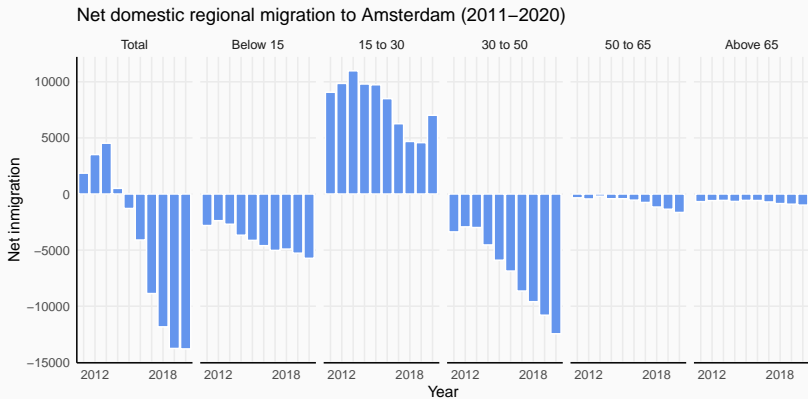# URBAN EXODUS OR RURAL SHRINKAGE?

Regional migration and attractiveness in a tight Dutch housing market

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March 17, 2022

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Urban Exodus?

Net domestic regional migration to Amsterdam (2011–2020)

Dutch population growth 2012–2020

- NUTS-3 regions
  - originally (1970) labour market regions

- Last decade:
  - homogeneous population growth
  - few peripheral regions decline

- Domestic migration
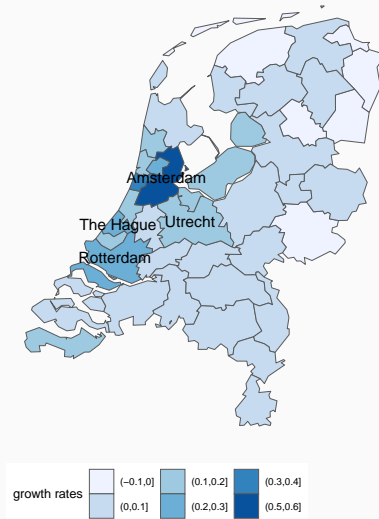 - slightly more within regions than between
  - growth is the same

Growth population, 2012–2020

| growth rates | (–0.2,–0.1] | (–0.05,0] | (0.05,0.1] |
| | (–0.1,–0.05] | (0,0.05] | (0.1,0.3] |
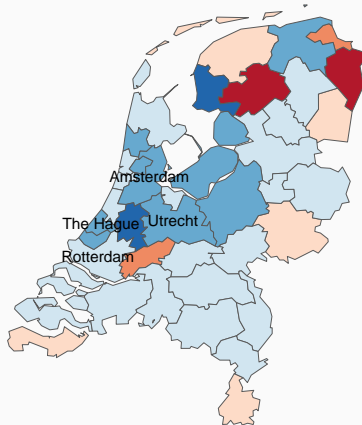
Tight Dutch housing market

- Average housing price: €410,000

- Change last year +20%

- Waiting list social renting Amsterdam: 13 years

- Large shortage of housing

- Decrease in housing transactions

Growth property tax value, 2012–2020

| growth rates | (−0.1,0] | (0.1,0.2] | (0.3,0.4] |
| | (0,0.1] | (0.2,0.3] | (0.5,0.6] |

3

Housing market, urban regions and interregional migration: why bother?

- Possible drivers of urban out-migration?
  - suburbanisation of poverty (Hochstenbach and Musterd, 2018)
  - crowding-out of the housing market by short-term rentals (Koster et al., 2021)
  - Influx of high-skilled migrants (Beckers and Boschman, 2019)

Housing market, urban regions and interregional migration: why bother?

- Possible drivers of urban out-migration?
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- Large literature on external effects of home-ownership (Dietz and Haurin, 2003)
  - negative: moving costs (Oswald, 1996, 1999)

My contributions to the literature

- Large empirical (economic) literature on impact home-ownership as drivers of interregional migration, but:
  - usually concerns marginal effect of home-ownership
  - less attention for the whole network (e.g., Amsterdam effect)

- Literature on impact of social renting on migration flows is scarce (De Graaff et al., 2009)
  - In the Netherlands social renting is a large phenomenon ($\approx$ 24% of total housing stock)
  - Social renting rights only valid within city/region
  - Social renting is an urban phenomenon (e.g. $\approx$ 30–40% in Amsterdam)

So, this paper

Does what? Estimates the impact of housing market structure on Dutch interregional migration flows using a multilevel gravity model

- UK context by Congdon (2010)
- social relations model *cf.* Koster and Leckie (2014)
- *Statistical Rethinking* from McElreath (2020)
- `ggplot2` code from Kurz (2020)

Aim To simultaneously assess the impact of housing market structure and region specific effects on domestic migration flows

Why a multilevel approach for the gravity model?

There are at least two levels in migration (I use three)

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Observed migration flows Migration between i and j with friction (e.g., distance) attributes (obs $= R^2 - R$)

$$\boxed{\text{REGION}_i} \longrightarrow \boxed{\mathbf{X}_{ij}} \longrightarrow \boxed{\text{REGION}_j}$$

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Observed push & pull factors Attributes of i and j (obs $= R$)

$$\boxed{\text{REGION}_i} \qquad\qquad \boxed{\text{REGION}_j}$$
$$\uparrow \qquad\qquad\qquad\qquad \uparrow$$
$$\boxed{\mathbf{x}_i} \qquad\qquad\qquad\qquad \boxed{\mathbf{x}_j}$$

Why a multilevel approach for the gravity model?

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Observed migration flows Migration between i and j with friction (e.g., distance) attributes (obs $= R^2 - R$)

| REGION$_i$ | —— $\mathbf{x}_{ij}$ ——→ | REGION$_j$ |

Observed push & pull factors Attributes of i and j (obs $= R$)

REGION$_i$ ↑ $\mathbf{x}_i$ REGION$_j$ ↑ $\mathbf{x}_j$

Observed flows within regional dyads migration from $i \rightarrow j$ is correlated with migration from $j \rightarrow i$ (obs $= \frac{R^2 - R}{2}$)
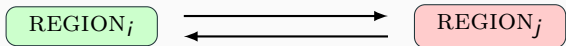
REGION$_i$ ⇄ REGION$_j$

- Hierarchical, mixed effects, varying intercept/parameter, shrinkage, partial pooling models

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## Why a Bayesian multilevel approach?

- Hierarchical, mixed effects, varying intercept/parameter, shrinkage, partial pooling models
- Increasingly used for model performance and flexibility
- Simultaneous modeling at various levels (e.g., cities, regions, flows, individuals)
    - no two-stage models anymore
    - precision (standard errors) is correct at all levels

Why a Bayesian multilevel approach?

- Hierarchical, mixed effects, varying intercept/parameter, shrinkage, partial pooling models
- Increasingly used for model performance and flexibility
- Simultaneous modeling at various levels (e.g., cities, regions, flows, individuals)
  - no two-stage models anymore
  - precision (standard errors) is correct at all levels
- Partial pooling: For example, origin specific effects are drawn from a distribution: $o_i \sim \mathcal{N}(0, \sigma)$
  - $\sigma \longrightarrow 0$: complete pooling
  - $\sigma \longrightarrow \infty$: no pooling (fixed effects)
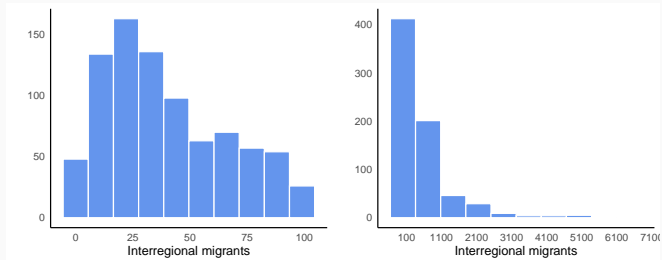
- Panel for the period 2012–2020
    - estimation: 2012–2019
    - out-of-sample prediction: 2020
- Migration flows between 40 Dutch regions
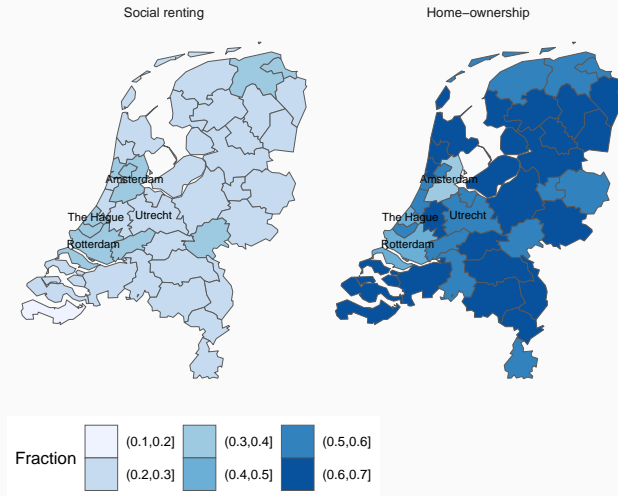- Variance ≫ mean: over-dispersion

Data: regional housing structure in 2018
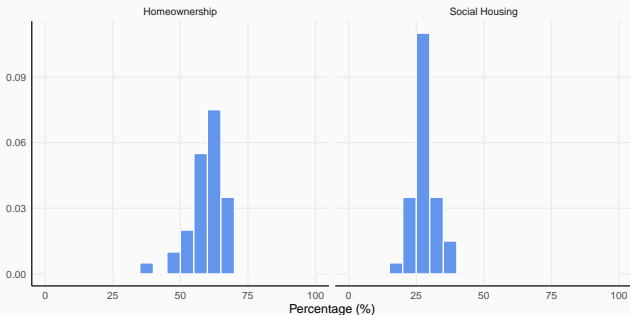
- Positive correlation between regional population and share social renting (0.46)
- Negative correlation between regional share social renting and share home-ownership (−0.88)

Data: regional housing structure in 2018 (cont.)

Dutch housing structure (2018)

$$\ln(\text{Migrants}_{ij}) = o_i + d_j + \gamma \ln(\text{dist}_{ij}) + \epsilon_{ij}$$

Origin and destination specific regional effects for multilateral resistance (Anderson and Van Wincoop, 2003), but:

- what about zeros in Migrants_{ij}?
- how to incorporate housing structure in the presence of o_i and d_j?
- over-dispersion and heteroskedasticity (Silva and Tenreyro, 2006)

Poisson versus negative binomial[1]

- Counts of migrants

- Constraints should hold

$$\sum_{j=1}^{R} \widehat{\text{Migrants}}_{ij} = O_i \qquad \sum_{i=1}^{R} \widehat{\text{Migrants}}_{ij} = D_j$$

  - poisson: ✓
  - negative binomial: ✗

- multilevel structure controls for overdispersion

---

[1]*We urge researchers to resist the siren song of the Negative Binomial (Head and Mayer, 2014)*

Modeling framework: multilevel gravity modeling

$\text{Migrants}_{ijt} \sim \text{Poisson}(\lambda_{ijt})$ (flow of migrants)

Modeling framework: multilevel gravity modeling

$$\text{Migrants}_{ijt} \sim \text{Poisson}(\lambda_{ijt}) \qquad \text{(flow of migrants)}$$

$$\ln(\lambda_{ijt}) = \alpha + o_i + d_j + t_t + \text{dyad}_{ij} +$$
$$\beta_1 \ln(\text{pop}_{it}) + \beta_2 \ln(\text{pop}_{jt}) + \gamma \ln(\text{dist}_{ijt}) +$$
$$\beta_3 \ln(\text{home}_{it}) + \beta_4 \ln(\text{home}_{jt}) + \beta_5 \ln(\text{soc}_{it}) + \beta_6 \ln(\text{soc}_{jt})$$
$$\text{(linear model)}$$

Modeling framework: multilevel gravity modeling

$$
\begin{aligned}
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& && \text{(linear model)} \\
\begin{pmatrix} o_i \\ d_j \end{pmatrix} \sim & \mathcal{N} \left\{ \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_i^2 & \rho_{ij} \\ \rho_{ij} & \sigma_j^2 \end{pmatrix} \right\} && \text{(regional varying effects)}
\end{aligned}
$$

Modeling framework: multilevel gravity modeling

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$$

$$
\begin{pmatrix} \text{dyad}_{ij} \\ \text{dyad}_{ji} \end{pmatrix} \sim \mathcal{N} \left\{ \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_{\text{dyad}}^2 & \rho \\ \rho & \sigma_{\text{dyad}}^2 \end{pmatrix} \right\}
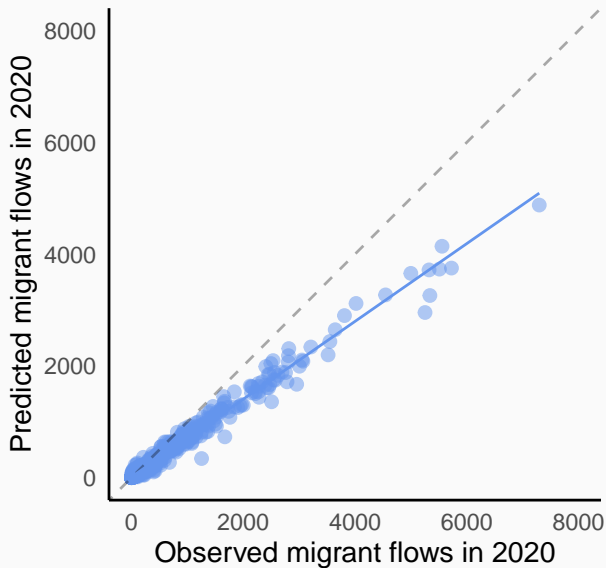$$

$$
\text{(dyad varying effects)}
$$

Main Estimation results

parameter	origin (push)	destination (pull)
ln(population)	**−0.10**	**0.70**
ln(% homeownership)	**−1.73**	**1.37**
ln(% social renting)	**−0.40**	**0.99**
ln(household size)	**5.46**	**−2.35**
ln(% western immigrants)	**−0.14**	−0.01
intercept	**3.89**	
migrants flow:		
ln(distance)	**−1.63**	
standard deviations:		
origin	**0.67**	
destination	**0.44**	
dyad	**0.39**	
correlation		
origin-destination	**0.78**	
dyad	**0.80**	

Bold: 89% credible intervals do not include zero

Samples are drawn using the NUTS sampler from STAN using 4 chains, each with 4,000 iterations and 1,000 warm-up samples

Out-of-sample prediction for 2020 ($R^2 = 0.98$)
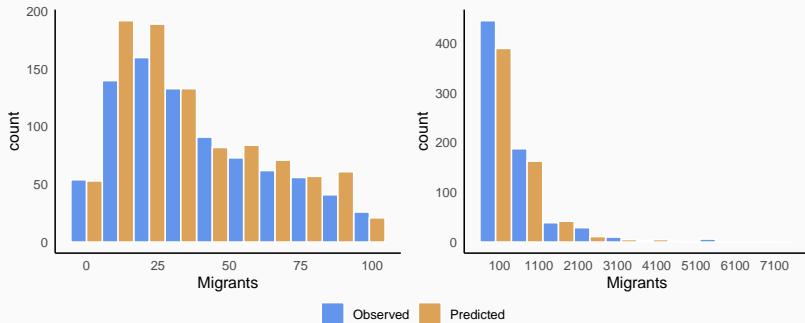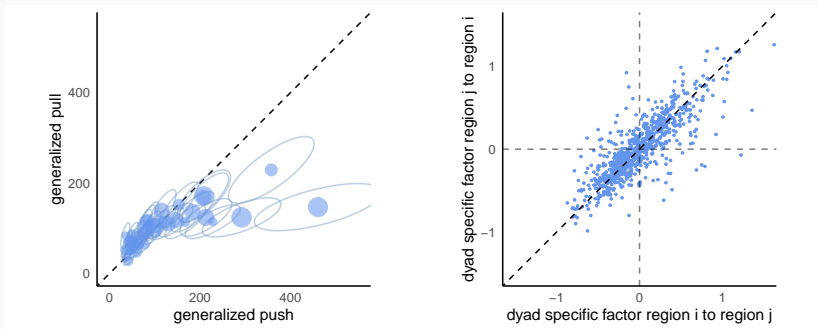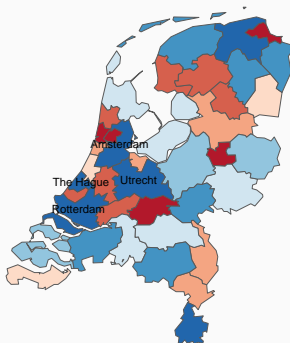
Correlation patterns

Figure 1: Correlation (0.78) between unobserved push and pull factors region (left) and flows (correlation $= 0.8$) within dyad pairs (right)
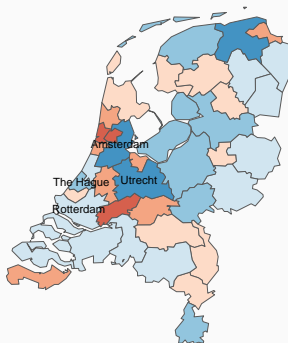
Asymmetric push and pull factors

Regional push and pull effects
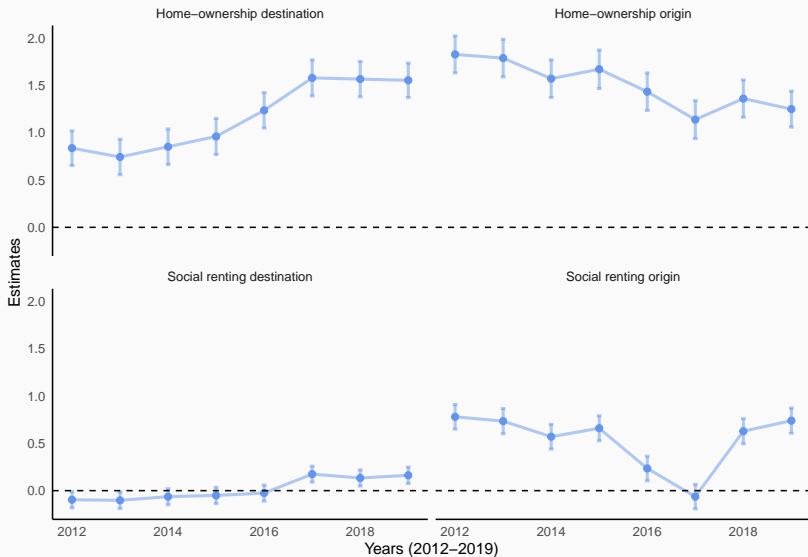
Determinants of push factors?
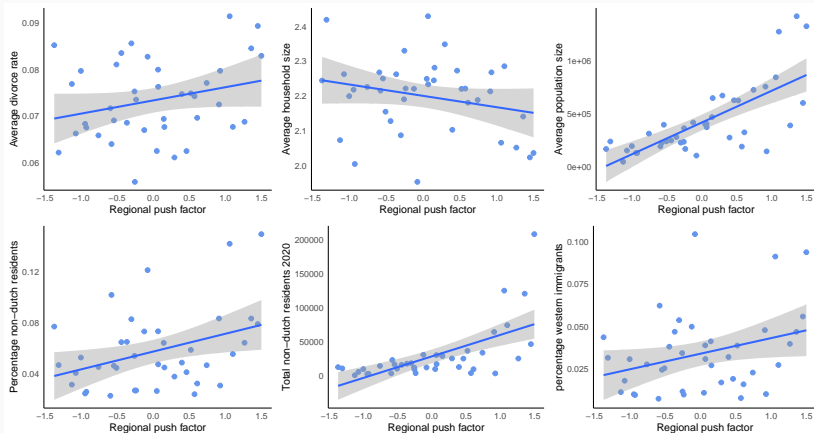
Sensitivity check: temporal stability?

Sensitivity check: spatial autocorrelation

- spatial autocorrelation in
  regional effects:

$$o_i, d_j \sim \text{MVNormal}(0, \mathbf{K})$$
$$\mathbf{K}_{ij} = \eta^2 \exp(-\rho^2 \mathbf{D}_{ij})$$

- results remain robust

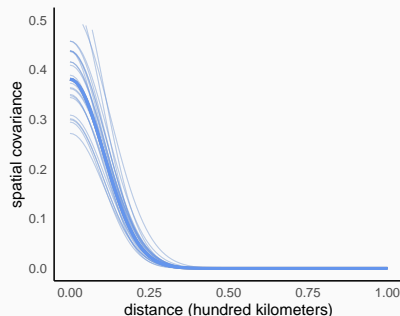## Sensitivity check: spatial autocorrelation

Modest spatial autocorrelation

- spatial autocorrelation in regional effects:

$$o_i, d_j \sim \text{MVNormal}(0, \mathbf{K})$$
$$\mathbf{K}_{ij} = \eta^2 \exp(-\rho^2 \mathbf{D}_{ij})$$

- results remain robust

Conclusions

Main results:

- home-ownership has a positive impact on regional domestic migration
    - social renting to a lesser extent
- large urban areas have large push effects
    - effect is different from housing market structure
    - similar to and larger than push effects in periphery

Speculation:

- home-ownership is a proxy for satelite communities close to major urban areas?
- tourism, short stay (high-skilled), and large housing investment companies drive natives out?

Supplementary materials

Paper, presentation, data and code can be retrieved from the project's GitHub page:

    https://github.com/Thdegraaff/migration_gravity

Thank you!

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