ReThinking Emergency Rental Allocation

Appendix C. Econometric models descriptors

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Contents

Being at risk of eviction is a result of several factors. Recognizing the multicasual nature of this social phenomenon, the *ReThinkers* team designed a quantitative strategy sensitive to both personal-level factors and county-level factors.

Datasets

- Household Pulse Survey (HSP)
- Census data
- State eviction laws data sets
- Treasury Emergency Rental Assistance (ERA) Dashboard

Software

For estimation of econometric modeling we used the following R-Packages:

- A grammar of data manipulation (`dplyr` package[@wickham2015dplyr])
- Elegant graphics for data analysis (`ggplot2` package[@wickham2011ggplot2])
- Analysis and Presentation of Social Scientific Data (`jtools` package[@long2017package])
- Econometric modeling (`stats` package[@R-core])
- GAM and Generalized Ridge Regression for R (`mgcv` package[@wood2012mgcv])

`dplyr`

A grammar of data manipulation, `dplyr` package, was built by Hadley Wickham. It "provides a consistent set of verbs that help you solve the most common data manipulation challenges".[@wickham2015dplyr] We used `dplyr` for the initial data processing in order to have clean data suited for the modeling and visualization processes.

`ggplot2`

All the visualizations in this report were built using the `ggplot2` package, created by Hadley Wickham, which is "a system for declaratively creating graphics, based on The Grammar of Graphics" by Leland Wilkinson[@wilkinson2012grammar].

`epitools`

We also took advantage of the `epitools` package, a set of "basic tools for applied epidemiolgy".[@aragon2012epitools] We used the package to estimate the observed variation of homicide data.

`lme4`

All the models from the fist section were buil using the `lme4` package, created by Ben Bolker. It is designed to fit Linear, Generalized Linear, And Nonlinear Mixed models, providing different functions such as `lmer()`, `glmer()`, and `nlmer()`.[@bates2007lme4] Since we are modeling counts and rates (assuming a Poisson distribuiton for the dependent variable), we used the `glmer()` function, fitted for Generalized Linear Mixed Models (GLMM).

`jtools`

Jacob A. Long wrote the `jtools` package as a set of tools "for the purpose of more efficiently understanding and sharing the results of regression analyses.[@long2017package] For our analysis, we used the `summ()` function to present the results of the `glmer()` models. The `summ()` command"prints output for a regression model in a fashin similar to `summary`, but formatted differently with more options", which include including data description, goodness of fit measurements, as well as fixed and random effects coefficients.[@long2017package]

`merTools`

The `merTools` package, Tools for Analyzing Mixed Effect Regression Models, "provides methods for extracting results from mixed-effect model objects fit with the `lme4` package" and "allows construction of prediction intervals efficiently from large scales linear and generalized linear mixed-effects models".[@knowles2016mertools] From this package, we used the `predictInterval` command, wich provides the confidence intervals for the random effects coefficients using bootstrapping techniques.

`mgcv`

Finally, we use the `mgcv` package, Mixed GAM Computation Vehicle with Automatic Smoothness Estimation, by Simon Wood to perform final modeling with the smoothnes transformations.[@wood2012mgcv] In particular, we used the `gamm()` function for modeling Generalized Additive Mixed Models with the smoothness (achived through the use of splines) applied to the *time* variable.

Probit model for personal-level factors

The following snipet code shows the probit model specification.

```r
# Model
m1 <- glm(
  eviction_likelihood ~ age + female + white + black + asian +
    hispanic + non_het + trans + single + kids + college +
    unemployment_month + military + disability_phys + disability_mental +
    rent_assistance + rent_increase + rent_delay_months + (single*kids),
    family = binomial(link = "probit"),
    weights = df_clean$pweight,
    data = df_clean,
    # na.rm = T
    )
```

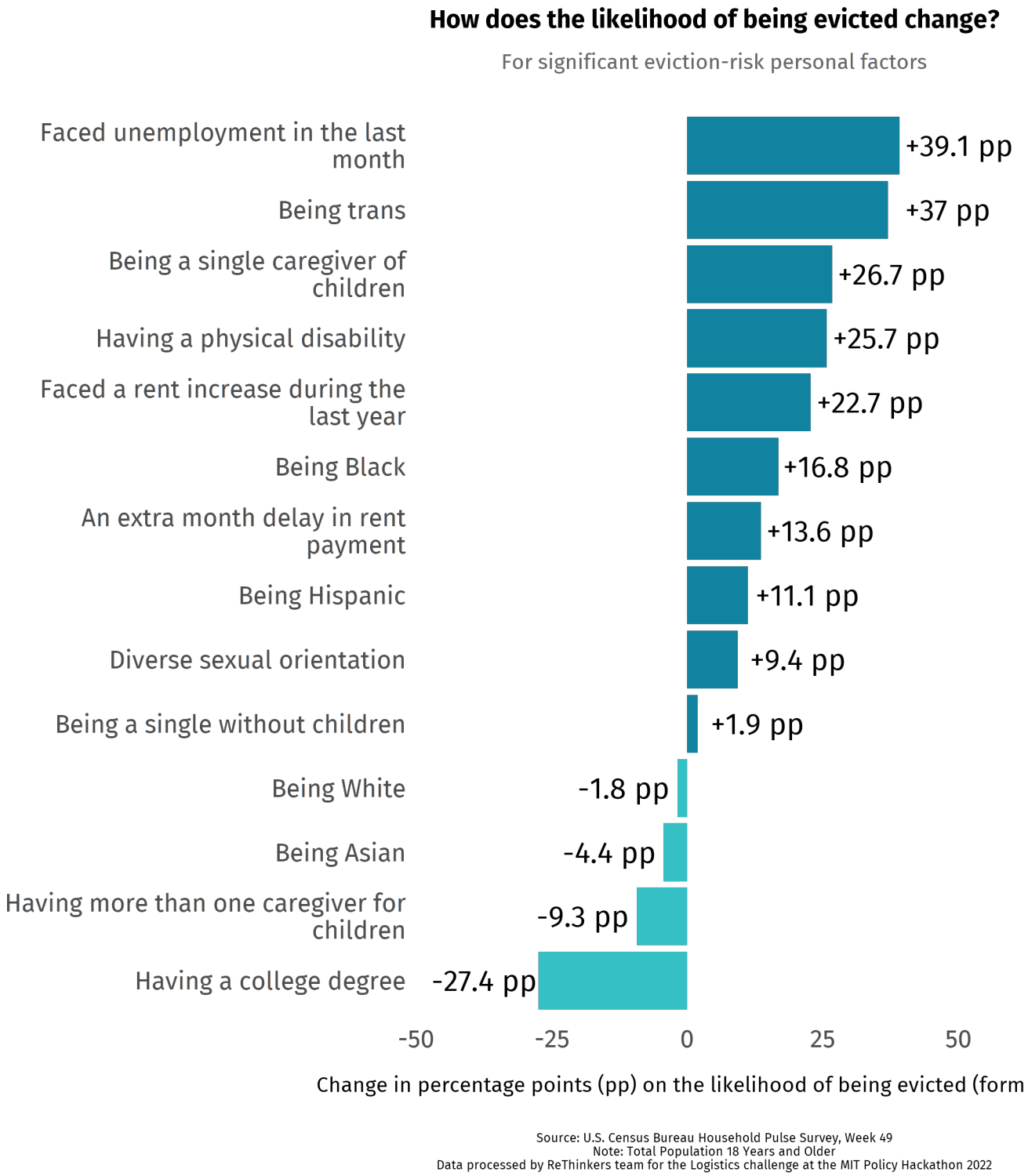
```
## Warning in eval(family$initialize): non-integer #successes in a binomial glm!
```

Here's the table of coefficient.

```
##
## Call:
## glm(formula = eviction_likelihood ~ age + female + white + black +
##     asian + hispanic + non_het + trans + single + kids + college +
##     unemployment_month + military + disability_phys + disability_mental +
##     rent_assistance + rent_increase + rent_delay_months + (single *
##     kids), family = binomial(link = "probit"), data = df_clean,
##     weights = df_clean$pweight)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -331.53   -35.84    -6.09    35.47   290.99
##
## Coefficients:
##                       Estimate Std. Error  z value Pr(>|z|)
## (Intercept)        -5.9060104  4.2964095   -1.375   0.1692
## age                -0.0001489  0.0000469   -3.175   0.0015 **
## female             -0.1828730  0.0011886 -153.853  < 2e-16 ***
## white              -0.0434406  0.0021189  -20.502  < 2e-16 ***
## black               0.1434287  0.0021817   65.741  < 2e-16 ***
## asian              -0.0194940  0.0030307   -6.432 1.26e-10 ***
## hispanic            0.1314997  0.0013926   94.428  < 2e-16 ***
## non_het             0.1084790  0.0015415   70.374  < 2e-16 ***
## trans               0.3320077  0.0055782   59.519  < 2e-16 ***
## single              0.0037670  0.0016866    2.233   0.0255 *
## kids               -0.0802096  0.0019753  -40.607  < 2e-16 ***
## college            -0.2647078  0.0013700 -193.213  < 2e-16 ***
## unemployment_month  0.3799888  0.0011967  317.528  < 2e-16 ***
## military            5.0417711  4.2964074    1.173   0.2406
## disability_phys     0.1881264  0.0012715  147.958  < 2e-16 ***
## disability_mental   0.1146980  0.0012116   94.669  < 2e-16 ***
## rent_assistance     0.1407315  0.0016351   86.071  < 2e-16 ***
## rent_increase       0.2144263  0.0011359  188.775  < 2e-16 ***
## rent_delay_months   0.1365571  0.0002486  549.245  < 2e-16 ***
## single:kids         0.2613878  0.0024008  108.878  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 4521035  on 860  degrees of freedom
## Residual deviance: 3430427  on 841  degrees of freedom
##   (50076 observations deleted due to missingness)
## AIC: 3434510
##
## Number of Fisher Scoring iterations: 6
```

And a more intuitive way of understanding significant results.



Source: U.S. Census Bureau Household Pulse Survey, Week 49
Note: Total Population 18 Years and Older
Data processed by ReThinkers team for the Logistics challenge at the MIT Policy Hackathon 2022