Mapping Community Structures by Health Exclusion, Poverty and Unemployment

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Abstract

Social exclusion, emphasized in European Social Agenda, presents an interesting case study on the discussion of universal vs. means-tested social policies. To understand the conditions under which universal policies may have an advantage over means-tested policies, we propose a novel method by mapping the relationship between social exclusion, unemployment and poverty in which households were represented as a community by their common background characteristics. Using data from three countries, our results show that households are less likely to form communities by poverty and health care exclusion profiles, compared to the community structures formed by poverty and unemployment characteristics. The results suggest that in cases where identifying beneficiaries is difficult, illustrated by weak community structures, universal coverage policies offer an advantage over means-tested social policies.

Keywords: Exclusion, Poverty, Unemployment, Clustering, Network Mapping, Community Structure

1. Introduction

Whether social policy should be designed by the principles of universal coverage or by means-tested programs has been subject to considerable debate both in developed and developing countries. In recent decades, means-tested policies are actively promoted with the expectation that focusing only on the poor will entail efficient use of limited resources. While the proposal may have its merits, the efficiency aspects require careful deliberation when beneficiaries are not easily identifiable or the program area is marred with structural constraints, such as lack of service provision.

Social exclusion, emphasized especially in European Social Agenda, presents an interesting case study for the discussions on universal vs. means-tested social policies. While its definitions are abound¹, in a simple operational definition social exclusion highlights the conditions under which individuals and subpopulations, confronted with multi-faceted barriers, are unable to access to and/or afford the resources and opportunities available to other members of the society. To understand the extent and the depth of social exclusion, the EU proposes using social statistics, summarized by the well-known list of Laeken indicators. Composed of three overarching portfolios, Laeken indicators on the one hand push for convergence of social policies across member and candidate countries; on the other hand allow for flexibility reflecting country specific conditions.

¹ See for instance Silver, H. and S.M. Miller (2003) "Social Exclusion", Indicators, vol. 2, Spring, pp. 5-21.

A careful examination of Laeken indicators illustrates how poverty, unemployment and social exclusion have been conceptualized as overlapping policy areas. Out of 13 of the primary Laeken indicators², eight indicators are about measuring poverty, of the remaining five, three indicators measure unemployment. The expectation that poverty is closely correlated with social exclusion supports the implementation of targeted anti-poverty policies to alleviate social exclusion. That said however, evidence has shown not all poor households are socially excluded, nor all socially excluded belong to poor households.³

2. Methodology

We propose a novel method by mapping the relationship between social exclusion, unemployment and poverty in which households form a network, or a community, by their common background characteristics.⁴ Observing the distance between households by these characteristics, the community structure approach exposes the patterns of the connections between households and visually depicts the communities formed by households sharing similar background.⁵

In our model, households are considered as "nodes" having three main background characteristics: expenditure level, proportion of persons denied access to health services and proportion of unemployed persons in the household. Each household can be conceptualized belonging to a community with links to other households, represented with a distance metric.⁶ The more similar are the attributes of the two households; the shorter is the distance between them. For instance, the distance from Household A to itself is 0, by the virtue of perfect similarity to itself. For two households with different backgrounds, the distance increases, with the upper limit being 1.4, indicating no common characteristics between two households. Once the distance matrix from each household to all other sampled households is calculated, households within the shortest distance from each other are grouped together, i.e., clustered. *We do not assert that communities represent real social groupings*; for our purposes, a community is a group of households which share similar background characteristics.

Our primary aim is to show how mapping households within a community structure by their common characteristics helps in discussions on universal vis-à-vis means-tested social policies. Consider a simple scenario in which households are clustered and mapped by their expenditure level and their experience of health care exclusion. If the community network analysis shows households with varying different expenditure levels are clustered, then the analysis infers that denied access to health care is independent of the expenditure levels. In this case, exclusion in health care system has a pervasive nature, indicating a need for universal health care policies. On the other hand, provided that clustered

² http://ec.europa.eu/employment_social/spsi/common_indicators_en.htm

³ See for instance Adato, M., M.R. Carter and J. May (2006) "Exploring poverty traps and social exclusion in South Africa using qualitative and quantitative data", Journal of Development Studies, 42(2), pp. 226 – 247

⁴ Girvan, M. and M.E.J. Newman (2002) "Community Structure in social and biological networks" PNAS 99(12), pp. 7821 – 7826

⁵ Newman, M.E.J. and M. Girvan (2004) "Finding and evaluating community structure in networks", Physical Review, 69, 026113.

⁶ In the Appendix we describe how the distance metric between households is calculated.

households show strong links by their expenditure level and health exclusion, then a policy removing barriers for the poor may have an efficiency advantage.

The graphics below depicts how clustering and community structure mapping is achieved using expenditure and health exclusion as two background characteristics of households, while using household expenditure quintiles to mark the household's placement in expenditure distribution.



Figure 1: Clustering households by expenditure levels and health care exclusion

The point that needs to be emphasized is that the mapping approach does not tell us whether the level of exclusion or level of unemployment faced by the clusters is high or low. The mapping analysis simply depicts how similar the households are by their common characteristics. In fact, this feature of clustering analysis is precisely the reason why the visual exploration of community structures is helpful in consideration of universal vs. means-tested social policies. Compared to a means-tested program, a universal social policy has more potential to be effective in cases where communities formed by expenditure levels and exclusion are weakly linked. A means-tested program, on the other hand, is likely to be more efficient when household clusters show strong connections between the background characteristics.

3. Data Source

We use 2004 Roma Vulnerability Survey, conducted by UNDP Bratislava Regional Center, to test the validity of the model for understanding the relationship between poverty, social exclusion and unemployment. The background characteristics of the households derived from the questionnaire are:

- a. Equivalized household expenditure level (in Euro),
- b. Exclusion from health services: weighted aggregation of persons in the households who did not consult a doctor even though suffered an illness, of people who are denied health service lacking proper documentation and people who stayed separate from other patients at the hospital, and

c. Unemployment: percent unemployed adults in each household.⁷

After discarding the missing observations, we had 7659 households living in the following nine countries with number of households provided in parenthesis: Albania (899), Bulgaria (935), Bosnia and Herzegovina (1171), Croatia (593), Macedonia (724), Serbia (1055), Montenegro (444), Romania (1146), and Kosovo (702). For brevity, here we will present only the results for three countries: Bosnia and Herzegovina, Macedonia and Romania. In what follows, in addition to clustering analysis, we will briefly discuss the means and averages of these variables to shed light how countries with similar averages may in fact present different community structures by exclusion, poverty and unemployment profiles.

4. Results

Before proceeding further, let us recapitulate: In the proposed community structure mapping methodology, for each household we take into account three background characteristics representing poverty, social exclusion and unemployment: household expenditures, proportion of persons denied access to health care and the proportion of unemployed persons, respectively. For each two characteristics (expenditure, health exclusion), (expenditure, proportion of unemployed), we calculate the distance between the households by these characteristics.⁸ Then, similar households, close in distance, are clustered together. We call a clustering of households, each linked to others within a threshold distance, a "community".

We map the clustered, i.e., similar, households together, using the expenditure quintile as a visual aid in understanding community structure. Once clustering is mapped, and the households are differentiated by the quintile levels, the resulting mapping helps us to observe how households in the same quintiles form a community by their expenditure levels, health care exclusion and unemployment, revealing the community structure in the sampled population by these background characteristics.

Country 1: Bosnia and Herzegovina

Poverty and Unemployment: Let's start our analysis with the patterns of network among households by expenditure level and proportion of the unemployed in households. These two characteristics will be closely associated at all quintile levels, undoubtedly, as unemployment is a significant constraint on household expenditure capacity (Figure 2A).

⁷ While measurement of exclusion from health services was relatively straightforward, we had difficulty in identifying precise questions on exclusion from labor market, therefore, selected "unemployed adults in the household" as our background characteristics for indicating labor market exclusion. We acknowledge that unemployment may result from a myriad of causes: low levels of education, discrimination or business cycle in the economy. In the absence of direct measurement however, percent unemployed adults will be the indicator of exclusion from labor markets.

⁸ It is possible to calculate the distance between households on more than two dimensions, or characteristics. For our purposes, distance across two dimensions is adequate as mapping below shows.

For the mapping depicted in Figure 2A, we first calculated the distance matrix from each household to the remaining households in the sample by using expenditure level and proportion of the unemployed in the household as background characteristics. Once the distances within households are calculated, households linked to each other with shortest distances are placed close to each other, showing the patterns of community structure across households. We then identified the expenditure quintile within which each household is placed; green color representing the lowest quintile and blue the top expenditure quintile.

The mapping shows us a persistent and close association, as expected, between expenditure level and percent unemployed adults in the households: households at lowest quintile are more alike, closer to each other by these characteristics, just as households at top quintiles are connected with each other. Yet, the visualization of structure also hints at some households being different than the other households even in the same expenditure quintile, as shown by minor clusters around the grand cluster.

Overall however, the link pattern by expenditure and percentage of unemployed of households in Bosnia and Herzegovina shows "like are close to like" and confirm our expectations that the clustering will show the strong correlation between expenditure and percentage of unemployed adults in households. The visual map shows how poor households form a community structure within themselves, where better-off households are more likely to be connected to each other.

Poverty and Exclusion from Health Services: If clustering shows a robust pattern between expenditure levels and unemployment across households, what can we expect for the pattern between expenditure and exclusion from health services in Bosnia and Herzegovina? The visual map of community structure formed by these characteristics across households is depicted in Figure 2B.

There are two striking observations for the expenditure level and health exclusion in Bosnia and Herzegovina. First, a significant number of poor households are disconnected from households with similar expenditure levels in their experience of health care exclusion and appear as a community by themselves, suggesting a third factor may be at play. This disconnect is visible by the minor clusters and applies not only to households at low expenditure quintiles but also to better-off households. Second, within the grand cluster, the continuity is not as robust as was the case for expenditure and unemployment, some mid-quintile households are similar in exclusion from health services to poorer households, other mid-quintile households are closer in health exclusion to better off households. A visual check of expenditure and health care exclusion therefore hints a weak community structure between these two background characteristics and minor clusters, showing dispersed community structures, around the grand cluster, support this weak correlation.

Country 2: Macedonia

Poverty and Unemployment: Our second case study, Macedonia, presents a different pattern between expenditure levels and share of unemployed adults in the households (Figure 2C). First of all, households in the same expenditure quintile are not grouped closely with one another, but instead are clustered together with households in other expenditure quintiles. For instance, some of the second quintile households are closely linked to higher quintile households whereas other mid-quintile households are

connected to bottom quintile households. Why might this weak community structure for expenditure levels and unemployment happen in Macedonia? One possibility is informal sector; while there may be officially unemployed persons in households, working in the informal sector may augment household expenditure levels, thereby allowing households to form close groupings with households in other expenditure quintiles.

Poverty and Exclusion from health services: Here, the clustering patterns of households by exclusion from health services and expenditure levels present a much more complex pattern, not only compared to poverty – unemployment links across households in Macedonia but also poverty – health exclusion clustering observed in Bosnia and Herzegovina. Exclusion from health services is experienced at all levels of expenditure quintiles: notice how lower level quintile households are clustered together with upper quintile households. In fact, clusters include households from all expenditure quintiles, indicated by variation in colors representing expenditure quintiles within each community structure. This variation in clusters by expenditure quintiles points to how households from all levels of expenditure are connected to each other by their exposure to health care exclusion in the sample (Figure 2D).

Country 3: Romania

Poverty and Unemployment: Our last case study is Romania, and we begin again with a visual mapping of the clustering between expenditure levels and unemployment. Compare to other case studies, sampled population in Romania has more poor households as depicted with the prevalence of bottom quintile households, denoted with green, in the clustering network (Figure 2E).

The visual analysis of the clustering and possible community structure within the sample shows many of these households are very similar to each other by expenditure levels and percent unemployed adults in the households. The low end of the grand cluster is indicative of this pattern, with green colored lowest quintile households forming a community. On the other hand, as expenditure quintile increases above the bottom quintile, the households are less likely to be linked to households with similar expenditure level and unemployment profile. Compared to visual mapping of the community structure by poverty and unemployment in Macedonia, poor households in Romania are more likely to be similar and form a close community, separate from other expenditure quintiles. Furthermore, relatively fewer minor clusters around the grand cluster shows a majority of households are linked to each other with poverty and unemployment characteristics.

Poverty and Exclusion from health services: The patterns of clustering between poverty and exclusion from health services is more concentrated, with lower level of household expenditures forming a community structure, and the continuity across clusters suggests that communities formed by household expenditure levels and exclusion from health services is closely correlated in Romania. Yet, the minor clustering independent of the grand cluster in the mapping is indicative that some of the poor households are somewhat different by their experience in health care exclusion than households in the same expenditure quintile (Figure 2F).

5. Summary Sample Statistics

In this section, we present the sample statistics to highlight the differences across countries included. Average household expenditures indicates Bosnia and Herzegovina having relatively the highest household expenditure level, 251 Euro, followed by Macedonia, 214 Euro, and Romania, 120 Euro. Average number of unemployed persons is highest in Macedonia, 1.6 persons, lowest in Romania and Bosnia and Herzegovina, 1 person per household. The sample statistics for Bosnia and Herzegovina shows, on the average, at least one person reported not visiting a doctor despite an illness in the month previous to the survey. Relatively fewer people reported exclusion from medical services due to lack of proper documentation and average number of persons reported to have stayed apart from other patients in the hospital is 0.13. The average number of unemployed adults in the household is 1.1, with average household size 3.7. In Macedonia, the average number of unemployed adults is around 1.5 persons in each household, average size 4.3 persons. The sample averages for exclusion from health services indicate that people are more likely to be denied health services because of lacking proper documentation. Romania has not only lower average number of unemployed adults in households, but also fewer individuals who experienced exclusion from health care services compared to other countries.

Bosnia and Herzegovina (N=1171)	Mean	Std. Dev
Household Expenditures (Euro)	251.347	183.255
Avg. No reporting Health Exclusion (Doctor)	1.025	1.626
Avg. No reporting Health Exclusion (Medical)	0.466	1.425
Avg. No reporting Health Exclusion (Hospital)	0.132	0.495
Avg. No of Unemployed in a Household	1.101	1.337
Household Size	3.763	2.080
Macedonia (N = 724)	Mean	Std. Dev.
Household Expenditures (Euro)	214.400	137.511
Avg. No reporting Health Exclusion (Doctor)	0.533	1.160
Avg. No reporting Health Exclusion (Medical)	0.698	1.569
Avg. No reporting Health Exclusion (Hospital)	0.235	0.762
Avg. No of Unemployed in a Household	1.564	1.488
Household Size	4.302	2.046
Romania (N = 1146)	Mean	Std. Dev.
Household Expenditures (Euro)	120.881	81.091
Avg. No reporting Health Exclusion (Doctor)	0.790	1.680
Avg. No reporting Health Exclusion (Medical)	0.210	0.950
Avg. No reporting Health Exclusion (Hospital)	0.059	0.446
Avg. No of Unemployed in a Household	0.925	1.467
Household Size	3.821	2.338

Table 1: Sample Statistics

With these sample statistics in the background, overall what does community structure mapping between poverty and unemployment suggest? Let us shortly summarize the clustering observed across countries: in Romania and Bosnia and Herzegovina, households are more likely to represent close community structures by expenditure and unemployment profiles. Considering unemployment is expected to be closely correlated with the household's ability to spend, the observed close community structures is expected. In Macedonia, however, this expected correlation between expenditure and unemployment is weaker, suggesting unemployment is pervasive at all levels of household expenditure.

Considering exclusion from health services, visual mapping depicts that the communities formed by expenditure levels and health care exclusion is weak in all three countries, compared to clustering between expenditure and unemployment. Consider Macedonia, here the clustering is especially weak, suggesting households placed at different expenditure levels may all experience exclusion from health care services. Furthermore, substantial number of minor clusters in Bosnia and Herzegovina suggests that, even within the same expenditure quintiles, not all households experience health care exclusion even though they may be placed in the same expenditure quintile.

This simple clustering analysis reveals first and foremost, in two countries with similar average expenditure levels, households in one country may form communities in different patterns than the ones observed in the other country. Second, the community structure patterns by expenditure and unemployment characteristics are stronger than the communities formed by expenditure and health care exclusion characteristics. In the former, households are more likely to be connected to other households sharing similar background characteristics, whereas in the latter case exclusion from health care is only weakly correlated with expenditure levels, leading to weak community structures, and this holds true for all country case studies. In Macedonia, although not the poorest country, exclusion from health care appears to be widespread at all expenditure levels.

6. Conclusion

Using a simple community structure mapping method, our aim is to approach the discussions on universal vs. means-tested policies by asking the following questions: If poverty, social exclusion and unemployment are related, how do we understand how closely linked the households are by these background characteristics? Can we detect a "community structure" helpful in identifying potential beneficiaries? If households with similar backgrounds do not form a community, what does this suggest for social policy?

The clustering analysis mapping community structures offers an innovative angle for designing social policy by the principles of universal coverage or with means-tested policies. We use exclusion from health care, poverty and unemployment as the background characteristics of households and assess the extent to which a community structure is formed by clustering households similar to each other. Our analysis shows that in two of the three countries investigated, households with similar unemployment profiles are closely linked to each other at similar expenditure levels, suggesting means-testing policies for employment creation may use resources efficiently. The clustering analysis of exclusion from health care and expenditure levels however suggests that universal policies are likely to be more effective compared to means-tested programs, as weak community structures make identification of beneficiaries difficult. This conclusion applies in particular to Macedonia, where denied access to health care is prevalent at all expenditure levels. Note also how even though the sample averages show

Romania as the poorest country, exclusion from health care is not as widespread at different expenditure levels as observed in Macedonia.

Although employing a community network analysis to map the interaction between social exclusion, unemployment and poverty is innovative for understanding community structures in the society, our approach can be improved with further calibrations. By increasing the number of background characteristics of households, it is possible to cluster the households at a more detailed level. An alternative for visualization of community structures is spatial distribution or by ascribed characteristics of household heads, thereby helping us to assess how households form communities by socio-demographic or geographical categories. All caveats notwithstanding, mapping households with similar background characteristics reveals how communities formed with weak ties may undermine the meanstested social policies, illustrating the efficiency aspect of universal policies.



Figure 2: Community Structures by Poverty, Health Exclusion and Unemployment

Appendix

The distances between the households were calculated simply considering the Euclidian distance.

$$d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

The distance is calculated for all households in the dataset for each two measures: (Household Expenditure Level, Health Exclusion), (Household Expenditure Level, Unemployment) to understand how similar are two households with respect to their expenditure level and exclusion levels and the threat level. Normalization is performed by (i) higher the value for income, better off the position of the household (ii) higher the value of exclusion index (normalized), the less is the exclusion.

Household	Expenditure Level	Health Exclusion	Unemployment
HH ₁	E ₁	$H_1 = [(a_1 + a_2 + a_3) / N \text{ per } HH_1]_1$	$L_1 = [NoUnemployed/ N per HH_1]_1$
HH ₂	E ₂	$H_2 = [(a_1 + a_2 + a_3) / N \text{ per } HH_2]_2$	$L_2 = [NoUnemployed/N per HH_2]_2$
HH ₃	E ₃	$H_3 = [(a_1 + a_2 + a_3) / N \text{ per } HH_3]_3$	$L_3 = [NoUnemployed/N per HH_3]_3$

$$\begin{array}{c|cccc} HH_1 & HH2 & HH3 \\ \hline HH_1 & d_{11} = 0 & d_{12} & d_{13} \\ HH_2 & d_{21} & d_{22} = 0 & d_{23} \\ HH_3 & d_{31} & d_{32} & d_{33} = 0 \end{array}$$

Where, $d_{12} = d_{21} = \sqrt{|E_1 - E_2|^2 + |H_1 - H_2|^2}$ is the distance for expenditure level – health exclusion parameters.