Aalto University

# Domestic Migration Networks

Progress reports

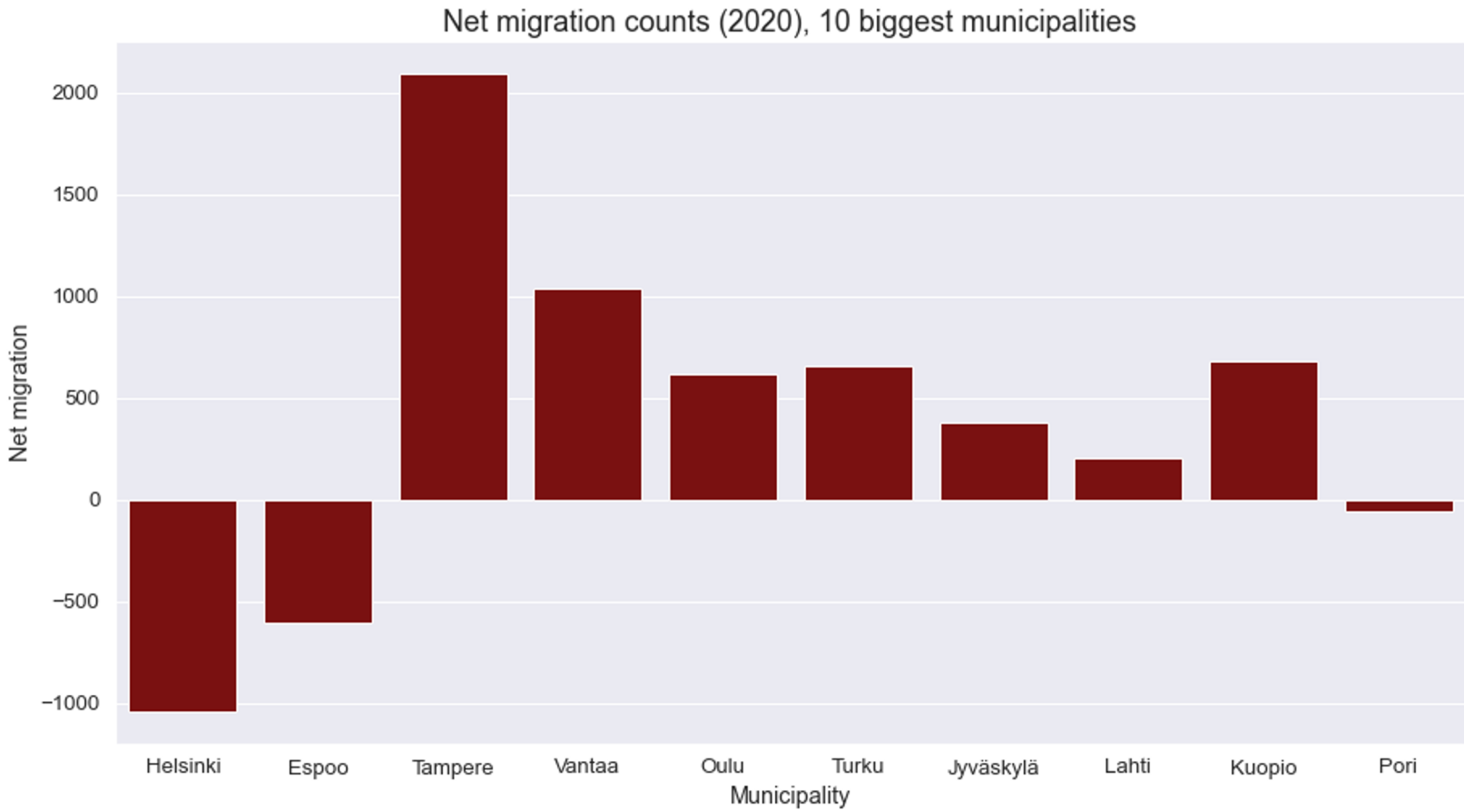
# Meeting dates

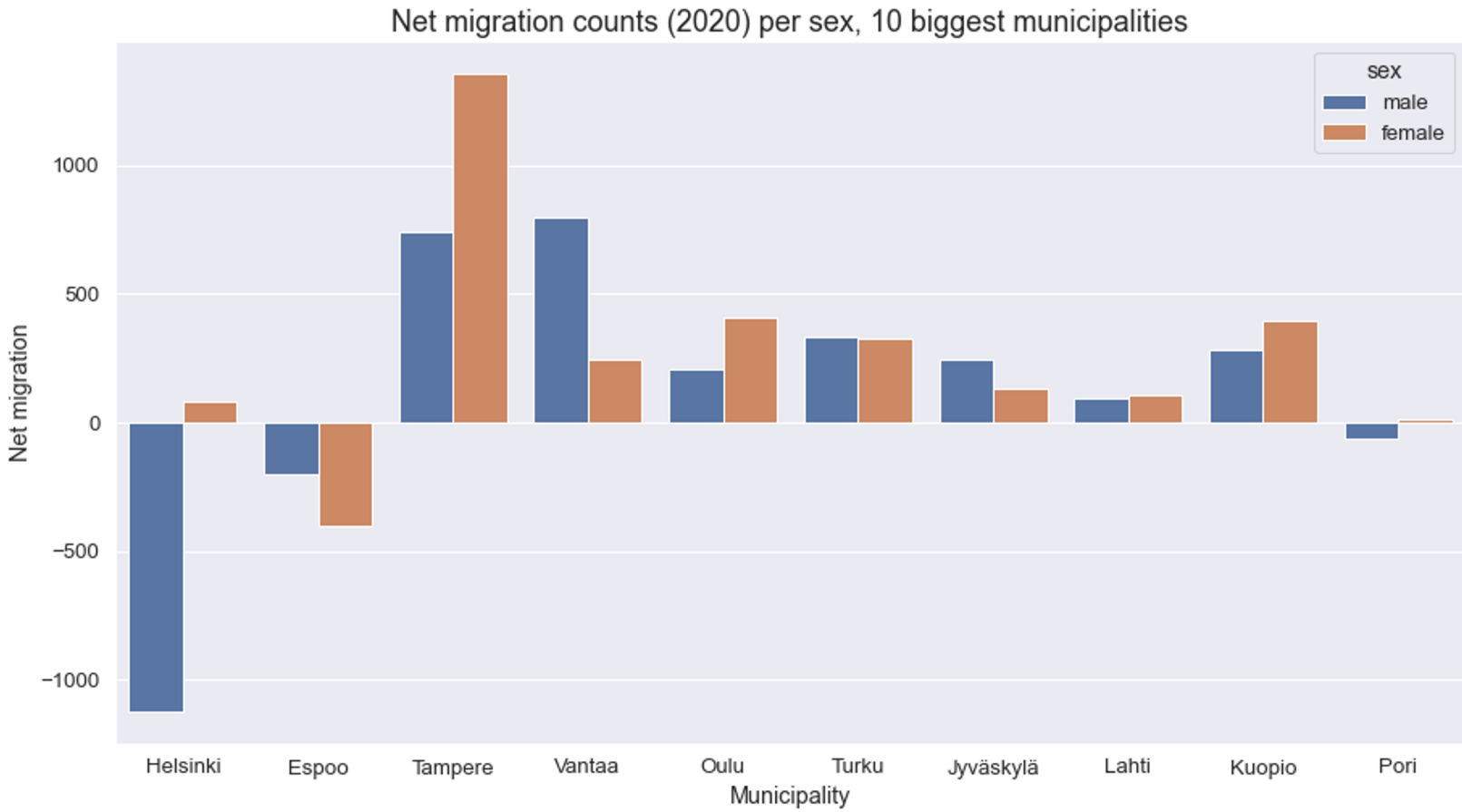
1. 25.3.2022
2. 08.04.2022

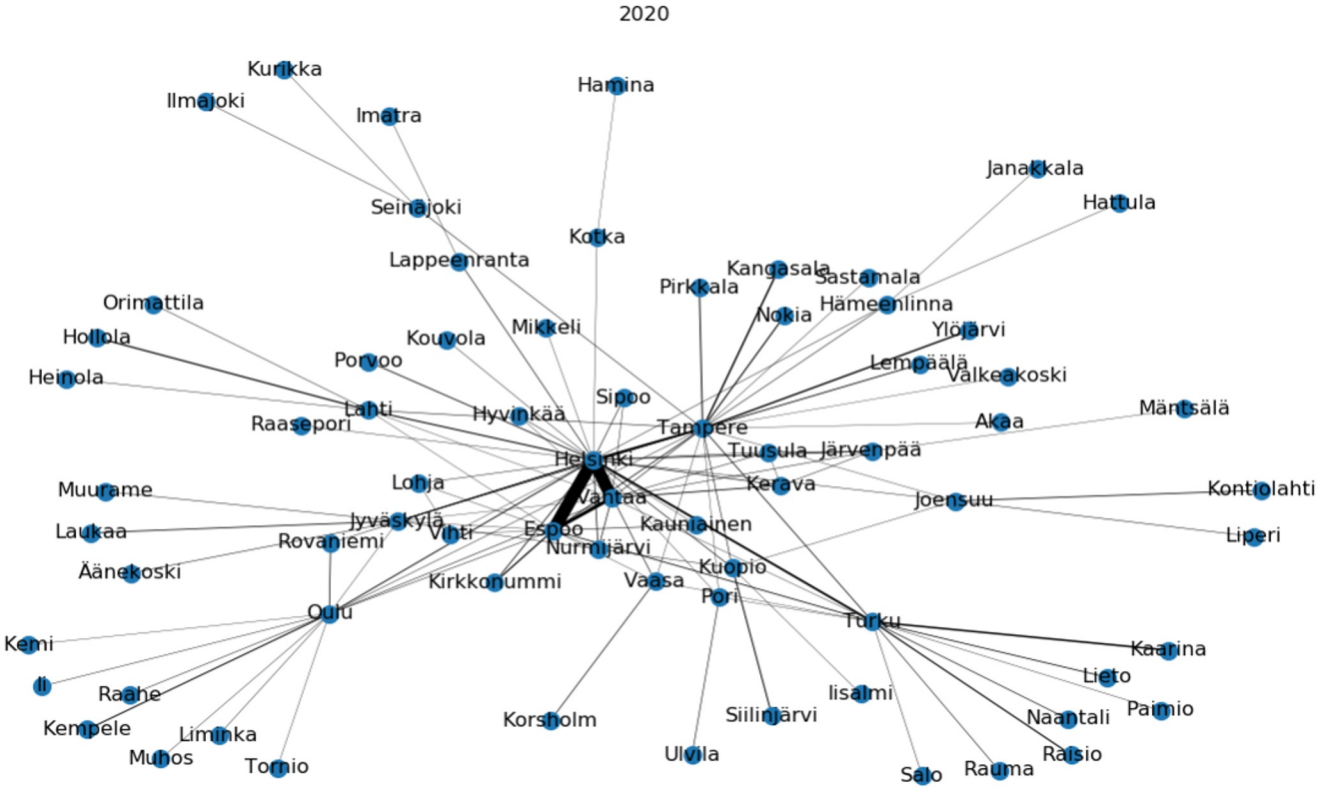
# Research Questions

- **Mitkä vaikutukset demografisilla tekijöillä on Suomen kuntien muuttoliikenteeseen?**
- **What demographic factors affect domestic migration in Finland?**
- **Miten muuttoliikenne on muuttunut vuosien 1990 ja 2020 välillä?**
- **How has domestic migration in Finland developed between 1990 and 2020?**

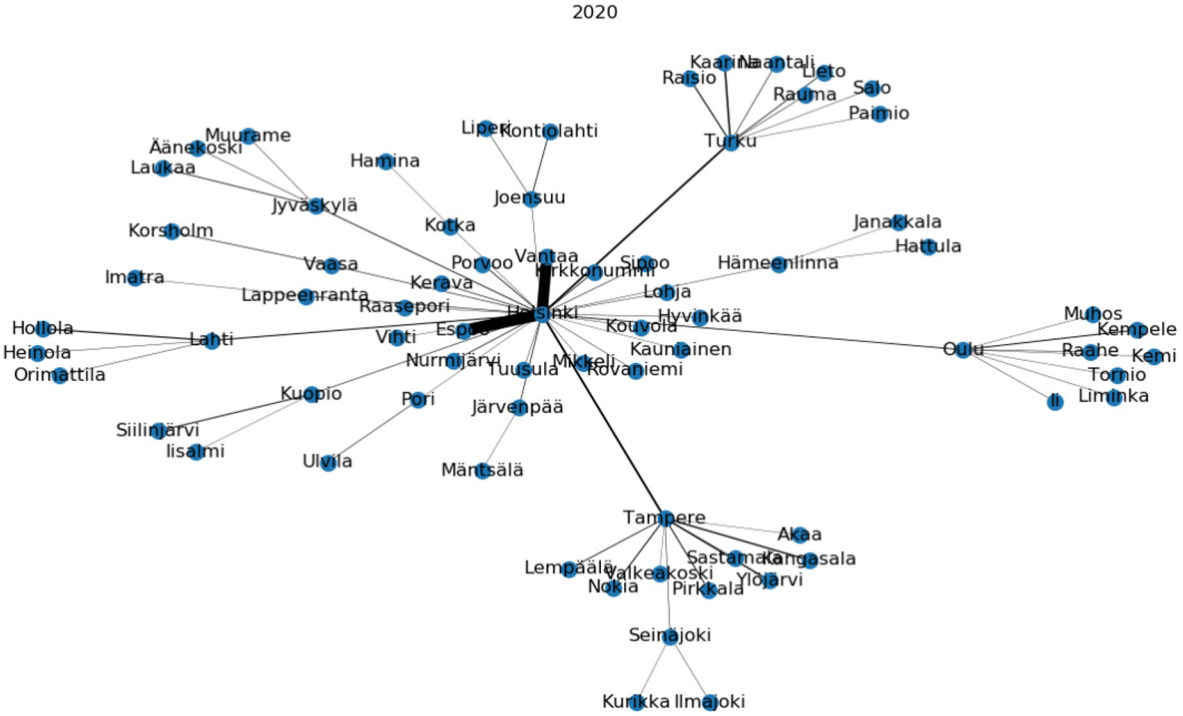
# Friday 25.3.2022


Net migration counts (2020), 10 biggest municipalities
Net migration
2000
1500
1000
500
0
−500
−1000
Helsinki
Espoo
Tampere
Vantaa
Oulu
Turku
Jyväskylä
Lahti
Kuopio
Pori
Municipality

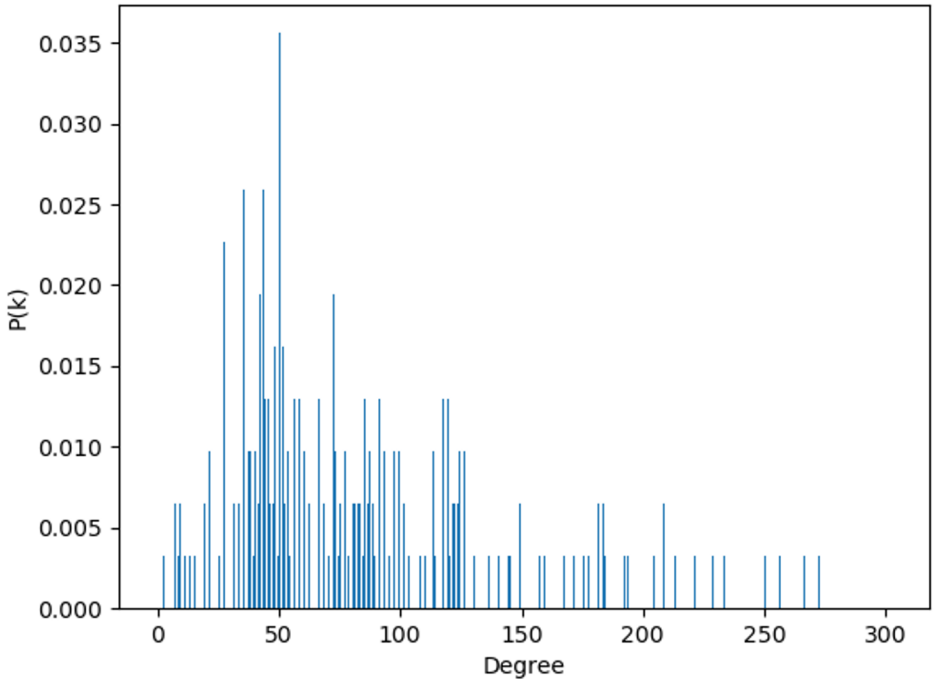

Net migration counts (2020) per sex, 10 biggest municipalities
sex
male
female
1000
500
0
−500
−1000
Net migration
Helsinki
Espoo
Tampere
Vantaa
Oulu
Turku
Jyväskylä
Lahti
Kuopio
Pori
Municipality


2020
Kurikka
Ilmajoki
Imatra
Hamina
Janakkala
Hattula
Seinäjoki
Kotka
Lappeenranta
Kangasala
Pirkkala
Sastamala
Hämeenlinna
Orimattila
Nokia
Mikkeli
Ylöjärvi
Hollola
Kouvola
Porvoo
Lempäälä
Heinola
Valkeakoski
Sipoo
Lahti
Hyvinkää
Mäntsälä
Raasepori
Tampere
Akaa
Tuusula
Järvenpää
Helsinki
Muurame
Lohja
Kerava
Kontiolahti
Vantaa
Joensuu
Laukaa
Jyväskylä
Vihti
Espoo
Kauniainen
Liperi
Rovaniemi
Nurmijärvi
Äänekoski
Kuopio
Kirkkonummi
Vaasa
Pori
Oulu
Turku
Kemi
Kaarina
Lieto
Ii
Raahe
Iisalmi
Siilinjärvi
Paimio
Kemijärvi
Korsholm
Limingka
Naantali
Muhos
Ulvila
Raisio
Tornio
Salo
Rauma

# Maximum spanning tree

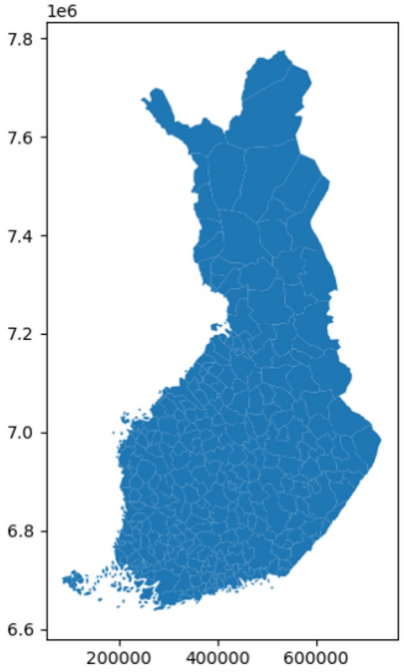


# Degree distribution



# Municipalities map visualization

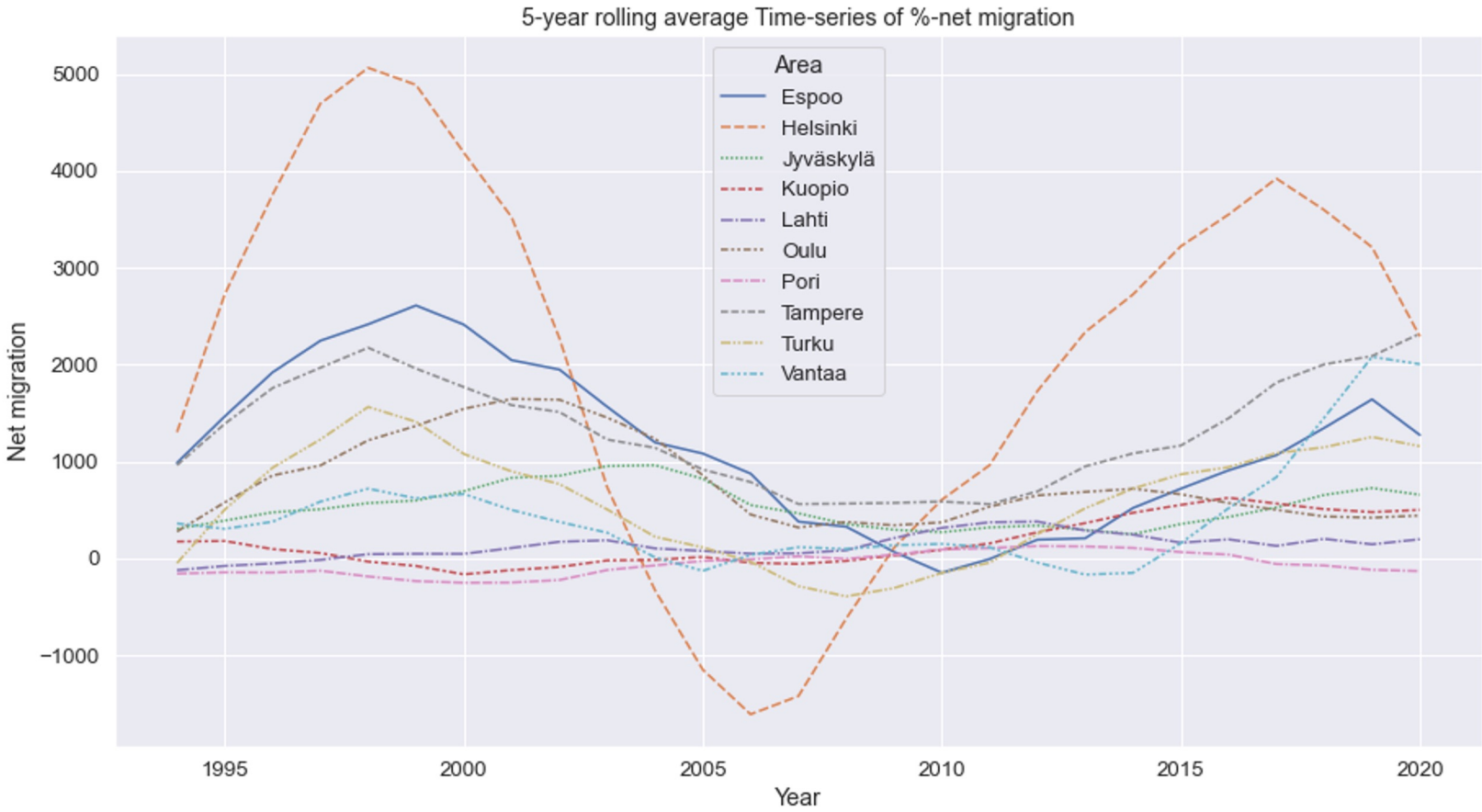
**GeoPandas plotting of .shp datafile**

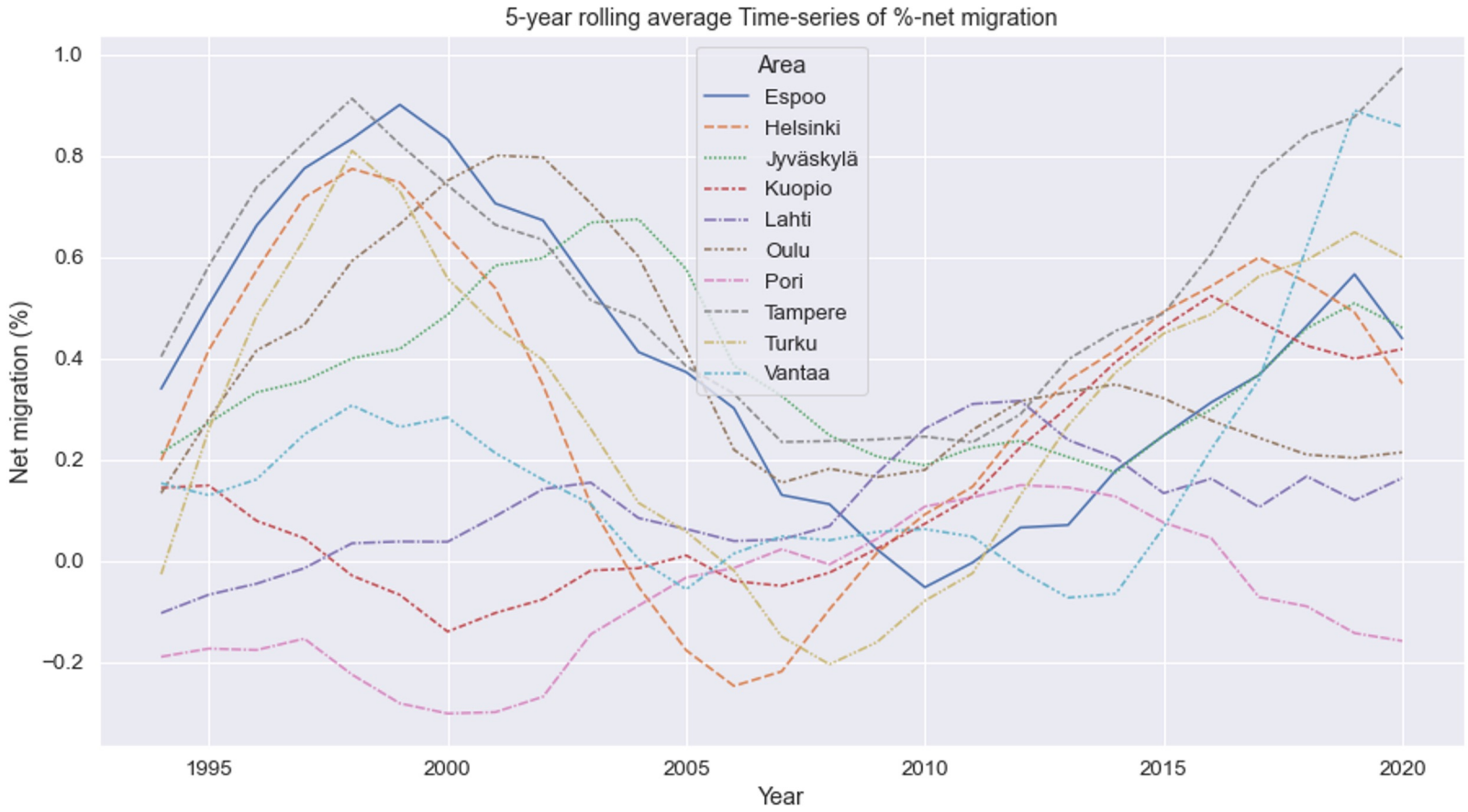


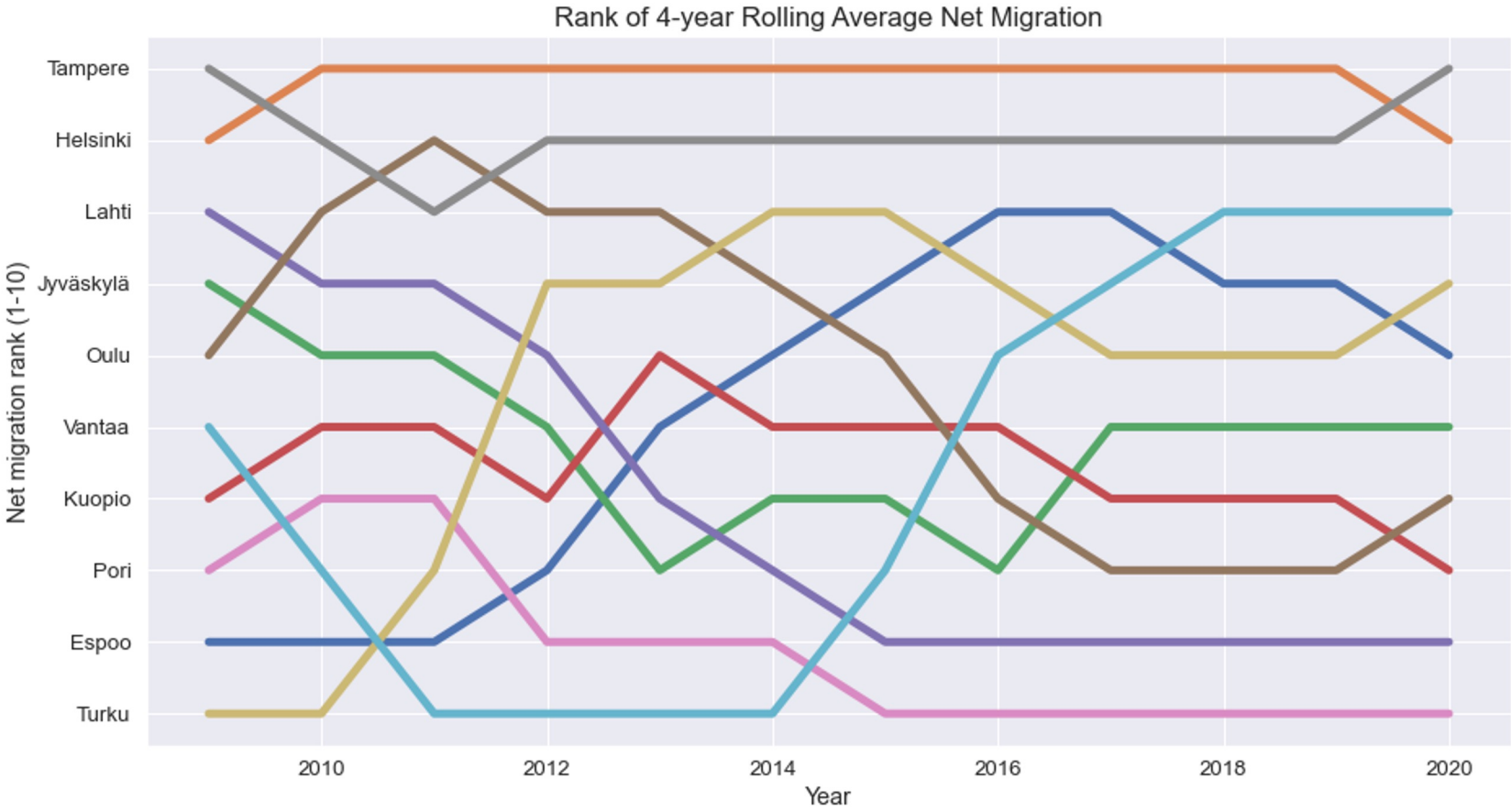
# What next?

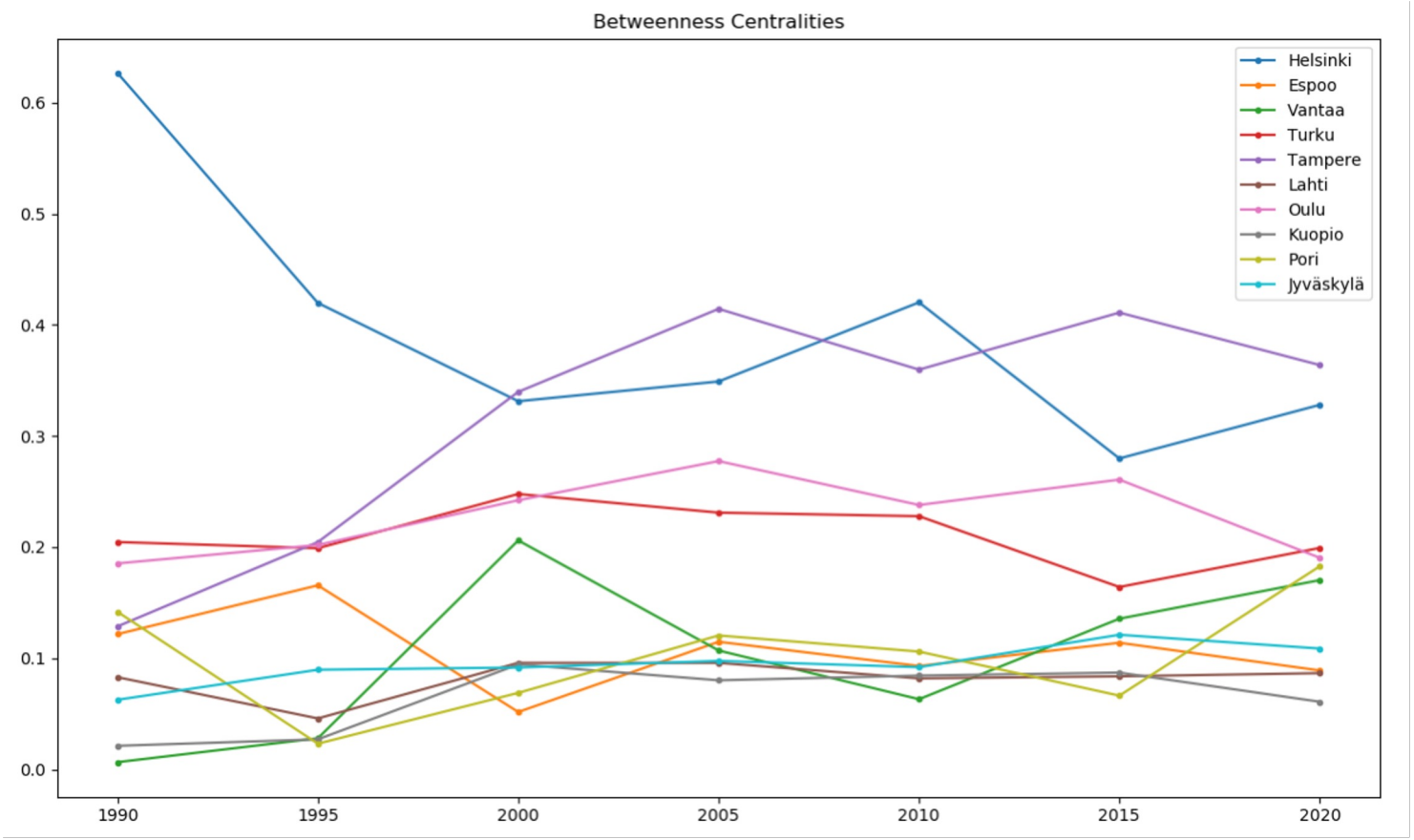
- **GeoPandas**
- **Visualize network on the Finnish map**
  - **Combine network and GIS data**
- **Time-series investigation**
- **More demographic features?**
- log of migration counts?
- mobility signature (check the paper)
- More network features (centralities → easy to do with networkx)
  - check how these have changed over the year
  - might also be useful to use as thresholds??

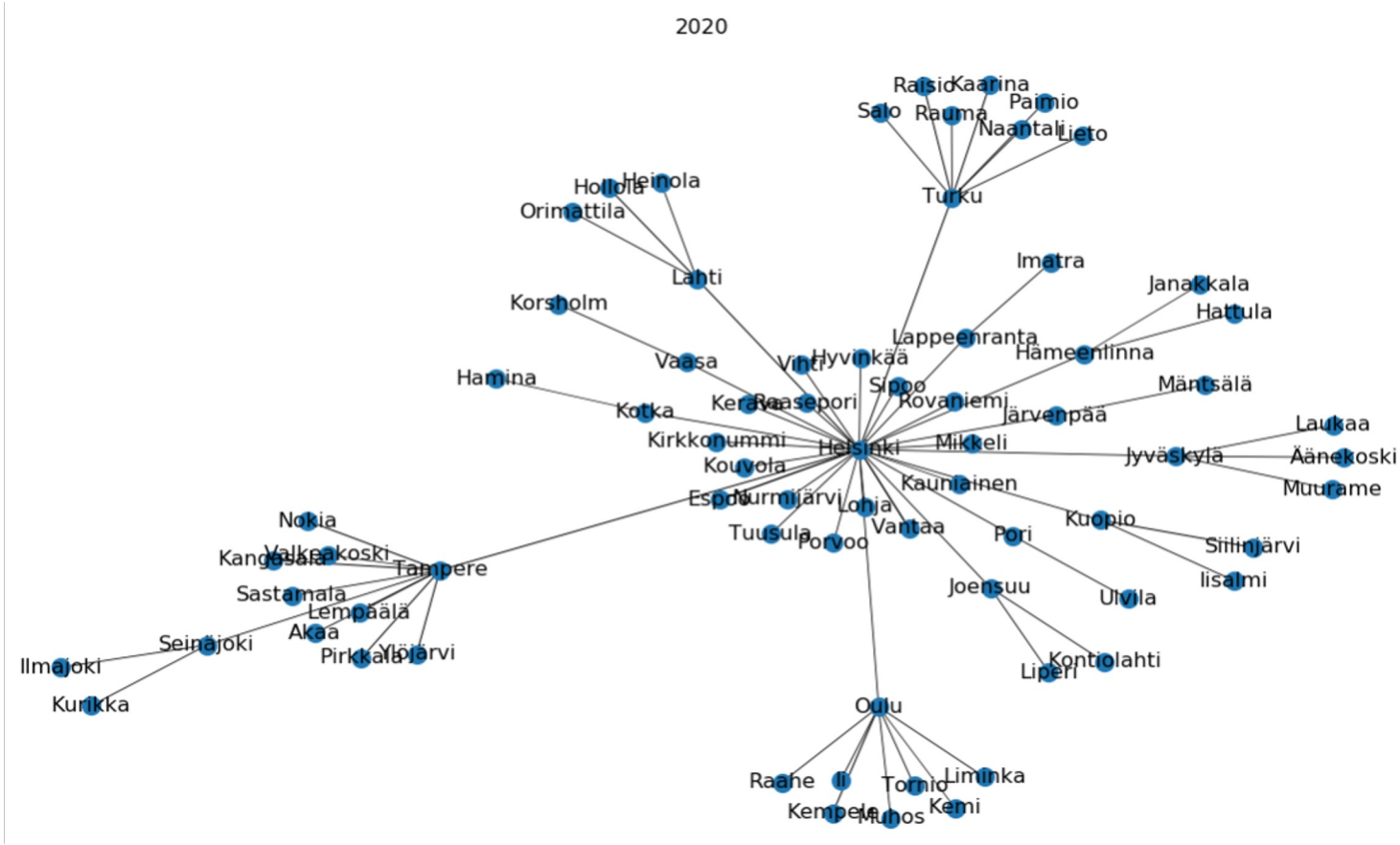
# Friday 08.04.2022


5-year rolling average Time-series of %-net migration
Area
Espoo
Helsinki
Jyväskylä
Kuopio
Lahti
Oulu
Pori
Tampere
Turku
Vantaa
Net migration
5000
4000
3000
2000
1000
0
−1000
1995
2000
2005
2010
2015
2020
Year


5-year rolling average Time-series of %-net migration
Net migration (%)
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
1995
2000
2005
2010
2015
2020
Year
Area
Espoo
Helsinki
Jyväskylä
Kuopio
Lahti
Oulu
Pori
Tampere
Turku
Vantaa

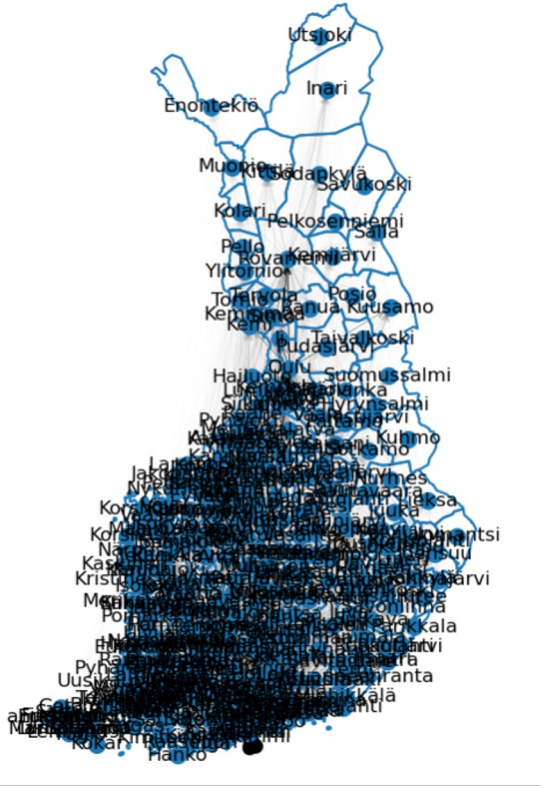

Rank of 4-year Rolling Average Net Migration
Tampere
Helsinki
Lahti
Jyväskylä
Oulu
Vantaa
Kuopio
Pori
Espoo
Turku
Net migration rank (1-10)
2010
2012
2014
2016
2018
2020
Year

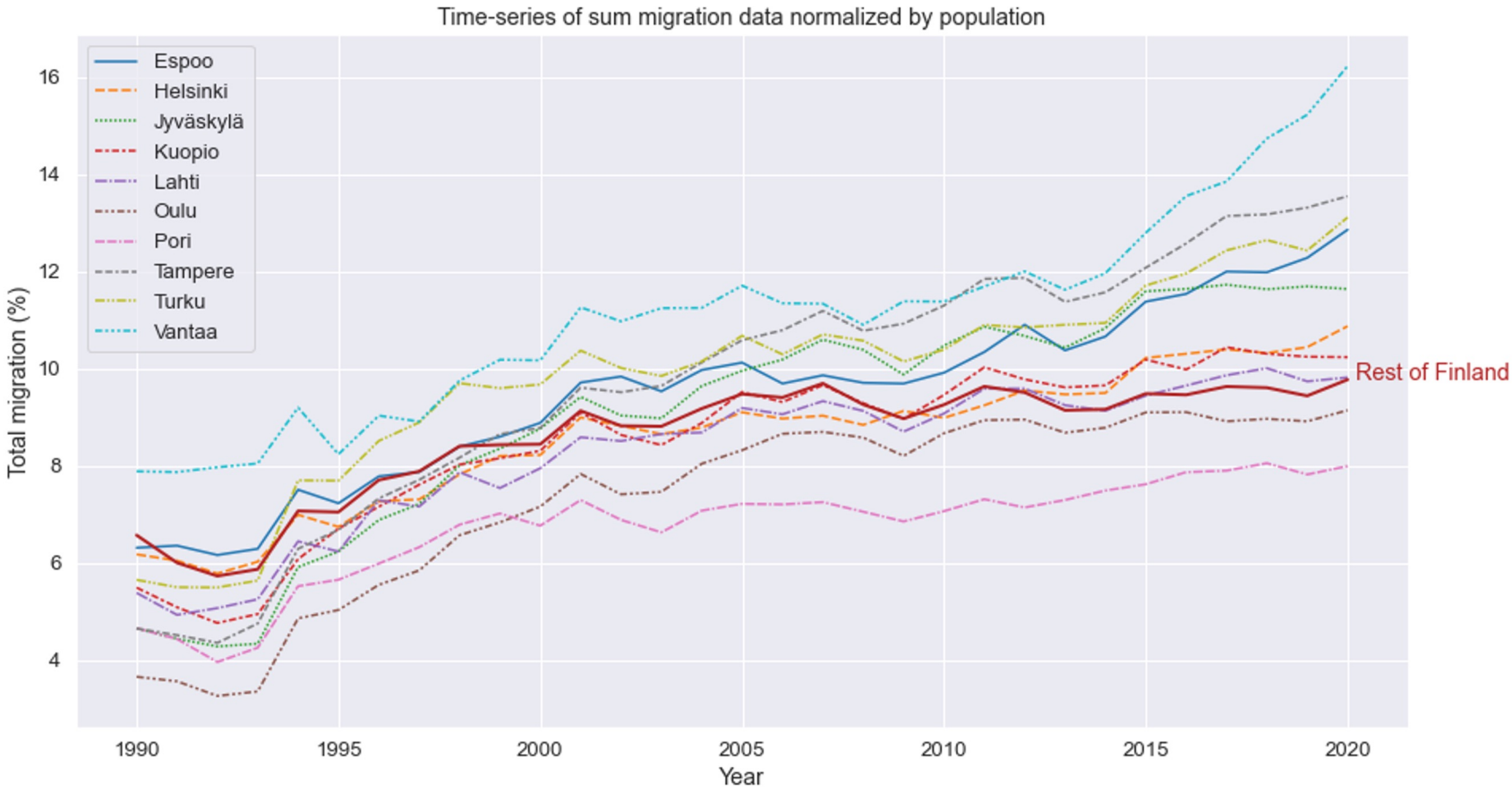

Betweenness Centralities
Helsinki
Espoo
Vantaa
Turku
Tampere
Lahti
Oulu
Kuopio
Pori
Jyväskylä
0.0
0.1
0.2
0.3
0.4
0.5
0.6
1990
1995
2000
2005
2010
2015
2020

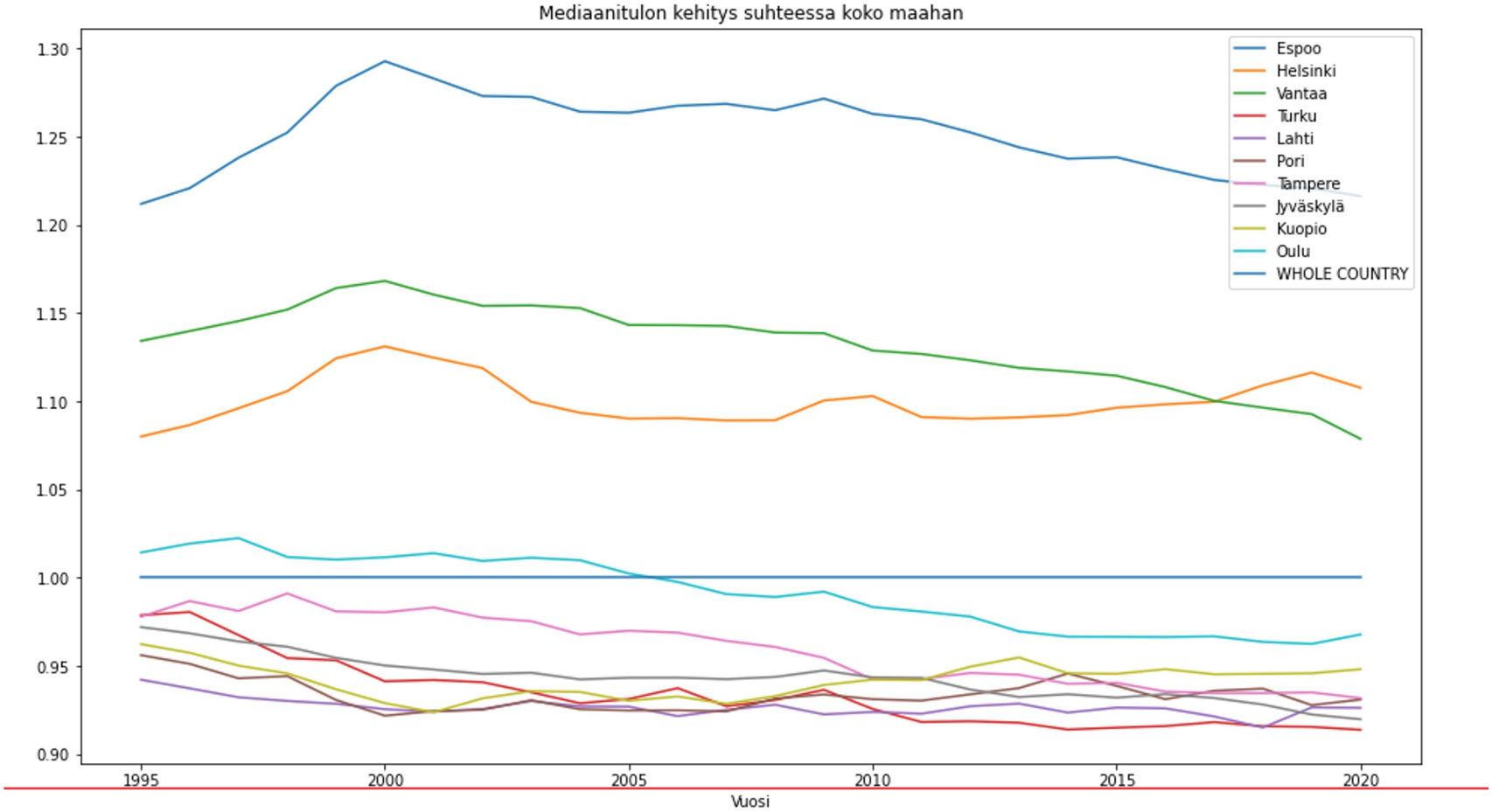

2020
Raisio
Kaarina
Salo
Rauma
Paimio
Naantali
Lieto
Turku
Hollola
Heinola
Orimattila
Lahti
Imatra
Janakkala
Hattula
Korsholm
Lappeenranta
Hämeenlinna
Vaasa
Vihti
Hyvinkää
Hamina
Kotka
Kerava
Raasepori
Sipoo
Rovaniemi
Mäntsälä
Järvenpää
Kirkkonummi
Helsinki
Mikkeli
Laukaa
Jyväskylä
Äänekoski
Kouvola
Muurame
Espoo
Kauniainen
Nurmijärvi
Lohja
Kuopio
Tuusula
Vantaa
Pori
Porvoo
Siilinjärvi
Nokia
Iisalmi
Kangasala
Valkeakoski
Tampere
Joensuu
Ulvila
Sastamala
Lempäälä
Akaa
Seinäjoki
Ylöjärvi
Pirkkala
Ilmajoki
Kontiolahti
Liperi
Kurikka
Oulu
Raahe
Ii
Tornio
Liminka
Kempele
Muhos
Kemi

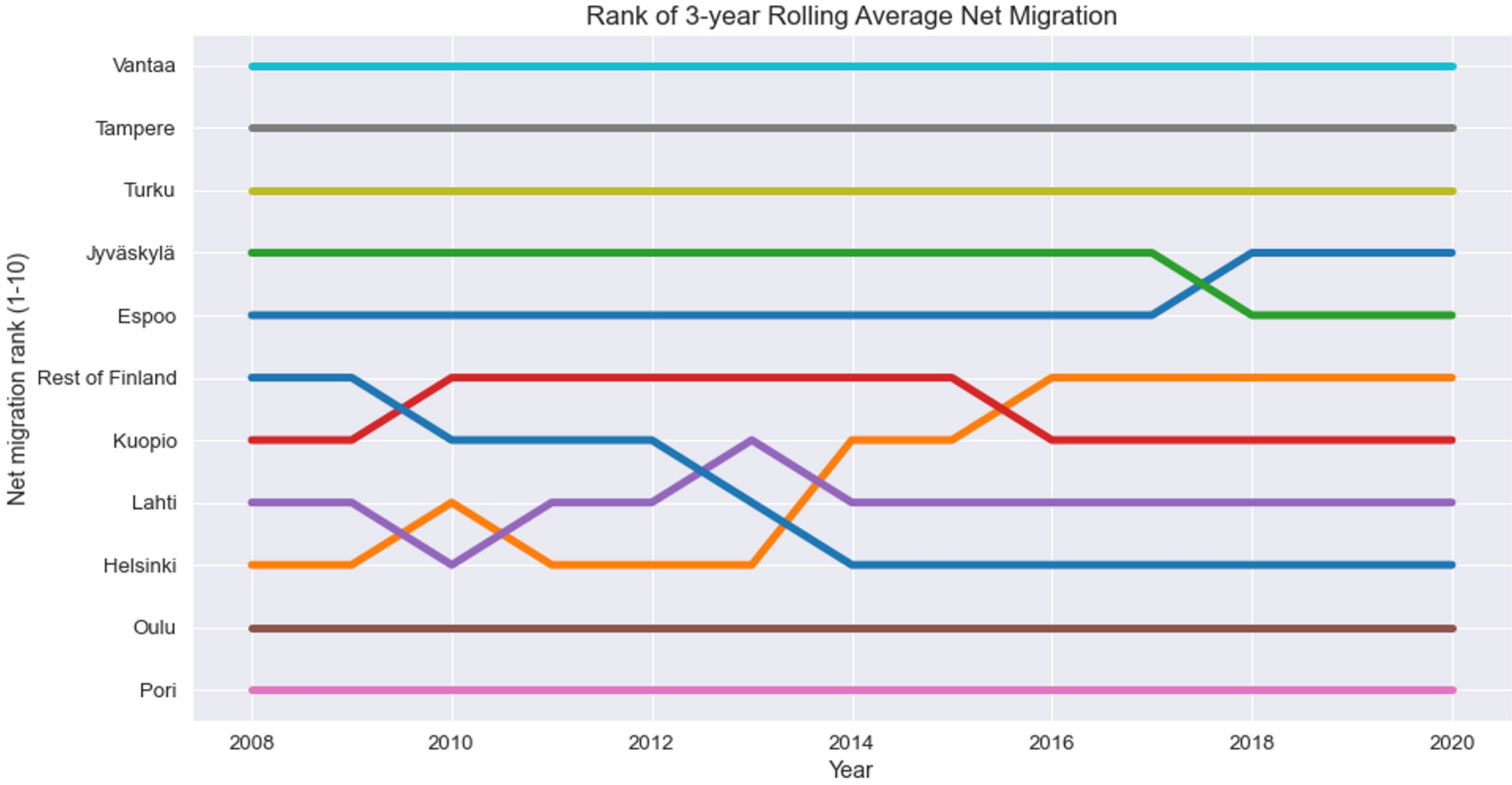
# Visualization of migration networks on the map of Finland

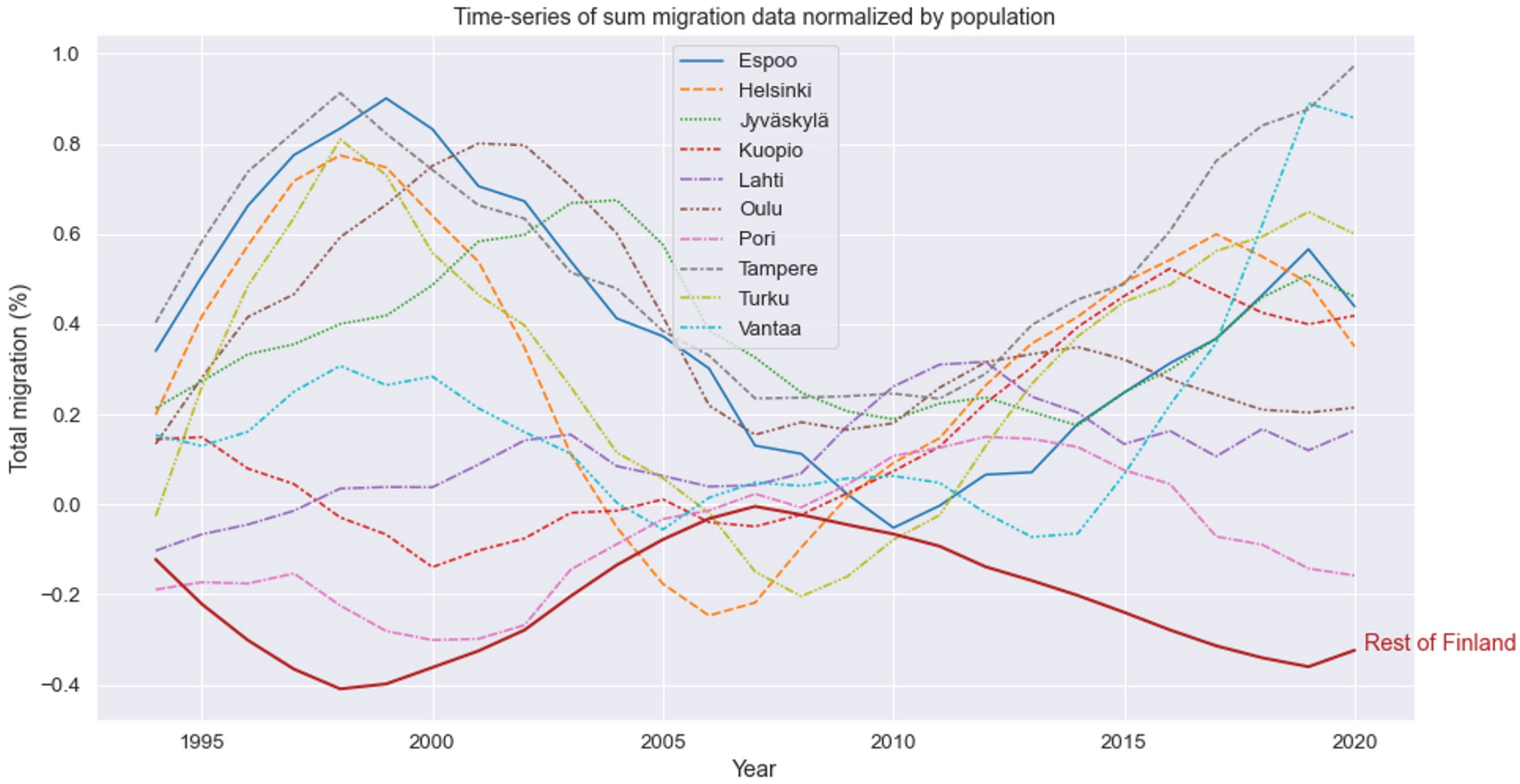
- All municipalities
- Quite muddy, municipalities cannot be distinguished from one another



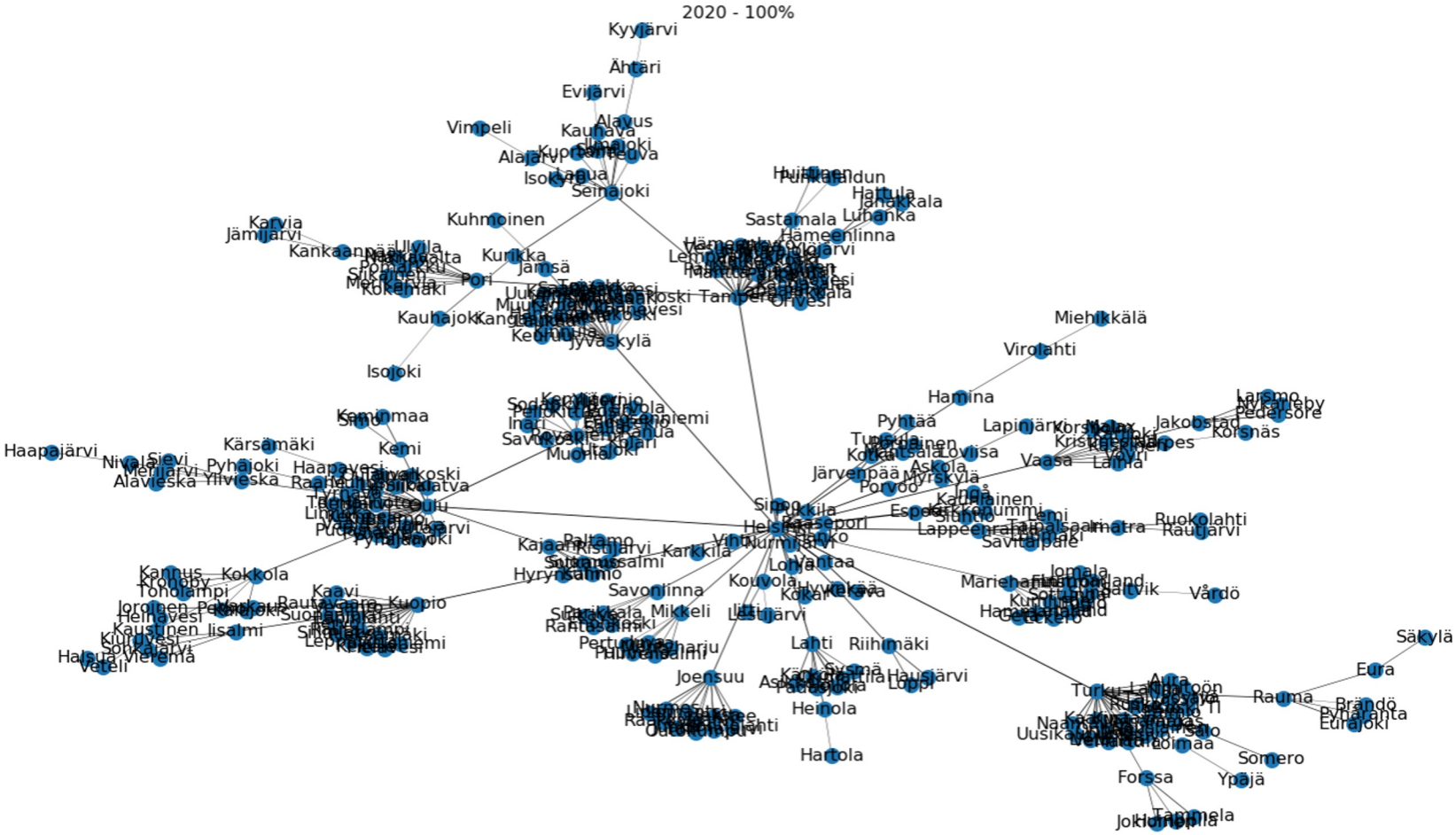

Time-series of sum migration data normalized by population
Espoo
Helsinki
Jyväskylä
Kuopio
Lahti
Oulu
Pori
Tampere
Turku
Vantaa
Rest of Finland
Total migration (%)
16
14
12
10
8
6
4
1990
1995
2000
2005
2010
2015
2020
Year


Mediaanitulon kehitys suhteessa koko maahan
1.30
1.25
1.20
1.15
1.10
1.05
1.00
0.95
0.90
1995
2000
2005
2010
2015
2020
Vuosi
Espoo
Helsinki
Vantaa
Turku
Lahti
Pori
Tampere
Jyväskylä
Kuopio
Oulu
WHOLE COUNTRY


Rank of 3-year Rolling Average Net Migration
Vantaa
Tampere
Turku
Jyväskylä
Espoo
Rest of Finland
Kuopio
Lahti
Helsinki
Oulu
Pori
Net migration rank (1-10)
2008
2010
2012
2014
2016
2018
2020
Year

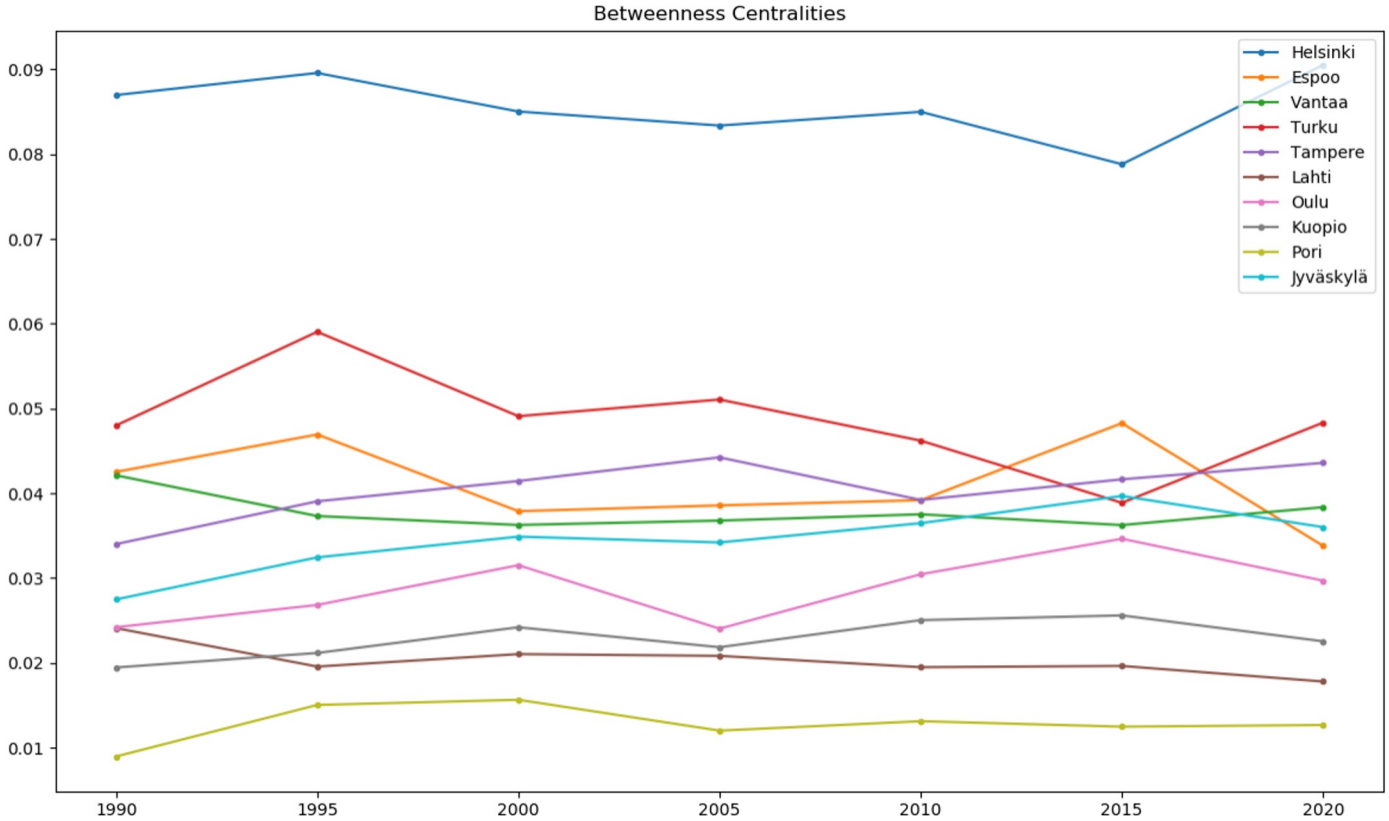

Time-series of sum migration data normalized by population
Total migration (%)
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
1995
2000
2005
2010
2015
2020
Year
Espoo
Helsinki
Jyväskylä
Kuopio
Lahti
Oulu
Pori
Tampere
Turku
Vantaa
Rest of Finland

# Maximum spanning tree, 100% of the links

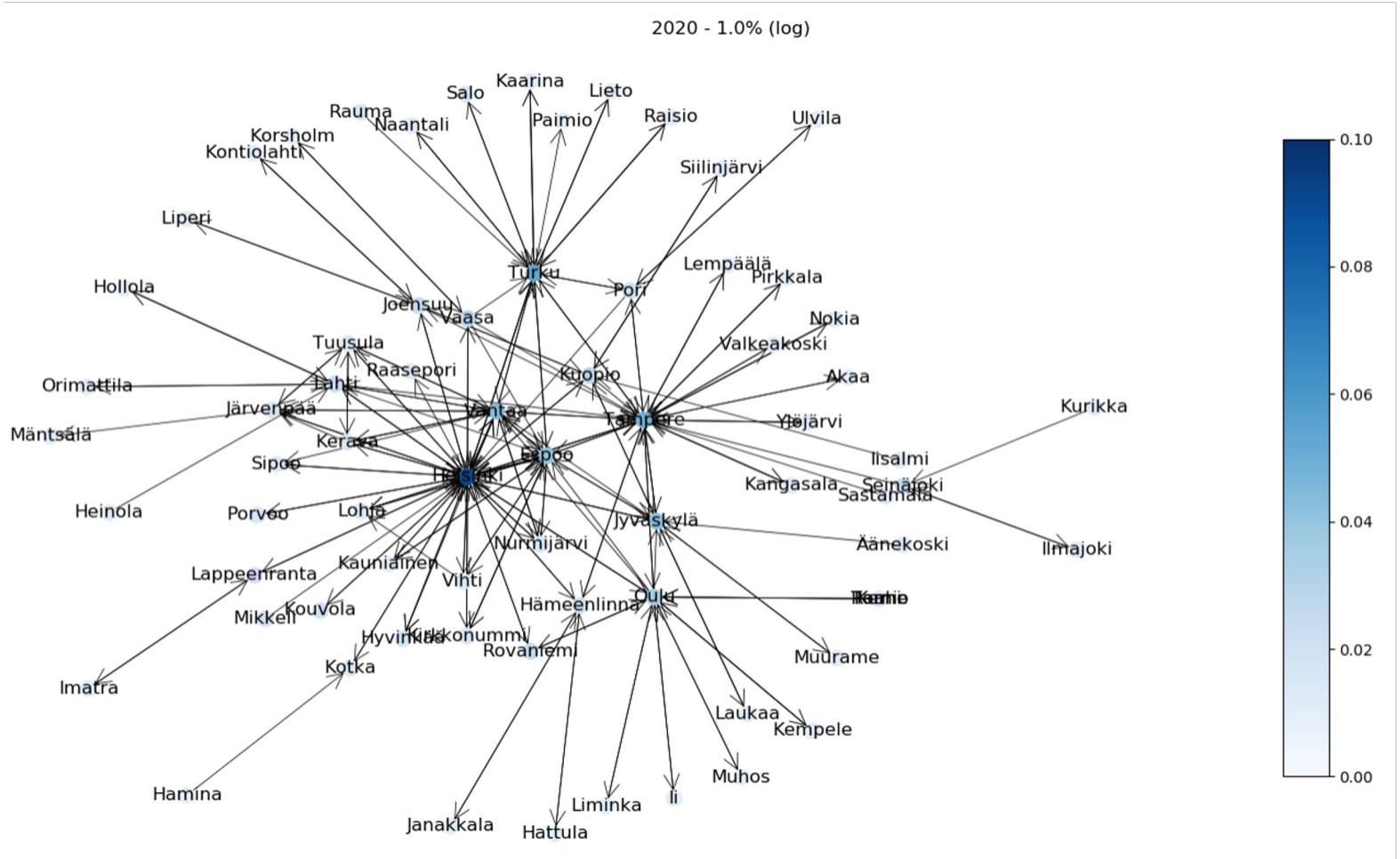


# Betweenness centralities of 10 biggest municipalities

- Calculated with reciprocals of total migration values
- No major changes during the years, Helsinki is clearly the most central city

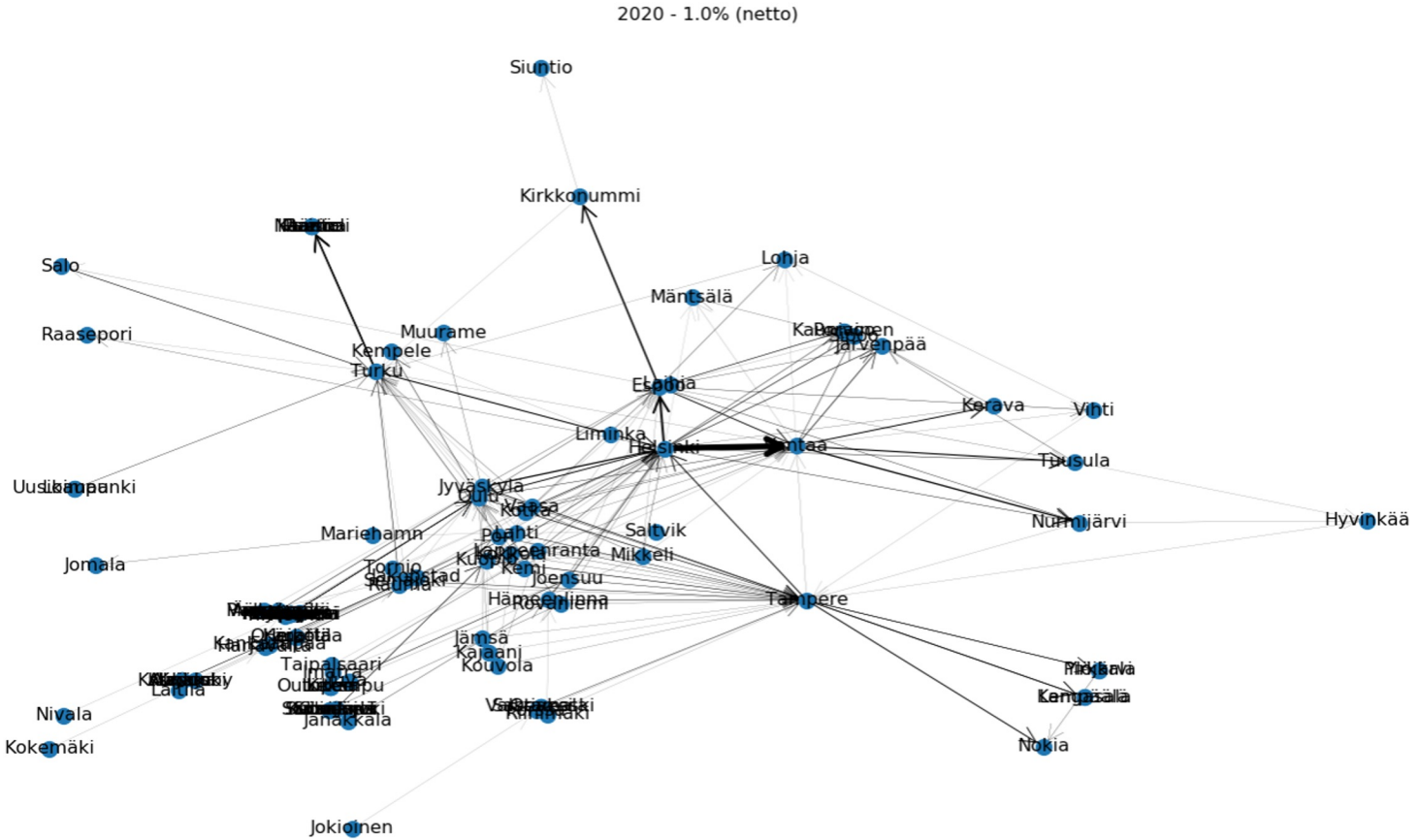


# Directed graph visualization with betweenness centralities as node colors



# Directed graph visualization with positive net migration as edge weight

- Some of the nodes overlap, fixed when the network is visualized on the map of Finland

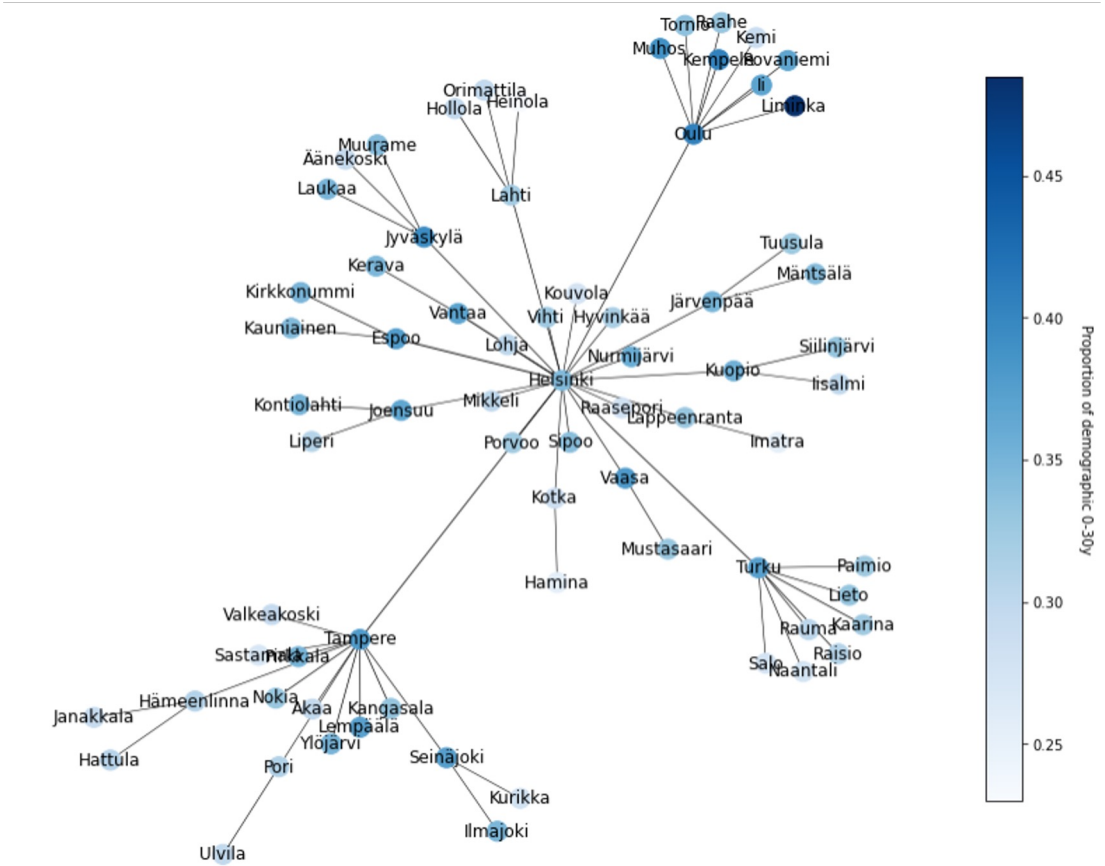


# What next?

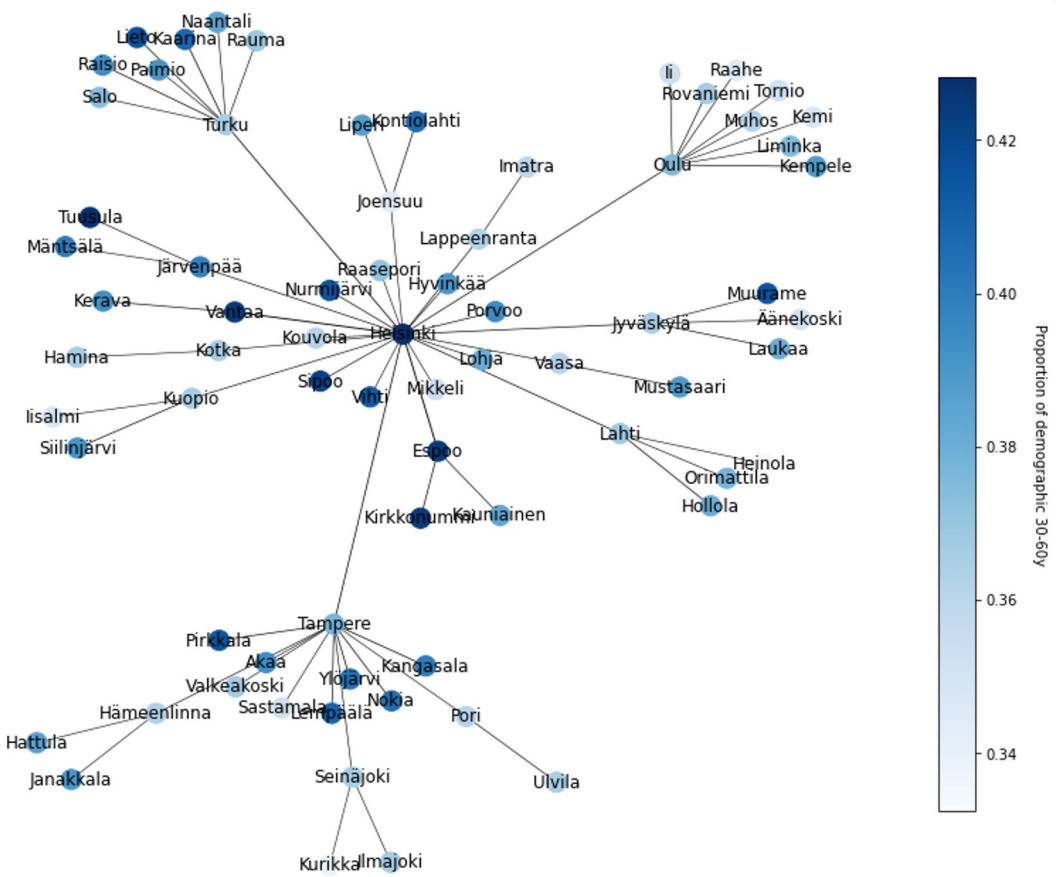
- Continue to visualize the networks on the finnish map
- Investigate connection of migration and municipality demographics
  - Visualizations on the map
  - Correlation heatmap
- Analysis of the migration and demographics
  - https://towardsdatascience.com/interactive-geographical-maps-with-geopandas-4586a9d7cc10

# The effect of demographic factors to finnish migration

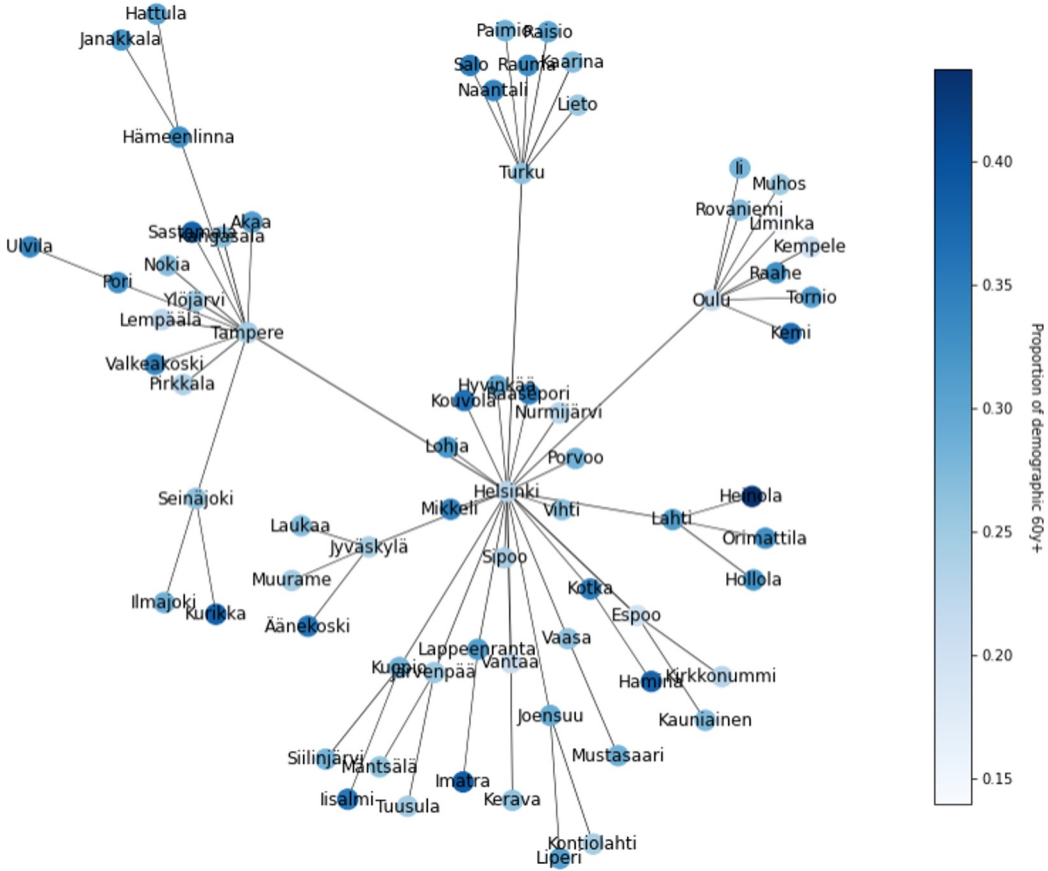
# 0-30 year-olds



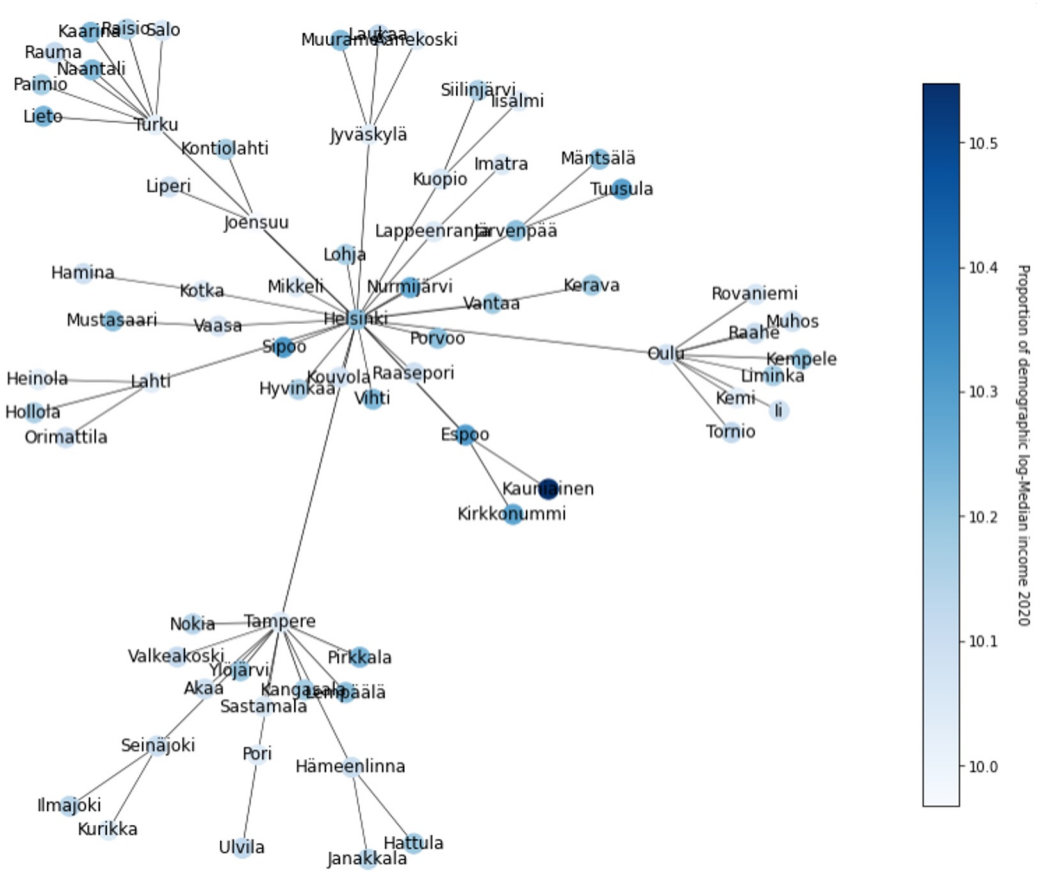
# 30-60 year-olds



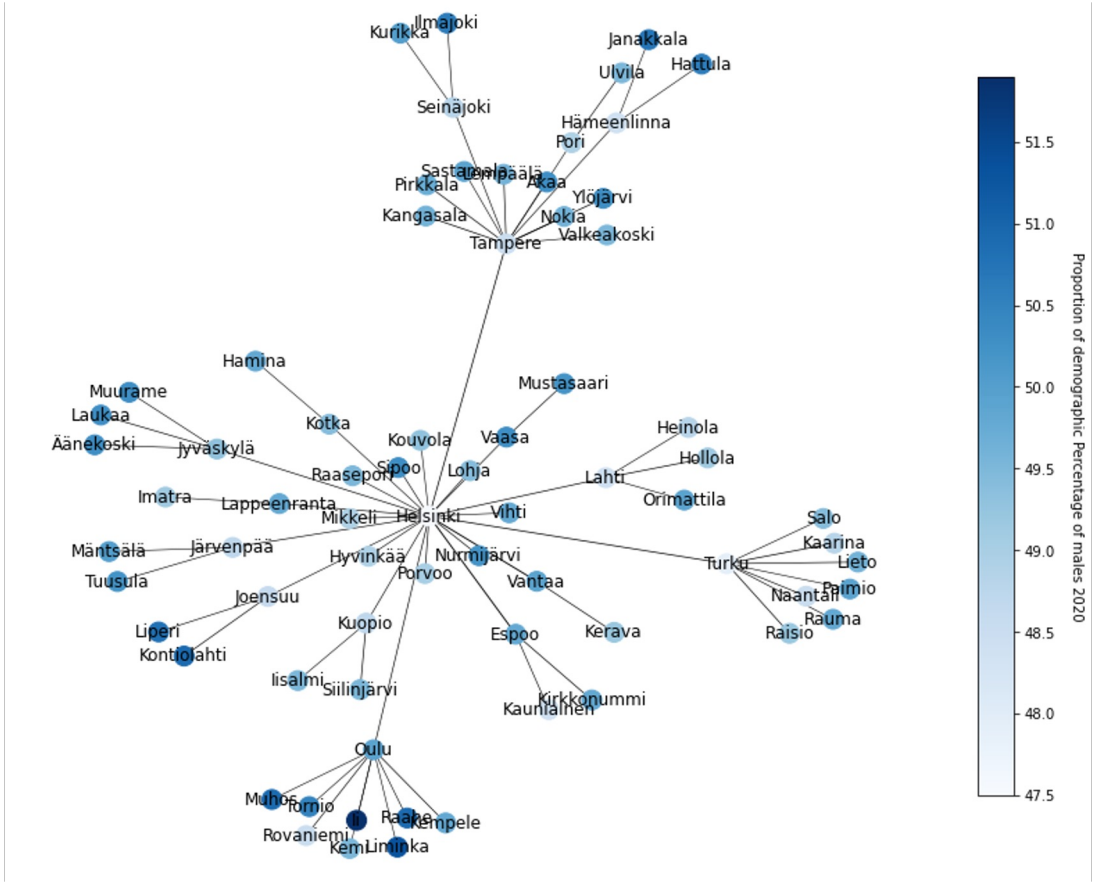
# 60+ year-olds


Hattula
Janakkala
Hämeenlinna
Ulvila
Nokia
Pori
Ylöjärvi
Lempäälä
Tampere
Valkeakoski
Pirkkala
Akaa
Seinäjoki
Ilmajoki
Kurikka
Laukaa
Jyväskylä
Muurame
Äänekoski
Palmio
Raisio
Salo
Rauma
Kaarina
Naantali
Lieto
Turku
Ii
Muhos
Rovaniemi
Oulu
Kempele
Raahe
Tornio
Kemi
Hyvinkää
Kouvola
Nurmijärvi
Lohja
Porvoo
Helsinki
Mikkeli
Vihti
Lahti
Heinola
Orimattila
Hollola
Sipoo
Kotka
Espoo
Vaasa
Lappeenranta
Vantaa
Kuopio
Järvenpää
Hamina
Kirkkonummi
Kauniainen
Joensuu
Mustasaari
Siilinjärvi
Mäntsälä
Imatra
Iisalmi
Tuusula
Kerava
Kontiolahti
Liperi
Proportion of demographic 60y+
0.40
0.35
0.30
0.25
0.20
0.15

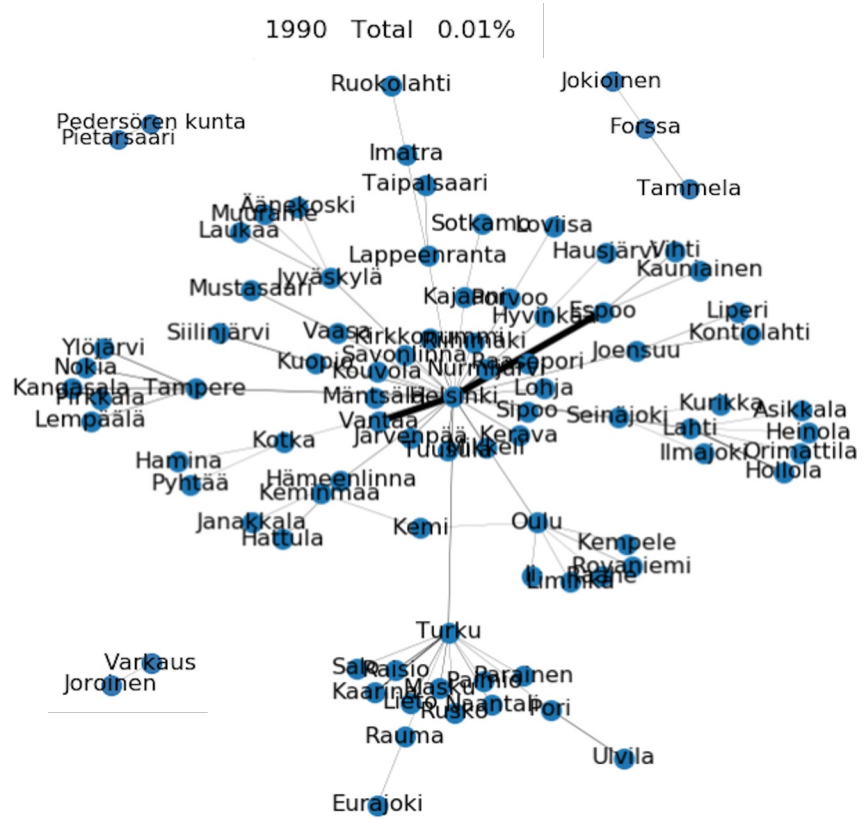
# Log-median income

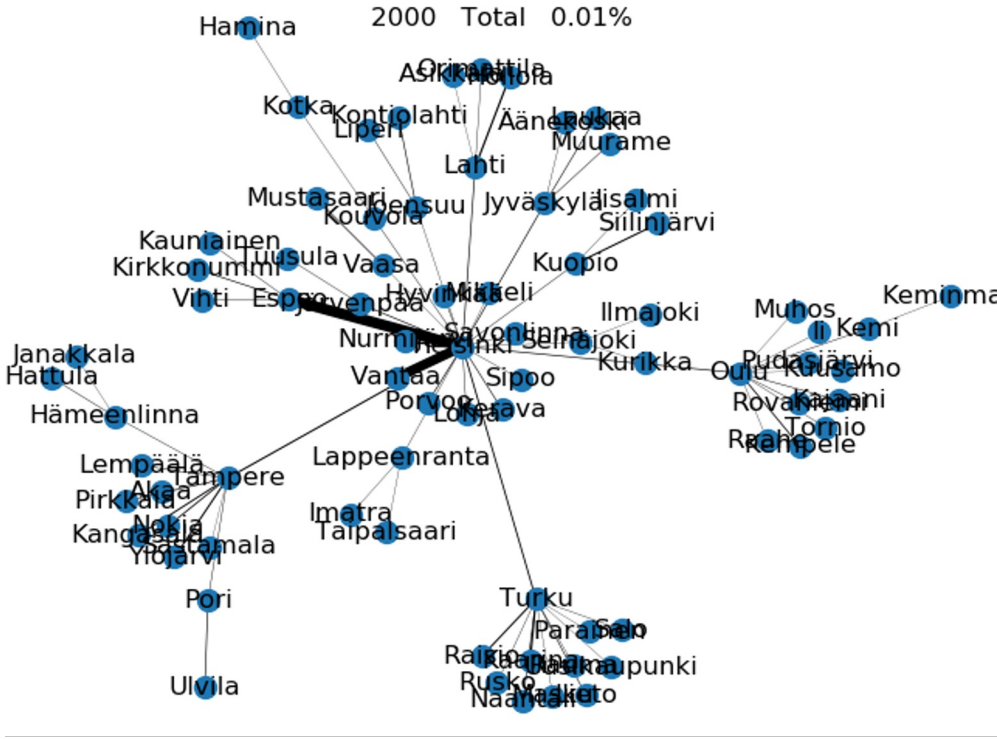


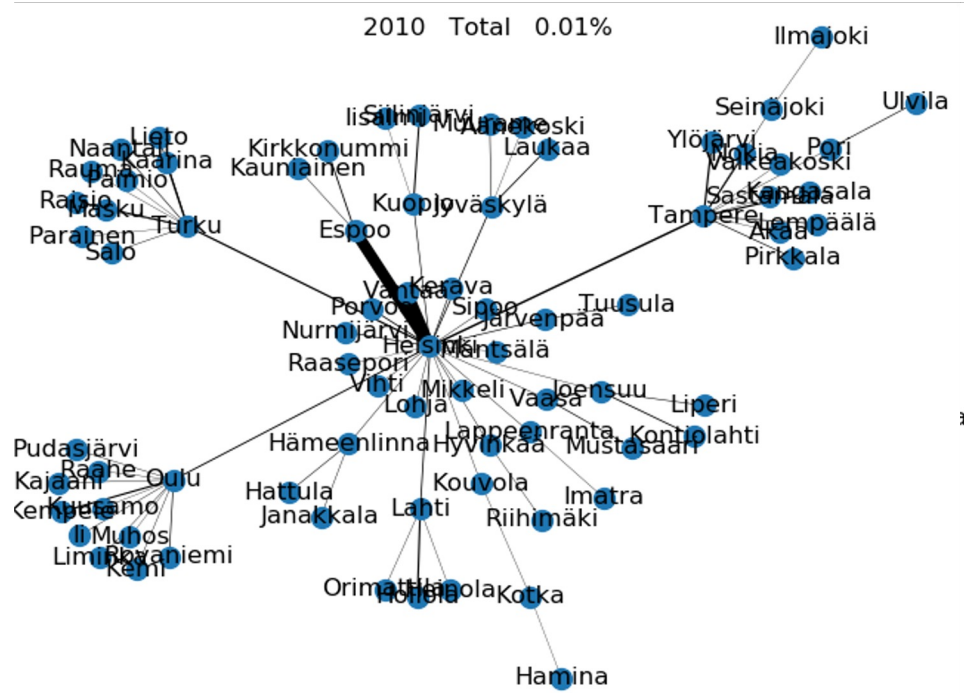
# Binary sex-distribution

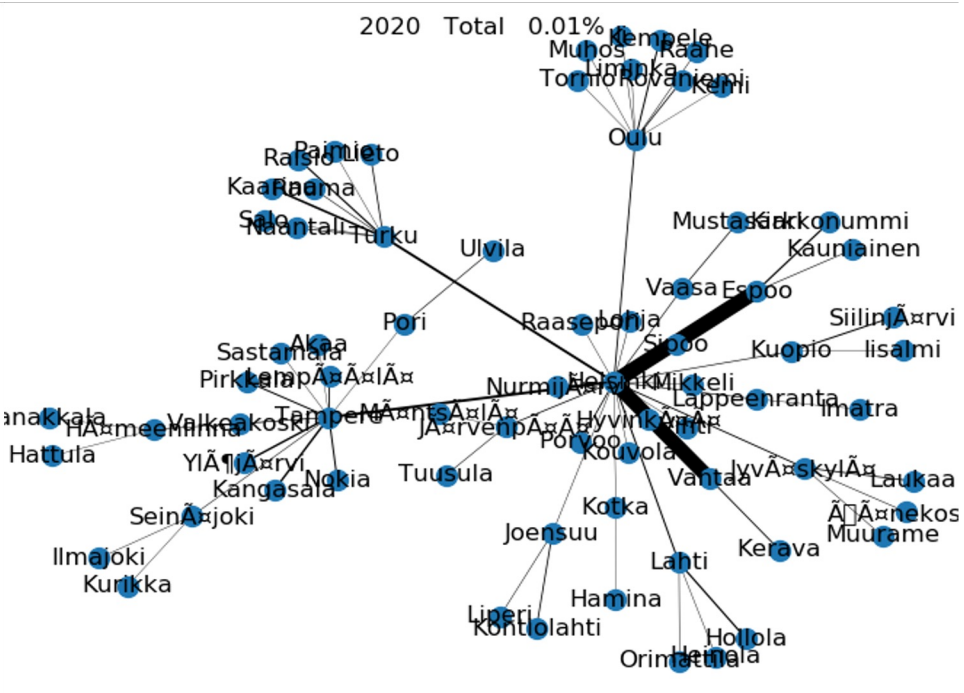


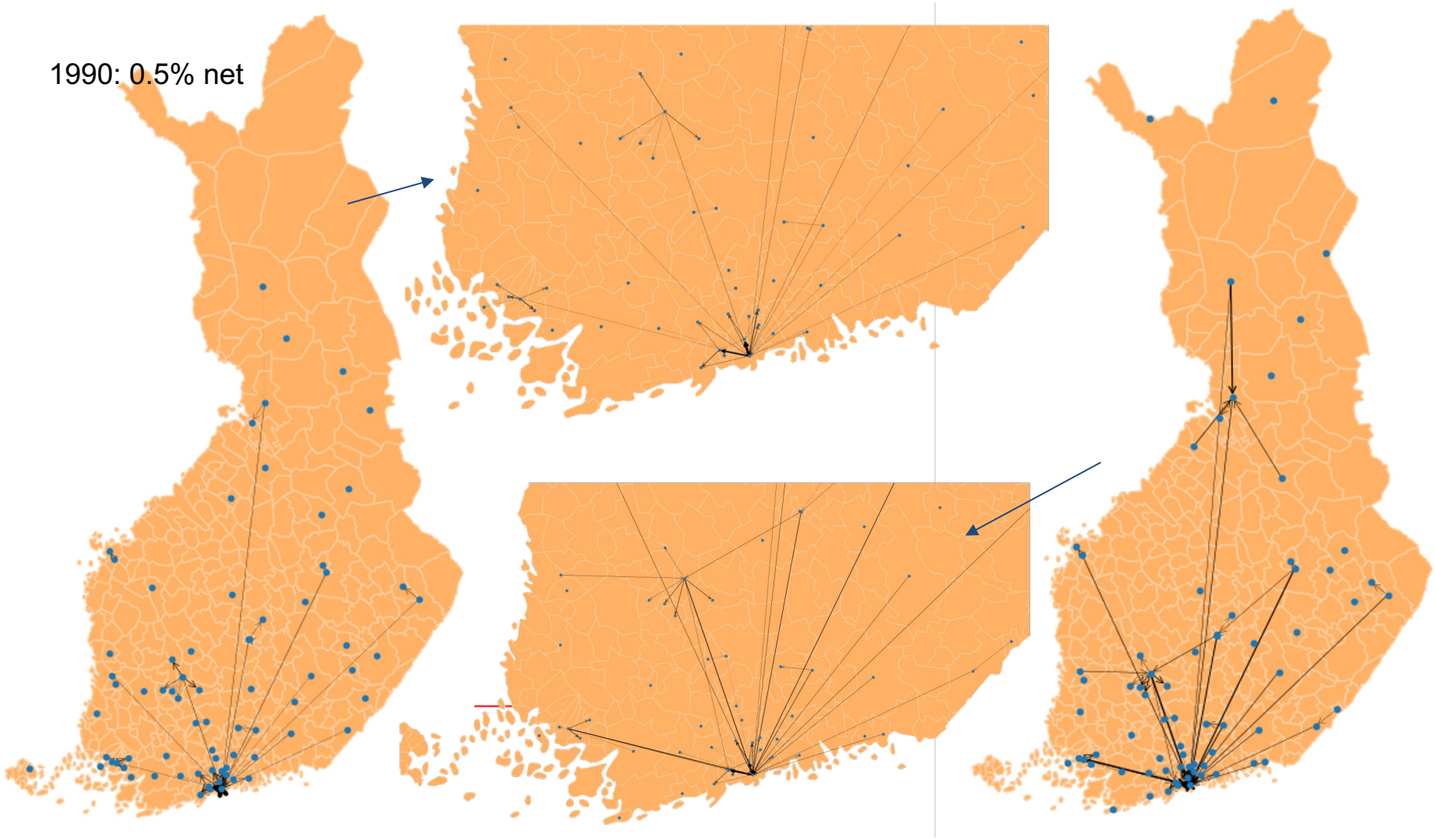
# Changes in finnish migration between years 1990-2020

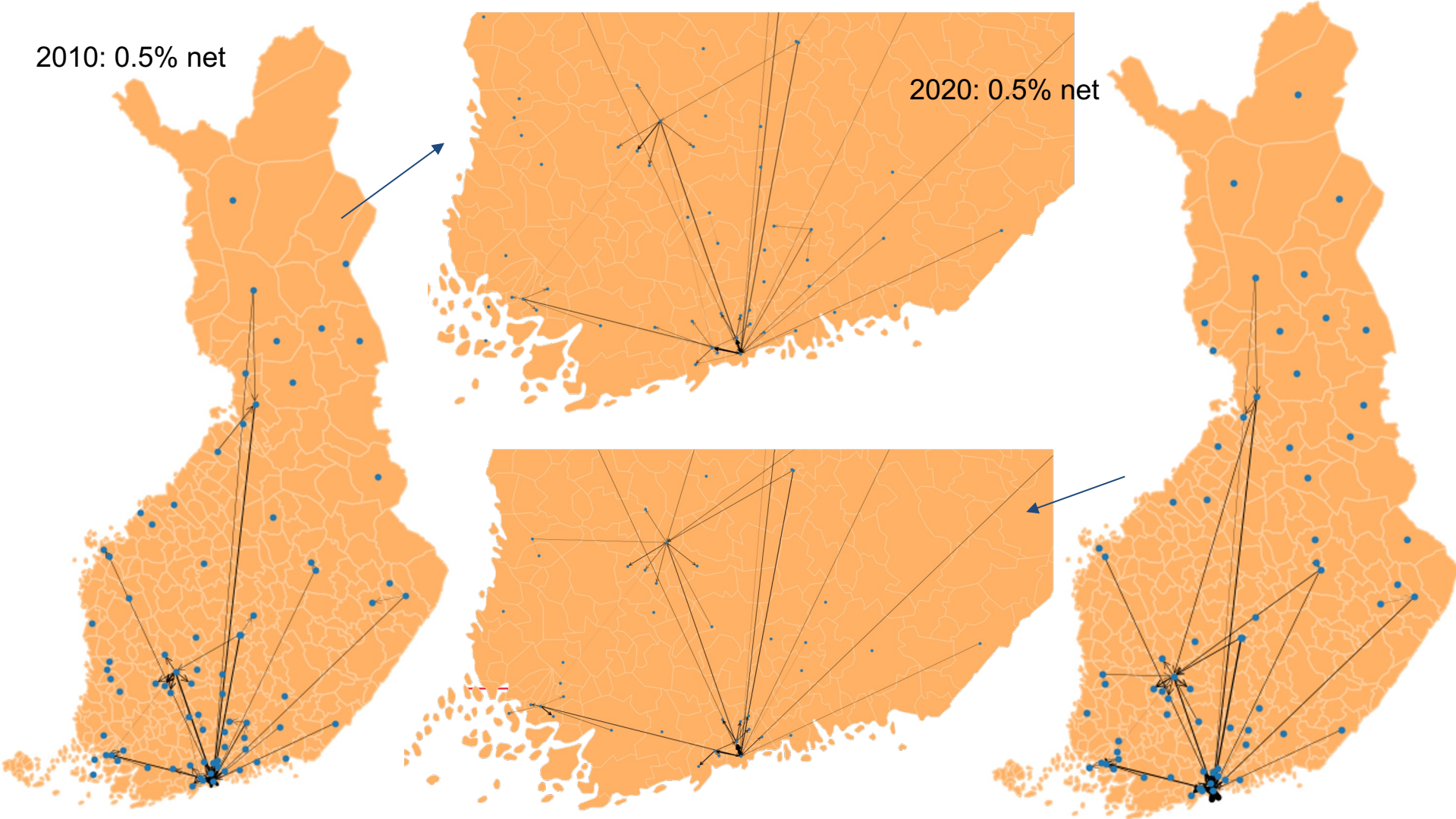

1990 Total 0.01%
Ruokolahti
Jokioinen
Pedersören kunta
Pietarsaari
Forssa
Imatra
Taipalsaari
Tammela
Äänekoski
Muurame
Laukaa
Sotkamo
Loviisa
Lappeenranta
Hausjärvi
Vihti
Jyväskylä
Kauniainen
Mustasaari
Kajaani
Porvoo
Espoo
Hyvinkää
Liperi
Siilinjärvi
Vaasa
Kirkkonummi
Kontiolahti
Ylöjärvi
Kuopio
Joensuu
Nokia
Savonlinna
Nurmijärvi
Kangasala
Tampere
Kouvola
Lohja
Pirkkala
Mäntsälä
Helsinki
Kurikka
Lempäälä
Sipoo
Seinäjoki
Asikkala
Vantaa
Lahti
Kotka
Järvenpää
Kerava
Heinola
Ilmajoki
Orimattila
Hamina
Tuusula
Liperi
Hollola
Pyhtää
Hämeenlinna
Keminmaa
Janakkala
Kemi
Oulu
Hattula
Kempele
Rovaniemi
Ii
Limingka
Turku
Varkaus
Joroinen
Salo
Raisio
Parainen
Kaarina
Masku
Lieto
Naantali
Pori
Rusko
Rauma
Ulvila
Eurajoki


2000 Total 0.01%
Hamina
Orimattila
Hollola
Kotka
Kontiolahti
Äänekoski
Liperi
Lahti
Muurame
Mustasaari
Jyväskylä
Iisalmi
Kouvola
Joensuu
Siilinjärvi
Kauniainen
Tuusula
Kuopio
Kirkkonummi
Vaasa
Vihti
Espoo
Hyvinkää
Mikkeli
Ilmajoki
Savonlinna
Nurmijärvi
Seinäjoki
Janakkala
Kurikka
Hattula
Vantaa
Sipoo
Porvoo
Hämeenlinna
Lohja
Lempäälä
Lappeenranta
Tampere
Pirkkala
Imatra
Kangasala
Nokia
Taipalsaari
Ylöjärvi
Pori
Turku
Ulvila
Rauma
Rusko
Naantali
Muhos
Keminma
Ii
Kemi
Pudasjärvi
Oulu
Kuusamo
Rovaniemi
Kajaani
Tornio
Kempele


2010 Total 0.01%
Ilmajoki
Seinäjoki
Ulvila
Pori
Ylöjärvi
Nokia
Valkeakoski
Kangasala
Tampere
Lempäälä
Akaa
Pirkkala
Kirkkonummi
Kauniainen
Laukaa
Kuopio
Jyväskylä
Espoo
Lieto
Naantali
Raisio
Masku
Parainen
Salo
Turku
Vantaa
Kerava
Porvoo
Sipoo
Järvenpää
Tuusula
Nurmijärvi
Helsinki
Mäntsälä
Raasepori
Vihti
Mikkeli
Lohja
Joensuu
Vaasa
Liperi
Lappeenranta
Kontiolahti
Hämeenlinna
Hyvinkää
Mustasaari
Pudasjärvi
Kajaani
Raahe
Oulu
Kuusamo
Muhos
Limingka
Ranua
Kemi
Hattula
Janakkala
Kouvola
Lahti
Imatra
Riihimäki
Orimattila
Hollola
Kotka
Hamina


2020 Total 0.01%
Kempele
Muhos
Raahe
Limingka
Tornio
Rovaniemi
Kemi
Oulu
Raisio
Lieto
Naantali
Turku
Ulvila
Pori
Mustasaari
Kirkkonummi
Kauniainen
Vaasa
Espoo
Raasepori
Sipoo
Kuopio
Iisalmi
Akaa
Sastamala
Pirkkala
Nurmijärvi
Helsinki
Mikkeli
Lappeenranta
Imatra
Tampere
Hyvinkää
Porvoo
Kouvola
Tuusula
Nokia
Kangasala
Vantaa
Laukaa
Kotka
Joensuu
Kerava
Lahti
Hamina
Liperi
Kontiolahti
Hollola
Orimattila
Ilmajoki
Kurikka


1990: 0.5% net


2010: 0.5% net
2020: 0.5% net