

# Econometric models of migration: 1990-2015

Aleskerov F. T. (NRU HSE, ICS RAS),

Rezyapova A. N. (NRU HSE)

# International Migration Trends

- Number of international migrants worldwide:  
258 million in 2017
- Growth of this number from 2,8% of global population in 2000 to 3,4% in 2017, which is higher than the growth of global population (United Nations, International Migration Report, 2017)

# Outline

- Literature Review
- Data on migration and asylum-seekers
- Main hypotheses of modeling
- Models of migration worldwide
- MENA – EU Migration overview
- Models of MENA – EU Migration
- Overall results

# Literature Review

Basic theoretical models

- Basic gravity model (Zipf, 1946)
- Gravity model of trade (Tinbergen et al., 1962)
- Generalized regional interaction model (Burger et al., 2009)

$$I_{ij} = C \frac{M_i^{\beta_1} M_j^{\beta_2}}{D_{ij}^{\beta_3}},$$

where  $I_{ij}$  - interregional flow

$M_i, M_j$  – sizes of regions  $i$  and  $j$  respectively

$\beta_1, \beta_2$  – potential of interaction between regions

$D_{ij}$  – distance between regions,  $\beta_3$  – impact of distance,  $C$  – proportionality constant

# Literature Review

Modern econometric models

- Bilateral migration stock model (Fagiolo et al., 2013):

$$m_{ij} = P_i^{\alpha_1} P_j^{\alpha_2} d_{ij}^{\alpha_3} rY_{ij}^{\alpha_4} \exp\{\beta_i + \beta_j + \gamma Z_{ij}\} \eta_{ij},$$

- where  $m_{ij}$  denote the stock of migrants from country  $i$  living in country  $j$
- $P_i, P_j$  – population of origin and destination countries
- $d_{ij}$  - distance between the countries
- $rY_{ij}$  - relative GDP per capita
- $\beta_i, \beta_j$  – origin and destination country effects
- $Z_{ij}$  - explanatory variable dummies (common border, language, religion, colony past and others)

Diaspora (migrant networks) influence on migration (Yap, 1977)

Language impact (Adsera et al., 2015) on international migration flows to OECD countries.

# Migration and asylum data

- International migration data:
  - Data from 1990 to 2015 annual inflow of migrants by country of origin
  - Sources: United Nations Dataset, OECD Global migration Database, Eurostat
- Asylum data
  - Annual number of asylum applications from 2000 to 2015
  - Source: UNHCR

# Education and diaspora

- Joint influence of education and diaspora is measured by interaction variable:

$$\alpha_1 \ln m_{ij}(t-5) + \alpha_2 \ln m_{ij}(t-5) * \ln edu_{i(t-1)}$$

- Impact of diaspora is the sum of its own effect and the effect because of interaction with education:

$$\alpha_1 + \alpha_2 \ln edu_{i(t-1)}$$

- Impact of diaspora is expected to be lower for countries of origin with higher education level ( $\alpha_2$  is expected to be negative)

# Policy variables

- Migration policy in receiving countries is approximated by population density and share of elderly population ( $\ln pop65_{j(t-1)}$  and  $\ln popdens_{j(t-1)}$ )
- Higher share of elderly population is expected to motivate country's authorities to implement stimulating migration policy
- Higher population density should induce government to put restrictions on migrant inflow



# Political Rights

- Political freedom in countries is measured by Freedom House Political Rights Index ( $\ln PR_{i(t-1)}$ ).
- Index is based on expert evaluation of political freedom in the country.
- It varies from 1 to 7, where 7 indicates the lowest level of freedom.
- Violation of political rights in sending country can motivate its citizens to leave it.
- On the contrary, low level of political freedom can be associated with restriction of emigration by government.

# Conflicts measurement

- Magnitude of conflicts is measured by the intensity of conflict index ( $\ln \text{conf}_{i(t-1)}$ ).
- It varies from 1 to 10 and includes all categories of conflicts with number of deaths more than 500.
- Conflicts are expected to be a strong push effect for emigration from country.

# Conflicts overview: 1990-2015

- 1991 – 2000: 1991-1992 South Ossetia war; 1991 wars in the Persian Gulf; 1991-1994 Karabakh war; 1992-1993 Georgian-Abkhazian war; 1998-1999 Kosovan war; 1999 war of NATO and Yugoslavia;
- 2001 – 2007: Main events: 2001-2014 war in Afghanistan; 2003 invasion of coalition forces into Iraq;
- 2008 – 2014: Main events: The conflict of Georgia and South Ossetia, war in Ukraine.

# Variables. Descriptive statistics

Variable	Source	Obs.	Mean	Std. Dev.	Min	Max
$\ln m_{ijt}$	UN, Eurostat, OECD	208 529	3,89	2,40	0,00	13,76
$\ln d_{ij}$	CEPII Geodist Database	197 659	8,55	0,87	4,10	9,88
$\ln m_{ij(t-5)}$	UN, Eurostat, OECD	147 837	4,15	2,36	0,69	13,76
$\ln GDP(pc)_{i(t-1)}$	World Bank	195 614	8,77	1,69	4,07	12,17
$\ln GDP(pc)_{j(t-1)}$	World Bank	199 913	9,24	1,51	4,07	12,17
$\ln m_{ij(t-5)} * \ln edu_{i(t-1)}$	Migration dataset; Human Development Reports	156 943	2,05	1,29	0,04	7,66
$\ln pop65_{j(t-1)}$	World Bank	202 666	2,42	0,54	0,53	3,28
$\ln popdens_{j(t-1)}$	World Bank	203 599	178,88	860,21	0,14	21595,4
$\ln PR_{i(t-1)}$	Freedom House	98 798	3,19	0,78	0	3,81
$\ln conf_{i(t-1)}$	MEPV Center for Systemic Peace	82 101	0,25	0,58	0	2,71
$l_{ij}$ (dummy)	CEPII Geodist Database	5 742	0,20	0,40	0	1,00

# Model (1). Migration Worldwide, 1990-2015: education and aging

## Description

- Dependent variable – migration and asylum flow from country  $i$  to country  $j$  at time  $t$ ,  $i \in \{1,180\}, j \in \{1,178\}, t \in \{1990, 2015\}$
- Diaspora - migration and asylum flow from country  $i$  to country  $j$  at time  $t - 5$
- Distance between the capital cities
- GDP per capita of origin and destination countries at  $t - 1$
- Education level at origin country at  $t - 1$
- Share of elder population (per cent) and population density at destination at  $t - 1$
- Common official language (dummy)

# Model (1). Migration Worldwide 1990-2015: education and aging

Estimation

$$\begin{aligned} \bullet \quad \ln(m_{ijt}) = & 0,78 * \ln m_{ij(t-5)} - 0,33 * \ln d_{ij} - 0,11 * \ln GDP(pc)_{i(t-1)} + \\ & (0,01) \qquad \qquad \qquad (0,01) \qquad \qquad \qquad (0,01) \\ & + 0,15 * \ln GDP(pc)_{j(t-1)} - 0,2 * \ln m_{ij(t-5)} * \ln edu_{i(t-1)} - 0,47 * \ln popdens_{j(t-1)} + \\ & (0,01) \qquad \qquad \qquad (0,01) \qquad \qquad \qquad (0,05) \\ & + 0,27 * \ln pop65_{j(t-1)} + 0,38 * l_{ij} + \delta_i + \delta_j + \varepsilon_{ijt} \\ & (0,04) \qquad \qquad \qquad (0,01) \end{aligned}$$

- Adj.  $R^2 = 0,859$ , Number of obs. = 105 998
- Estimation with fixed effects for origin and destination
- Robust standard errors in parenthesis

# Model (1). Migration Worldwide, 1990-2015: education and aging

## Results

- Strong pull effect of diaspora (78%)
- Education level at origin reduces the impact of diaspora by 20%
- Pull effect of aging population at destination is higher than the effect of GDP of destination (27 and 15%, correspondingly)
- Push effect of population density of destination is 36% higher, than push effect of GDP of origin

# Model (2). Migration Worldwide, 1990-2015: education and political rights

## Description

- Dependent variable – migration and asylum flow from country  $i$  to country  $j$  at time  $t$ ,  $i \in \{1, 179\}$ ,  $j \in \{1, 187\}$ ,  $t \in \{1990, 2015\}$
- Diaspora - migration and asylum flow from country  $i$  to country  $j$  at time  $t - 5$
- Distance between the capital cities
- GDP per capita of origin and destination countries at  $t - 1$
- Education level at origin country at  $t - 1$
- Political rights at origin at  $t - 1$
- Common official language (dummy)



# Model (2). Migration Worldwide, 1990-2015: education and political rights

Estimation

$$\begin{aligned} \bullet \quad \ln(m_{ijt}) = & 0,77 * \ln m_{ij(t-5)} - 0,33 * \ln d_{ij} - 0,10 * \ln GDP(pc)_{i(t-1)} + \\ & (0,01) \qquad \qquad \qquad (0,01) \qquad \qquad \qquad (0,01) \\ & + 0,13 * \ln GDP(pc)_{j(t-1)} - 0,2 * \ln m_{ij(t-5)} * \ln edu_{i(t-1)} + 0,09 * \ln PR_{i(t-1)} + \\ & (0,01) \qquad \qquad \qquad (0,01) \qquad \qquad \qquad (0,02) \\ & + 0,38 * l_{ij} + \delta_i + \delta_j + \varepsilon_{ijt} \\ & (0,01) \end{aligned}$$

- Adj.  $R^2 = 0,968$ , Number of obs. = 105 920
- Estimation with fixed effects for origin and destination
- Robust standard errors in parenthesis

# Model (2). Migration Worldwide, 1990-2015: education and political rights

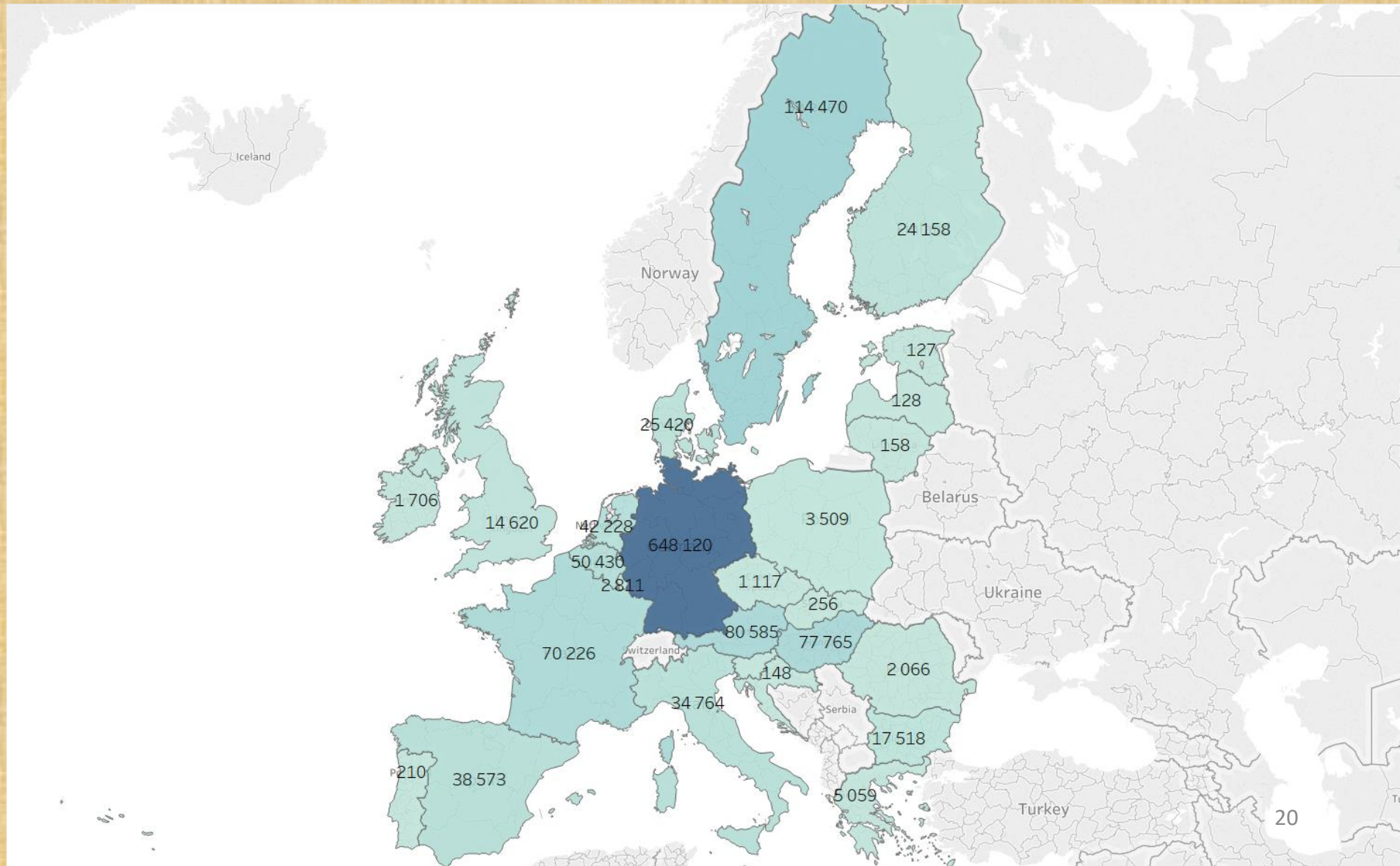
## Results

- Strong pull effect of diaspora (77%)
- Education level at origin reduces the impact of diaspora by 20%
- The increase of political rights index by 1% leads to increase of international migration flows by 9% (low level of political freedom in migrants' countries is associated with higher political rights index)

# MENA – EU Migration: overview

- Migration from 13 developing countries of Middle East and North Africa region to European Union countries
- Study period: 2001 - 2015

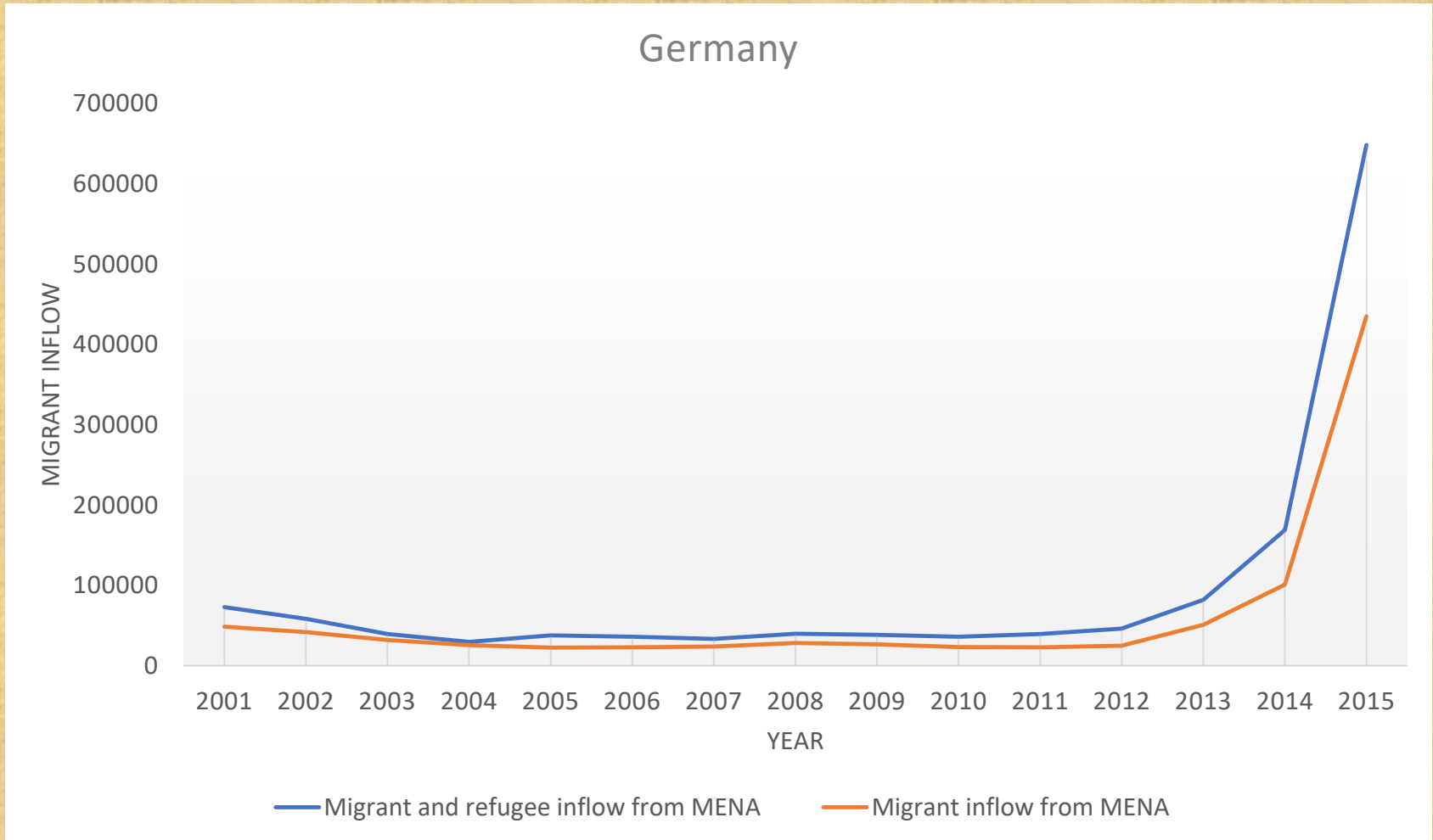
# Migrant inflow from MENA to EU in 2015



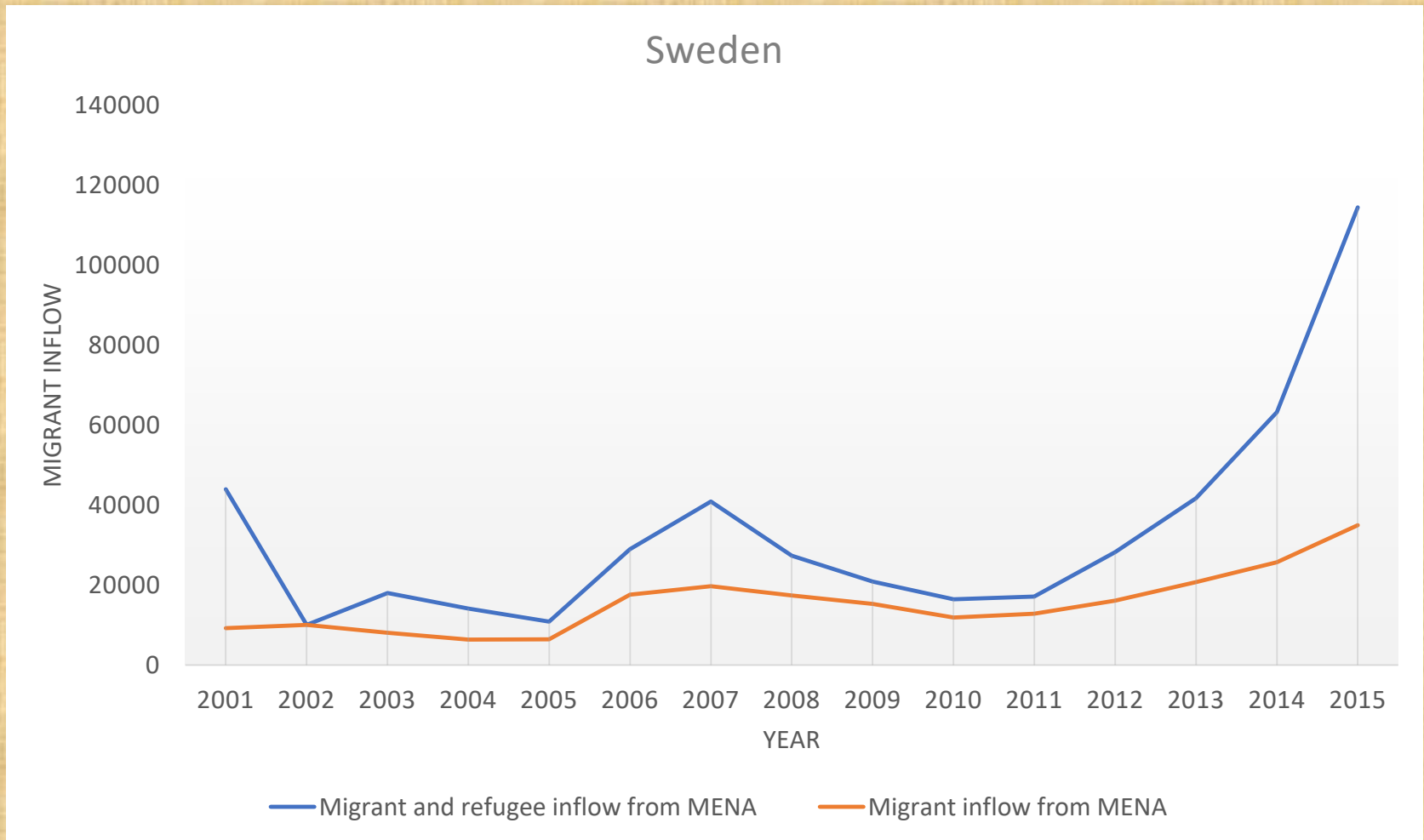
# MENA – EU Migration, 2015

From	Migrants and asylum-seekers	Migrants
Syrian Arab Republic	776 196	410 943
Iraq	218 764	94 533
Morocco	80 640	76 554
Iran	59 613	29 274
Algeria	46 956	40 197
Egypt	25 557	19 122
Tunisia	24 021	22 243
Lebanon	11 977	8 343
Libya	8 568	4 370
State of Palestine	4 264	991
Jordan	3 522	2 777
Yemen	3 401	1 707
Djibouti	694	312
<b>Total</b>	<b>1 264 173</b>	<b>711 366</b>

# MENA – EU Migration: Germany



# MENA – EU Migration: Sweden



# Model (3). MENA – EU Migration, 2001 – 2015: education

## Description

- Dependent variable – migration and asylum flow from country  $i$  to country  $j$  at time  $t$ ,  $i \in \{1,13\}, j \in \{1,28\}, t \in \{2001, 2015\}$
- Diaspora - migration and asylum flow from country  $i$  to country  $j$  at time  $t - 5$
- Distance between the capital cities
- GDP per capita of destination country at  $t - 1$
- Education level at origin country at  $t - 1$
- Common official language (dummy)



# Model (3). MENA – EU Migration, 2001 – 2015: education

Estimation

$$\bullet \quad \ln(m_{ijt}) = 0,62 * \ln m_{ij(t-5)} - 0,94 * \ln d_{ij} + 0,6 * \ln GDP(pc)_{j(t-1)} -$$

(0,04)                      (0,1)                      (0,08)

$$- 0,42 * \ln m_{ij(t-5)} * \ln edu_{i(t-1)} + 0,98 * l_{ij} + \delta_i + \delta_j + \varepsilon_{ijt}$$

(0,01)                      (0,12)

- Adj.  $R^2 = 0,965$ , Number of obs. = 2 941
- Estimation with fixed effects for origin and destination
- Robust standard errors in parenthesis

# Model (3). MENA – EU Migration, 2001 – 2015: education

## Results

- The effect of diaspora is smaller, than in general sample (62% compared to 77%)
- Effect of distance is stronger: increase in distance by 1% will reduce migration flows by 94%
- Education has higher impact, than on migration worldwide: 42% compared to 27%

# Model (4). MENA – EU Migration, 2001 – 2015: aging and conflicts

## Description

- Dependent variable – migration and asylum flow from country  $i$  to country  $j$  at time  $t$ ,  $i \in \{1,13\}$ ,  $j \in \{1,28\}$ ,  $t \in \{2001, 2015\}$
- Diaspora - migration and asylum flow from country  $i$  to country  $j$  at time  $t - 5$
- Distance between the capital cities
- GDP per capita of origin and destination countries at  $t - 1$
- Magnitude of conflicts at origin at  $t - 1$
- Share of elder population and population density at destination at  $t - 1$ , per cent
- Common official language (dummy)

# Model (4). MENA – EU Migration, 2001 – 2015: aging and conflicts

Estimation

$$\begin{aligned} \bullet \quad \ln(m_{ijt}) &= 0,38 * \ln m_{ij(t-5)} - 1,00 * \ln d_{ij} + 0,26 * \ln GDP(pc)_{j(t-1)} - \\ &\quad (0,03) \qquad \qquad \qquad (0,15) \qquad \qquad \qquad (0,12) \\ &- 3,6 * \ln popdens_{j(t-1)} + 3,96 * \ln pop65_{j(t-1)} + \\ &\quad (0,65) \qquad \qquad \qquad (0,94) \\ &+ 0,62 * \ln conf_{i(t-1)} + 1,57 * l_{ij} + \delta_i + \delta_j + \varepsilon_{ijt} \\ &\quad (0,07) \qquad \qquad \qquad (0,18) \end{aligned}$$

- Adj.  $R^2 = 0,967$ , Number of obs. = 2 049
- Estimation with fixed effects for origin and destination
- Robust standard errors in parenthesis

# Model (4). MENA – EU Migration, 2001 – 2015: aging and conflicts

## Results

- The effect of diaspora is smaller, than in general sample (38% compared to 77%)
- Effect of distance is stronger: increase in distance by 1% will reduce migration flows by 100%
- Increase in population density by 1% will reduce migration flows by more than 3 times
- Conflicts at origin have strong push effect

# Overall Results

Dependent variable - $\ln m_{ijt}$	(1) Worldwide	(2) Worldwide	(3) MENA-EU	(4) MENA-EU
$\ln m_{ij(t-5)}$	0.78*** (0.01)	0.77*** (0.01)	0.62*** (0.04)	0.38*** (0.03)
$\ln d_{ij}$	-0.33*** (0.01)	-0.33*** (0.01)	-0.94*** (0.1)	-1.00*** (0.15)
$\ln GDP(pc)_{i(t-1)}$	-0.11*** (0.01)	-0.10*** (0.01)	—	—
$\ln GDP(pc)_{j(t-1)}$	0.15*** (0.01)	0.13*** (0.01)	0.6*** (0.08)	0.26** (0.12)
$\ln m_{ij(t-5)} * \ln edu_{i(t-1)}$	-0.20*** (0.01)	-0.20*** (0.01)	-0.42*** (0.1)	—
$\ln pop65_{j(t-1)}$	0.27*** (0.04)	—	—	3.96*** (0.94)
$\ln popdens_{j(t-1)}$	-0.47*** (0.05)	—	—	-3.60*** (0.65)
$l_{ij}$	0.38*** (0.01)	0.38*** (0.01)	0.98*** (0.12)	1.57*** (0.18)
$\ln PR_{i(t-1)}$	—	0.09*** (0.02)	—	—
$\ln conf_{i(t-1)}$	—	—	—	0.62*** (0.07)
Number of origin countries	180	179	13	13
Number of destination countries	178	187	28	28
Origin and destination effects	Yes	Yes	Yes	Yes
Study period	1990-2015	1990-2015	2001-2015	2001-2015
Observations	105 998	105 920	2 941	2 049
Adjusted R <sup>2</sup>	0.859	0.968	0.965	0.967

Thank you!

# References

- Алескеров Ф. Т., Мещерякова, Н. Г., Резяпова, А. Н., & Швыдун, С. В. Анализ влияния стран в сети международной миграции // Политическая наука. – 2016. – №. 4. – С. 137-158.
- Adsera A., Pytlikova M. The role of language in shaping international migration // The Economic Journal. – 2015. – Т. 125. – №. 586. – С. F49-F81.
- Aleskerov F., Meshcheryakova N., Rezyapova A., Shvydun S. Network analysis of international migration // National Research University Higher School of Economics Working Paper, Series WP7 “Mathematical methods for decision making in economics, business and politics”, WP7/2016/06 – 2016.
- Aleskerov F., Meshcheryakova N., Rezyapova A., Shvydun S. Network Analysis of International Migration // International Conference on Network Analysis. – Springer, Cham, 2016. – С. 177-185.
- Burger M., Van Oort F., Linders G. J. On the specification of the gravity model of trade: zeros, excess zeros and zero-inflated estimation // Spatial Economic Analysis. – 2009. – Т. 4. – №. 2. – С. 167-190.
- Fagiolo G., Mastorillo M. International migration network: Topology and modeling // Physical Review E. – 2013. – Т. 88. – №. 1. – С. 012812.
- Tinbergen J. Shaping the world economy: suggestions for an international economic policy. // №. HD82 T54., (The Twentieth Century Fund, New York), 1962
- United Nations, Department of Economic and Social Affairs, Population Division (2017). International Migration Report 2017: Highlights(ST/ESA/SER.A/404).
- Yip L., The attraction of cities: A review of the migration literature. // Journal of Development Economics 4.3, 239-264, 1977.
- Zipf, G. K. The P1 P2/d Hypothesis: On the Intercity Movement of Persons. // American Sociological Review 11.6, 677–686, 1946.