Political Language and Economy – A Network Analysis

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Abstract

In this paper we propose a method to analyze political discourse in Greece. This type of language has quite distinct properties which differentiate it from others. Furthermore, political language generally uses a large number of economic terms, especially during crisis periods like the one Greece has been involved. In order to analyze this type of language, we collected data from the pre-elections speeches of four political leaders from the 25th of January 2015 Greek general elections. After extensive preprocessing, we created networks of words, which in turn analyzed and compared through social analytic tools. Results reveal interesting patterns, particularly on the way leaders use economic terms, together with political rhetoric.

Introduction

After the 2008 eruption of the economic crisis in Greece, the political stage has been shattered to a large degree. Older, well established political parties lost their dominance and new ones were formed. Due to the extremely hard economic situation, no government scheme was able to last for more than 2.5 years. In six years (2009 – 2015) there have been five general elections in Greece, with six different prime ministers. During these years political discourse in Greece is mainly involved with the economy and related problems and less with other areas which have been traditionally important in the Greek political life.

In this paper we seek to analyze political discourse in Greece with the use of Social Network Analysis (SNA). SNA has been widely applied in social, economic and other sciences. There is no real consensus on the exact definition of SNA as a field, since it is sometimes described as a theory or as a strategy or approach and sometimes as a set of techniques (Buch-Hansen, 2013). It has also been considered to be a "paradigm" itself, containing a set of theoretic definitions, methodologies and empirical research (Carrington and Scott, 2011; Marin and Wellman, 2011). In any case, its target is to analyse the social relations created between persons (or actors in general), the structure of these relations and the ways through these relations affect (or are affected by) social behaviour, attitudes and beliefs of actors (Prell, 2012, p. 1).

SNA shares the general belief of structural approaches for the existence of underlying deep structures (Wellman, 1983), but it should be distinguished from them, as it perceives the concept of *structure* differently: for SNA social structure is formed by patterns or regularities of relations which develop between interacting units (Freeman, 2004; Wasserman and Faust, 1994; Wellman, 1983). Being a structural perspective, it adopts a critical attitude against individualistic approaches that ignore social aspects of behavior (Freeman, 2004). A typical social research focuses on characteristics and attributes of single units – persons, while SNA focuses on relations and interactions between acting subjects (Knoke and Kuklinski, 1982; Marin and Wellman, 2011; Wasserman and Faust, 1994).

SNA and Political Discourse

Political discourse is actually a narrowed field of literature, of course quite different from drama, fiction or poetry. SNA has been applied in many ways in cultural studies (see DiMaggio, 2011, for a comprehensive review). In literature, in particular, social networks of authors have been subjects of research in order to investigate one key hypothesis of Bourdieu's theory of the structure of cultural fields (Anheier, Gerhards, and Romo, 1995), to show off the interdependence between material and symbolic production of literature (De Nooy, 1991), to seek for similarities between narrative and social structure (De Nooy, 2001), to explore dynamic relations between author's and literary journal's prestige (De Nooy, 2002) or to study the Afrikaans literary system (Senekal, 2012).

Other approaches regard relations between actors on drama (Freeman, 2004; Hare and Hare, 1996; Moreno, 1978) or interactions between actors of works of literature as social networks (Elson, Dames, and McKeown, 2010). Some studies pose the question of how similar is the network structure of characters of a literature work to real-life networks (Alberich, Miro-Julia, and Rossello, 2002; Kydros and Anastasiadis, 2015; Kydros, Notopoulos, and Exarchos, 2015; Mac Carron and Kenna, 2012; Stiller and Hudson, 2005; Stiller, Nettle, and Dunbar, 2003). To our knowledge, no actual research regarding political discourse and SNA has been presented up to now.

Of course, being largely involved in social sciences, SNA has been extensively applied in political science. In the edited volume by Diani and McAdam (2003) the role of individual and inter-organizational networks as well as the relevance of networking in Network Analysis in the political process is analyzed. Lazer (2011) has presented a comprehensive review on the applications of SNA in political science. Adamic and Glance (2005) dealt with the 2004 presidential elections and the blogosphere in the U.S. There has been a number of symposiums and conferences regarding applications of SNA in political science, however few political scientists have actually been involved in the area. Applied social networks (Facebook or twitter) are extensively used in all modern political campaigns or used to measure social capital (Lake and Hackfeldt, 1998; McClurg, 2003; and a large number of press articles).

In this paper we will use another approach, coming from the field of natural language processing, in order to create networks of adjacent words. We will use published speeches of political leaders during the January 25th, 2015 pre-electoral period. After extensive preprocessing

we will create networks of words and find out which are the most prominent or influential of them for each leader. Furthermore we check whether the overall networks follow the general rules of real-life networks in the topological sense, by checking whether they belong to the small-world or scale free categories (Barabási and Réka, 1999; Watts and Strogatz, 1998). Finally we will discuss differences between those networks and try to assess the "quality" of these word networks with respect to the final outcome of the elections.

Terms and Methodology

A social network is comprised of a set of nodes (or actors or vertices), which are the acting subjects. The nodes are interconnected through one or more relations (Marin and Wellman, 2011; Wasserman and Faust, 1994). Nodes are usually persons or organizations, but in general any unit that can connect to another can be considered as a node (web pages, journal articles, countries etc.). Different types of relations, defined as arcs, ties, links or edges, can connect nodes and may refer to biological relation (ancestry, family), communication, exchange, emotions, collaboration, power or influence, physical connections, etc. (Knoke and Kuklinski, 1982; Wasserman and Faust, 1994).

In our case we will use the word adjacency idea as presented in Pardo et al. (2006), who used word adjacent networks to formulate and represent summaries of Portuguese texts as complex networks. Each word becomes a node in the network. Two nodes are connected by an edge when they are adjacent within the text (resulting in an undirected network). If one needs to also represent order, then an arc (an arrow) is drawn emanating from one word and ending on the following word (a directed network). In Figure 1 we represent such an example (text in Greek).
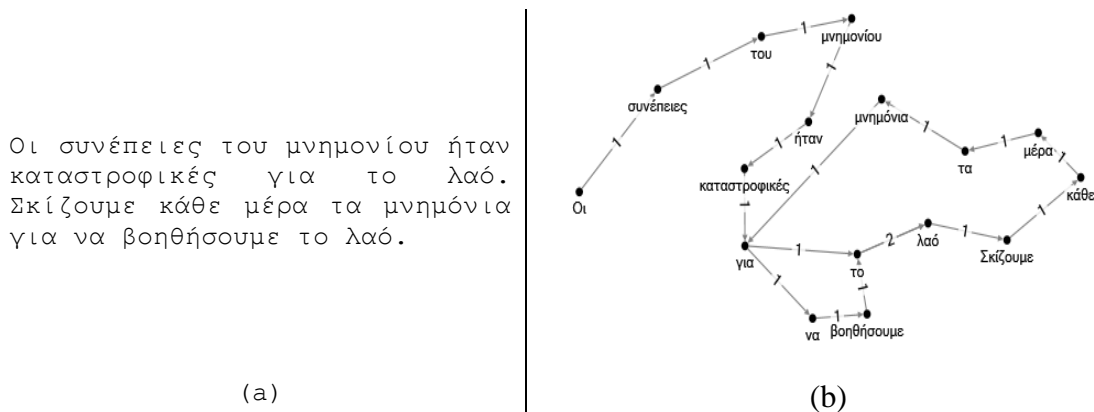
Οι συνέπειες του μνημονίου ήταν καταστροφικές για το λαό. Σκίζουμε κάθε μέρα τα μνημόνια για να βοηθήσουμε το λαό.

(a)   (b)

Figure 1: A sample text (a) and its respective directed network (b).

On the network of Fig. 1 (b), all edge weights equal to one, except for one edge (2) which is found twice in the text. However, serious problems arise after close inspection. The same word appears as different nodes (single – plural). Many words (i.e. articles) do not add important information and it seems that they impose noise in the network. When sentences break, words should not be considered to be adjacent. Such issues, being extremely magnified by the Greek language complexity had to be resolved with extensive preprocessing, which was mainly done "by hand", since no complete automated tool, specialized

for the purposes of our study for the Greek Language was found. In the following table we summarize all rules we followed in order to wipe out such problems.

Table 1: Rules for text preprocessing

Nouns	Converted to their nominative singular forms.
Adjectives	Converted to their nominative masculine singular forms.
Verbs	Converted to their first person singular, present tense, active voice, indicative mood forms.
Pronouns	If possible, pronouns were replaced with the name to which they refer. Some pronouns were deleted and the remaining were converted to their nominative masculine singular forms.
Participles	Active participles were treated like verbs, passive participles were treated like adjectives.
Adverbs	Adverbs remained unchanged.
Articles, particles, conjunctions, prepositions	They were mostly deleted. Few remained, as they were considered to be important for the meaning.
	Appropriate words were added to make the implicit subjects, explicit.
Exception	Pronouns *εμείς-we* and *εσείς-you* remained unchanged, as useful conclusions can be drawn from the use of personal pronouns in political speeches.

After applying all rules of Table 1 on the text of Fig. 1 (a), the new text with its corresponding network is shown in Figure 2.

συνέπεια   μνημόνιο
είμαι καταστροφικός
λαός. εμείς σκίζω
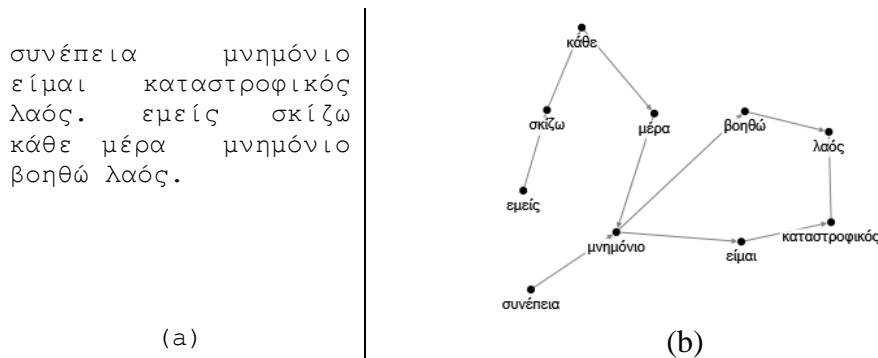κάθε μέρα μνημόνιο
βοηθώ λαός.

(a)

(b)

Figure 2: Text after preprocessing (a) and its respective directed network (b).

Such a network can be investigated both in the nodes level and in a macroscopic (topological) level. We will follow the procedure described by Kydros and Anastasiadis (2015), by examining first the nodes' clustering in communities, followed by the importance of individual nodes in terms of centrality metrics, followed by a topological set of metrics, together with an examination of the way these networks evolve.

Nodes can cluster in groups. These groups can be cliques, cores, clans etc., according to the group definition[1]. Recently, the notion of community structure was introduced by Girvan and Newman (2002). The more general definition is based on the principle that pairs of nodes are more likely to be connected if they are both members of the same community(ies), and less likely to be connected if they do not share communities. Algorithms for detecting community structure in networks

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[1] See Wasserman and Faust (1994, Chapter 7) for a full presentation

are proposed in Blondel et al. (2008). Modularity is a measurement that corresponds to the quality of grouping. If this metric is high enough then nodes are grouped in clearly bounded communities.

Nodes are important in a variety of ways through special metrics. In this paper, five of these metrics are used, namely: degree, closeness, betweenness and eigenvector centralities, together with PageRank metric. The intuitional (not formal - mathematical) definitions for the above metrics can be found in Kydros and Anastasiadis (2015)[2].

On topology, Newmann (2002) has assembled a set of metrics that regarding the topology of a simple, undirected network. We will use this approach, since it has been reported as the most inclusive and concise. More specifically, we will deal with link density, degree, distance, diameter and average clustering coefficient. Furthermore, as proved by Barabási and Réka (1999), in small worlds the degree distribution follows a power-law manner, reflecting the very few nodes with large degree (hubs) and the many nodes with small degree with an exponential tail. If failures occur randomly and the majority of nodes are those with small degree, the likelihood that a hub would be affected is almost negligible. If a hub-failure occurs, the network will generally not lose its connectedness, due to the remaining hubs. On the other hand, if we choose a few major hubs and take them out of the network, the network is turned into a set of rather isolated graphs. Again, full definitions can be found in Kydros and Anastasiadis (2015).

Data were collected from the official webpages of four political parties, right after the 25th of January 2015 general elections. We collected all speeches of political leaders of these four parties, namely SYRIZA, NEA DIMOKRATIA, KKE and ANEL, since they span almost completely over the political spectrum in Greece. These data were preprocessed (as already described) and were transformed to networks with the use of NodeXL (2014), a free Excel-based template to calculate some of the metrics and produce visualizations. For topological metrics and scale-free testing we also used Pajek (Batagelj and Mrvar, 1998) together with R package (R Core Team, 2013).

Results and discussion

Visualizations and communities

In Figure 3 we present the network produced from Mr Tsipras' (SYRIZA) speeches. Nodes are clustered in communities (with a modularity index of 0.32) while their size is proportional to PageRank.
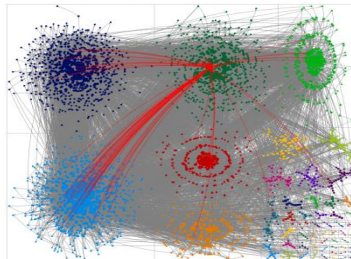

Figure 3: Mr. Tsipras' network (TsN) in communities.

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[2] The actual formal definitions can be found in Wasserman and Faust (1994, Chapter 5).

Table 2 shows most important (central) nodes within the six larger communities. All centralities gave similar rankings, meaning that the network does not exhibit special structure.

Table 2: Major Communities and most important nodes in TsN

Group/position	Important nodes (Greek)	Important nodes (English)
G1/top left (737 nodes)	Πολιτικός, νέος, μεγάλος, κοινωνικός, δημόσιος, άνθρωπος, …	Politician, young, great, social, public, human, …
G2/bottom left (727 nodes)	Σαμαράς, ΣΥΡΙΖΑ, λαός, Ελλάδα, αντίπαλος, χώρα, εσείς, εγώ, …	Samaras, SYRIZA, people, Greece, opponent, country, you, I, …
G3/top middle (588 nodes)	Όλος, Ευρώπη, μνημόνιο, χρέος, κυβέρνηση, υπάρχω, δημοκρατία, …	Whole, Europe, memorandum, debt, government, exist, democracy, …
G4/middle (379 nodes)	Εμείς, ένας, θέση, ευθύνη, ιστορικός, …	We, one, thesis, responsibility, historical, …
G5/bottom middle (298 nodes)	Είμαι, φίλος, εθνικός, φτώχεια, σταματώ, …	I am, friend, national, poverty, stop, …
G6/top right (253 nodes)	Μόνο, κάθε, σπίτι, δικαίωμα, αφορώ, χιλιάδες, ανθρώπινος, …	Only, every, home, rights, regard, thousands, humane, …

G3 mainly deals with economic issues but a negative feeling comes through the used words (memorandum, debt, austerity and the problems they create). On the contrary, G1 contains words with positive feelings, SYRIZA's proposals for the economy, the development, farmers, pensions and taxes. G2 deals with the opposition against Mr. Samaras, together with the proposition that a solution can come only through SYRIZA. Finally, G4 incorporates sentiment. This clustering seems to be quite balanced in the sense that no particular weight is given to one direction. Sentiment, reason, the future, the fight are all included evenly in this network. In the level of individual nodes, the – by far - most prominent node in all centrality measurements (εμείς–we) belong to G4.

Figure 4 shows Mr. Samaras' (ND) network (SaN), again with the same clustering algorithm (modularity was computed to 0.27) and the same visualization technique.
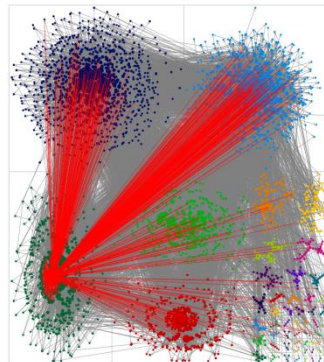

Figure 4: Mr. Samaras' (ND) network (SaN)

Table 3 shows most important (central) nodes within the five larger communities. All centralities gave similar rankings, meaning that the network also does not exhibit special structure.

Table 3: Major Communities and most important nodes in SaN

Group/position	Important nodes (Greek)	Important nodes (English)
G1/top left (968 nodes)	Έχω, γίνομαι, νέος, Ευρώπη, ανάπτυξη, μεγάλος, …	I have, become, new, Europe, development, great, …
G2/top right (808	Αντίπαλος, ΣΥΡΙΖΑ, όλος, εγώ,	Opponent, SYRIZA, whole, I, say,

Group/position	Important nodes (Greek)	Important nodes (English)
modes)	λέω, μπορώ, …	I can, …
G3/bottom left (656 nodes)	Εμείς, Ελλάδα, χώρα, τελευταίος, μέλλον, θέση, …	We, Greece, country, last, future, position, …
G4/middle (466 nodes)	Ευρώ (numbers), φόρος, πάνω, μειώνω, Δημόσιο, σύνταξη, …	Euro (numbers), tax, over, reduce, public sector, pension, …
G5/bottom middle (426 nodes)	Είμαι, ελληνικός, Τσίπρας, ασφάλεια, αρχή, προστασία, …	I am, Greek, Tsipras, Security, authority, protection, …

In SaN, distinguished groups are less than TsN. G1 contains mainly economic issues like *investment*, *business*, *airport*, *reform*. G4 deals mainly with tax issues and tax reduces. G2 is about politics, the opponent's positions etc. G5 is a new finding where words tend to move to issues like security, migration, criminality etc. G3 deals with the position of Greece in Europe. Interestingly here, the most important node in all rankings is again *εμείς–we*.

Figure 5 shows Mr. Koutsoumbas' (KKE) network (KoN), produced with the same techniques. Modularity was computed to be 0.36.
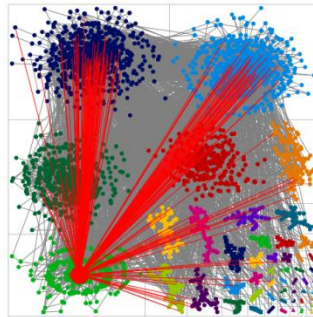

Figure 5: Mr. Koutsoumbas' (KKE) network (KoN)

In Table 4 we list the six larger groups together with some representative words.

Table 4: Major Communities and most important nodes in KoN

Group/position	Important nodes (Greek)	Important nodes (English)
G1/top left (453 nodes)	Εμείς, νέος, ΚΚΕ, λαϊκός, δικαίωμα, όχι, …	We, young, KKE, people's, rights, no, …
G2/top right (416 modes)	ΣΥΡΙΖΑ, ΕΕ, κυβέρνηση, ΝΔ, αντίπαλος, …	SYRIZA, EU, government, ND, opponent, …
G3/middle left (380 nodes)	Είμαι, χώρα, ΝΑΤΟ, χρόνος, ευρώ(numbers), Ελλάδα, …	I am, country, NATO, time, euro(numbers), Greece, …
G4/bottom left (272 nodes)	Λαός, πολιτικός, μεγάλος, πρόβλημα, χρέος, κατάργηση, …	The people, political, big, problem, debt, abolishment, …
G5/middle (254 nodes)	Μείωση, αντιλαϊκός, μέτρο, ψίχουλο, νόμος, …	Reduction, counter-popular, measure, crumb, law, …
G6/middle right (100 nodes)	Εφοπλιστής, χαράτσι, εργασιακός, ευρώ, μέλλον, …	Ship-owner, amerce, labor, euro, future, …

The situation in KoN corresponds perfectly to the communist ideology and the marxist perspectives of KKE. There is no clear difference on the groups, as in the previous networks, however some observations are interesting. This party stands against all others, as can be seen from G2. Furthermore, words with "negative" feelings are present in groups G2, G5 and G6, in the protesting sense. Only G1 seems to contain words with positive thesis, still however regarding the party itself. The most important word here is computed to be *λαός–the people*.

In Figure 6 we draw Mr. Kamenos' network (KaN) from party ANEL (independent Greeks). This party stands to the right of the political

spectrum; however it formed a coalition in government after the January 2015 elections.
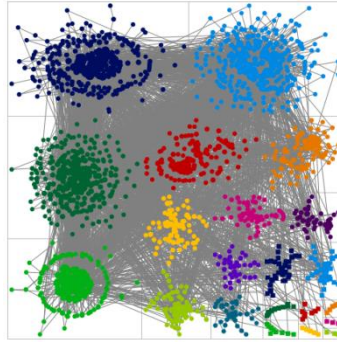

Figure 6: Mr. Kamenos' (ANEL) network (KaN)

In Table 5 we list the five larger groups (with a modularity of 0.37) together with some representative words.

Table 5: Major Communities and most important nodes in KaN

Group/position	Important nodes (Greek)	Important nodes (English)
G1/top left (287 nodes)	Είμαι, εθνικός, ελληνικός, ΑΝΕΛ, μεγάλος …	I am, national, Greek, ANEL, great, …
G2/top right (245 modes)	Σαμαράς, Ελλάδα, έχω, πολιτικός, χώρα, κυβέρνηση …	Samaras, Greece, I have, political, country, government …
G3/middle left (226 nodes)	Όλος, αντίπαλος, Έλληνας, πηγαίνω, υπάρχω, πολίτης …	Whole, opponent, Greek, go, exist, citizen …
G4/bottom left (186 nodes)	Εμείς, χρέος, ανάπτυξη, μιλώ, μετρώ, Βουλή …	We, debt, development, talk, count, Parliament, …
G5/middle (125 nodes)	Εγώ, χρόνος, βρίσκω, ευρώ(numbers), τελευταίος, …	I, time, find, euros, (numbers) last, …

Similar groupings are seen in this network. Group G1 regards the ANEL party, its allies and the notions of the nation, the people, democracy, etc. In G2 words about the policies of the current (at that time) government, together with the troika are presented, as long as proposals from ANEL for taxation and tourism. In G4 he deals with debt, negotiations and development. G5 regards personal actions of the leader himself (it contains a series of verbs acting in the first person). Finally, G3 is more of a call to Greek citizens and other parties' voters to think about problems of everyday life, created by the opponents (dangers for property, loss of national sovereignty, etc.

Important nodes regarding economy and their neighbors

In Table 6 we rank the ten most important nodes (after PageRank) regarding economic issues. Thus, word *μνημόνιο-memorandum* is the first word in this context for TsN and it is ranked in the 19th position.

Table 6: Ranking of words about economy

	TsN		SaN		KoN		KaN	
1	μνημόνιο memorandum	19	ανάπτυξη development	23	εργαζόμενος worker	20	επιχείρηση business	47
2	χρέος debt/duty	22	επένδυση investment	46	εργατικός working	39	χρέος debt/duty	64
3	λιτότητα austerity	49	χρέος debt/duty	54	άνεργος unemployed	47	τουρίστας tourist	70
4	πρόγρ.Θεσ.	51	φόρος	55	κεφάλαιο	51	φορολογία	76

	prog. Thess.		tax		capital		taxation	
5	ανάπτυξη development	52	επιχείρηση business	56	μονοπώλιο monopoly	53	αγρότης farmer	78
6	τρόικα troika	70	πληρώνω pay	65	δουλειά job	56	πληρώνω pay	81
7	οικονομία economy	72	μεταρρύθμιση reform	70	χρέος debt/duty	57	τράπεζα bank	84
8	τράπεζα bank	97	οικονομία economy	81	μνημόνιο memorandum	62	φόρος tax	87
9	αγροτικός agricultural	106	μείωση reduction	82	καπιταλιστικός capitalistic	66	μειώνω reduce	111
10	φόρος tax	111	χρήμα money	90	μισθός salary	81	συνταξιούχος pensioner	112
11	οικονομικός economic	121	αγορά market	104	ανεργία unemployment	87	δανειστής creditor	119
12	αγρότης farmer	123	μειώνω reduce	105	ανάπτυξη development	95	αγωγός pipeline	128
13	σύνταξη pension	126	λεφτά money	107	σύνταξη pension	110	οικοδομή building	139
14	παραγωγικός productive	137	έλλειμμα deficit	108	οικονομία economy	123	ανάπτυξη development	151
15	φορολογώ to tax	138	εισόδημα income	109	φόρος tax	129	περιουσία fortune	154

Word *χρέος-debt* is found within the ten first in all networks, being a common and important issue during this period. Among the top 20 words, *ανάπτυξη-development* and *φόρος-tax* are common, while for TsN, SaN, KoN words *οικονομία-economy*, *μνημόνιο-memorandum*, *σύνταξη-pension* and *τράπεζα-bank* (*τράπεζα-bank* is missing in KoN, but it is prominent in Kan).

The network structure allows us to study how the words and therefore their concepts interact with each other revealing the main political and economic positions of the party leaders. Thus, in TsN:

- The most prominent word is *μνημόνιο-memorandum*. Its immediate neighborhood contains words like *Σαμαράς-Samaras*, *αντίπαλος-opponent*, *καθεστώς-regime*, *κατεστημένος-status quo*, *τρόικα-troika*, *κυβέρνηση-government*, *λιτότητα-austerity*, *χρέος-debt*, *καταστροφή-catastrophe*, *λεηλατώ-looting*, *βαρβαρότητα-barbarism*, *πληγή-wound*, *παραλογισμός-irrationality*, *απολυταρχία-absolutism* etc., showing Mr. Tsipras' intentions to underline its negative consequences, coming from the application of these policies and persons. It also makes dyads with *ΣΥΡΙΖΑ-SYRIZA*, *τέλος-end*, *καταργώ-abolish*, *έξοδος-exit*, *φως-light*, *φεύγω-leave*, *ακυρώνω-cancel*, showing intensions to leave this policy.
- The party's economic program (*Πρόγραμμα Θεσσαλονίκης*) is immediately connected with *δέσμευση-commitment*, *δεσμεύω-bound*, *διαπραγμάτευση-negotiation* and also *υλοποιώ-apply*, *εφαρμόζω-implement*, *εφαρμογή-application*, *ρεαλιστικός-realistic*, *κοστολογημένος-cost*, *τεκμηριωμένος-documented* and *αποδοχή-reception*, *αγκαλιάζω-embrace*, *ανακουφίζω-relieve*.
- Word *φόρος-tax* is connected with the opponent's policies like *Σαμαράς-Samaras*, *ΕΝΦΙΑ-ENFIA*, *δυσβάστακτος-unbearable*, *παράλογος-absurd*, *λαιμητόμος-guillotine* and also imprints future willing (*καταργώ-abolish*, *ελάφρυνση-lighten*, *δίκαιος-fair*, *αντικαθιστώ-replace* etc.).
- The presence of words regarding the agricultural sector in TsN first positions is also important. Such words make dyads with *επιδότηση-subsidy*, *σύνταξη-pension*, *φορολογία-taxation* etc., aiming in supporting the lives of farmers and their production.

In SaN, the idea of *ανάπτυξη-development* stands out, making dyads with positive verbs (such as *μπαίνω-enter*, *αρχίζω-start*, *επιστρέφω-return*, *έρχομαι-come*, *ξεκινώ-begin*), with adjectives showing the form (like *βιώσιμος-viable*, *συνεχής-continuous*, *αληθινός-real*, *υψηλότερος-higher*, *αγροτικός-agricultural*, *περιφερειακός-regional*) or the best suitable environment (*σταθερότητα-stability*, *ομαλότητα-normality*, *ανταγωνιστικότητα-competitiveness*, *Ευρώπη-Europe*, *επένδυση-investment*, *επιχειρηματικότητα-entrepreneurship*, *τουρισμός-tourism*, *μεταρρύθμιση-reform*). Word *ανάπτυξη-development* lies in the same group, dealing with the development procedures, according to Mr. Samaras: *επιχείρηση-business*, *αποκρατικοποίηση-privatization*, *εξωστρέφεια-extroversion*, *εξαγωγή-export*, *εμπόριο-commerce*, *ΕΣΠΑ-NSRF*, *ιδιώτης-private*, *πλεόνασμα-surplus*, *έρευνα-research*, *ρευστότητα-liquidity*, *τράπεζα-bank*, *αεροδρόμιο-airport*, *νοικοκύρεμα-tidying* etc. Furthermore, one can note words *μείωση-reduction* and *μειώνω-reduce* in ranks 9 and 12 respectively. They form dyads with *φόρος-tax*, *ΦΠΑ-VAT*, *ΕΝΦΙΑ-ENFIA*, *ασφαλιστικός-insurance*, *έλλειμμα-deficit*, *χρέος-debt*, *δαπάνη-expenditure* etc., reflecting a belief that reduced taxes are a key factor for development and a promise that these reductions will become true after the elections.

Rankings in KoN correspond immediately to the Marxist's theory on the structure of economy and the war between two worlds, the workers, the unemployed, the labor force against the capitalistic world of monopolies and capital. The most important node is *εργαζόμενος-worker* which is paired with *δικαίωμα-right*, *ανάγκη-need*, *διεκδίκηση-claim*, *ιδρώτας-sweat*, *κλέβω-steal*, *λαός-people*, *νεολαία-youth* etc., denoting the context within the leader speaks. On the opposite side lies *μονοπώλιο-monopoly*, closely connected with *αντίπαλος-opponent*, *εναντίον-against*, *ρήξη-rupture*, denoting this collision. Words *καπιταλισμός-capitalism*, *κέρδος-profit*, *εξουσία-authority*, *EE-EU*, *NATO* and *συμφέρον-interest* are also connected with *μονοπώλιο-monopoly*. The solution proposed is *αποδέσμευση-release* from monopolies and their *κοινωνικοποίηση-socialization*. Word *μνημόνιο-memorandum* pairs with *άδικος-unjust*, *EE-EU*, *δεσμός-bound*, *συνθήκη Μάαστριχτ-Maastricht*, *ΝΔ-ND*, *ΣΥΡΙΖΑ-SYRIZA*, *Τσίπρας-Tsipras* in an effort to show that the EU and all the rest of the parties are in favor of the memorandum. Finally, word *ανάπτυξη-development* pairs with *καπιταλιστικός-capitalistic* και *ΝΔ-ND*.

In KaN, the most prominent word is *επιχείρηση-business*, (meaning SME). Adjacent nodes deals with taxation, the need to return those migrated, the issue of settlements. Word *τουρίστας-tourist* is in a high position, and connecting words have to do with lower taxation. Important position has the word *αγρότης-farmer*, for whom the adjacent nodes deal with taxation in oil, subsidies, costs and selling of products, deception from Mr. Samaras. Word *φορολογία-taxation* is combined with *Σαμαράς-Samaras*, *αντίπαλος-opponent*, *βαρύς-heavy*, but also with words *μείωση-reduction*, *μειώνω-reduce*, *επιχείρηση-business*, *γειτονικός-neighbor*, meaning the neighboring countries and the need to equalize taxation.

Topology and scale-free testing

In Table 7 we show the basic topological features of all networks. All calculations were done using NodeXl and Gephi.

Table 7: Basic topology

Metric	TsN	SaN	KoN	KaN
Number of Nodes	3482	3831	2350	1561
Number of Links	14407	20903	8184	5086
Density (undirected)	0.0023	0.0028	0.03	0.004
Average degree	8.27	10.9	6.9	6.51
Average distance	3.44	3.22	3.5	3.4
Diameter	11	9	9	13
Average eccentricity	7.45	6.02	6.78	7.22
Average clustering coefficient	0.14	0.18	0.13	0.15

It is easy to see that all networks have similar metrics (apart from KoN which is rather denser). Some local differences (i.e. in the average degree which is too large in SaN), can be explained by the different way those leaders are expressing their ideas. Larger values in diameter also might correspond to "loose" usage of language (especially in KaN). Differences in the volume (between TsN, SaN in contrast to KoN and KaN), are due to the absolute number of speeches that were uploaded in the website of the parties.

However, from the average distance and the small diameter and clustering coefficient, it seems that all networks fall in the small world category. In order to check the power-law property of the comparing networks and to verify the small world property, we calculated and checked each distribution's fitness to power law using the R statistical package (R Core Team, 2013). Results are shown in Figure 7, which shows the degree distributions of the examined networks, together with the computed alpha coefficient. In all cases, x_{min} value was set to 10 in order to avoid including heavy heads in the distributions and the alpha parameter's computations.

TsN, alpha=2.27   SaN, alpha=2.04

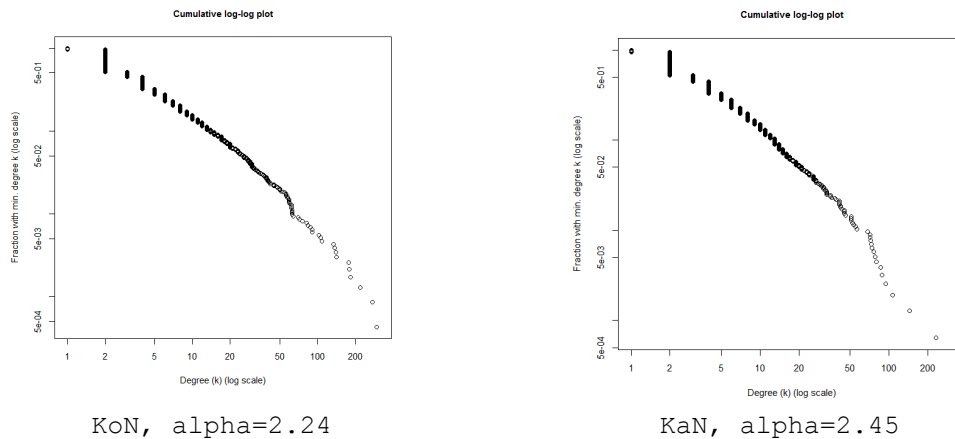KoN, alpha=2.24   KaN, alpha=2.45
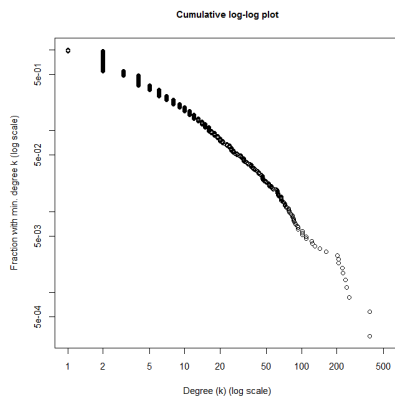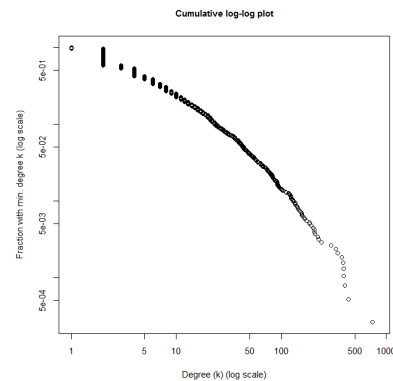
Figure 7: Degree distributions in cumulative log-log scale.

From a simple inspection of the cumulative log-log plots in Figure 7, together with the relevant computed alpha parameters (which in power-law networks must lie between 2 and 3), it is obvious that all these networks belong to the well-known scale-free category (with a small question-mark for SaN). It seems that when preparing their speeches, leaders select some words that will serve as hubs and build the rest of their speech on these words-ideas. These networks are robust and quite tolerant in node-removal, until a number of hubs is removed which will lead to a total breakdown in isolated chunks of nodes. Hubs are usually the most important words regarding their degree centrality, so it is easy to locate hub-words by just sorting nodes according to this metric.

It is very interesting to note that not all networks belong to the scale-free category, especially when we talk about a class of discourse. In Kydros and Anastasiadis (2015) it was found that epic works like *the Iliad* or even *The Great Eastern* are scale-free networks with respect to the actor's interactions. It seems that this quality can hold in various levels, from interactions of actors to interactions of words within the text.

Conclusions and further research

In this paper we proposed a model that can be used to analyze political discourse. We collected real data from the pre-electoral period of the 25th of January 2015 in Greece, and after extensive preprocessing we created networks of adjacent words. These networks were analyzed in the micro and macro level, by computing communities, locating important words, especially regarding economy, and computing topology and degree distributions.

In our view, this model can be successfully used to provide a researcher with important insights regarding political theses. In the micro level individual nodes-words can be ranked regarding their importance in order to be compared with other nodes. The local vicinity may reveal more general ideas and, perhaps, hidden context that is not outspoken clearly. Grouping helps here, since communities of words can reveal general attitudes on different issues. Finally, topology and scale-free testing can be used to assess the 'quality' of the speeches' structure, together with possible points of weakness

(hubs). This model could be used in political science, macroeconomics, and journalism or even by politicians or simple citizens who seek to prepare concrete theses or investigate politicians' speeches in the structural but also in the semantics context.

On further research, a number of different threads emanate from this paper. The same model can be used longitudinally, in order to compare the same politicians' speeches (and henceforth theses). Actually, at this time a similar study is being prepared regarding the latest September 20th, 2015 elections in Greece. More analysis can be introduced in the link level. All networks in this paper did not take into account the number of links between two nodes. More links may have a more significant meaning. Furthermore, if we treat networks as directed, then different results (especially in the local level) may be produced. Finally, such networks can also be investigated in the motif context, in the sense that there may be different motifs (types of subgraphs) that prevail in different leaders' speeches. This might lead to produce 'winning strategies', if confirmed, at least in the preparation of political discourse.

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