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Housing market and migration revisited: a multilevel gravity model for Dutch municipalities

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Abstract
This paper revisits the impact of the housing market structure on interregional migration, but adopts an alternative modeling approach to migration flows between cities. The starting point is a gravity model, but instead of using fixed effects for cities of origin and destination, I use a multilevel mixed effects approach allowing me to simultaneously model migration flow characteristics and the cities of origin and destination characteristics. This approach has two main advantages. First, it allows for simultaneous estimation of the impact of city characteristics on migration flows, where the impact is not necessarily symmetrical for cities of origin and destination. Second, it allows for prediction of migration flows between cities both in and out of sample. Preliminary results show that homeownership decrease migration flows significantly with an elasticity below -1. Municipal social renting rate has a negative impact as well, but its elasticity is close to zero.

Keywords
Gravity model — housing market — migration — multilevel model — partial pooling — prediction

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1. Introduction

In the 1990s, Andrew Oswald wrote two famous working papers (Oswald, 1996, 1999) postulating that homeownership rates would have a negative impact on labor market behavior, as the high costs of moving residence associated with homeownership would impede regional mobility. These two working papers evoked a large empirical literature (see, e.g., Munch et al., 2006, 2008; De Graaff and Van Leuvensteijn, 2013) looking at the impact of individual and aggregate homeownership on labor market performance, where seemingly paradoxically at the aggregate level homeownership is indeed harmful for labor market behavior where at the individual level it is correlated with positive labor market performance.

That housing market structure has an effect on migration decisions is well-established, especially at the micro-level, where it is widely accepted that homeownership has a negative effect on regional mobility (Dietz and Haurin, 2003). For example, Palomares-Linares and van Ham (2018) find that homeownership has a very strong immobility effect on in internal migration in Spain during the period 2001–2011.

On an aggregate level, Amirault et al. (2016) already looked at the impact of homeownership on migration flows within a gravity model using a Poisson pseudo maximum likelihood estimator and found an elasticity around -1. However, traditional gravity modeling has the disadvantage that either regional fixed effects of origins and destinations can be incorporated or the regions' characteristics when not varying over flows. Moreover, theoretically, regional effecs should be incorporated leaving no room in the traditional approach to incorporate regional characteristics

This paper circumvents this disadvanted by adopting a multilevel approach with partial pooling[1], where the latter terms indicates that I adopt regions of origin and destination specific effects, but that I "draw" them from a distribution, hence the name partial pooling (where complete pooling states no group effects and no pooling fixed effects.

A partial pooling approach has another advantege, namely the regional specific effects are completely probabilistic, making it feasible to predict both within and out-of-sample. In other words, with the results at hand I can predict flows between hypothetical regions.

This paper reads as follows. The next section describes the data and focuses especially on the distribution of regional migration flows and regional labour market structure. Section 3 describes the modeling approach, where starting from traditional gravity model and using the descriptives of migration flows I argue for a specific type of model. Section 4. gives both the model results and their analysis. By the latter I mean that this sections deals as well with interpretation by giving prediction both within and out-of-sample. The last section concludes.

[1] There is a whole variety of names for these types of models, including varying effects, mixed effects and shrinkage models. I use the more generic multilevel description as regions and flows are by definition measured at a different level (scale).

2. Data

I model the migration flows measured in individuals between the 393 Dutch municipalities in 2015. There is no information available about within municipality residential migration. So, I have 393 regional characteristics (or doubled when accounting for both regions of origin and destination) and 154,056 flows ($393 \times 393 - 393$).

Figure 1 shows the distribution of migrant flows within my sample. The left panel deals with migrant flows below 20, the right panel with migrant of 20 and larger. Two main observations can be made.

First, there is strong but consistent decay in both panels, which points to a strong underlying pattern. However, the 'tail' in this distribution is rather thick.[2] There are still observations quite far right in the distributution. Indeed, sample mean is about 10, while the sample variance is aournd 40, leading to a strong presence of *overdispersion*.

Secondly, most of my dataset consists of zero observations. Although they do seem to be genuine observations and not caused by another proces (we will check for this later), they do need to be taken specifically into account.

I include 7 other variables in my model. First,

3. Modeling framework

3.1 The traditional gravity model

We adopt the basic gravity model specification pioneered by Tinbergen (1962).

Anderson and Van Wincoop (2003) argued that origin and destination specific variables should be incorporated to take into account multilateral resitance terms.

Given that the variance is four times the mean of the migration flows, we need to correct for overdispersion of heterogeskedasticity (Silva and Tenreyro, 2006, states that heteroskedasticity (rather than the presence of too many zeros) is responsible for the main differences.)

$$
\begin{aligned}
\text{Migrants}_{ij} &\sim \text{GammaPoisson}(\lambda_{ij}, \tau) && \text{(1a)}\\
\log(\lambda_{ij}) &= \alpha + o_{\text{mun}[i]} + d_{\text{mun}[j]} + \\
&\quad \beta_1 \log(\text{home}_i) + \beta_2 \log(\text{home}_j) + \\
&\quad \beta_3 \log(\text{soc}_i) + \beta_4 \log(\text{soc}_j) + \\
&\quad \beta_5 \log(\text{pop}_i) + \beta_6 \log(\text{pop}_j) + \\
&\quad \beta_7 \log(\text{dist}_{ij}) && \text{(1b)}\\
o_{\text{mun}} &\sim \text{Normal}(\alpha_o, \sigma_o) && \text{(1c)}\\
d_{\text{mun}} &\sim \text{Normal}(\alpha_d, \sigma_d) && \text{(1d)}\\
\beta_1, \ldots, \beta_7 &\sim \text{Normal}(0, 2) && \text{(1e)}\\
\alpha_o, \alpha_d &\sim \text{Normal}(0, 2) && \text{(1f)}\\
\sigma_o, \sigma_d &\sim \text{HalfCauchy}(0, 1) && \text{(1g)}\\
\tau &\sim \text{Gamma}(0.01, 0.01) && \text{(1h)}
\end{aligned}
$$

[2] The largest migration flows are between the municipalities of Amsterdam and Amstelveen and amount to about 3,500 migrants.

4. Results

4.1 Parameter estimates

I estimated model (1) by using the *No U-Turn Sampler* (NUTS) in Stan.[3] NUTS is a relatively recent developed Hamiltonian Monte Carlo (a specific form of Markov Chain Monte Carlo simulation) method, able to draw samples efficiently from large multilevel models (Hoffman and Gelman, 2014).

Table 1. Parameter estimates with 95% probability intervals (group speficic origin and destination estimates are not presented)

Parameter	mean	sd	2.5%	97.5%
b_Intercept	-0.74	0.04	-0.82	-0.66
b_pop_d	0.89	0.03	0.83	0.96
b_pop_o	0.88	0.04	0.79	0.97
b_hom_d	-1.48	0.19	-1.86	-1.10
b_hom_o	-1.27	0.25	-1.75	-0.78
b_soc_o	-0.04	0.04	-0.11	0.03
b_soc_d	-0.06	0.03	-0.12	-0.01
b_log_distance	-1.96	0.01	-1.97	-1.95
sd_destination__Intercept	0.45	0.02	0.42	0.49
sd_origin__Intercept	0.61	0.02	0.57	0.66
shape	1.22	0.01	1.20	1.24

4.2 Model predictions

5. In conclusion

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[3] As interface to Stan (see for an overview article of Stan Carpenter et al., 2017) I used the `brms` R-package (Bürkner, 2017).

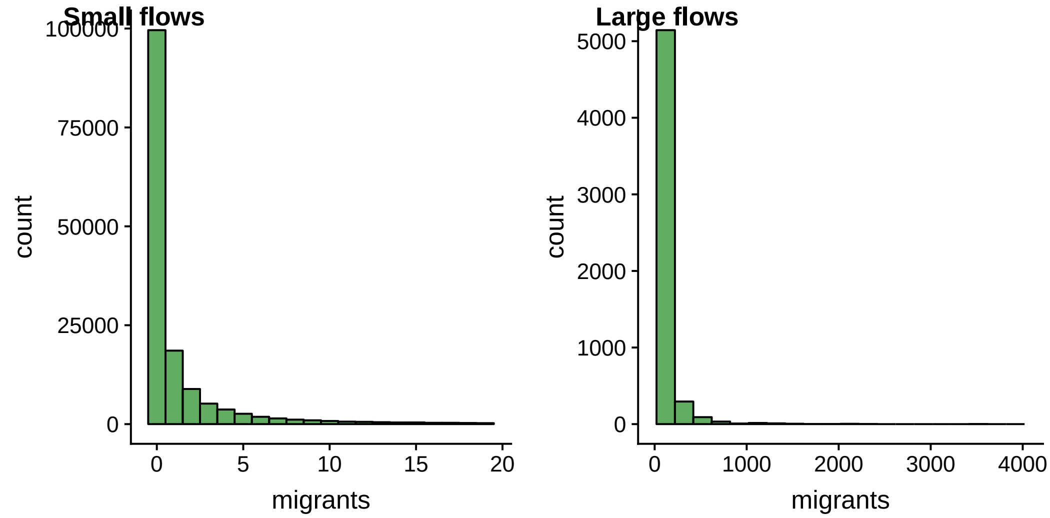

Figure 1. Histogram of migrant flows. Left panel shows the histogram of small migrant flows ($N < 0$) and the right panel shows the histogram of large migrant flows ($N \geq 20$). Note the different scale of the y-axis.

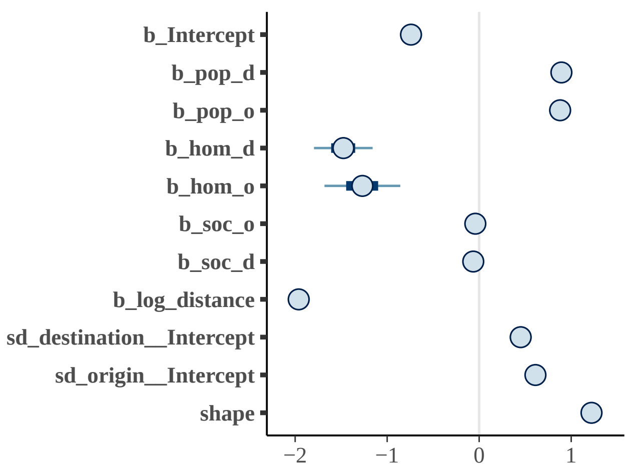

Figure 2. Forest plot of parameter means and 95% probability intervals (group speficic origin and destination estimates are not presented)

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