-black people is measured. In their study, blacks are the minority group in the society. The other index Jahn, Schmid & Schrag (1947) studied is the isolation index. It measures how much the neighborhoods are isolated from each other.

CHAPTER 3

METHODOLOGY

The main objective in this paper is to apply the segregation index developed by Ballester & Vorsatz (2014) to the neighborhood level election data in Istanbul and Ankara. I make this using the last three general elections data of Turkey. These are the elections held in June 2011, in June and November 2015. I took the data from the Supreme Committee of Elections. The main approach is constructing the networks for neighborhoods by defining each neighborhood as a node in the society. The links between the neighborhoods are constructed based on adjacency level. After building these connections between nodes, for each county of Istanbul and Ankara, the segregation index is measured. In order to measure this index, the density and concentration of each county is calculated for each political group. Density of a political group for a neighborhood is the ratio of the number of voters for this political gorup who live in this neighborhood; to the total number of voters who belong to this group in the county. Concentration of a political group for a neighborhood is the ratio of the number of voters for this political group who live in this neighborhood; to the total number of voters who live in the census tract. After finding the segregation levels, the correlation between different voter groups is analyzed. Then for each neighborhood in Istanbul and Ankara, the effect of segregation on real estate prices is investigated.

The definition of segregation by Ballester &Vorsatz (2014, pp. 386), which I also use in this thesis, is as follows: segregation index is “the probability that a randomly chosen individual from a group meets an individual from the same social group in the node where her random walk terminates”. Within this concept, a random

walk is described as follows: "In every subsequent period t, a walk continues with probability α which takes a value between [0,1) from the current position in the network W_t to an adjacent node W_{t+1} , and stops with probability 1- α." (Ballester & Vorsatz, 2014, pp.385). In this concept, α is the degree of mobility which shows the frequency of altering node by an agent. They also assume that in period t = 0, a walk passes from node W_o (initial node) to some adjacent node W_1.

While creating networks, the process starts with a geographical space that is divided into counties and the counties are divided into smaller units called as census tracts or neighborhoods. While constructing the network, there are some assumptions that are used in the model. To begin with, the voters are located in neighborhoods in a county that are interconnected through links and multiple voters could be located in the same neighborhood. The segregation of a group changes with the distribution of the other groups in all neighborhoods. I construct many number of networks in order to measure the segregation level of voters in Turkey. Istanbul has 39 counties which include corresponding 910 census tracts while Ankara has 25 counties with corresponding 1419 neighborhoods. Therefore the number of nodes is equal to the number of neighborhoods.

In this study, there is a finite set of individuals called as N = {1,2.....n}. In order to represent neighborhoods in each county, M is used as M={1,2.....m}. G={1,2.....g} of g groups form a partition of the society; there are four groups in my network as representing the big four party voters in the society. Therefore if g=1, then the agent is a dominant party voter which is AKP; if g=2, then the agent is a primary opposition party voter which is CHP; if g=3, then the agent is a secondary opposition party voter that is MHP and lastly if g=4, then the agent is a ternion opposition party voter that is HDP.

In the analysis, for each county in a city, a transition probability matrix is created and the entries of this matrix are calculated with the transition probabilities (See Appendix A). Therefore, each matrix has a different dimension depending on the number of census tracts that a county has. Within this concept, p_{ij} is the transition probability of going to the neighborhood j starting from the neighborhood i. The entries of the intersection of two neighborhoods which are not connected are automatically zero. In this context, in order to be connected, two census tract should become geographically adjacent to each other. The entries of the intersection of two neighborhoods which are connected are equal to 1/n where n is the number of census tracts the neighborhood is connected to. In addition, the main assumption is that each node can be accessible from itself , it means that p_{ii} =1. After calculating the probability transition matrices, for each group in the society, concentration and density values are computed. For each county, a concentration matrix is measured. Each county's matrix has dimension of m x g where g is always four regardless of the county;since I focus on four political groups. M stands for the number of census tracts in the county. In order to find the ij^{th} entry of the concentration matrix, the number of voters who belong to group g and live in census tract i, is divided to the number of voters who reside in neighborhood i. Within the same context, the density matrices are computed. The ij^{th} entry of the density matrix is equal to the number of voters who belong to group g and live in census tract i, divided to the number of voters who belong to group g, where i and j are the indices for census tracts.

The software Matlab is used to measure the segregation index. (See Appendix B) The mobility level (α) is selected as 0.85 in the first phase of the study, implying that each agent has ability to change their current node with random walk. In order to measure the index; I use the formula below (Ballester & Vorsatz,2014):

$\sigma_g(D,\alpha) = (1-\alpha)D_g^T\ inv(I-\alpha P)P\ C_g$. The left hand side of the equation represents the segregation index of group g who live in the county D with mobility level α . D_g is the density of group g, I is the identity matrix, P is the transition probability matrix and C_g is the concentration of group g. In order to make a valid comparison, the index should be normalized to purify the effect of the number of voters in the measurement. In other words, only the normalized measure is invariant to the relative group sizes. According to the equation below, n_g is the number of voters who belong to group g and n is the total number of voters. The left hand side is the normalized segregation index for group g. $\bar{\sigma}_g(C,\alpha) = \sigma_g\left(\frac{n_g}{n}\right)^{-1}$ (Ballester, Vorsatz, 2014)

In this study, the counties of Istanbul are; Adalar, Arnavutköy, Ataşehir, Bağcılar, Bahçelievler, Bakırköy, Başakşehir, Bayrampaşa, Beşiktaş, Beykoz, Beylikdüzü, Beyoğlu, Büyükçekmece, Çatalca, Çekmeköy, Esenler, Esenyurt, Eyüp, Fatih, Gaziosmanpaşa, Güngören, Kadıköy, Kağıthane , Kartal, Küçükçekmece, Maltepe, Pendik, Sancaktepe, Sarıyer, Silivri, Sultanbeyli, Sultangazi, Şile, Şişli, Tuzla, Ümraniye, Üsküdar, Zeytinburnu. The counties of Ankara are; Akyurt, Altındağ, Ayaş, Bala, Beypazarı, Çamlıdere, Çankaya, Çubuk, Elmadağ, Etimesgut, Evren, Gölbaşı, Güdül, Haymana, Kalecik, Kazan, Keçiören, Kızılcahamam, Mamak, Nallıhan, Polatlı, Pursaklar, Sincan, Şereflikoçhisar, Yenimahalle. A particular calculation example is shown below conducted for Sarıyer county in Istanbul. In the first place the census tracts of Sarıyer are identified then the network map of the county is created according to the adjacency of these neighborhoods. After that, the number of census tracts that a neighborhood is connected to should be measured for each neighborhood in Sarıyer. In this example, the political groups are indicated with notation g and list of g consists of four variables: G= {AKP

voters,CHP voters,MHP voters,HDP voters}.The total number of voters who reside in Sarıyer is 214,048 based on the general parliamentary elections held in November 2015. The notation N stands for the number of voters in Sarıyer, therefore N starts from 1 and goes up to 214,048. M is used for representation of the census tracts of Sarıyer. It starts from 1 and goes up to 38 since Sarıyer has 38 neighborhoods. Therefore if m= 1, then it means the neighborhood Ayazağa is analyzed. (alphabetically ordered) Table 1 shows the number of neighborhoods for each counties of Sarıyer. Table 2 shows the vote distribution of Sarıyer for the last election results.

Table 1. Neighborhood Situation of Sarıyer

Number	Neighborhood	NNC	Number	Neighborhood	NNC
1	Ayazağa	4	21	Kireçburnu	3
2	Bahçeköy merkez	3	22	Kocataş	5
3	Bahçeköy yeni	4	23	Kumköy	4
4	Baltalimanı	5	24	Maden	6
5	Büyükdere	5	25	Maslak	7
6	Cumhuriyet	5	26	Merkez	6
7	Çamlıtepe	8	27	Pınar	5
8	Çayırbaşı	4	28	Poligon	5
9	Daruşşafaka	6	29	Ptt evleri	9
10	Ferahevler	5	30	Reşitpaşa	8
11	Demirci	5	31	Rumeli feneri	5
12	Emirgan	4	32	Rumeli hisarı	3
13	Fsm	4	33	Rumeli kavağı	7
14	Garipçe	3	34	Tarabya	6
15	Gümüşdere	4	35	Uskumruköy	5
16	Huzur	2	36	Yeni	3
17	İstinye	8	37	Yeniköy	4
18	Kazım karabekir paşa	7	38	Zekeriyaköy	7
19	Kemer	4			
20	Kısırkaya	2			

Note: NNC is the number of neighborhoods that a census tract is connected to.

Table 2. Vote Distribution of Sarıyer in 2015 Elections

Type of voter	Number of votes	Share
AKP	89,097	41,60%
CHP	86,359	40,30%
MHP	18,480	8,60%
HDP	15,775	7,30%
Others	4,337	2%

Note: Data represents 2015 November election results.

Notation $N_{g,i}$ is used for the number of individuals of group g who live in the neighborhood i, for instance in this example $N_{1,1}$ is 13,415, it means that there are 13,415 dominant party voters who live in neighborhood Ayazağa. And the remaning vote distribution of Ayazağa is: $N_{2,1}$=5,795 (number of CHP voters who live in Ayazağa) ; $N_{3,1}$=1,356 (number of MHP voters who live in Ayazağa); $N_{4,1}$=185 (number of HDP voters who live in Ayazağa); $N_{5,1}$=624 (number of other party voters who live in Ayazağa). C_g is used to represent the concentration of a group. For instance in Ayazağa, concentration of AKP voters can be found by dividing the number of AKP voters in Ayazağa to total number of valid votes in Ayazağa which is 13,418/21,186. D_g is used to represent the density of a group. For instance in Ayazağa, density of AKP voters can be found by dividing the number of AKP voters in Ayazağa to total number of AKP votes in Sarıyer which is 13,418/89,097. An example of network for Beşiktaş county is represented in Figure 1. In this study, for each county of Istanbul and Ankara, similar networks are constructed. Since the neighborhood structures of the counties might change from election to election, I construct my networks based on the 2015 November election data.

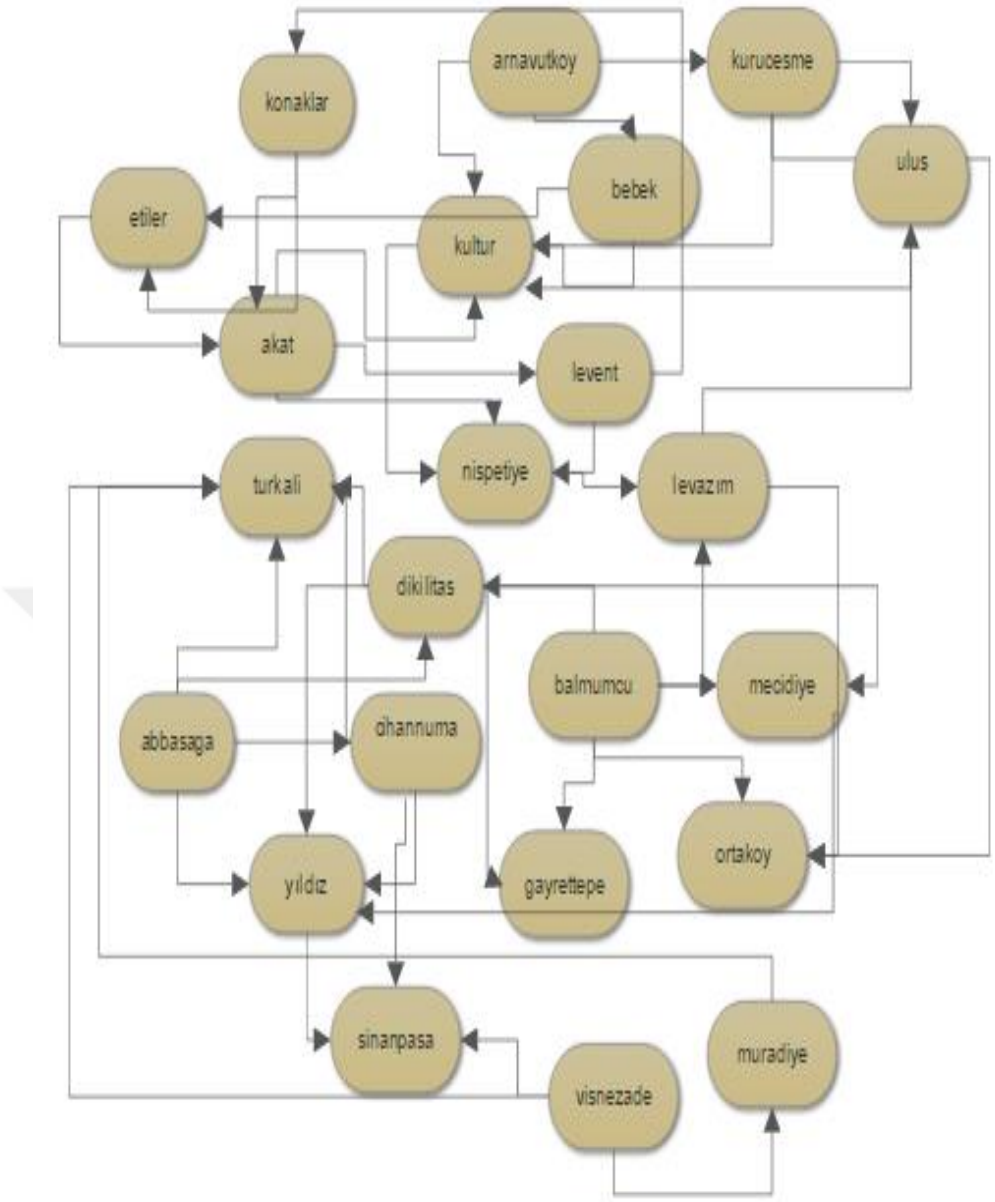


Figure 1 A network diagram for the counties of Beşiktaş

CHAPTER 4

SEGREGATION RELATIONS

4.1 Mobility and segregation level

As an introductory example, it is assumed that there are four neighborhoods such as a,b,c,d in a county, therefore in the network constructed for this county, there would be four nodes connected through links. Figure 2 represents the neighborhood status of the nodes. There are 14 agents living in this county and there are only two groups such as blacks and whites. Within this perspective, it is assumed that the network diagram would be as follows:

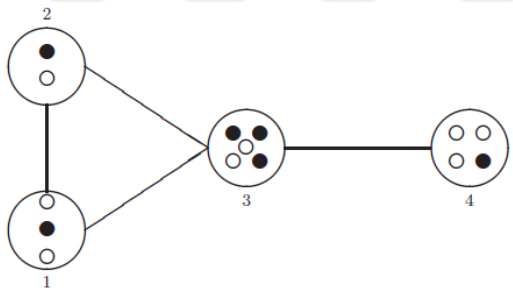


Figure 2 An example of a neighborhood

Source:[Ballester, Vorsatz,2014]

According to this network, first I calculate the transition probabilities in order to measure the segregation level of blacks and whites separately. The transition probability matrix will be 4x4 since there are four census tracts in the county. The entries of the matrix which correspond to the intersection of the two non adjacent nodes would be zero. The other entries are 1/n where n is the number of nodes that the neighborhood i is connected to.

Then the corresponding P matrix is;

$$\begin{bmatrix} 1/3 & 1/3 & 1/3 & 0 \\ 1/3 & 1/3 & 1/3 & 0 \\ 1/4 & 1/4 & 1/4 & 1/4 \\ 0 & 0 & 1/2 & 1/2 \end{bmatrix}$$

After that, the density and concentration matrices of blacks and whites are computed, each one would be 1x4 column matrix since there are four census tracts in the county. Density of blacks is $[1/6 \quad 1/6 \quad 1/2 \quad 1/6]$, density of whites is $[1/4 \quad 1/8 \quad 1/4 \quad 3/8]$, concentration of blacks is $[1/3 \quad 1/2 \quad 3/5 \quad 1/4]$ and concentration of whites is $[2/3 \quad 1/2 \quad 2/5 \quad 3/4]$.

When the formula of segregation level is implemented, the segregation index of black and white is found for 0.85 mobility level in the county. $\sigma_{black}(D, 0.85) = 0.4481$ and $\sigma_{white}(D, 0.85) = 0.5525$. Then α decreased from 0.85 to 0.45 which means that the ability of agents of changing their location decreased. For the new mobility levels, segregation indices are recalculated. Then $\sigma_{black}(D, 0.45)$ is 0.4442 and $\sigma_{white}(D, 0.45)$ is 0.5556. In order to be able to make correct assessments, the segregation levels are normalized by multiplying the segregation index of blacks with the reciprocal of the weight of the blacks in the county and by multiplying the segregation index of whites with the reciprocal of the weight of the whites. For each mobility levels, normalized segregation indices of two groups are found. $\bar{\sigma}_{black}(D, 0.85) = 1.0456$; $\bar{\sigma}_{white}(D, 0.85) = 0.9669$; $\bar{\sigma}_{black}(D, 0.45) = 1.0365$ and $\bar{\sigma}_{white}(D, 0.45) = 0.9723$

In this example, it is seen that when α decreased, the segregation level of blacks decreased from 0.4481 to 0.4442 whilst the segregation index of whites increased from 0.5525 to 0.5556. When the normalized index values are analyzed, the same movement is seen as it became in the segregation values. A rational

explanation could be that a higher mobility level could mean an individual has increasing ability for changing her location, so that it would be easier to travel between neighborhoods. This result could lead to a lower level of segregation for this voter group that this travelling agent belongs to. Because it makes sense when mobility increased the segregation becomes less observable since segregation means living apart from the majority. However when the agent travels more frequently, she is getting close to the majority and becoming less segregated. On the other hand this is not always the case as black groups are showing the contrast in the example. Because the mobility level is decreasing for both groups in the example, but the segregation level of blacks decreased at the end according to the computations.

However, there could be a third case which is resulting in a constant segregation level even though the mobility level changed regardless of the changing direction(increase or decrease). This case could be observed in Adalar county in Istanbul. In this county, there are five neighborhoods that are Kınalıada, Burgazada, Heybeliada, Büyükada Maden and Büyükada Nizam. There is only one connection which is between the neighborhoods of Büyükada. So the other census tracts are not adjacent to each other because of the geographical conditions of Adalar county. Therefore corresponding P matrix would be:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1/2 & 1/2 & 0 & 0 \\ 0 & 1/2 & 1/2 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

$P_{2,3} = 0.5$ by indicating that Büyükada Maden and Büyükada Nizam are connected with each other. There are four voter groups in this example as AKP,CHP,MHP and HDP. Therefore the density matrix will be 4x5 (four voter groups for corresponding five census tracts). The density matrix of these voter groups are as follows; the first

row shows the density of AKP in five neighborhoods (Burgazada, Büyükada Maden, Büyükada Nizam, Heybeliada and Kınalıada respectively- alphabetic order) and the second row shows the density of CHP voters in these five neighborhoods. The analysis is conducted for 2011 general parliamentary elections data. Table 3 represents the density values of voter groups in Adalar based on 2011 election results.

Table 3. Density Matrix of Adalar for 2011 Elections

	Burgazada	Büyükada Maden	Büyükada Nizam	Heybeliada	Kınalıada
AKP	0,066073	0,281068	0,19822	0,284492	0,170147
CHP	0,137868	0,278493	0,1875	0,262408	0,133732
MHP	0,079065	0,325167	0,242762	0,285078	0,067929
HDP	0,084433	0,350923	0,255937	0,23219	0,076517

Note:There are five neighborhoods in Adalar county. While constructing density matrices, the neighborhoods are ordered alphabetically. Other party voters are omitted, only four main party voters are considered.

The concentration matrix is also computed in the same way, however this time concentration matrix is 5x4; it indicates that the first column shows the concentration of AKP voters in five neighborhoods, the second column shows the concentration values of CHP voters in neighborhoods. Table 4 represents the concentration values for voter groups in Adalar based on 2011 election results.

Table 4. Concentration Matrix of Adalar for 2011 Elections

	AKP	CHP	MHP	HDP
Burgazada	0,203801	0,63358	0,074974	0,033791
Büyükada Maden	0,312881	0,46189	0,11128	0,050686
Büyükada Nizam	0,316048	0,445415	0,118996	0,052948
Heybeliada	0,334946	0,460298	0,103184	0,03547
Kınalıada	0,411424	0,481788	0,050497	0,024007

Note:There are five neighborhoods in Adalar county. While constructing concentration matrices, the neighborhoods are ordered alphabetically. Other party voters are omitted, only four main party voters are considered.

Identity matrix in the formula would be 5x5 since there are five census tracts, then the segregation levels for each voter group for 0.85 mobility level are; $\bar{\sigma}_{Akp}(Adalar, 0.85) = 1.0256$,$\bar{\sigma}_{Chp}(Adalar, 0.85) = 1.0111$, $\bar{\sigma}_{Mhp}(Adalar, 0.85) = 1.0549$ and $\bar{\sigma}_{Hdp}(Adalar, 0.85) = 1.0651$. When the mobility level changed to 0.45, exactly the same values are found. This is because of the structure of the P matrix; since geographically the neighborhoods are separated from each other by sea, P matrix does mainly consist of zeros. Therefore the changing mobility value does not affect the segregation level of voter groups.

4.2 Number of votes and segregation level

4.2.1 Number of vote change only in one census tract

One of the main research issues in this study is to understand the change in segregation level when one individual changed her political preference, in other words I investigate the segregation level change when an agent who voted for a party votes for another party in the subsequent elections.

The previous network structure could be considered again, which consists of four neighborhoods in a county, however this time the groups are going to be the different party voters such as black ones are the voters of political party I, and the white ones are the voters of political party II. A possible alteration could be changing the vote distribution of people who live in the neighborhood 4 in this structure. New vote distribution could be seen in Figure 3.

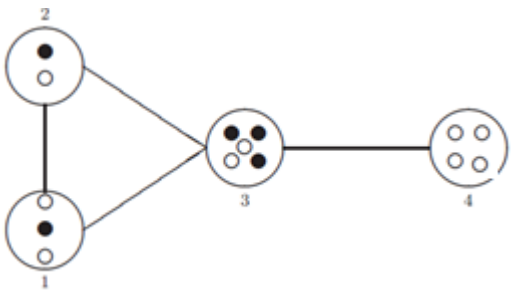


Figure 3 A new neighborhood situation when there is a vote change in node 4

The segregation levels of voter group I and II is going to be computed for the previous and new vote distribution in the county. In the new network, the calculated segregation level of voter group I (black ones) for mobility level 0.85 is 0.4099 while the segregation level of voter group II (white ones)for the same mobility level is 0.6034. The normalized segregation index for voter group I is 1.1477; for voter group II is 0.9386 for this mobility level.

When the segregation values are compared with the previous result for the same mobility level 0.85(by keeping the ability to move as constant) , it is seen that the normalized segregation level of voter group I rose from 1.0456 to 1.1477, while the normalized segregation index for voter gorup II decreased from 0.9669 to 0.9386. Then it could be concluded that within this network and for mobility level 0.85, when a former voter of party I changed her idea by voting for party group II afterwards, the segregation level of voter group I increased, in other words when the number of votes of group I decreased, the segregation index of them increased. It could be interpreted as when a group became minority in a society, the segregation level of this group rose which makes sense.

However there is an interesting result when I change the idea of a voter located in another census tract. Figure 4 represents the new neighborhood situation.

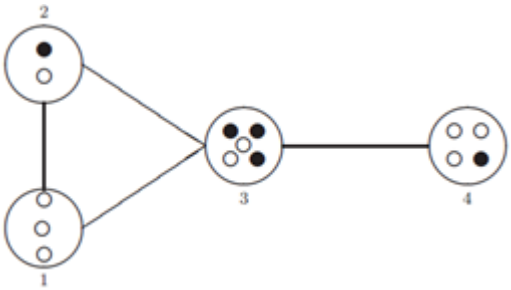


Figure 4 A new neighborhood situation when there is a vote change in node 1

The voter of group I changed to group II. In this new circumstance, density of voters of party I = [0,1/5, 3/5, 1/5], density of voters of party II = [1/3, 1/9, 2/9, 1/3], concentration of voters of party I = [0, ½, 3/5, 1/4] while the concentration of voters of party II=[1, 1/2, 2/5, 3/4]. In this new structure, new values of segregation indices are; $\sigma_{voter\ I}(D, 0.85) = 0.3669$, $\sigma_{voter\ II}(D, 0.85) = 0.6307$,$\bar{\sigma}_{voter\ I}(D, 0.85) = 1.0273$ and $\bar{\sigma}_{voter\ II}(D, 0.85) = 0.9801$. Then it is seen that the segregation level of voter group I decreased from 0.4481 to 0.3669 and normalized index also decreased from 1.0456 to 1.0273; while the segregation level of voter group II rose from 0.5525 to 0.6307 and the normalized segregation index also increased from 0.9669 to 0.9811. Therefore, when the number of voters who belong to party I decreased only in neighborhood 1, the segregation index of voters also diminished. However this was contrary to the result obtained when an agent who live in neighborhood 4 changed her idea. Then it could be stated that it is not possible to make a general interpretation about the relation between the number of voters of a group and segregation level of that group by comparing these results.

A real data could be used to understand the relation between the number of votes and segregation level. For this analysis, Yenimahalle county of Ankara is selected. Yenimahalle consists of 52 census tracts, and to be consistent, the same four political party voters are the subject of investigation which are AKP, CHP, MHP and HDP voters. According to the 2011 general parliamentary election results, the number of AKP voters who live in Yenimahalle is 159,996 and the computed segregation level of AKP for 0.85 mobility level is 0.4048, the corresponding normalized value is 0.9099. In the elections held in June 2015, the number of AKP voters in Yenimahalle is 142,922 and the segregation index is 0.3931 with a normalized valued of 1.0915. In 2015 elections conducted in November, the number

of AKP voters in Yenimahalle is 176,526, the segregation index of AKP voters is 0.4589 with a normalized index value of 1.0741. As a result of that, if 2015 June and november election results are compared, it is seen that when the number of AKP voters increased, even though the segregation level of AKP voters increased; the normalized segregation index of AKP voters decreased. However, when 2011 June and 2015 November elections are compared, it is seen that the segregation level of AKP voters increased when the number of AKP voters increased but the normalized index did also increase from 0.9099 to 1.0741. According to the segregation index calculation formula used in this study, it could be anticipated that the segregation index of a voter group and the number of votes of this group are related positively. Because in the formula, mobility level, transition probability matrix and identity matrix are kept constant, only the concentration and density matrices changed when the number of votes increased in a county. However it is not that simple to anticipate the same change in the normalized index value, because it is also influenced by the number of changes in the total votes in the county. When the number of AKP votes increased in a county, it is also significant to see the change in the total valid number of votes. The reason of experiencing a decrease in the normalized segregation index of AKP voters while the total number of AKP votes are increasing, is totally related with that situation. Because when comparing 2015 June and November elections, the change in the total number of AKP votes in Yenimahalle is approximately 23% increase while the change in total votes is 4.11% increase.Since when normalizing a segregation index, it is multiplied by the ratio of the number of total votes to the number of votes belong to a specific party, in this situation the numerator changed by 4.11% but the denominator changed by 23%, resulting in a decrease in the normalized index for the AKP voters in Yenimahalle.

4.2.2 The effect of the uniform number of vote change in all census tracts

In this section, the resulting segregation levels of the voter groups will be investigated when there is a uniform change in all neighborhoods in a county. By declaring uniform change, it should be understood that there is same percentage of increase or decrease in the number of votes of a specified group within all neighborhoods. However, in this analysis, the significant point is to keep the total number of votes in a node constant. It means that when there is an increase in the number of votes of a party in the node, it will automatically result with a decrease in the number of votes of the remaining parties in the current node. For instance, it is assumed that there are two voter groups: political party I supporters and party II supporters. For the sake of simplicity, it is assumed that there are two census tracts in the county and they are connected to each other. Again it is supposed that the party II supporters are the minority groups in the county so that the possible situtation could be like this: In the node 1 there are 12 voters living and two of them are the political party II supporters. It is supposed that an individual can not be noncommittal, therefore remaining 10 voters should belong to the group I. In the second node, there are 13 voters living with three of them are supporters of party II so that the remaining 10 agents are from the party I. For this structure, P matrix is 2x2 matrix whose entries are 0.5. And the density of party I is $[1/2 \quad 1/2]$ and the density of party II is $[2/5 \quad 3/5]$ while the concentration matrix of party I is $[10/12 \quad 10/13]$ and of party II is $[2/12 \quad 3/13]$. When the formula applied for 0.85 mobility level, it is found that the segregation index of voter group I is 0.8013. The normalized segregation index for voter group I is 1.0016.Then a new voting distribution is created such as there is an increase in the voters of group I and it is assumed that this increase will be 10%. Therefore in the new network, node 1 would include 11 party I

voters and only 1 party II voters. Node 2 would contain 11 party I voters and 2 party II voters. So the total number of voters are the same as before, there are 12 voters in node 1 and 13 voters in node 2. It is again assumed that there is no agent who does not vote for any political party. And there is no voter who votes incorrectly or has an invalid vote. When this uniform change occurs in the number of votes, it is found that the segregation level of voter I is 0.8814 and the corresponding normalized index is 1.0016. Then it could be stated that when there is a uniform change in the number of votes of a group, the segregation index of that group changed as much as the increase or decrease amount; however the normalized segregation index kept constant. Because in the formula all related variables changed by 10%. Particularly, α, P matrix and identity matrix are the same. Density matrix for the mentioned voter group is also the same as 1x2 column matrix with having all entries 0.5. Only concentration matrix is changed from [10/12, 10/13] to [11/12, 11/13] with a ten percent increase in all entries; so resulting segregation index of the voter group I rose from 0.8013 to 0.8814. But when it comes to normalization, the segregation index is multiplied by 25/20 in case 1, by 25/22 in case 2. So the denominator also increased by 10% resulting in a same normalized index value.This is a good result for generating general results for the huge networks. For example when the voter groups of Turkey is considered, it could be stated that in a county, when the number of votes of a specific group altered uniformly in all neighborhoods in the county, the normalized segregation level of that group does not change overall.It means that when the number of the supporters of a party changed uniformly in all census tracts of a region, the probability that meeting with a voter from the same group stays constant when a voter starts to realize a random walk.

CHAPTER 5

OUTCOMES

5.1 General parliamentary elections in June 2011

In the first place, the segregation levels of AKP ,CHP, MHP and HDP are computed for 39 counties of Istanbul for two different mobility levels that are 0.85 and 0.45. Particularly, HDP was not available in 2011, instead of that BDP was the representative of it. But for the sake of simplicity, in order to be consistent with the subsequent elections, BDP is evaluated as HDP in 2011 election results. Then the values are normalized in order to remove the effect of the different number of vote weights among the party groups.

In Table 5 and Table 6, the segregation index of the voter groups is shown for different mobility levels. While measuring the index, the valid votes are considered and their effect is measured in computation of the segregation level of a group. In other words, the number of invalid votes for each political party occurred during the elections are omitted. According to the average indices based on 2011 election results, the highest segregation index is observed in HDP voters for each mobility level, especially in Fatih. In addition, AKP voters are the least segregated group between these four political groups. Especially in Şişli, the segregation index of the voters of AKP is very low.

Table 5. Normalized Segregation Values for the Counties of Istanbul Based on 2011 Elections(α=0.85)

County	$\bar{\sigma}_{AKP}$(C, 0.85)	$\bar{\sigma}_{CHP}$(C, 0.85)	$\bar{\sigma}_{MHP}$(C, 0.85)	$\bar{\sigma}_{HDP}$(C, 0.85)
Adalar	1.0256	1.0112	1.0550	1.0651
Arnavutköy	0.9766	1.3808	1.1027	1.0625
Ataşehir	1.0128	1.0261	0.9761	1.0814
Avcılar	0.9537	1.0551	1.0566	0.8824
Bağcılar	0.9868	1.0608	1.0183	0.9897
Bahçelievler	1.0182	0.9948	0.9970	1.0395
Bakırköy	0.9570	1.0381	0.9925	1.0863
Başakşehir	1.0504	0.9885	0.9693	1.0768
Bayrampaşa	1.0157	0.9607	0.9953	1.2216
Beşiktaş	1.0256	0.9957	1.0018	1.1419
Beykoz	0.9864	1.0822	1.0176	0.8608
Beylikdüzü	1.1325	0.9474	0.9967	0.9717
Beyoğlu	1.0181	1.0935	1.0414	1.6439
Büyükçekmece	1.0783	0.9459	0.9837	1.1816
Çatalca	1.0342	1.0178	1.0799	1.3473
Çekmeköy	1.0023	1.0081	1.0382	1.1028
Esenler	0.9797	1.0870	1.0417	1.0080
Esenyurt	1.0192	0.9832	0.9774	1.0291
Eyüp	1.0460	0.9482	1.0755	0.9417
Fatih	1.0399	1.0899	1.0632	1.7776
Gaziosmanpaşa	0.9913	1.1336	1.0487	1.3115
Güngören	0.9701	1.1663	1.0167	0.9626
Kadıkoy	1.0901	1.0050	1.0103	1.2227
Kağıthane	1.0027	1.0048	1.0332	1.0327
Kartal	0.9976	1.0208	1.0188	1.0966
Küçükçekmece	0.9987	1.0185	1.0427	0.9427
Maltepe	1.0096	1.0060	1.0225	1.1606
Pendik	1.0052	1.0592	1.0314	1.1272
Sancaktepe	1.0317	1.0584	1.0663	0.9974
Sarıyer	0.9656	0.9943	0.9917	1.1131
Silivri	0.9412	1.0846	1.0052	0.9354
Sultanbeyli	0.9956	1.0477	1.0357	1.1252
Sultangazi	1.0186	1.2007	1.0380	0.9681
Şile	1.0554	0.9453	1.0115	1.1095
Şişli	0.9297	1.0685	0.9986	1.0190
Tuzla	1.0034	1.0403	1.0861	0.9866
Ümraniye	0.9901	1.0570	1.0001	1.1190
Üsküdar	1.0139	1.0792	1.0050	0.9790
Zeytinburnu	1.0124	0.9767	1.0348	0.9619
Average	1.0098	1.0431	1.0251	1.0944

Note: $\bar{\sigma}_{AKP}$(C, 0.85) stands for the normalized segregation level of the AKP voters for α=0.85

Table 6. Normalized Segregation Values for the Counties of Istanbul Based on 2011 Elections(α=0.45)

County	$\bar{\sigma}_{AKP}$(C, 0.45)	$\bar{\sigma}_{CHP}$(C, 0.45)	$\bar{\sigma}_{MHP}$(C, 0.45)	$\bar{\sigma}_{HDP}$(C, 0.45)
Adalar	1.0256	1.0112	1.0550	1.0651
Arnavutköy	0.9872	1.4194	1.1085	1.1603
Ataşehir	1.0240	1.0504	0.9877	1.1024
Avcılar	0.9449	1.0658	1.0607	0.9145
Bağcılar	0.9883	1.0630	1.0206	1.0162
Bahçelievler	1.0165	1.0212	1.0055	1.0816
Bakırköy	1.0044	1.0315	0.9961	1.1152
Başakşehir	1.0891	1.0493	1.0006	1.0755
Bayrampaşa	1.0161	0.9640	0.9943	1.2216
Beşiktaş	1.0236	1.0005	1.0062	1.1419
Beykoz	0.9754	1.1347	1.0107	0.9334
Beylikdüzü	1.1312	1.0253	0.9967	0.9717
Beyoğlu	1.0487	1.1051	1.0452	1.8999
Büyükçekmece	1.0898	0.9579	0.9863	1.2181
Çatalca	1.0082	1.0003	1.0518	1.4040
Çekmeköy	1.0029	1.0109	1.0326	1.1692
Esenler	0.9875	1.0778	1.0331	1.0298
Esenyurt	1.0223	0.9869	0.9737	1.0630
Eyüp	1.0365	0.9798	1.0565	1.0312
Fatih	1.0314	1.1271	1.0558	1.8318
Gaziosmanpaşa	0.9999	1.1428	1.0498	1.5175
Güngören	0.9959	1.1392	1.0208	1.0482
Kadıköy	1.1395	1.0275	1.0103	1.3039
Kağıthane	1.0046	1.0220	1.0332	1.0562
Kartal	1.0048	1.0424	1.0157	1.1292
Küçükçekmece	1.0018	1.0214	1.0341	1.0286
Maltepe	1.0307	1.0151	1.0347	1.2095
Pendik	1.0247	1.0777	1.0178	1.2136
Sancaktepe	1.0377	1.1310	1.0821	1.0041
Sarıyer	0.9981	1.0188	1.0219	1.1647
Silivri	0.9789	1.0620	0.9954	1.1788
Sultanbeyli	0.9994	1.0535	1.0539	1.1457
Sultangazi	1.0330	1.3626	1.0629	1.0138
Şile	1.0554	1.0236	1.0425	1.5023
Şişli	0.9710	1.0587	1.0145	1.0421
Tuzla	1.0226	1.0455	1.0889	1.1515
Ümraniye	0.9903	1.0820	1.0175	1.1567
Üsküdar	1.0309	1.0955	1.0040	1.0249
Zeytinburnu	1.0122	0.9758	1.0280	0.9980
Average	1.0201	1.0636	1.0284	1.1625

Note: $\bar{\sigma}_{AKP}$(C, 0.45) stands for the normalized segregation level of the AKP voters for α=0.45

According to Table 5 and Table 6, it could be concluded that based on 2011 election results, HDP is the most segregated party overall for both mobility level. When the averages of segregation indices of each party is calculated it is seen that HDP is the first with an average of 1.09 for mobility 0.85 and with an average of 1.162 for mobility 0.45. This makes sense because HDP supporters are not distributed homogenously over all counties meaning that it could have higher segregation level. In addition, when mobility decreased the average segregation of HDP increased. Actually not only the average segregation level of HDP icreased, all parties' segregation index shows the same movement. However this is only valid for the average values, when each county of Istanbul is examined closely, it is seen that this is not always the case. For instance, in Avcılar, when mobility diminished to 0.45, the segregation index of AKP also diminished from 0.953 to 0.944.

The results show that Fatih is the county which HDP is mostly segregated. When looking the average values again, it is clear that AKP is the less segregated party which is not surprise , because it contains the majority of votes in the society in 2011 and it is distributed evenly over all counties.

As another measure, the homophily index of each voter group for all counties of Istanbul is calculated. Ballester & Vorsatz's homophily index definition and measurement methodology is used as a fundamental approach. According to the study of Ballester & Vorsatz, when $\alpha=0$, the resulting segregation value becomes equal to the homophily index for a specific group in the society. It means that, in a geographical entity, when the movement of agents are not allowed, the probability of meeting a voter who belongs to the same social group with a voter who makes the search would give the homophily index of that group. Since there is no random walk realization when $\alpha=0$, voters could only meet if they live in the same census tract.

In other words, the possibility of getting across with a voter is a matter of significance only if the voter who makes the walk and a voter who meets with that voter, live in the same neighborhood in the network.

Since social interactions with voters who live far away became more and more feasible as mobility level increases, the segregation index could be evaluated as a generalized version of homophily index.

$h_g = \sum_{i \in M} d_{g,i} \left(\sum_{j \in M} n_{g,j} a_{i,j} / (\sum_{k \in M} n_k a_{i,k}) \right)$ (Echenique, Fryer, 2006)

In this formula the left hand side is the homophily index of group g, M stands for the neighborhoods, n is the number of voters, a is the binary variable which takes the value one if its subindices are connected neighborhoods to each other, otherwise takes the value zero. In order to normalize the values, the computed indices are multiplied by the reciprocal of the weight of the specified voter group.

$\overline{h_g} = h_g \left(\frac{n_g}{n} \right)^{-1}$ (Echenique, Fryer, 2006)

According to Table 7, the results show that homophily indices present similarity with the segregation indices which is an anticipated circumstance because of the formula used in the calculation of homophily index. As it became in the segregation calculation, HDP has the highest homophily index with an average of 1.18. It is expected to see the similar observations with the segregation level, because both of them indicates that higher indices mean living physically apart as a minority so that the probability of getting across with a voter from the same social group is very high and desiring an agent from the same voter group as a neighbor is also high.

Table 7. Normalized Homophily Values for the Counties of Istanbul Based on 2011 Elections

County	$NormHI_{AKP}$	$NormHI_{CHP}$	$NormHI_{MHP}$	$NormHI_{HDP}$
Adalar	1.0250	1.0124	1.0509	1.0603
Arnavutköy	1.0112	1.2756	1.0480	1.1745
Ataşehir	1.0304	1.0437	1.0135	1.1155
Avcılar	0.9655	1.0406	1.0525	1.0431
Bağcılar	0.9998	1.0141	1.0042	1.0655
Bahçelievler	1.0105	1.0425	1.0023	1.1402
Bakırkoy	1.0327	0.2675	0.5723	0.1198
Başakşehir	1.1053	1.0808	0.9861	1.3381
Bayrampaşa	1.0002	1.0031	1.0021	1.1096
Beşiktaş	1.0453	1.0018	0.9985	1.0971
Beykoz	1.0075	1.0467	1.0146	1.0579
Beylikdüzü	1.0715	1.0969	1.0020	0.9941
Beyoğlu	1.0600	1.1080	1.0225	2.1450
Büyükçekmeçe	1.0750	1.0304	1.0011	1.1314
Çatalca	1.0111	1.0137	0.9890	1.2794
Çekmeköy	0.9961	1.0233	1.0067	1.2437
Esenler	0.9993	1.0318	1.0051	1.0699
Esenyurt	1.0023	1.0183	0.9970	1.0495
Eyüp	1.0018	1.0654	1.0070	1.1995
Fatih	1.0417	1.1366	1.0419	1.8298
Gaziosmanpasa	1.0167	1.1208	1.0433	1.5451
Güngören	1.0217	1.1109	1.0055	1.1610
Kadıköy	1.1559	1.0376	1.0080	1.3472
Kağıthane	1.0109	1.0149	1.0220	1.0666
Kartal	1.0184	1.0501	0.9985	1.0739
Küçükçekmece	0.9902	1.0294	1.0299	1.2350
Maltepe	1.0600	1.0151	1.0303	1.0922
Pendik	1.0347	1.0983	1.0217	1.1894
Sancaktepe	1.0285	1.1846	1.0347	1.0254
Sarıyer	1.0275	1.0481	1.0229	1.1561
Silivri	1.0172	1.0224	1.0070	1.4222
Sultanbeyli	1.0032	1.0465	1.0440	1.1446
Sultangazi	1.0486	1.3333	1.0845	1.0669
Şile	1.0302	1.0980	1.0887	1.7041
Şişli	1.0153	1.0352	1.0269	1.1163
Tuzla	1.0171	1.0777	1.0454	1.2549
Ümraniye	1.0078	1.0446	1.0315	1.1885
Üsküdar	1.0427	1.0924	1.0030	1.1116
Zeytinburnu	1.0009	0.9954	0.9949	1.0569
Average	1.0267	1.0464	1.0092	1.1852

Note:Table shows the normalized homophily indices of each voter group for each county in Istanbul.

Thereafter the same analysis is applied to the counties of Ankara, however this time some counties are eliminated from the investigation; such as Güdül, Pursaklar and Polatlı. The underlying reason is that; for instance Polatlı county consists of 95 villages which approximately 90 of them are not adjacent and there is no neighborhood unit in the county, the whole units are small villages. Therefore the transition probability matrix of Polatlı which is a huge matrix with dimension of 95x95 are full of ones in the diagonal of the matrix. And that is a reason to result in misleading segregation levels for each voter group, because without imposing a mobility level, the original network already highly segregated. The similar case is valid for Güdül and Pursaklar too.

In Table 8 and Table 9, the results show that for each mobility level, ternian opposition party HDP has the highest segregation level in Ankara. When examined closely, the average value of the segregation index of HDP is high up to 3.81 and 4.13 for the mobility levels 0.85 and 0.45 respectively. When each county is analyzed separately, in Evren, HDP has no segregation, that is because of having zero vote in Evren for HDP.

There are some counties of Ankara which HDP is not the most segregated party such as Çubuk, Evren, Gölbaşı, Kazan, Mamak and Yenimahalle. For instance in Mamak and Gölbaşı, MHP voters are the most segregated group while in Yenimahalle and Çubuk, CHP voters are highly segregated. Undoubtedly, there are many factors affecting the segregation level of a group. The structure of transition probability matrices is one of them , when the neighborhoods of a county are distributed far away from each other, it means that the voter groups who live in this kind of census tracts are already segregated. For instance in Çubuk, there are 83 census tracts and many of them are only connected with itself. So if at the beginning

(before imposing a mobility level) the majority of voters who live in these census tracts is CHP voters then in the result CHP voters would be the highest segregated group in Çubuk.

Table 8. Normalized Segregation Values for the Counties of Istanbul Based on 2011 Elections(α=0.85)

County	$\bar{\sigma}_{AKP}$(C, 0.85)	$\bar{\sigma}_{CHP}$(C, 0.85)	$\bar{\sigma}_{MHP}$(C, 0.85)	$\bar{\sigma}_{HDP}$(C, 0.85)
Akyurt	1.0387	0.8031	0.9004	1.1906
Altındağ	1.0350	1.1411	1.0769	2.5567
Ayaş	1.0849	1.1096	1.1053	2.9071
Bala	1.0648	1.2486	1.3337	8.7635
Beypazarı	1.0476	2.4398	1.0561	3.4929
Çamlıdere	1.0397	1.3875	1.5021	34.8264
Çankaya	1.1386	0.9805	1.0305	1.0678
Çubuk	0.9654	2.4122	0.8625	0.6157
Elmadağ	1.0118	1.0116	1.0199	2.3885
Etimesgut	1.0448	1.0722	1.0468	1.1403
Evren	1.0476	1.1133	1.2668	0.0000
Gölbaşı	0.9830	0.9806	1.1351	1.0784
Haymana	1.0502	1.5809	2.2086	4.4009
Kalecik	1.0888	1.5427	1.2090	0.9223
Kazan	1.0559	0.7697	0.9326	0.8368
Keçiören	1.0204	1.0498	0.9652	1.3952
Kızılcahamam	1.0437	1.1498	1.1017	2.8562
Mamak	1.0725	1.0493	1.1229	0.9764
Nallıhan	1.0500	1.1112	1.1069	3.4115
Sincan	0.9941	1.0393	1.0315	1.5697
Şereflikoçhisar	1.0246	1.0722	1.0721	6.6558
Yenimahalle	0.9100	1.0245	0.9179	0.8853
Average	1.0369	1.2313	1.1366	3.8154

Note: $\bar{\sigma}_{AKP}$(C,0.85) stands for the normalized segregation level of the AKP voters for α=0.85

Table 9. Normalized Segregation Values for the Counties of Istanbul Based on 2011 Elections(α=0.45)

County	$\bar{\sigma}_{AKP}(C, 0.45)$	$\bar{\sigma}_{CHP}(C, 0.45)$	$\bar{\sigma}_{MHP}(C, 0.45)$	$\bar{\sigma}_{HDP}(C, 0.45)$
Akyurt	1.0321	0.8670	0.9301	1.4635
Altındağ	1.0357	1.1808	1.1138	2.8036
Ayaş	1.0879	1.1301	1.1222	3.9379
Bala	1.0636	1.3058	1.3782	8.7703
Beypazarı	1.0440	2.4515	1.0765	3.6429
Çamlıdere	1.0397	1.3949	1.5058	34.8264
Çankaya	1.1472	1.0006	1.0339	1.0955
Çubuk	0.9651	2.4732	0.8964	0.7477
Elmadağ	0.9936	1.0820	1.0412	2.8943
Etimesgut	1.0741	1.1227	1.0444	1.1801
Evren	1.0491	1.1120	1.2623	0.0000
Gölbaşı	0.9984	1.0166	1.1304	1.2363
Haymana	1.0512	1.5764	2.2124	4.4009
Kalecik	1.0889	1.6122	1.2488	0.9223
Kazan	1.0419	0.9567	0.9435	0.9863
Keçiören	1.0173	1.0939	0.9856	1.5672
Kızılcahamam	1.0436	1.1616	1.1067	6.5692
Mamak	1.0967	1.1756	1.1521	1.0913
Nallıhan	1.0509	1.1116	1.1064	3.4115
Sincan	1.0022	1.0618	1.0179	1.6714
Şereflikoçhisar	1.0267	1.0774	1.0705	6.7236
Yenimahalle	1.0199	1.1384	0.9936	1.1231
Average	1.0441	1.2774	1.1533	4.1393

Note: $\bar{\sigma}_{AKP}(C,0.45)$ stands for the normalized segregation level of the AKP voters for α=0.45

In Table 10, it is not very surprise to see the voters of HDP as the most segregated group in Ankara, especially in Çamlıdere, the homophily index of HDP is very high as 34.82. As a second county; Kızılcahamam comes with a homophily index of 11.92 for HDP voters.

Table 10. Normalized Homophily Values for the Counties of Ankara Based on 2011 Elections

County	$NormHI_{AKP}$	$NormHI_{CHP}$	$NormHI_{MHP}$	$NormHI_{HDP}$
Akyurt	1.0036	1.0384	1.0280	2.2076
Altındağ	1.0285	1.2815	1.1287	2.1512
Ayaş	1.0521	1.1716	1.1568	3.7642
Bala	1.0401	1.3304	1.4762	9.0787
Beypazarı	1.0420	2.4767	1.0955	2.6333
Çamlıdere	1.0296	1.4978	1.5349	34.8264
Çankaya	1.0887	1.0354	1.0112	1.1233
Çubuk	1.0114	1.8213	1.0704	1.2754
Elmadağ	1.0014	1.0952	1.0442	3.0723
Etimesgut	1.1045	1.1814	1.0054	1.1005
Evren	1.0515	1.1346	1.2252	0.0000
Gölbaşı	1.0278	1.0560	1.0162	1.2231
Haymana	1.0531	1.5616	2.2261	4.3967
Kalecik	1.0722	1.6705	1.3565	3.1947
Kazan	1.0199	1.6207	1.0063	12.5228
Keçiören	1.0134	1.1063	1.0263	1.5863
Kızılcahamam	1.0277	1.2173	1.1314	11.9245
Mamak	1.0910	1.3115	1.1169	1.2253
Nallıhan	1.0486	1.1167	1.1128	3.4115
Sincan	1.0051	1.0734	1.0224	1.1918
Şereflikoçhisar	1.0103	1.1083	1.0972	6.7763
Yenimahalle	1.1146	1.1973	1.0282	1.7706
Average	1.0426	1.3229	1.1780	5.0207

Note: Table shows the normalized homophily indices of voter groups who live in the counties of Ankara.

The segregation index of the counties of Istanbul and Ankara is indicated in Figure 5 and Figure 6 for three specific elections.

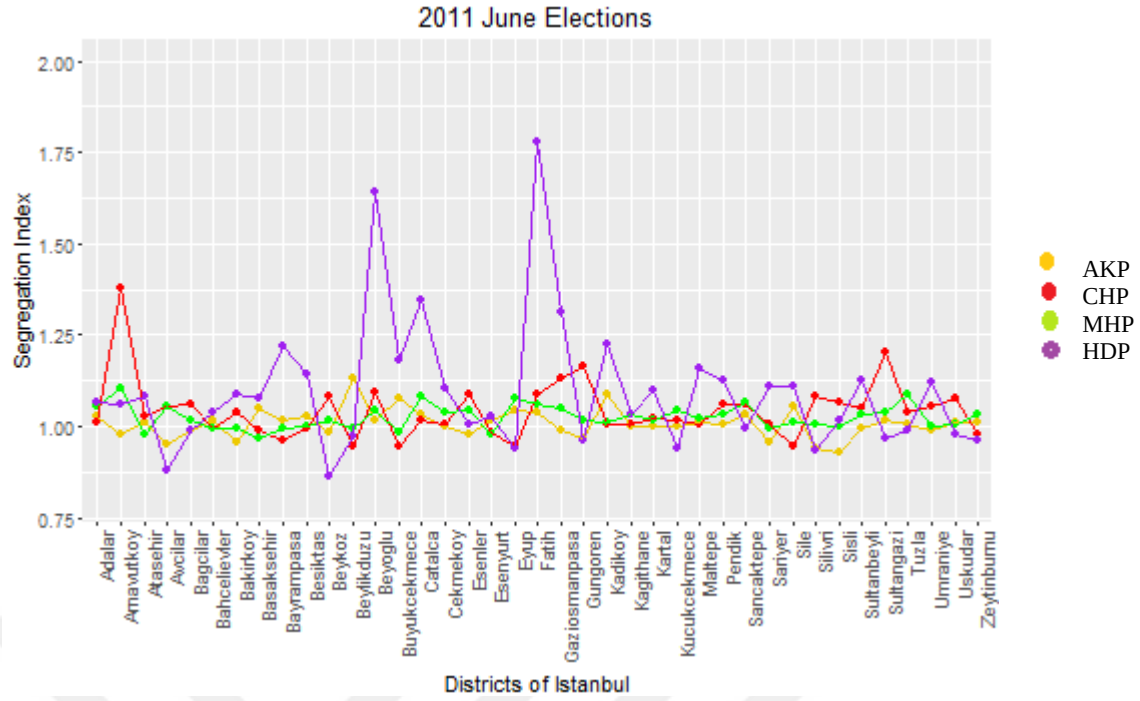


Figure 5 Normalized segregation index graph for the counties of Istanbul based on 2011 elections

In Figure 6, the counties Ayaş, Çamlıdere,Kalecik and Evren are eliminated from the analysis because in these counties the total valid vote number is below 10,000. In 2011 elections, Ayaş has 9,034 valid votes, Çamlıdere has 4,837 valid votes, Kalecik has 1,829 and Evren has 9,223 valid votes; that causes huge normalized segregation index values for voter groups. For instance in Çamlıdere, there is only one HDP voter, and the total number of valid votes is 4,837; the segregation level of HDP is computed as 0.0072 for 0.85 mobility level, but the normalized index value is approximately 34.8. That is because of the small number of HDP votes (in fact only one)in the county. Therefore in order to remove the effect of dummy results, this county is eliminated from the graph.

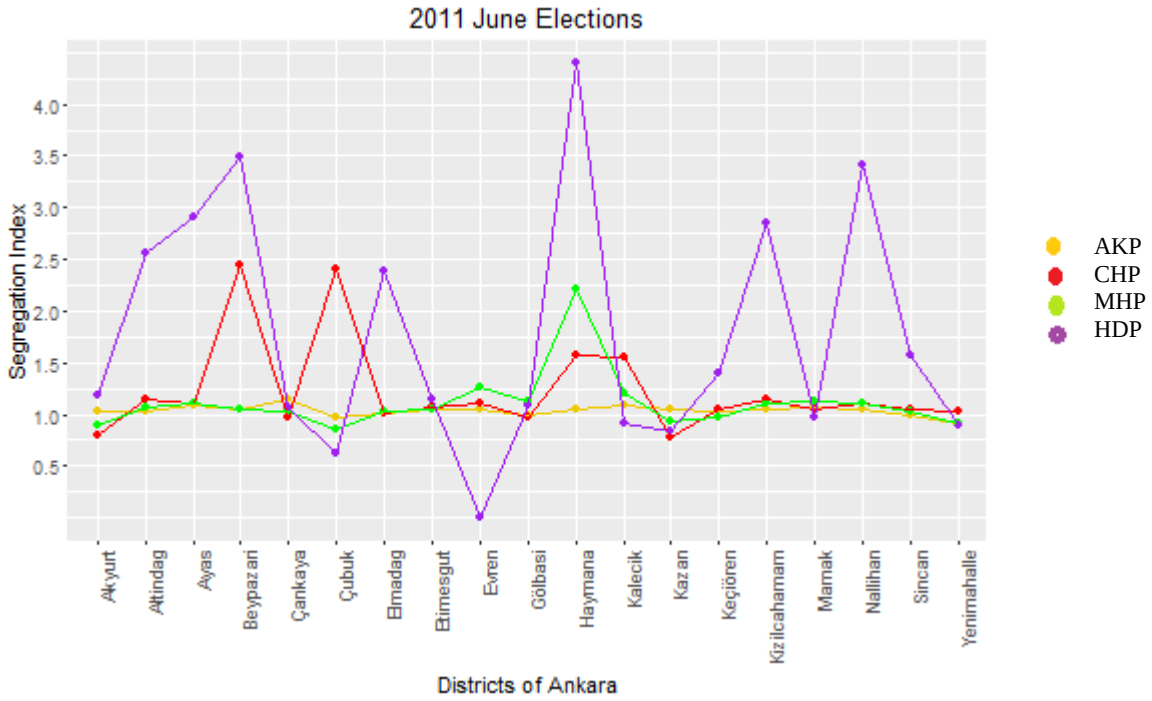


Figure 6 Normalized segregation index graph for the counties of Ankara based on 2011 elections

Figure 7, Figure 8, Figure 9 and 10 represent the histogram of vote distribution in Istanbul based on the election results obtained in 2011. Figure 7 explains the distribution of frequency of the segregation levels of the dominant party voters in the counties of Istanbul. For instance in Istanbul there are 15 counties whose segregation levels of dominant party voters are below 1.00.The histogram is similar to the normal distribution with mean level of segregation is 1.00. It means that the average segregation level of the counties of Istanbul is approximately 1.00. In these representations, to have consistency, the normalized index values are taken as a measure.

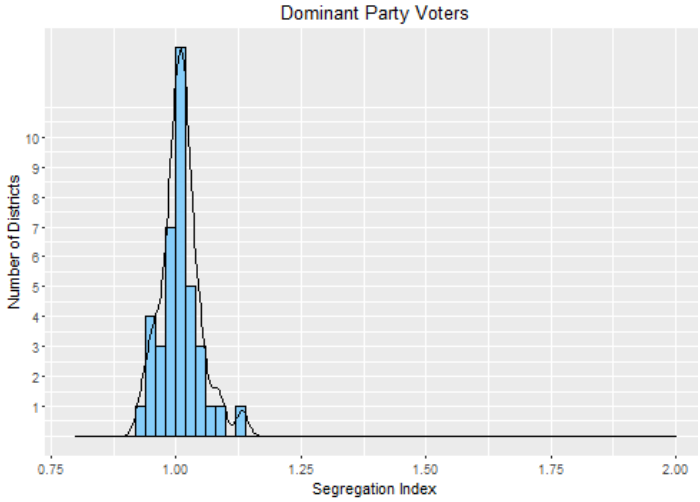


Figure 7 Normalized segregation index histogram for AKP voters in Istanbul based on 2011 elections

The distribution of the segregation level of the primary opposition party voters can be seen in Figure 8. The normality of the diagram is distorted when compared to the dominant party voters. However MHP votes are more close to normal curve. That could be because of the fact that AKP and MHP voters are the kind of political groups that spread around the all country. This could also be seen from the average segregation levels of these groups, their segregation measures are so low compared to the HDP voters especially.

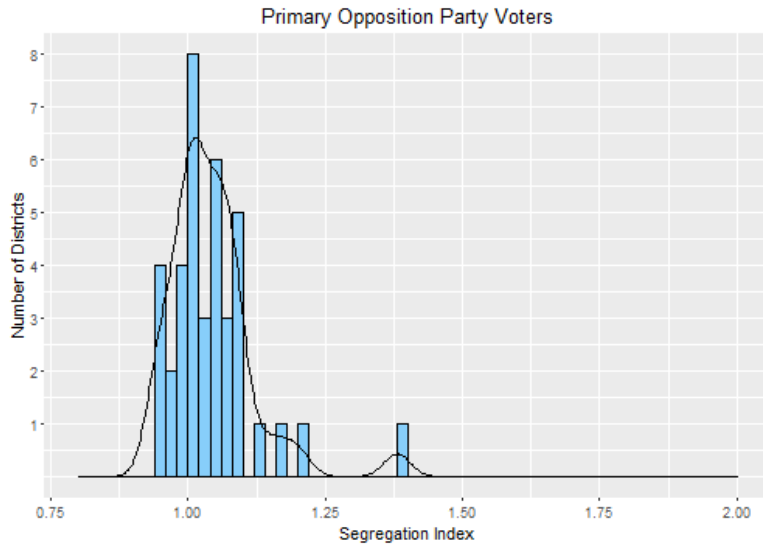


Figure 8 Normalized segregation index histogram for CHP voters in Istanbul based on 2011 elections

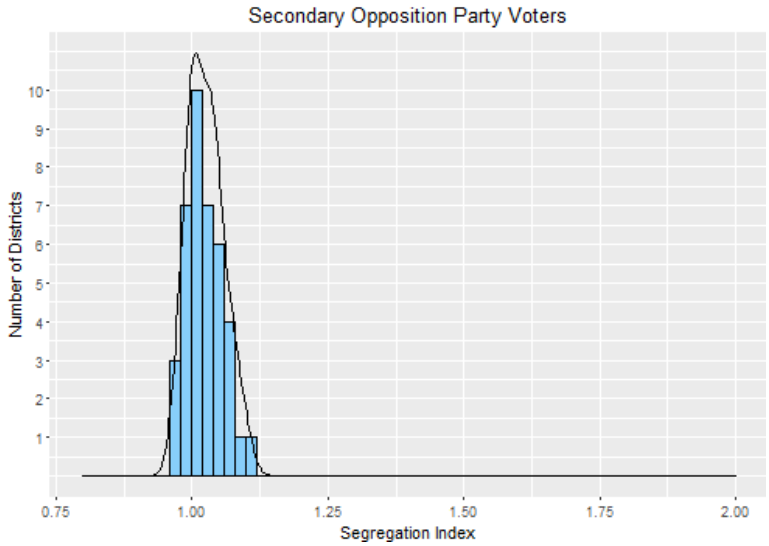


Figure 9 Normalized segregation index histogram for MHP voters in Istanbul based on 2011 elections

Since HDP voters are the most segregated group in Istanbul, in Figure 10, the histogram of segregation levels of HDP voters support this statement with having some extreme values close to 1.75 level of segregation and constructing heavy tails in the distribution.

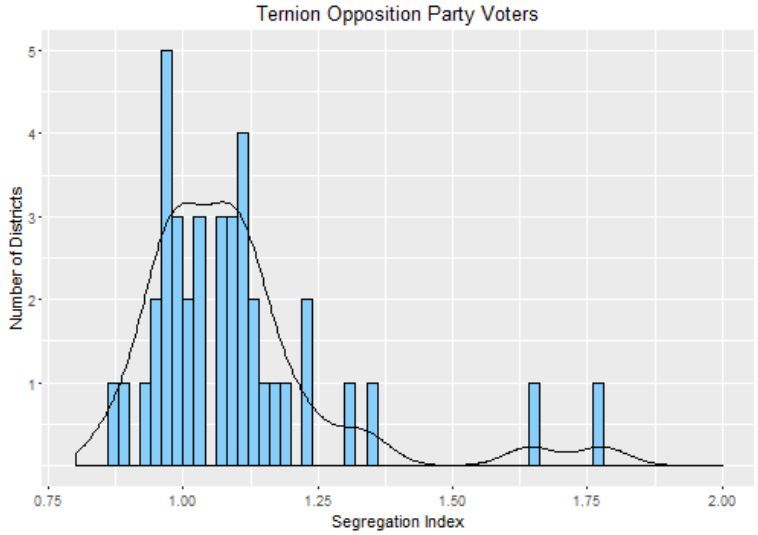


Figure 10 Normalized segregation index histogram for HDP voters in Istanbul based on 2011 elections

Figure 11,Figure 12, Figure 13 and 14 represent the corresponding segregation level distributions of Ankara for each political group. When AKP voters are analyzed, they are far away from the normal distribution including some heavy tails.

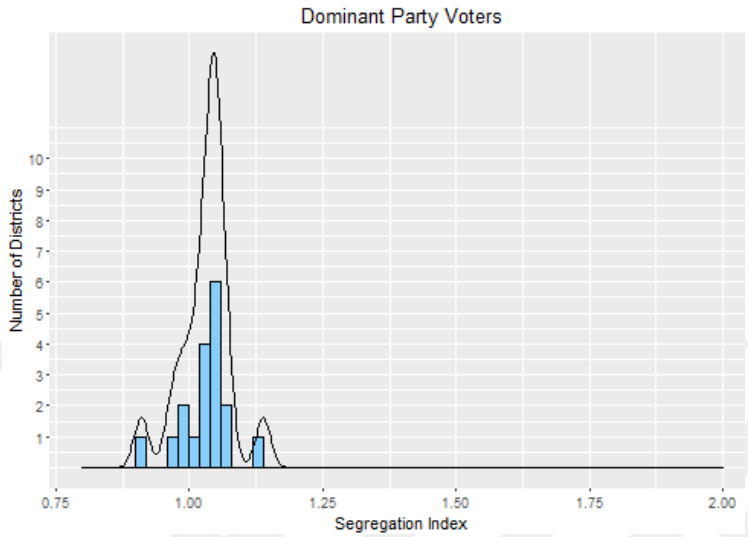


Figure 11 Normalized segregation index histogram for AKP voters in Ankara based on 2011 elections

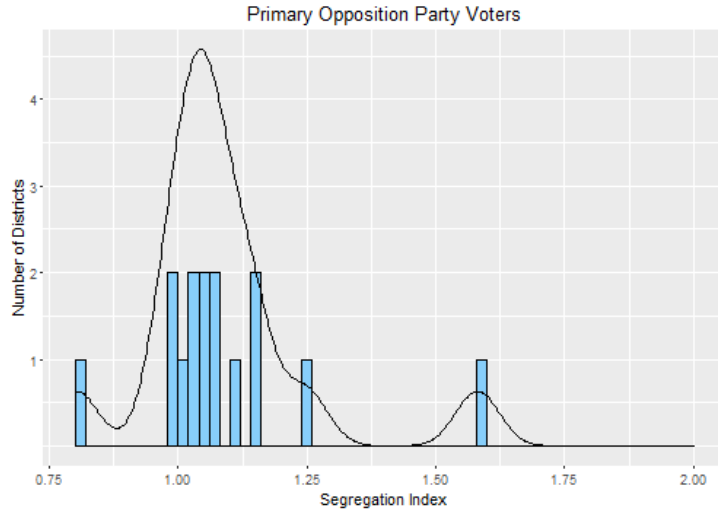


Figure 12 Normalized segregation index histogram for CHP voters in Ankara based on 2011 elections

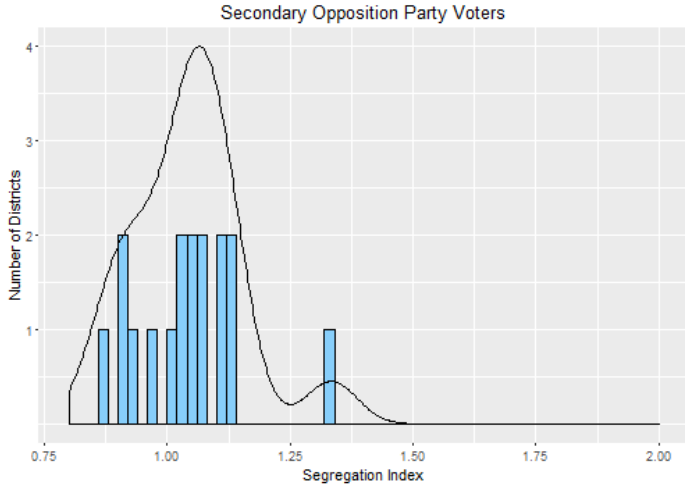


Figure 13 Normalized segregation index histogram for MHP voters in Ankara based on 2011 elections

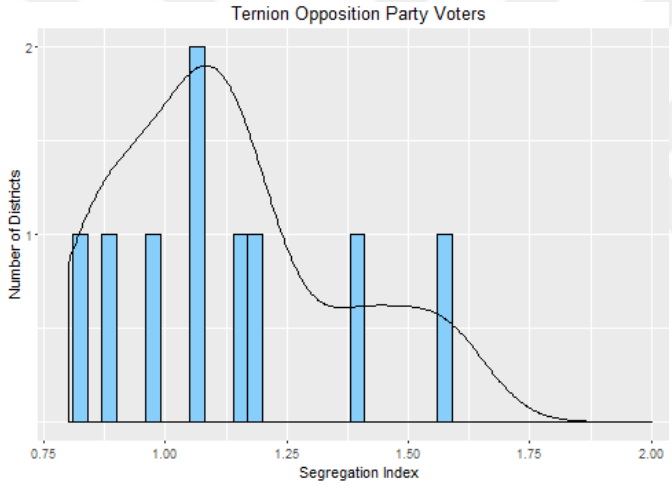


Figure 14 Normalized segregation index histogram for HDP voters in Ankara based on 2011 elections

5.2 General parliamentary elections in June 2015

The second election analysis is conducted for the elections realized on 7th of June in 2015. In this elections, as it was the case in the prior elections, Istanbul is separated to three election regions and Ankara is separated to two election regions. And this is the first election that the ternion opposition party entered the elections with a name HDP- The Democratic Party of The Communities. The first election region of Istanbul consists of the counties; Adalar, Ataşehir, Beykoz, Çekmeköy, Kadıköy,

Kartal, Maltepe, Pendik, Sultanbeyli, Sancaktepe, Şile, Tuzla, Ümraniye, Üsküdar. The second region of Istanbul contains Bayrampaşa, Beşiktaş, Beyoğlu, Esenler, Eyüp, Fatih, Gaziosmanpaşa, Kağıthane, Sarıyer, Eyüp, Sultangazi, Şişli, Zeytinburnu. The third region includes the remaining counties of Istanbul which are Arnavutköy, Avcılar, Bağcılar, Bahçelievler, Bakırköy, Başakşehir, Beylikdüzü, Büyükçekmece, Çatalca, Esenyurt, Güngören, Küçükçekmece and Silivri. The first election region of Ankara consists of counties; Akyurt, Bala, Çankaya, Elmadağ, Etimesgut, Evren, Gölbaşı, Haymana, Mamak, Polatlı, Sincan and Şereflikoçhisar. The second region of Ankara contains Altındağ, Ayaş, Beypazarı, Çamlıdere, Çubuk, Güdül, Kalecik, Kazan, Keçiören, Kızılcahamam, Nallıhan, Pursaklar, Yenimahalle.

Table 11 and 12 represent the segregation levels of main four political party voters who live in the counties of Istanbul. According to the indices, for the first time the situation of having the highest segregation level changed. This time in Istanbul, when the average segregation level of all counties are examined, CHP voters has the higher segregation level than HDP voters. In addition to that, in some counties, CHP voters protect their high level segregation in Arnavutköy, Avcılar, Bağcılar, Beykoz, Esenyurt, Sultangazi, Sultanbeyli, Üsküdar and Ümraniye. If the attention is paid, these counties are the ones inwhich the votes of AKP is pretty higher and the segregation level of AKP voters is very low, it means that in the counties that AKP voters is evenly distributed(because low segregation implies that conclusion), the voters of CHP is highly segregated which indicates a higher negative correlation between the segregation levels of AKP and CHP voters.

Table 11. Normalized Segregation Values for the Counties of Istanbul Based on 2015 June Elections(α=0.85)

County	$\bar{\sigma}_{AKP}(C, 0.85)$	$\bar{\sigma}_{CHP}(C, 0.85)$	$\bar{\sigma}_{MHP}(C, 0.85)$	$\bar{\sigma}_{HDP}(C, 0.85)$
Adalar	1.0268	1.0240	1.0722	1.1776
Arnavutköy	0.9436	1.5142	1.0937	0.8686
Ataşehir	1.0211	1.0206	0.9706	1.0577
Avcılar	0.9486	1.0747	1.0185	0.9202
Bağcılar	0.9858	1.0740	1.0218	0.9861
Bahçelievler	1.0197	0.9972	1.0025	1.0080
Bakırköy	0.9475	1.0220	0.9810	1.1374
Başakşehir	1.0494	0.9029	1.0423	1.2009
Bayrampaşa	1.0131	0.9691	0.9771	1.1362
Beşiktaş	1.0260	0.9913	1.0136	1.0242
Beykoz	1.0013	1.0872	0.9799	1.0065
Beylikdüzü	1.1538	0.9539	0.9909	0.9680
Beyoğlu	1.0133	1.0703	1.0470	1.3900
Büyükçekmece	1.0964	0.9894	1.1488	1.2149
Çatalca	1.0472	1.0250	1.0418	1.1697
Çekmeköy	0.9996	1.0147	1.0242	1.0292
Esenler	0.9765	1.1026	1.0307	0.9967
Esenyurt	0.9913	1.0604	0.9983	1.0296
Eyüp	1.0580	0.9596	1.0805	0.9071
Fatih	1.0503	1.0700	1.0535	1.4174
Gaziosmanpaşa	0.9908	1.1719	1.0423	1.1760
Güngören	0.9629	1.1606	1.0166	0.9821
Kadıkoy	1.1074	0.9935	1.0232	1.0695
Kağıthane	1.0001	1.0097	1.0303	0.9987
Kartal	0.9987	1.0258	1.0087	1.0196
Küçükçekmece	1.0167	1.0150	1.0226	0.9559
Maltepe	1.0103	1.0270	1.0320	0.9691
Pendik	1.0089	1.0495	1.0237	1.1001
Sancaktepe	1.0391	1.0542	1.0410	1.0061
Sarıyer	0.9703	0.9920	0.9667	1.0445
Silivri	0.9282	1.1251	0.9975	0.8434
Sultanbeyli	0.9974	1.0424	1.0178	1.0767
Sultangazi	1.0372	1.1442	1.0585	0.9869
Şile	1.0972	0.9463	0.9812	0.9495
Şişli	0.9234	1.0483	0.9793	1.1200
Tuzla	1.0268	1.1034	1.0656	0.8456
Ümraniye	0.9993	1.0433	0.9908	1.0249
Üsküdar	1.0270	1.0733	0.9922	0.9871
Zeytinburnu	0.9971	1.0062	1.0182	0.9518
Average	1.0130	1.0501	1.0230	1.0450

Note: $\bar{\sigma}_{AKP}(C,0.85)$ stands for the normalized segregation level of the AKP voters for α=0.85

Table 12. Normalized Segregation Values for the Counties of Istanbul Based on 2015 June Elections(α=0.45)

County	$\bar{\sigma}_{AKP}(C, 0.45)$	$\bar{\sigma}_{CHP}(C, 0.45)$	$\bar{\sigma}_{MHP}(C, 0.45)$	$\bar{\sigma}_{HDP}(C, 0.45)$
Adalar	1.0268	1.0240	1.0722	1.1776
Arnavutköy	0.9543	1.4967	1.1255	0.8945
Ataşehir	1.0352	1.0511	0.9788	1.0654
Avcılar	0.9409	1.0857	1.0185	0.9402
Bağcılar	0.9878	1.0815	1.0227	1.0039
Bahçelievler	1.0183	1.0263	1.0069	1.0227
Bakırköy	1.0015	1.0173	0.9873	1.1609
Başakşehir	1.0853	0.9779	1.0444	1.1650
Bayrampaşa	1.0166	0.9662	0.9784	1.1342
Beşiktaş	1.0221	0.9966	1.0227	1.0174
Beykoz	0.9859	1.1293	0.9791	1.0590
Beylikdüzü	1.1645	1.0224	0.9858	0.9702
Beyoğlu	1.0588	1.0719	1.0598	1.4494
Büyükçekmece	1.1136	1.0128	1.1764	1.2484
Çatalca	1.0227	1.0052	1.0149	1.2086
Çekmeköy	0.9996	1.0136	1.0204	1.0745
Esenler	0.9857	1.0919	1.0210	1.0127
Esenyurt	0.9984	1.0990	1.0024	1.0596
Eyüp	1.0471	0.9848	1.0601	0.9719
Fatih	1.0546	1.1174	1.0460	1.4059
Gaziosmanpaşa	1.0002	1.1846	1.0406	1.3131
Güngören	0.9943	1.1449	1.0201	1.0228
Kadıkoy	1.1429	1.0149	1.0232	1.0860
Kağıthane	1.0027	1.0240	1.0288	1.0141
Kartal	1.0070	1.0433	1.0079	1.0387
Küçükçekmece	1.0167	1.0141	1.0204	1.0146
Maltepe	1.0407	1.0341	1.0349	1.0004
Pendik	1.0294	1.0726	1.0110	1.1434
Sancaktepe	1.0476	1.1244	1.0511	1.0127
Sarıyer	1.0002	1.0142	0.9987	1.0802
Silivri	0.9686	1.0911	0.9967	0.9900
Sultanbeyli	1.0030	1.0449	1.0346	1.0902
Sultangazi	1.0511	1.2711	1.0793	1.0436
Şile	1.0938	1.0254	1.0066	1.2295
Şişli	0.9722	1.0446	1.0054	1.1262
Tuzla	1.0461	1.1135	1.0799	0.9027
Ümraniye	0.9989	1.0769	1.0002	1.0349
Üsküdar	1.0473	1.0871	0.9904	0.9871
Zeytinburnu	0.9959	1.0012	1.0168	0.9809
Average	1.0251	1.0692	1.0274	1.0809

Note: $\bar{\sigma}_{AKP}(C,0.45)$ stands for the normalized segregation level of the AKP voters for α=0.45

According to Table 13 results, compared to 2011 elections, the homophily index of HDP voters decreased except some counties such as Adalar, Bakırköy, Bayrampaşa, Beykoz, Büyükçekmece and Şişli. This could be due to the fact that the increase in HDP votes is actually sourced from the temporary votes from the other political parties. It means that, in the political conjuncture during the 2015 elections, the rise in the votes of HDP was attributed to the AKP voters in other words, the reason of decrease in AKP votes was because of the vote transmittion mainly to HDP, according to the statistics. Since HDP gained votes from the least segregated party in the society which is AKP on the average, the segregation index of HDP diminished overall.

When the homophily indices are analyzed, the least index in terms of average values belongs to the MHP voters. Especially in Bayrampaşa, the corresponding index value is 0.9791. In addition, Beyoğlu has the highest homophily index value as 1.4650(belongs to the HDP voters). It means that the HDP voters in Beyoğlu are the voters who want their neighborhoods from the same political group the most.

There are some interesting results observed in this analysis. For instance, in Adalar, the second highest homophily value belongs to the MHP voters. Also in Başakşehir, according to the results, the second highest homophily value belongs to the AKP voters. In addition, in Maltepe AKP voters have the highest index of homophily.

Table 13. Normalized Homophily Values for the Counties of Istanbul Based on 2015 June Elections

County	$NormHI_{AKP}$	$NormHI_{CHP}$	$NormHI_{MHP}$	$NormHI_{HDP}$
Adalar	1.0268	1.0240	1.0722	1.1776
Arnavutköy	0.9578	1.4888	1.1455	0.9034
Ataşehir	1.0462	1.0611	0.9829	1.0731
Avcılar	0.9329	1.0940	1.0194	0.9482
Bağcılar	0.9884	1.0865	1.0236	1.0092
Bahçelievler	1.0176	1.0384	1.0087	1.0315
Bakırköy	1.0217	1.0153	0.9900	1.1723
Başakşehir	1.1011	1.0289	1.0475	1.1416
Bayrampasa	1.0179	0.9629	0.9791	1.1362
Beşiktaş	1.0208	0.9987	1.0273	1.0129
Beykoz	0.9822	1.1377	0.9808	1.0704
Beylikdüzü	1.1696	1.0450	0.9807	0.9714
Beyoğlu	1.0697	1.0783	1.0609	1.4650
Büyükçekmece	1.1194	1.0198	1.1789	1.2419
Çatalca	1.0206	1.0031	1.0090	1.2086
Çekmeköy	0.9991	1.0136	1.0186	1.0963
Esenler	0.9888	1.0890	1.0175	1.0195
Esenyurt	1.0019	1.1177	1.0044	1.0742
Eyüp	1.0428	0.9964	1.0499	0.9887
Fatih	1.0609	1.1304	1.0469	1.4141
Gaziosmanpasa	1.0011	1.1898	1.0406	1.3647
Güngören	1.0060	1.1401	1.0192	1.0483
Kadıköy	1.1631	1.0228	1.0244	1.0947
Kağıthane	1.0038	1.0331	1.0288	1.0172
Kartal	1.0096	1.0527	1.0061	1.0438
Küçükçekmece	1.0187	1.0144	1.0211	1.0277
Maltepe	1.0547	1.0365	1.0349	1.0167
Pendik	1.0370	1.0794	1.0070	1.1607
Sancaktepe	1.0505	1.1464	1.0561	1.0163
Sarıyer	0.9848	1.0347	1.0037	1.0958
Silivri	0.9822	1.0811	0.9938	1.0581
Sultanbeyli	1.0048	1.0398	1.0398	1.0935
Sultangazi	1.0558	1.3169	1.0871	1.0584
Şile	1.0903	1.0531	1.0048	1.3027
Şişli	0.9908	1.0435	1.0138	1.1312
Tuzla	1.0579	1.1127	1.0828	0.9217
Ümraniye	0.9986	1.0901	1.0030	1.0379
Üsküdar	1.0535	1.0937	0.9894	0.9896
Zeytinburnu	0.9950	0.9961	1.0155	0.9973
Average	1.0293	1.0771	1.0286	1.0931

Note: Only four main party groups' normalized homophily indices are calculated, the other voter groups are omitted.

As it was the case in Istanbul, Table 14 and 15 indicate that the voters of HDP are the most segregated group in Ankara, especially when the mobility level of the voters decreased, the segregation level of HDP voters are high as 2.0036. This is in line with the general intuition which considers that the mobility is a variable that causes a decrement in segregation level. When examined closely, it is seen that Şereflikoçhisar and Kızılcahamam is the most segregated counties in terms of the HDP voters for both mobility levels.

Table 14. Normalized Segregation Values for the Counties of Ankara Based on 2015 June Elections(α=0.85)

County	$\bar{\sigma}_{AKP}(C, 0.85)$	$\bar{\sigma}_{CHP}(C, 0.85)$	$\bar{\sigma}_{MHP}(C, 0.85)$	$\bar{\sigma}_{HDP}(C, 0.85)$
Akyurt	1.0683	0.8200	0.9197	0.7869
Altındağ	1.0572	1.1763	1.0251	1.4800
Ayaş	1.0586	1.1422	1.0754	2.0742
Bala	1.0768	1.4366	1.2234	3.9497
Beypazarı	1.0172	1.4967	1.0029	3.2055
Çamlıdere	1.0418	1.2242	1.2711	2.3270
Çankaya	1.1362	0.9865	1.0472	0.9838
Çubuk	1.0226	2.0917	0.7016	1.0145
Elmadağ	1.0416	1.0271	0.9875	1.7168
Etimesgut	1.0237	1.0995	1.0168	0.9767
Evren	1.0326	1.1093	1.0664	1.2146
Gölbaşı	1.0278	1.0139	1.1059	0.9130
Haymana	1.0864	1.8547	2.1963	2.0586
Kalecik	1.1382	1.6266	1.1594	2.1711
Kazan	1.0858	0.9894	0.9306	1.1344
Keçiören	1.0241	1.0416	0.9781	1.1369
Kızılcahamam	1.0487	1.1244	1.1168	4.5859
Mamak	1.0733	1.0631	1.1305	0.9732
Nallıhan	1.0466	1.0855	1.0699	1.8676
Sincan	0.9873	1.0568	0.9982	1.3175
Şereflikoçhisar	1.0481	1.0514	1.0522	5.4177
Yenimahalle	1.0915	1.0311	0.9502	0.9966
Average	1.0561	1.2068	1.0921	1.9228

Note: $\bar{\sigma}_{AKP}(C,0.85)$ stands for the normalized segregation level of the AKP voters for α=0.85

Table 15. Normalized Segregation Values for the Counties of Ankara Based on 2015 June Elections(α=0.45)

County	$\bar{\sigma}_{AKP}(C, 0.45)$	$\bar{\sigma}_{CHP}(C, 0.45)$	$\bar{\sigma}_{MHP}(C, 0.45)$	$\bar{\sigma}_{HDP}(C, 0.45)$
Akyurt	1.0540	0.8682	0.9493	0.8864
Altındağ	1.0557	1.2174	1.0566	1.5912
Ayaş	1.0676	1.1703	1.0904	2.4096
Bala	1.0829	1.5296	1.2425	3.9542
Beypazarı	1.0201	1.5027	1.0237	3.1443
Çamlıdere	1.0404	1.2262	1.2814	2.4511
Çankaya	1.1420	1.0045	1.0484	0.9920
Çubuk	1.0459	1.9745	0.7655	1.1222
Elmadağ	1.0208	1.0912	1.0058	1.9946
Etimesgut	1.0640	1.1349	1.0154	0.9940
Evren	1.0358	1.1099	1.0664	1.1891
Gölbaşı	1.0369	1.0448	1.1113	0.9802
Haymana	1.0867	1.8504	2.1941	2.0602
Kalecik	1.1395	1.6662	1.1919	2.2063
Kazan	1.0539	1.2775	0.9637	1.6119
Keçiören	1.0181	1.0842	0.9896	1.1780
Kızılcahamam	1.0477	1.1438	1.1209	4.5859
Mamak	1.1041	1.1789	1.1450	1.0478
Nallıhan	1.0473	1.0851	1.0694	1.8813
Sincan	0.9919	1.0761	0.9982	1.3202
Şereflikoçhisar	1.0520	1.0530	1.0514	5.4277
Yenimahalle	1.1468	1.1195	0.9874	1.0514
Average	1.0616	1.2459	1.1077	2.0036

Note: $\bar{\sigma}_{AKP}(C,0.45)$ stands for the normalized segregation level of the AKP voters for α=0.45

As it was the case in segregation values, the homophily indices of HDP voters are highest at Kızılcahamam and Şereflikoçhisar in Table 16. On the other hand, Yenimahalle is the county in which AKP voters are highly segregated. Figure 15 and 16 show the segregation index values of each county in Istanbul and Ankara respectively.

Table 16. Normalized Homophily Values for the Counties of Ankara Based on 2015 June Elections

County	$NormHI_{AKP}$	$NormHI_{CHP}$	$NormHI_{MHP}$	$NormHI_{HDP}$
Akyurt	1.0492	0.8785	0.9650	0.8999
Altındağ	1.0532	1.2350	1.0761	1.6251
Ayaş	1.0713	1.1812	1.0964	2.5446
Bala	1.0862	1.5738	1.2499	3.9542
Beypazarı	1.0195	1.5064	1.0324	3.1076
Çamlıdere	1.0400	1.2182	1.2870	2.5442
Çankaya	1.1457	1.0105	1.0478	0.9955
Çubuk	1.0590	1.9133	0.7906	1.1335
Elmadağ	1.0133	1.1137	1.0132	2.0548
Etimesgut	1.0832	1.1442	1.0140	0.9997
Evren	1.0375	1.1099	1.0664	1.1635
Gölbaşı	1.0394	1.0508	1.1122	1.0021
Haymana	1.0865	1.8493	2.1931	2.0613
Kalecik	1.1426	1.6806	1.1985	2.2063
Kazan	1.0438	1.4070	0.9769	1.8352
Keçiören	1.0175	1.0953	0.9948	1.1935
Kızılcahamam	1.0470	1.1512	1.1227	4.5985
Mamak	1.1156	1.2217	1.1450	1.0797
Nallıhan	1.0482	1.0847	1.0690	1.8813
Sincan	0.9940	1.0855	1.0011	1.3148
Şereflikoçhisar	1.0542	1.0514	1.0514	5.4317
Yenimahalle	1.1573	1.1412	0.9925	1.0660
Average	1.0638	1.2592	1.1135	2.0315

Note:Some counties of Ankara are omitted in order to have consistency with the prior election results.

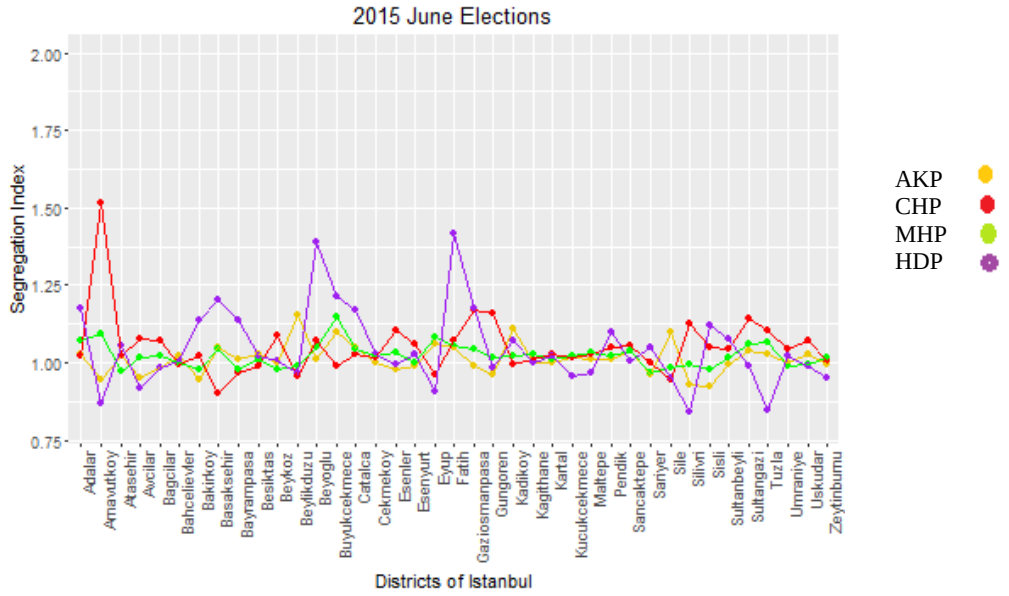


Figure 15 Normalized segregation index graph for the counties of Istanbul based on 2015 June elections

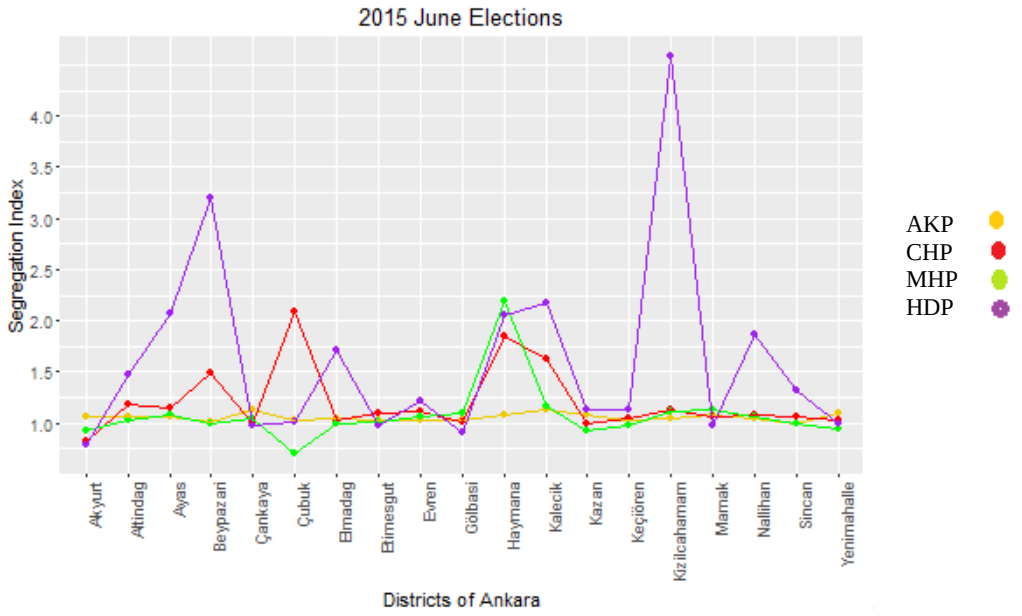


Figure 16 Normalized segregation index graph for the counties of Istanbul based on 2015 June elections

5.3 General parliamentary elections in November 2015

There are two elections realized in 2015, the first one was held in June 7 and the other one was held in November 1, so that it is expected to see the similar segregation and homophily measures in November elections with June elections. Based on the results in Table 17 and Table 18, when the segregation indices of AKP voters are considered, compared to the elections conducted on June of the same year, in all counties of Istanbul the values are so close to each other, only in Büyükçekmece, AKP voters became more segregated in November elections but this is also a small difference as 2.2% increase compared to June elections. When the average segregation values of each party is examined, it could be said that the levels are more or less the same, there is a huge similarity, however it can be explicitly seen that the average segregation of HDP voters has shown an increase from 1.045 to 1.073. So there is a 3% increase in the average values of the ternion opposition party voters segregation levels.

Table 17. Normalized Segregation Values for the Counties of Istanbul Based on 2015 November Elections(α=0.85)

County	$\bar{\sigma}_{AKP}$(C, 0.85)	$\bar{\sigma}_{CHP}$(C, 0.85)	$\bar{\sigma}_{MHP}$(C, 0.85)	$\bar{\sigma}_{HDP}$(C, 0.85)
Adalar	1.0228	1.0110	1.1017	1.1658
Arnavutköy	0.9470	1.4985	1.0644	0.8741
Ataşehir	1.0173	1.0221	0.9637	1.0716
Avcılar	0.9439	1.0769	1.0301	0.9270
Bağcılar	0.9880	1.0769	1.0229	0.9873
Bahçelievler	1.0170	0.9991	1.0061	1.0126
Bakırköy	0.9426	1.0310	0.9643	1.1311
Başakşehir	1.0651	0.8674	0.9292	1.2116
Bayrampaşa	1.0105	0.9664	0.9904	1.1467
Beşiktaş	1.0175	0.9942	1.0118	1.0352
Beykoz	0.9842	1.1021	0.9732	1.0218
Beylikdüzü	1.1287	0.9610	0.9913	0.9577
Beyoğlu	1.0118	1.0879	1.0361	1.4454
Büyükçekmece	1.1185	1.0677	1.6369	1.9985
Çatalca	1.0500	1.0253	1.0029	1.1632
Çekmeköy	1.0023	1.0137	1.0091	1.0271
Esenler	0.9786	1.1075	1.0364	0.9978
Esenyurt	0.9883	1.0711	1.0064	1.0313
Eyüp	1.0600	0.9441	1.0513	0.9192
Fatih	1.0457	1.0880	1.0487	1.4726
Gaziosmanpaşa	0.9874	1.1574	1.0459	1.1999
Güngören	0.9655	1.1717	1.0202	0.9789
Kadıkoy	1.1124	0.9918	1.0217	1.0809
Kağıthane	1.0018	1.0078	1.0296	0.9994
Kartal	1.0010	1.0258	1.0060	1.0156
Küçükçekmece	1.0158	1.0109	1.0226	0.9522
Maltepe	1.0136	1.0323	1.0153	0.9704
Pendik	1.0120	1.0534	1.0155	1.1016
Sancaktepe	1.0391	1.0632	1.0324	1.0049
Sarıyer	0.9655	0.9944	0.9695	1.0543
Silivri	0.9150	1.1190	0.9946	0.8930
Sultanbeyli	0.9952	1.0531	1.0300	1.0935
Sultangazi	1.0306	1.1619	1.0463	1.0205
Şile	1.0963	0.9299	0.9708	0.9342
Şişli	0.9189	1.0583	0.9681	1.1179
Tuzla	1.0229	1.0984	1.0430	0.8532
Ümraniye	0.9974	1.0545	1.0038	1.0231
Üsküdar	1.0207	1.0779	0.9919	0.9973
Zeytinburnu	0.9893	1.0415	1.0246	0.9603
Average	1.0113	1.0542	1.0289	1.0730

Note: $\bar{\sigma}_{AKP}$(C,0.85) stands for the normalized segregation level of the AKP voters for α=0.85

Table 18. Normalized Segregation Values for the Counties of Istanbul Based on 2015 November Elections(α=0.45)

County	$\bar{\sigma}_{AKP}$(C, 0.45)	$\bar{\sigma}_{CHP}$(C, 0.45)	$\bar{\sigma}_{MHP}$(C, 0.45)	$\bar{\sigma}_{HDP}$(C, 0.45)
Adalar	1.0228	1.0110	1.1017	1.1658
Arnavutköy	0.9577	1.4912	1.0979	0.8919
Ataşehir	1.0302	1.0561	0.9750	1.0808
Avcılar	0.9362	1.0864	1.0312	0.9490
Bağcılar	0.9895	1.0861	1.0266	1.0047
Bahçelievler	1.0156	1.0299	1.0104	1.0295
Bakırköy	0.9931	1.0244	0.9794	1.1551
Başakşehir	1.0875	0.9502	0.9812	1.1771
Bayrampaşa	1.0129	0.9668	0.9875	1.1467
Beşiktaş	1.0136	1.0003	1.0244	1.0288
Beykoz	0.9703	1.1463	0.9822	1.0763
Beylikdüzü	1.1371	1.0275	0.9846	0.9606
Beyoğlu	1.0552	1.0876	1.0521	1.5102
Büyükçekmece	1.1335	1.0910	1.6871	2.0739
Çatalca	1.0270	1.0079	0.9656	1.1815
Çekmeköy	1.0010	1.0133	1.0103	1.0785
Esenler	0.9867	1.0953	1.0286	1.0141
Esenyurt	0.9952	1.1128	1.0159	1.0642
Eyüp	1.0481	0.9705	1.0373	0.9849
Fatih	1.0430	1.1292	1.0450	1.4706
Gaziosmanpaşa	0.9954	1.1682	1.0435	1.3434
Güngören	0.9952	1.1563	1.0202	1.0244
Kadıkoy	1.1434	1.0135	1.0265	1.1014
Kağıthane	1.0042	1.0245	1.0285	1.0160
Kartal	1.0080	1.0442	1.0071	1.0324
Küçükçekmece	1.0178	1.0112	1.0198	1.0144
Maltepe	1.0454	1.0403	1.0198	0.9956
Pendik	1.0288	1.0788	1.0135	1.1540
Sancaktepe	1.0493	1.1364	1.0408	1.0131
Sarıyer	0.9951	1.0180	1.0007	1.0896
Silivri	0.9544	1.0863	0.9956	1.0558
Sultanbeyli	0.9998	1.0582	1.0524	1.1102
Sultangazi	1.0448	1.2964	1.0711	1.1007
Şile	1.0902	1.0198	0.9971	1.2207
Şişli	0.9688	1.0532	0.9956	1.1239
Tuzla	1.0474	1.1072	1.0556	0.9109
Ümraniye	0.9972	1.0910	1.0189	1.0358
Üsküdar	1.0401	1.0915	0.9992	0.9973
Zeytinburnu	0.9885	1.0358	1.0227	0.9932
Average	1.0223	1.0747	1.0372	1.1122

Note: $\bar{\sigma}_{AKP}$(C,0.45) stands for the normalized segregation level of the AKP voters for α=0.45

The situation of the counties of Istanbul and Ankara in terms of homophily indices is shown in Table 19 and Table 22 respectively. It can be concluded that the trend of HDP voters did not change, sustaining the highest homophily index among the other groups. As it was in the elections held in June in the same year, CHP voters have the second highest homophily index on average. However this time the group who has the least homophily index is the voters of dominant party. In June 2015 elections, MHP voters had the smallest homophily index.

In Table 19, when each county is analyzed closely, the tendency of AKP voters having neighbors from the like-minded people is the most in Kadıköy. For CHP voters, this tendency is shown most in Arnavutköy. For MHP and HDP voters this tendecy is highest in Büyükçekmece county.

However, there are some counties that the CHP voters have the highest homophily indices. Arnavutköy, Avcılar, Bağcılar, Bahçelievler, Beykoz are some of the counties that have the highest indices for CHP voters among the other political groups.

In each counties of Istanbul, according to the elections held in November 2015, either CHP or HDP voters have the highest homophily indices except Beşiktaş, Beylikdüzü, Eyüp, Kadıköy, Küçükçekmece and Maltepe. In Beşiktaş, an interesting result is observed such that the highest homophily index belongs to the MHP voters. In Eyüp, Kadıköy, Küçükçekmece, Maltepe and Beylikdüzü, the AKP voters have the highest homophily values. But apart from these counties, the results are as expected.

Table 19. Normalized Homophily Values for the Counties of Istanbul Based on 2015 November Elections

County	$NormHI_{AKP}$	$NormHI_{CHP}$	$NormHI_{MHP}$	$NormHI_{HDP}$
Adalar	1.0228	1.0110	1.1017	1.1658
Arnavutköy	0.9616	1.4912	1.1190	0.8949
Ataşehir	1.0403	1.0678	0.9826	1.0899
Avcılar	0.9285	1.0939	1.0312	0.9580
Bağcılar	0.9902	1.0929	1.0278	1.0090
Bahçelievler	1.0150	1.0429	1.0125	1.0401
Bakırköy	1.0123	1.0212	0.9863	1.1667
Başakşehir	1.0981	1.0066	1.0000	1.1541
Bayrampasa	1.0138	0.9650	0.9865	1.1494
Beşiktaş	1.0131	1.0030	1.0307	1.0242
Beykoz	0.9669	1.1550	0.9866	1.0888
Beylikdüzü	1.1414	1.0493	0.9798	0.9606
Beyoğlu	1.0652	1.0927	1.0550	1.5255
Büyükçekmeçe	1.1384	1.0978	1.6871	2.0526
Çatalca	1.0258	1.0065	0.9551	1.1741
Çekmeköy	1.0001	1.0133	1.0103	1.1031
Esenler	0.9893	1.0925	1.0246	1.0209
Esenyurt	0.9987	1.1327	1.0199	1.0804
Eyüp	1.0436	0.9825	1.0303	1.0017
Fatih	1.0472	1.1408	1.0462	1.4830
Gaziosmanpaşa	0.9963	1.1730	1.0435	1.3957
Güngören	1.0064	1.1521	1.0191	1.0511
Kadıköy	1.1615	1.0214	1.0297	1.1116
Kağıthane	1.0051	1.0344	1.0285	1.0173
Kartal	1.0099	1.0539	1.0050	1.0384
Küçükçekmece	1.0205	1.0119	1.0188	1.0284
Maltepe	1.0595	1.0427	1.0209	1.0097
Pendik	1.0352	1.0871	1.0145	1.1741
Sancaktepe	1.0531	1.1593	1.0459	1.0175
Sarıyer	0.9809	1.0390	1.0031	1.1086
Silivri	0.9671	1.0770	0.9946	1.1293
Sultanbeyli	1.0010	1.0557	1.0592	1.1138
Sultangazi	1.0499	1.3446	1.0825	1.1235
Şile	1.0852	1.0498	0.9954	1.2890
Şişli	0.9876	1.0515	1.0042	1.1292
Tuzla	1.0603	1.1061	1.0575	0.9309
Ümraniye	0.9970	1.1045	1.0232	1.0396
Üsküdar	1.0463	1.0986	1.0013	1.0003
Zeytinburnu	0.9875	1.0318	1.0207	1.0121
Average	1.0262	1.0834	1.0395	1.1247

Note: Table shows the normalized homophily indices of each voter group in the counties of Istanbul based on the elections held in June 2015.

Table 20. Normalized Segregation Values for the Counties of Ankara Based on 2015 November Elections(α=0.85)

County	$\bar{\sigma}_{AKP}$(C, 0.85)	$\bar{\sigma}_{CHP}$(C, 0.85)	$\bar{\sigma}_{MHP}$(C, 0.85)	$\bar{\sigma}_{HDP}$(C, 0.85)
Akyurt	1.0411	0.7957	0.9329	0.8637
Altındağ	1.0390	1.2060	1.0244	1.5231
Ayaş	1.0666	1.1158	1.0665	2.4471
Bala	1.0643	1.4778	1.3304	5.2333
Beypazarı	1.0349	1.5346	1.0425	1.8675
Çamlıdere	1.0394	1.2876	1.2954	12.2560
Çankaya	1.1442	0.9868	1.0479	0.9854
Çubuk	0.9940	2.1995	0.7146	0.9631
Elmadağ	1.0370	1.0238	0.9787	1.7898
Etimesgut	1.0251	1.1001	1.0229	0.9762
Evren	1.0248	1.1127	1.1582	1.6455
Gölbaşı	1.0258	0.9973	1.0593	0.9226
Haymana	1.0502	1.7342	2.3779	2.8912
Kalecik	1.1143	1.7360	1.1571	2.3674
Kazan	1.0448	0.8843	0.9703	10.8008
Keçiören	1.0202	1.0429	0.9734	1.1720
Kızılcahamam	1.0262	1.2966	1.1151	1.8968
Mamak	1.0756	1.0763	1.1554	1.0281
Nallıhan	1.0372	1.0961	1.1276	3.7172
Sincan	0.9869	1.0614	1.0036	1.3769
Şereflikoçhisar	1.0456	1.0573	1.0543	5.7088
Yenimahalle	1.0741	1.0144	0.9464	1.0267
Average	1.0460	1.2199	1.1161	2.8845

Note: $\bar{\sigma}_{AKP}$(C,0.85) stands for the normalized segregation level of the AKP voters for α=0.85

Table 21. Normalized Segregation Values for the Counties of Ankara Based on 2015 November Elections(α=0.45)

County	$\bar{\sigma}_{AKP}(C, 0.45)$	$\bar{\sigma}_{CHP}(C, 0.45)$	$\bar{\sigma}_{MHP}(C, 0.45)$	$\bar{\sigma}_{HDP}(C, 0.45)$
Akyurt	1.0313	0.8672	0.9545	1.0077
Altındağ	1.0391	1.2542	1.0686	1.6179
Ayaş	1.0750	1.1481	1.0911	2.8890
Bala	1.0674	1.5739	1.3729	5.2370
Beypazarı	1.0300	1.5475	1.0556	1.7957
Çamlıdere	1.0392	1.3171	1.3052	12.3945
Çankaya	1.1504	1.0054	1.0526	0.9925
Çubuk	1.0203	2.0655	0.7715	1.0586
Elmadağ	1.0151	1.0925	1.0052	2.0909
Etimesgut	1.0635	1.1405	1.0212	0.9960
Evren	1.0268	1.1112	1.1571	1.8218
Gölbaşı	1.0384	1.0253	1.0753	0.9924
Haymana	1.0509	1.7302	2.3718	2.8921
Kalecik	1.1138	1.7871	1.2115	2.4147
Kazan	1.0164	1.1387	1.0715	18.4749
Keçiören	1.0157	1.0885	0.9919	1.2234
Kızılcahamam	1.0243	1.3165	1.1188	1.8968
Mamak	1.1020	1.1963	1.1758	1.1289
Nallıhan	1.0380	1.0961	1.1271	3.7172
Sincan	0.9912	1.0884	1.0017	1.4026
Şereflikoçhisar	1.0462	1.0623	1.0586	5.7189
Yenimahalle	1.1277	1.0971	0.9841	1.0905
Average	1.0510	1.2613	1.1383	3.3115

Note: $\bar{\sigma}_{AKP}(C,0.45)$ stands for the normalized segregation level of the AKP voters for α=0.45

Table 22. Normalized Homophily Values for the Counties of Ankara Based on 2015 November Elections

County	$NormHI_{AKP}$	$NormHI_{CHP}$	$NormHI_{MHP}$	$NormHI_{HDP}$
Akyurt	1.0279	0.8923	0.9599	1.0759
Altındağ	1.0371	1.2769	1.0917	1.6440
Ayaş	1.0789	1.1616	1.1018	3.0600
Bala	1.0691	1.6180	1.3898	5.2370
Beypazarı	1.0275	1.5546	1.0608	1.7670
Çamlıdere	1.0398	1.3250	1.2991	12.4637
Çankaya	1.1535	1.0115	1.0526	0.9954
Çubuk	1.0372	1.9889	0.7950	1.0499
Elmadağ	1.0072	1.1178	1.0147	2.1538
Etimesgut	1.0816	1.1526	1.0190	1.0034
Evren	1.0279	1.1102	1.1565	1.9099
Gölbaşı	1.0432	1.0292	1.0793	1.0104
Haymana	1.0511	1.7283	2.3718	2.8930
Kalecik	1.1165	1.8049	1.2285	2.4305
Kazan	1.0089	1.2490	1.1053	22.0325
Keçiören	1.0152	1.1004	1.0005	1.2439
Kızılcahamam	1.0229	1.3297	1.1188	1.9252
Mamak	1.1113	1.2400	1.1792	1.1692
Nallıhan	1.0385	1.0961	1.1271	3.7172
Sincan	0.9925	1.1001	1.0043	1.4099
Şereflikoçhisar	1.0473	1.0623	1.0607	5.7240
Yenimahalle	1.1378	1.1168	0.9896	1.1087
Average	1.0533	1.2757	1.1457	3.5011

Note:Normalized homophily indices are calculated for the counties of Ankara based on the elections held in November 2015.

Figure 17 and 18 show the segregation index values of each county in Istanbul and Ankara respectively.

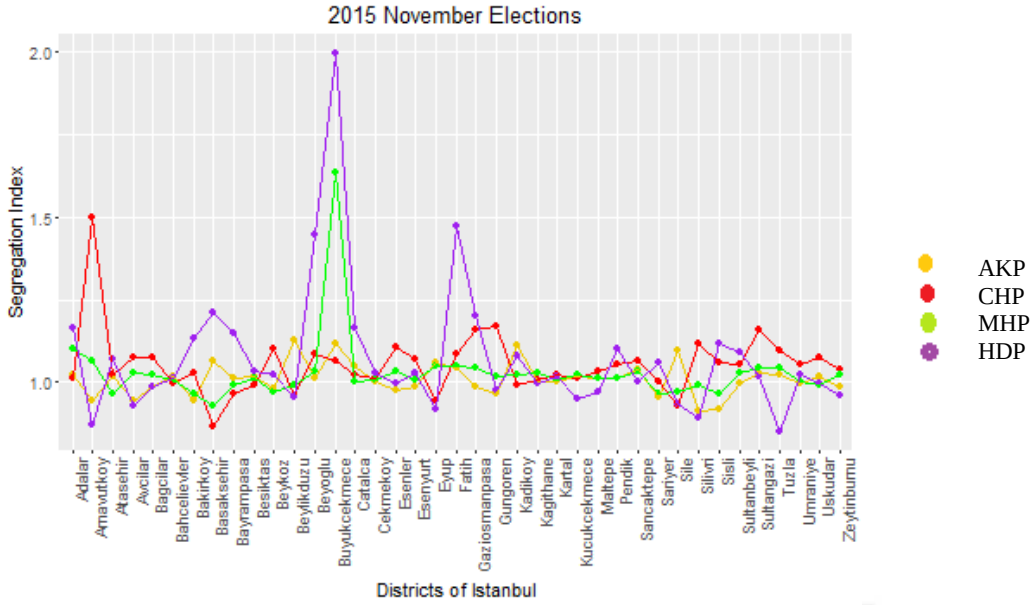


Figure 17 Normalized segregation index graph for the counties of Istanbul based on 2015 November elections

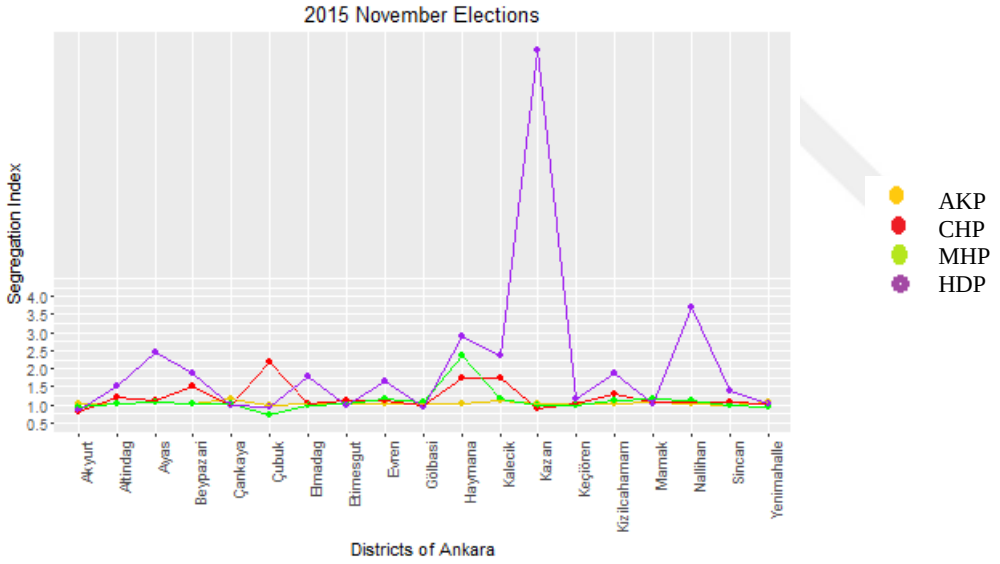


Figure 18 Normalized segregation index graph for the counties of Ankara based on 2015 November elections

After these results, I combine the segregation indices in three elections for each voter group in order to see the overall change between the elections: In Istanbul, when the segregation indices of AKP voters are examined closely, there is not much difference between the elections. However in Ankara, it is obvious that for Çubuk, Gölbaşı and Yenimahalle, there is a lower normalized segregation index of AKP voters in 2011

elections compared to other election results. Figure 19 and 20 show the segregation situation of the dominant party voters in Istanbul and Ankara.

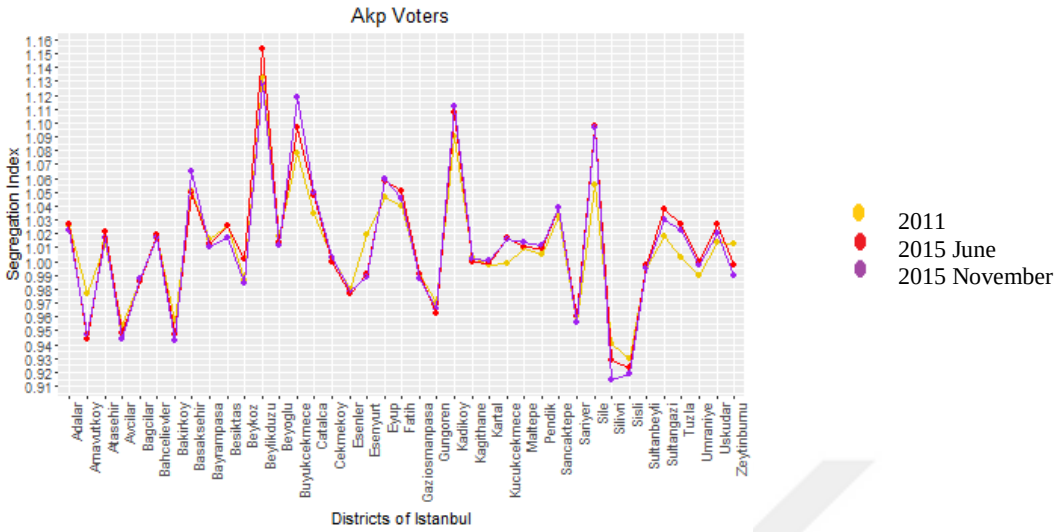


Figure 19 Normalized segregation index of the AKP voters in Istanbul for all three Elections

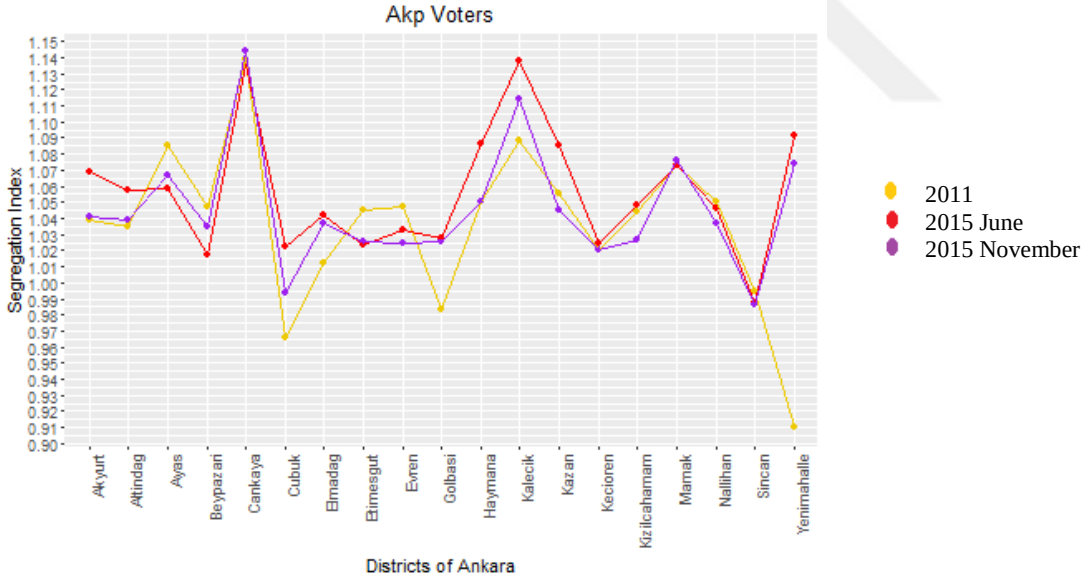


Figure 20 Normalized segregation index of the AKP voters in Ankara for all three elections

For CHP voters, the normalized segregation index of voters is relatively higher for the last two elections as seen in Figure 21 and 22. The lower values are seen in the 2011 elections except the counties Başakşehir and Sultangazi.

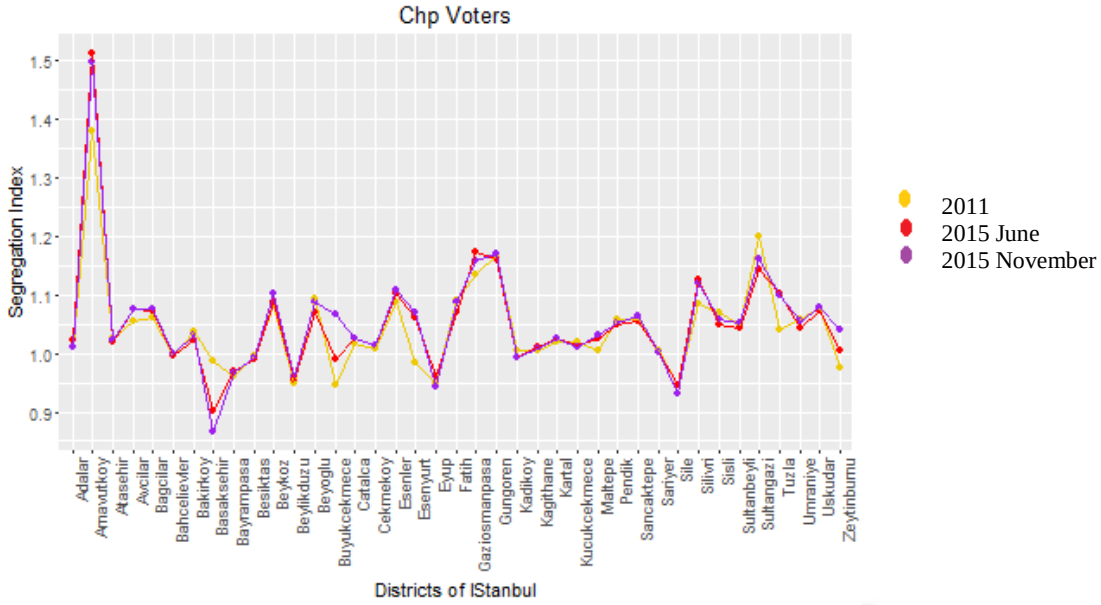


Figure 21 Normalized segregation index of the CHP voters in Istanbul for all three elections

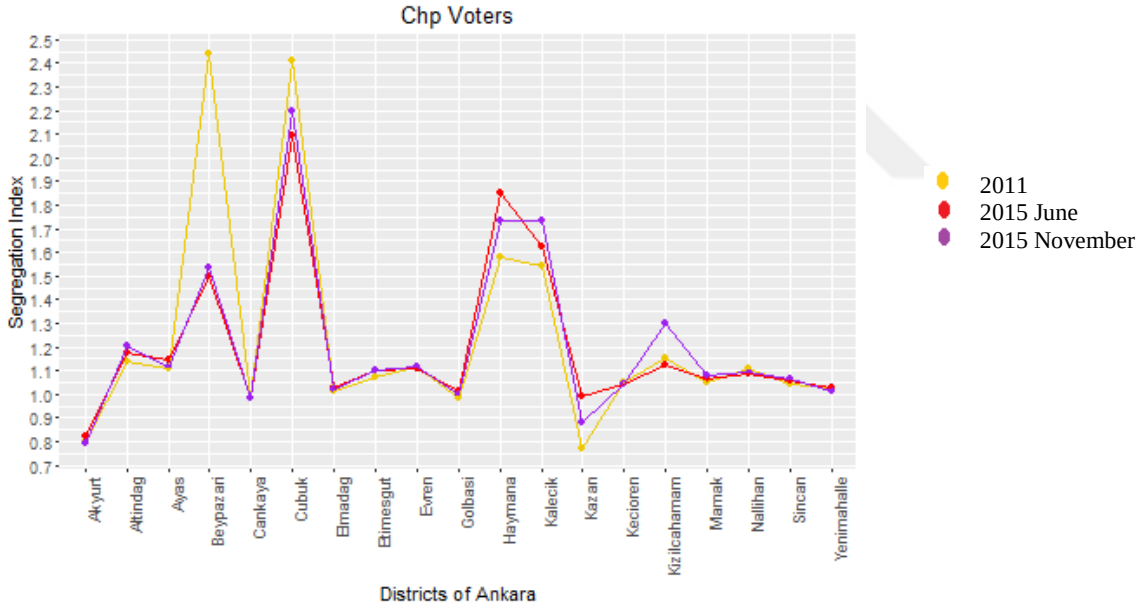


Figure 22 Normalized segregation index of the CHP voters in Ankara for all three elections

For MHP voters, there is a clear higher value for the normalized segregation index of the voters located in Büyükçekmece in 2015 November elections as seen in Figure 23 and 24. For the other counties of Istanbul, the indices are very much similar between the elections.

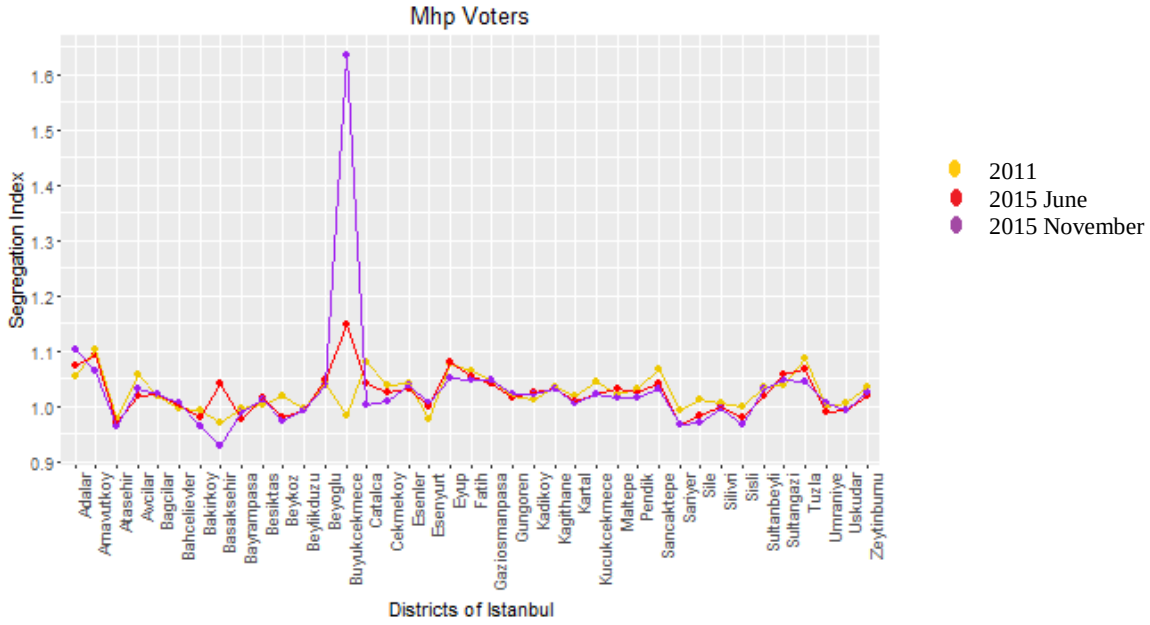


Figure 23 Normalized segregation index of the MHP voters in Istanbul for all three elections

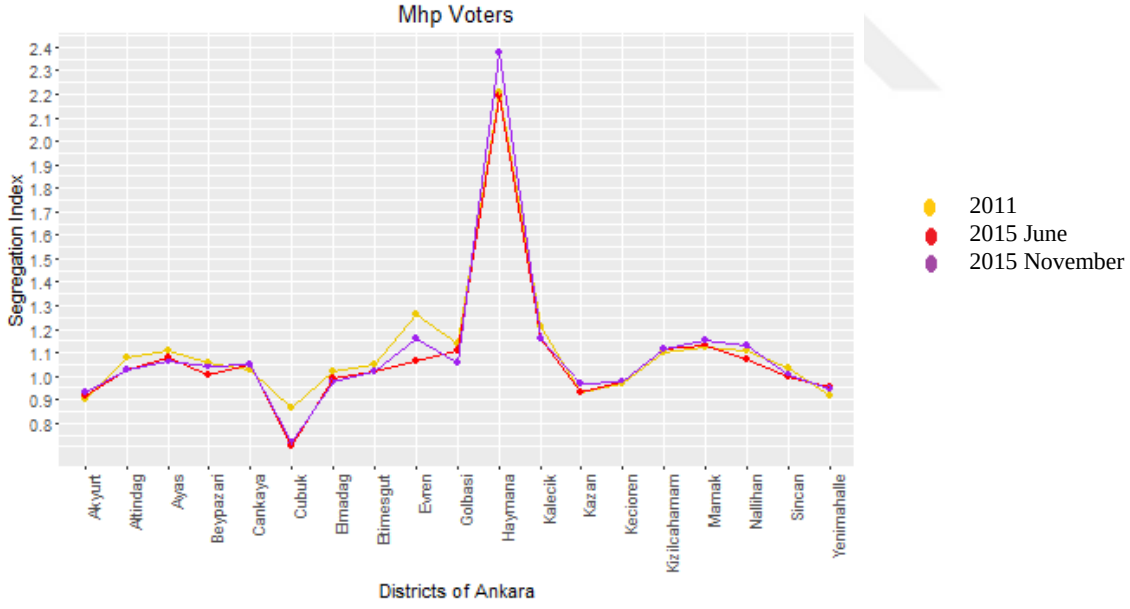


Figure 24 Normalized segregation index of the MHP voters in Ankara for all three elections

Among the all voter groups, the most unstable one in terms of the segregation indices is HDP voters. As it can be seen in the Figure 25, between the three elections, the

higher variance and dispersion belong to these voters. Since the last two elections held in the different months of the same year, the difference between the segregation indices calculated for these two elections is quite lower. However for 2011 elections, the results are quite different than the ones obtained from the other elections.

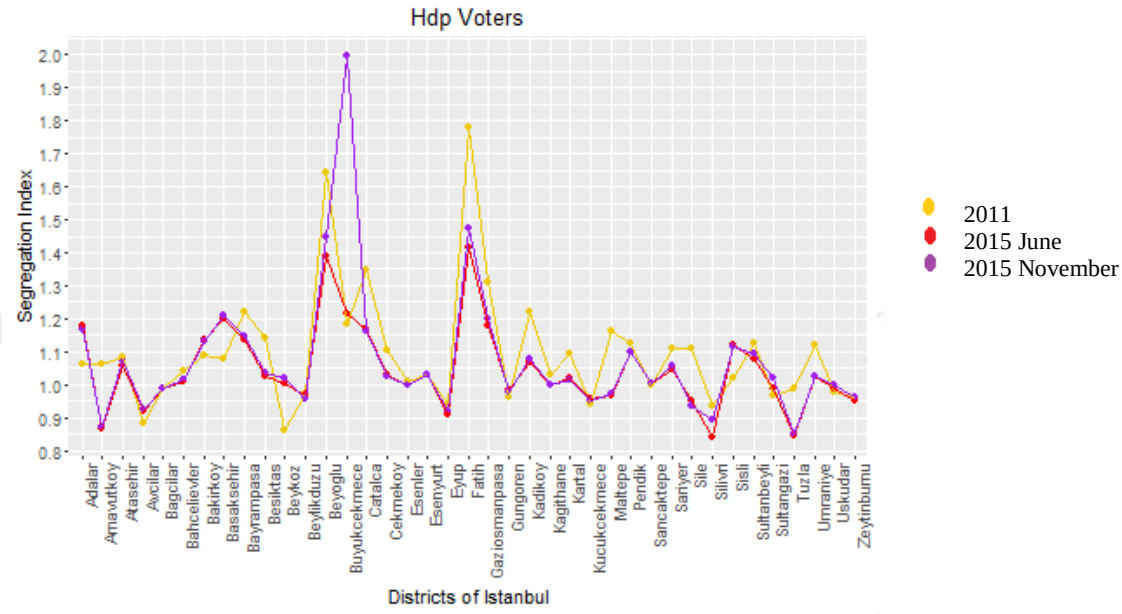


Figure 25 Normalized segregation index of the HDP voters in Istanbul for all three elections

In Ankara, the highest segregation index for HDP voters is seen in Kazan county in Figure 26. In addition to that, as it was the case in Istanbul, the highest dispersion between the segregation indices among different elections belongs to the HDP voters.

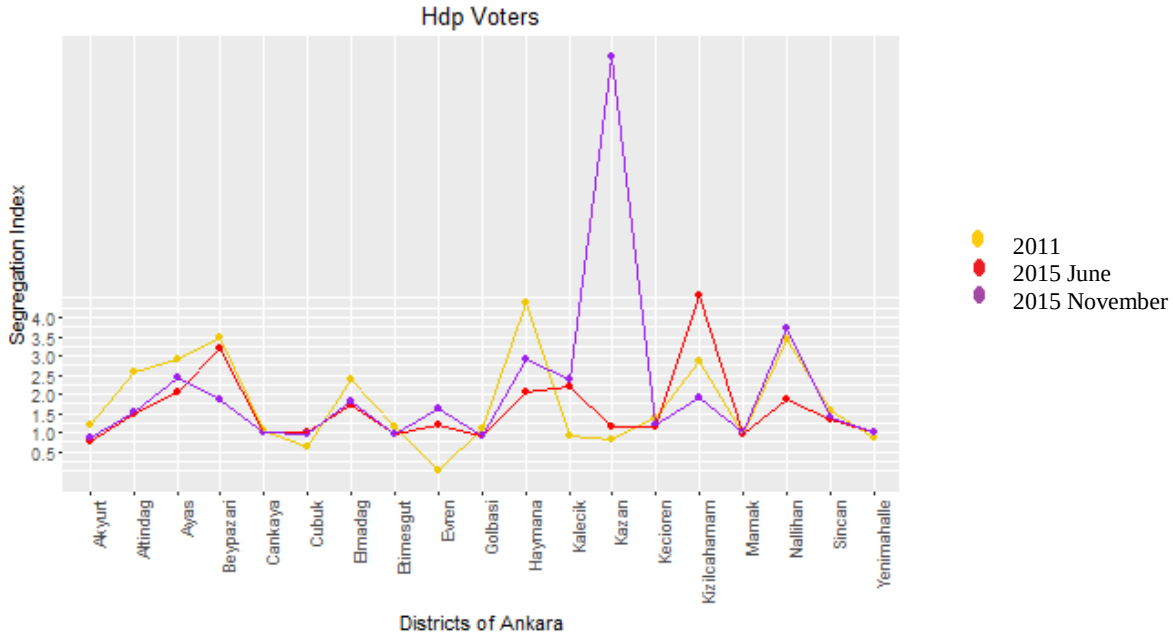


Figure 26 Normalized segregation index of the HDP voters in Ankara for all three elections

After that, I focus on analyzing the correlation between the segregation level of the voters of political parties and the results could be seen in Table 24. In order to test the significance of correlations between the segregation levels of the voter groups, I apply the Spearman test in Stata. According to the results represented in Table 23, the correlation between the segregation levels of AKP and CHP voters are significant for all three elections. For 2011 general parliamentary elections, this correlation level is -0.5409, for 2015 June elections it is -0.5030 and for 2015 November elections it takes value -0.4785. In all these calculations mobility level is fixed as 0.85. It means that in the counties that the voters of AKP are homogenously distributed(less segregated), the voters of CHP are highly segregated and vice versa. This is the case for all three elections in the analysis.

In addition, the correlation between the segregation indices of CHP and MHP voters in Istanbul shows significance, but only in 2015 November elections. The corresponding correlation value is 0.4115. However I do not observe a consistent positive correlation between the segregation indices of CHP and MHP voters, because in 2011 and 2015 June elections, these correlations are statistically insignificant. On the other hand, the correlation measures between the normalized segregation levels of other party voters are insignificant overall. The Spearman significance test is conducted for 99% significance level.

Table 23. Correlation Matrix for Segregation Indices of Voters in Istanbul

2011	AKP	CHP	MHP	HDP
AKP	1.00			
CHP	-0.540*	1.00		
	0.0004			
MHP	-0.0532	0.4071	1.00	
	0.7475	0.0101		
HDP	-0.3067	-0.1202	-0.0915	1.00
	0.0576	0.4659	0.5796	
2015/June	AKP	CHP	MHP	HDP
AKP	1.00			
CHP	-0.5030*	1.00		
	0.0011			
MHP	0.3113	0.2080	1.00	
	0.0537	0.2151		
HDP	0.1474	-0.2020	0.0512	1.00
	0.3706	0.2174	0.7568	
2015/November	AKP	CHP	MHP	HDP
AKP	1.00			
CHP	-0.4785*	1.00		
	0.0021			
MHP	0.1354	0.4115*	1.00	
	0.0411	0.0092		
HDP	0.1555	-0.1174	-0.0810	1.00
	0.3446	0.4766	0.6241	

Note: Spearman rank coefficient is used in Stata for 99% significance level. Corresponding p values are shown below each number.

After measuring correlation, I draw a scatter plot for the segregation levels of AKP and CHP voters based on 2011 election results in Istanbul. Figure 27, Figure 28 and 29 verify the Spearman test results by indicating a negative correlation between the AKP and CHP voters.

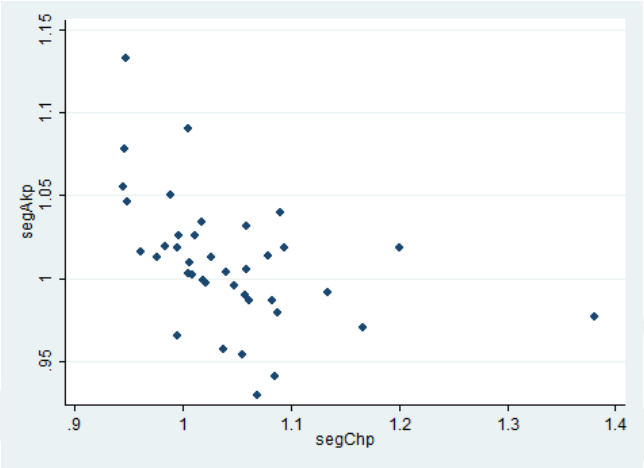


Figure 27 Scatter plot for the segregation of AKP and CHP voters in 2011

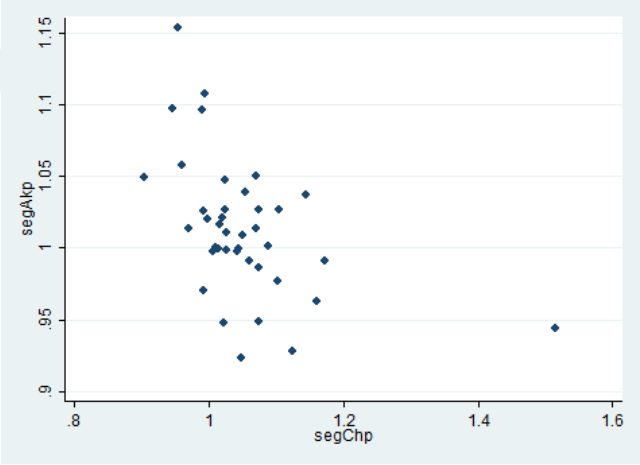


Figure 28 Scatter plot for the segregation of AKP and CHP voters in 2015 June

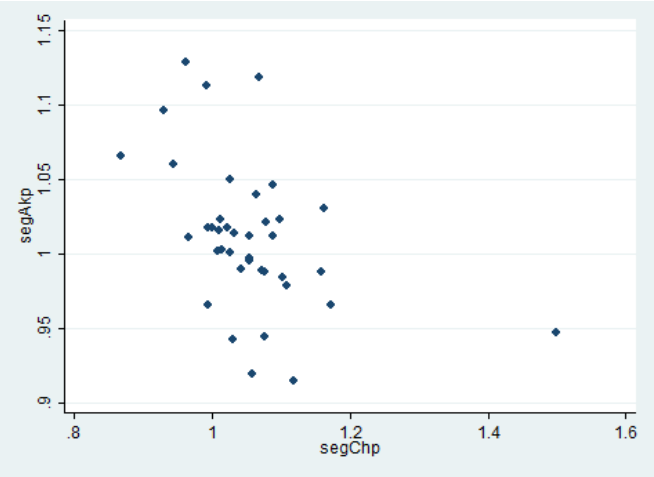


Figure 29 Scatter plot for the segregation of AKP and CHP voters in 2015 November

Table 24 indicates the correlation between the segregation indices of the voters in Ankara. According to the results, the negative correlation between the AKP and CHP voters are sustained; however this time the values are so small compared to the results in Istanbul. Then it could be concluded that in Ankara, the vote distribution of AKP and CHP voters are not much affected by each other, meaning that it is not always the case that when there is a high level of CHP segregation in a county, it is not always because of the less segregation of AKP voters. In other words, in the places where AKP voters are homogenously distributed, it does not mean that in these places it is expected to see many clusters of CHP voters.In order to test the significance of the correlations , I apply the Spearman correlation test in Stata. According to the Spearman test results; it is seen that, in Ankara, there is a statistically significant correlation between the segregation levels of CHP and HDP voters in the elections held in June 2015. The corresponding correlation value is 0.5607 in Table 24. Another significant correlation is seen between the segregation measures of HDP and MHP voters in the elections held in November 2015. The corresponding correlation value is 0.5404.

Table 24. Correlation Matrix for Segregation Indices of Voters in Ankara

2011	AKP	CHP	MHP	HDP
AKP	1.00			
CHP	0.1508	1.00		
	0.5030			
MHP	0.4500	0.4896	1.00	
	0.0356	0.0207		
HDP	0.0932	0.3834	0.4274	1.00
	0.6801	0.0782	0.0472	
2015/June	AKP	CHP	MHP	HDP
AKP	1.00			
CHP	-0.0966	1.00		
	0.6691			
MHP	0.3123	0.4545	1.00	
	0.1571	0.0336		
HDP	0.0164	0.5607*	0.4681	1.00
	0.9423	0.0066	0.0280	
2015/November	AKP	CHP	MHP	HDP
AKP	1.00			
CHP	-0.0751	1.00		
	0.7398			
MHP	0.3235	0.4896	1.00	
	0.1419	0.0207		
HDP	0.2693	0.3258	0.5404*	1.00
	0.2255	0.1390	0.0094	

Note: Spearman rank coefficient test is used in Stata for significance level 99%. Corresponding p values are shown below each number.

After completing the measurement of segregation and homophily indices, I calculated the average values for these indices as shown in Table 25.

Table 25. Average Segregation Levels of Party Voters

Mobility level :0.85							
Ankara	2011	2015/1	2015/2	Istanbul	2011	2015/1	2015/2
AKP	1.037	1.054	1.046	AKP	1.009	1.012	1.011
CHP	1.160	1.143	1.146	CHP	1.043	1.050	1.054
MHP	1.140	1.110	1.132	MHP	1.025	1.023	1.028
HDP	4.343	1.994	3.078	HDP	1.094	1.045	1.073
Mobility level :0.45							
Ankara	2011	2015/1	2015/2	Istanbul	2011	2015/1	2015/2
AKP	1.045	1.059	1.051	AKP	1.019	1.024	1.021
CHP	1.205	1.192	1.199	CHP	1.063	1.069	1.075
MHP	1.156	1.123	1.152	MHP	1.025	1.027	1.037
HDP	4.705	2.082	3.555	HDP	1.094	1.081	1.112

Note: 2015/1 stands for the elections held in June 2015, 2015/2 stands for the elections held in November 2015.

According to the results, HDP voters are the most segregated group no matter which election results I am analyzing. For higher mobility level, their segregation index is greater in 2011 compared to the other elections. In addition, AKP is the less segregated group along with MHP voters. This could be interpreted as being part of a majority group also implies to be evenly distributed over the country. Therefore it leads to a lower segregation value.

CHAPTER 6

IMPACT OF SEGREGATION ON REAL ESTATE PRICES

After the measurement of the segregation levels of the different party voters in Istanbul and Ankara, in the next step I analyze whether there is an impact of these segregation levels on real estate prices in the neighborhoods of Istanbul. In the regressions, I use 910 neighborhood units in Istanbul, some census tracts are omitted from the analysis because they have zero housing price due to the lands which are not open to public zoning. Since I do not have any information about the segregation levels of neighborhoods, (because I only know the segregation levels of the districts in a city), I made an assumption such that I assumed that the segregation level of the neighborhoods of a county is equal to the normalized segregation index of that county.

In the regressions, I use the calculated normalized segregation indices of the counties in Istanbul based on the elections held in November 2015. The outcome variable is the real estate prices that are collected in terms of the prices per metersquare for each neighborhood in Istanbul. I extracted the data from the database of Mapaktif. Data represents the real estate prices from the year 2015. I exclude the homopohily measures of each party voters from the regression, because there would be a high level of multicollinearity between them and the segregation levels of the different party groups. Table 26 shows the summary statistics for political segregation in Istanbul.

Table 26. Descriptive Statistics

	AKP Segregation	CHP Segregation	MHP Segregation	HDP Segregation
Number of Census Tracts	910	910	910	910
Mean	0.4866	0.3334	0.0891	0.1043
Std.dev	0.1682	0.1695	0.0307	0.1004
Min	0.0368	0.0132	0	0
Max	0.9633	0.9533	0.2400	0.9024

Note: Minimum 0 values represent the census tracts where there is no voter for MHP or HDP.

In the first regression, I only use the percentage of votes for different groups in the neighborhood level as control variables. Before running regression, it is expected that the housing prices are affected from the vote number of a group. It means that the housing prices differ for census tracts depending on the groups which the majority of residents belong to. It is seen that the adjusted R^2 is 0.2610 which satisfies our expectation that the percentage of the votes of a political party in an neighborhood is very much related with the housing prices.

In the second regression, I check if the segregation indices are better than the percentage variables in terms of predicting housing prices. When I add the normalized segregation indices of voters at the district level, I come up with a higher adjusted R^2 value(0.3658) which is an indicator of much better prediction. This approach would not generate a problem of multicollinearity because the percentages are at the nighborhood level, while the segregation indices used are at the district level.

In the third regression, I use the normalized segregation indices for neighborhoods(census tracts). I can normalize the segregation indices of

neighborhoods by multiplying the vote weight of a corresponding group in the neighborhood. This way, I am able to keep the correct interpretation of segregation in the neighborhoods, because by multiplying the percentage of the votes that a group has in a neighborhood, I allow the neighborhoods that include more voters from a group to have higher segregation level. Because having more voters which belong to a specific group in a neighborhood implies that higher probability of getting across with a voter from the same group when random walk terminates. Shortly, by multiplying the percentage of votes with the segregation levels of a specific political group, I obtain the neighborhood level segregation indices. According to the regression results, this methodology generates a predictive power that is on par compared to the methodology in which only the percentages of votes are used.

In the fourth regression, I utilize from neighborhood level education variables which are the percentages of university, high school and primary school graduates in the neighborhood level. There is also statistically significant estimates related to education levels. According to the results, the percentage of the university, high school and primary school graduates are significant for 95% level. One unit increase in the percentage of the university graduates in a neighborhood leads to 6.6 % inrease in housing prices. One unit increase in the percentage of the high school graduates in a neighborhood leads to 3 % inrease in housing prices. In addition, one unit increase in the percentage of the primary school graduates causes a decrease in housing prices by 4.32 %. When these results are interpreted, they make sense in such a way that when the education level of the voters is higher in a neighborhood, it implies that the higher housing prices are observed in these places.

Table 27 presents an ordinary least squares estimates, using the normalized segregation indices calculated beforehand.

Table 27. OLS Estimates of the Effects of Segregation on Outcomes

log(RealEstatePrices)	(1)	(2)	(3)	(4)	(5)
%AKP	25.4154***	32.6875***			
	(5.8294)	(5.5254)			
%CHP	27.6962***	34.3775***			
	(5.7417)	(5.4498)			
%MHP	26.7162***	34.7851***			
	(6.1934)	(5.8706)			
%HDP	36.4141***	40.8861***			
	(5.7058)	(5.3933)			
AKP segregation(district)		-4.2398**			
		(1.3473)			
CHP segregation(district)		-.2228			
		(.6030)			
MHP segregation(district)		-6.3059***			
		(.7706)			
HDP segregation(district)		4.0682***			
		(.3435)			
AKPsegregation(censustract)			-6.4639***	-2.2427*	
			(1.3378)	(1.0333)	
CHPsegregation(censustract)			-3.8012**	-4.7542***	
			(1.2999)	(.9816)	
MHPsegregation(censustract)			-4.4979*	-4.6492**	
			(2.0080)	(1.5704)	
HDPsegregation(censustract)			4.5538***	5.3966***	
			(1.0462)	.8009	
%University Grads				.0660***	.0367***
				.0075	.0078
%High School Grads				(.0308)	.0176**
				(.0075)	.0089
%Primary School Grads				-.0432***	-.0516***
				(.0042)	.0051
Number of observation	910	910	910	910	910
Adjusted Rsquared	0.2610	0.3658	0.2682	0.5877	0.3753
F statistic	81.28	66.54	84.28	186.11	183.02
Prob>F	0.000	0.000	0.000	0.000	0.000

Note: Robust standard errors are shown in paranthesis. In total, data for 910 census tracts in Istanbul are used. *p<0.05 **p<0.01 ***p<0.001

CHAPTER 7

CONCLUSION

The purpose of this paper is to measure the segregation index of main four political groups in Istanbul and Ankara based on data obtained from the last three general parliamentary elections of Turkey which are 2011 June, 2015 June and November elections. I apply the methodology of Ballester and Vorsatz while constructing networks and measuring segregation. I also measure the homophily indices of these voter groups and compare the segregation and homophily indices. In order to measure the segregation levels of the voters located in the various counties of Istanbul and Ankara, I utilize from the neighborhoods which are constructing these counties. According to the results, the highest segregated group is HDP for all three elections.

In the second stage, I focus on the relation between mobility and segregation and correlation between the segregation levels. I found that the correlation between AKP and CHP voters' segregation indices is a higher negative value and statistically significant for all three elections. Apart from that, mobility level has an ambiguous effect on segregation. In some counties I found a positive relation between mobility and segregation and in some counties it was negative. This is mostly because of the structure of the counties, i.e some of them consist of very independent neighborhoods, in these cases mobility has no impact on segregation as expected.

In the next stage, I examine the effect of a change in the number of valid votes of a group on segregation level. I found that if there is a uniform change meaning that if each neighborhood is affected from this number of vote change at the same rate , then normalized segregation level of this group keeps constant. However if the number of votes of a group changes only in one neighborhood meaning that if an agent changes her mind about the political party she voted before and she votes for another one now, then the segregation level of this group (the group which she voted before) increases. However I am not able to generalize this situation because there are also cases the opposite case is seen as explained in the related section.

Then I check if my methodology for finding neighborhood level segregation indices is really good enough in terms of predicting housing pricese. While trying to answer this question I utilize from some other control variables like education levels of voters. At the end, by looking at the R^2 values, I conclude that this methodology improves the predictive success.

APPENDIX A

TRANSITION PROBABILITY MATRIX SAMPLE

Table 28. An example of transition probability matrix for Evren county

	Altınbaşak	Cebirli	Çatalpınar	Demirayak	Esentepe	Eksitorun	İbrahimbeyli	İnebeyli	Modern	Solakusağı	Şerafettin	Yeni	Yusufuşağı
Altınbaşak	1	0	0	0	0	0	0	0	0	0	0	0	0
Cebirli	0	1	0	0	0	0	0	0	0	0	0	0	0
Çatalpınar	0	0	1	0	0	0	0	0	0	0	0	0	0
Demirayak	0	0	0	0,5	0	0	0	0	0	0,5	0	0	0
Esentepe	0	0	0	0	0,333333	0	0	0	0	0	0,333333	0,33333	0
Eksitorun	0	0	0	0	0	1	0	0	0	0	0	0	0
İbrahimbeyli	0	0	0	0	0	0	1	0	0	0	0	0	0
İnebeyli	0	0	0	0	0	0	0	1	0	0	0	0	0
Modern	0	0	0	0	0	0	0	0	0,5	0	0	0,5	0
Solakusağı	0	0	0	0,5	0	0	0	0	0	0,5	0	0	0
Şerafettin	0	0	0	0	0,333333	0	0	0	0	0	0,333333	0,33333	0
Yeni	0	0	0	0	0,25	0	0	0	0,25	0	0,25	0,25	0
Yusufuşağı	0	0	0	0	0	0	0	0	0	0	0	0	1

APPENDIX B

SAMPLE CODES

Matlab code for calculating the segregation indices in Istanbul:

```
S = load('matlab_istt_seg.mat');
seg=zeros(39,4);
alpha=0.85;
for j=0:38
   for i=1:4
      seg(j+1,i)=(1-alpha)*S.(sprintf('densS%d', j))(i,:)*inv(S.(sprintf('I%d', j))-
alpha*S.(sprintf('pIstS%d', j)))*S.(sprintf('pIstS%d', j))*S.(sprintf('concS%d', j))(:,i);
   end
end
seg
S = load('matlabistseg20151.mat');
seg=zeros(39,4);
alpha=0.45;
for j=0:38
   for i=1:4
      seg(j+1,i)=(1-alpha)*S.(sprintf('distS%d', j))(i,:)*inv(S.(sprintf('I%d', j))-
alpha*S.(sprintf('pIstS%d', j)))*S.(sprintf('pIstS%d', j))*S.(sprintf('istS%d', j))(:,i);
   end
end
seg
S = load('matlabistseg20152.mat');
seg=zeros(39,4);
segnorm=zeros(39,4);
alpha=0.45;
for j=0:38
   for i=1:4
      seg(j+1,i)=(1-alpha)*S.(sprintf('distS%d', j))(i,:)*inv(S.(sprintf('I%d', j))-
alpha*S.(sprintf('pIstS%d', j)))*S.(sprintf('pIstS%d', j))*S.(sprintf('istS%d', j))(:,i);
   end
end
seg
```

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