# Fairness and frictions:
# The impact of unequal raises on quit behavior

## ONLINE APPENDIX

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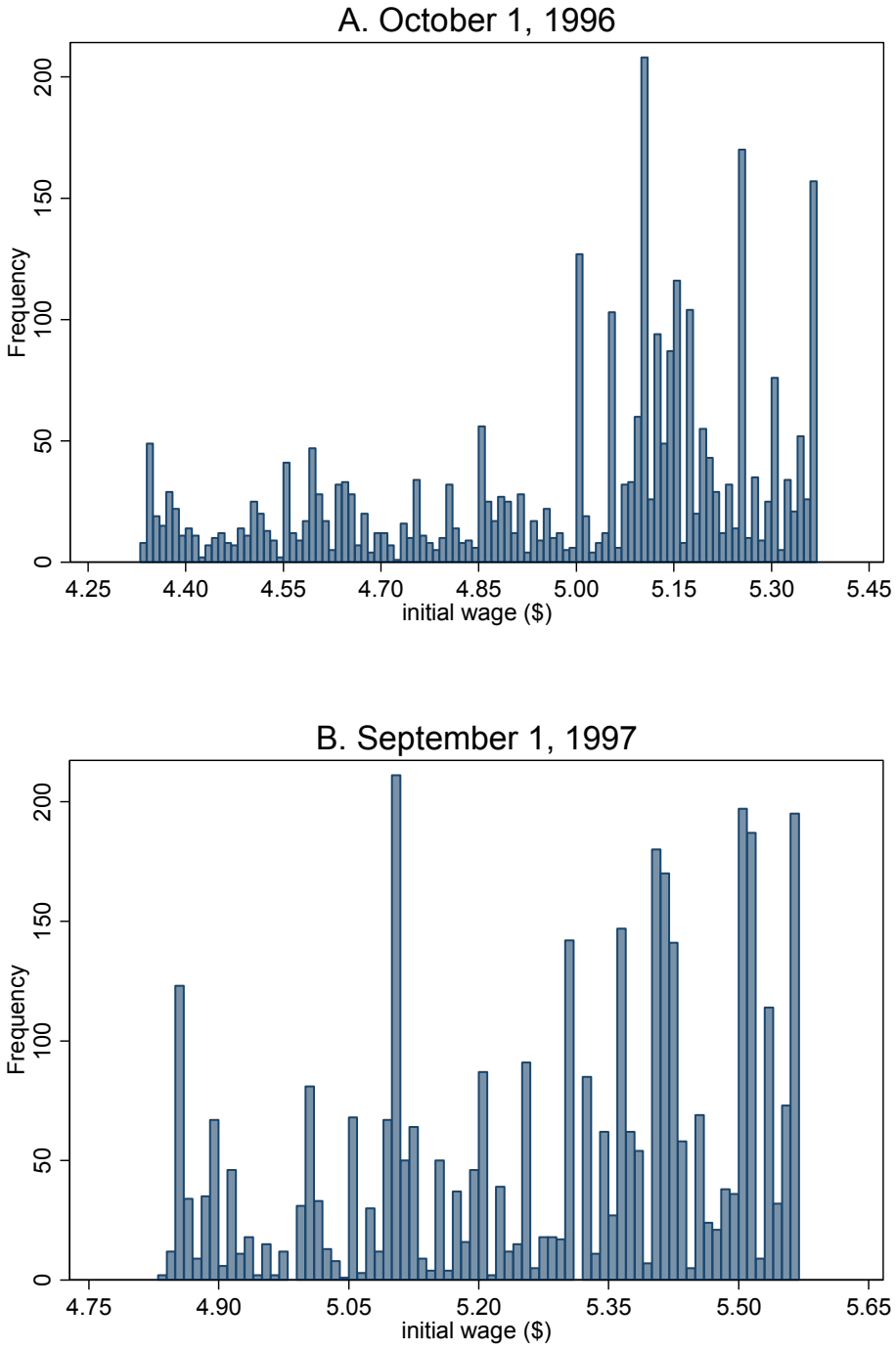
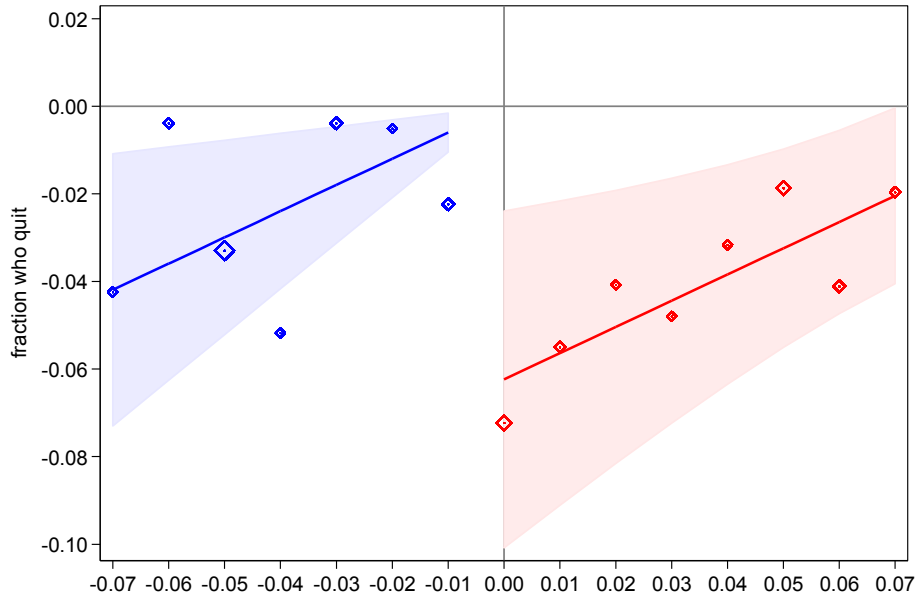
# Appendix A: Additional Figures and Tables

Figure A1. Distribution of wages on day before each minimum wage increase, estimation sample

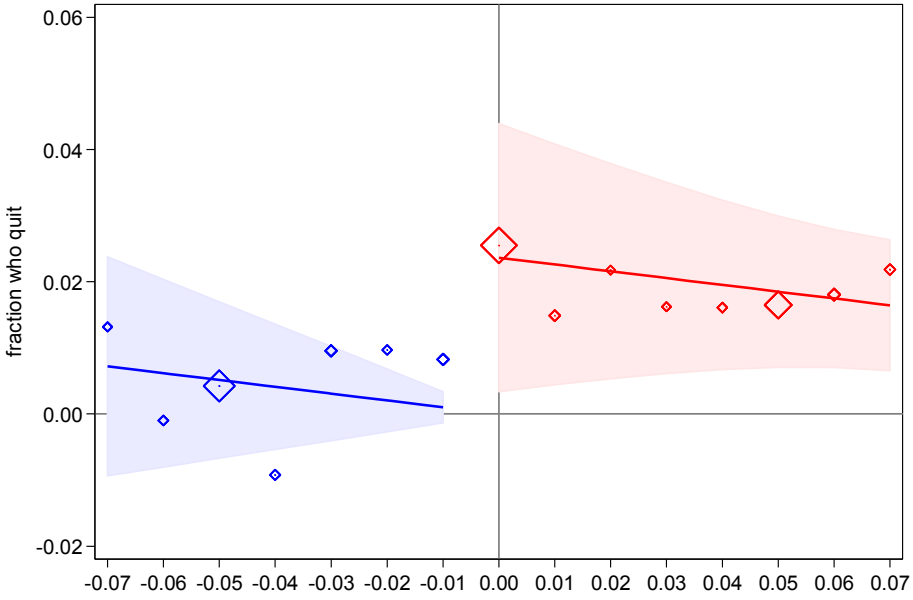



Note: Frequency distribution of initial wages for the estimation sample, including 3,009 workers employed on October 1, 1996 and 3,682 workers employed on September 1, 1997.

Figure A2. Three-month quit rate by distance from own and peer initial wages to nearest pay-step thresholds



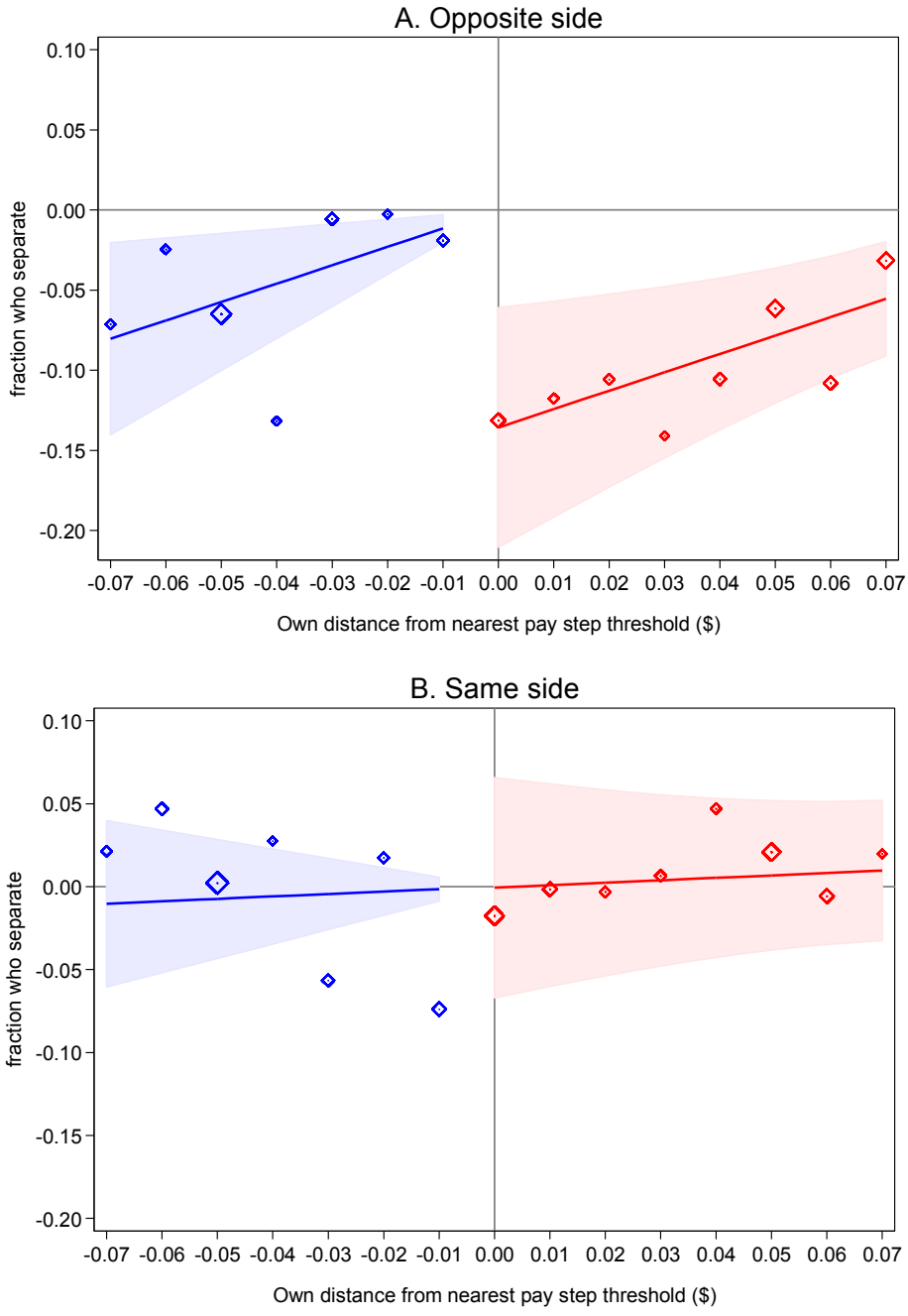

A. Own distance from nearest pay step threshold ($)




B. Peer's distance from nearest pay step threshold ($)

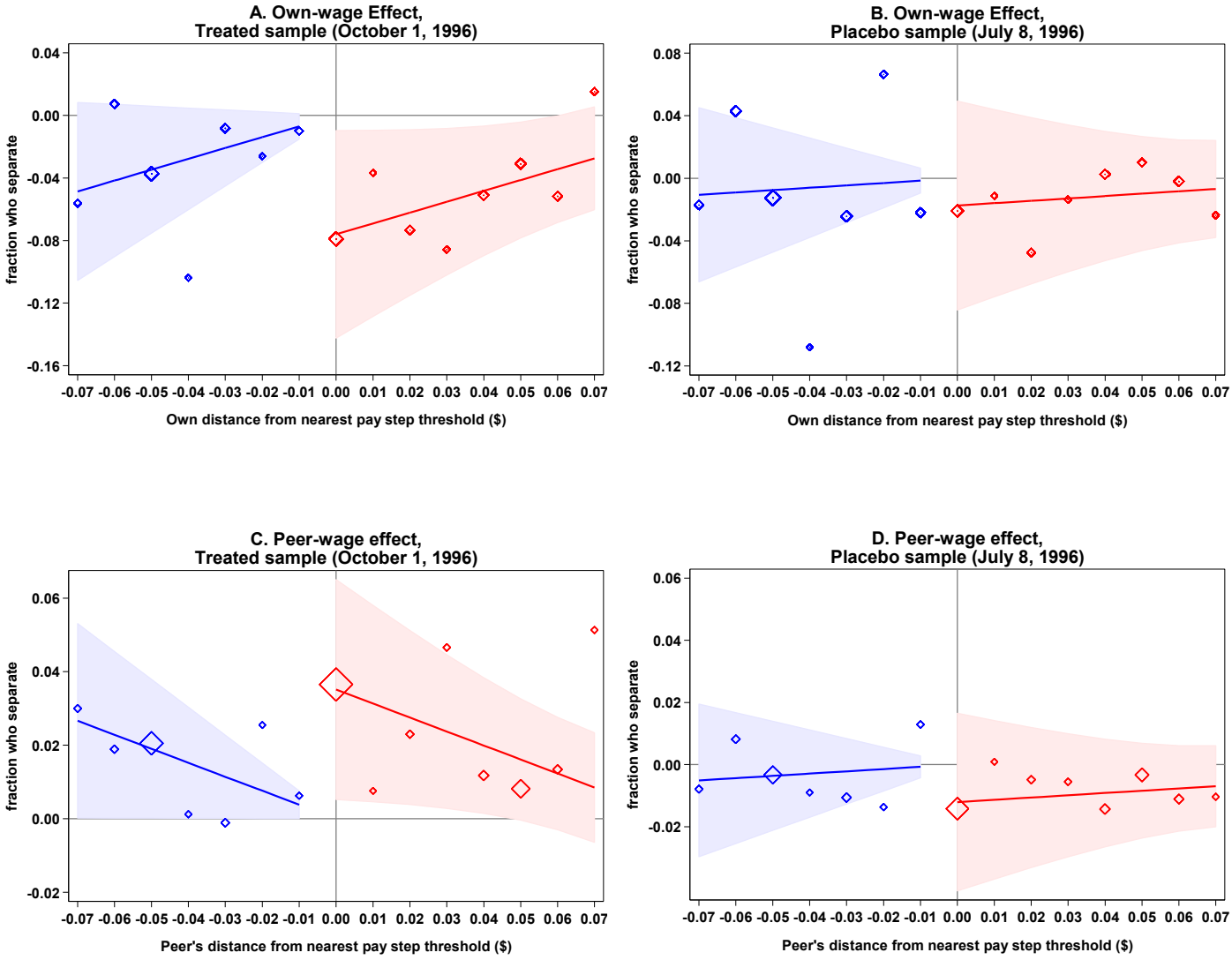
Note: The figure shows residuals from the stacked MRD model of 3-month quits with baseline controls (as in Appendix Table A9, column 4; see section 5.4 for details). The running variables are the distance from own initial wage (panel A) and the initial wage of a representative peer (panel B) to the nearest pay-step thresholds. The markers show the mean residuals for each value of the running variable; marker size is scaled by the number of observations at each value. The lines show the fitted relationship between the running variable and the residualized quits. The intercepts are normalized to be zero at the left limit of the threshold, so that the value at the right limit is the estimated effect of the $.10 discontinuity in the wage of a representative peer, and the shaded area at the right limit shows the 95% confidence interval for this estimate. Estimation samples are as in the third row of Appendix Table A9, column 4.

Figure A3. Discontinuity in 3-month separation rate at pay threshold, employees on opposite vs. same side of pay threshold as majority of peer



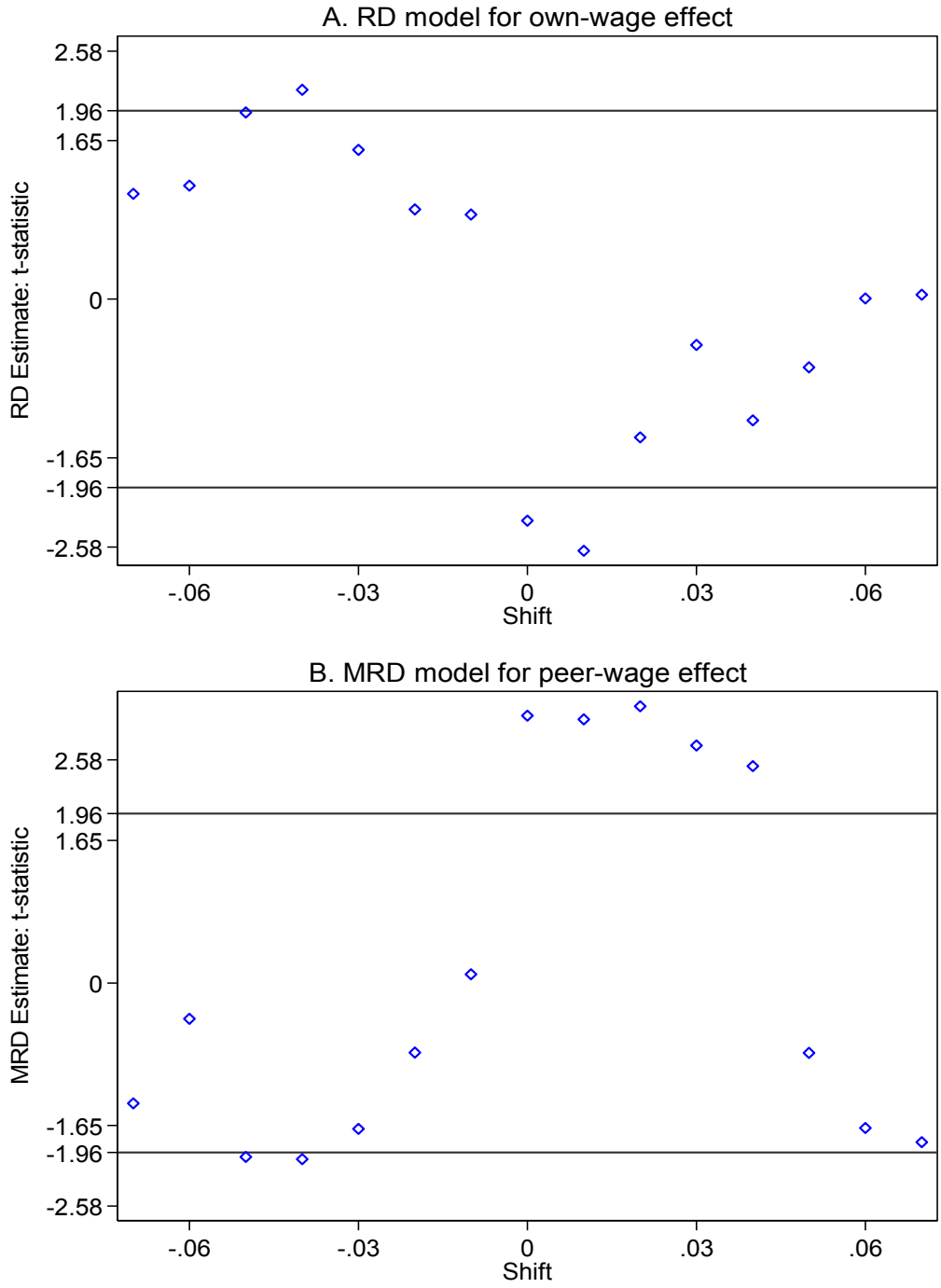

Note: The figures show residuals from stacked RD models for 3-month separations, similar to Figure 4 (see Figure 4 note). Panel A uses a sample in which the worker and the majority of her peers are on opposite sides of their nearest pay-step threshold. In Panel B, the worker and peers are on the same side of the nearest threshold. See section 5.5 for details.

Figure A4. Three-month separation rate by distance from to pay-step threshold, treated and placebo samples




Note: Panels A and B show residuals from stacked RD models for 3-month separations against the distance from the worker's own initial wage to the nearest pay-step threshold, similar to Figure 3 (see Figure 3 note). Panels C and D show residuals from stacked MRD models for 3-month separations against the distance from a given peer's initial wage to the nearest pay-step threshold, similar to Figure 4 (see Figure 4 note). Treated sample used in Panels A and C is the subset of workers in the main estimation sample who are present on the day of the first minimum wage increase (October 1, 1996). Placebo sample used in Panels B and D is employees who received a merit raise during the week of June 30 - July 7, 1996 (the week that annual merit raises were given), who were employed on July 8, 1996, and whose wages on July 8 are in the same range as the October 1, 1996 wages in the main estimation sample. Peers in the placebo sample are coworkers employed on July 8, 1996 whose wage on that day was +/- $.30 from the worker's own wage.

Figure A5. Placebo test for RD and MRD models of 3-month separations; placebo raises constructed using initial wage +/- $.07




Note: T-statistics for estimated discontinuities from RD model of quits on own wage (Panel A) and MRD model of quits on peer wage (Panel B). Each model is estimated on a data set in which the distribution of wages (or peer wages) is "shifted" by the amount indicated on the x-axis, so that estimates at all values other than 0 are estimated discontinuities in quits at wages for which there is no discontinuity in the scheduled raise. See text for details.

## Table A1. RD Estimates for wage growth

| | Dependent variable is wage growth after: | | | | |
|---|---|---|---|---|---|
| | (1) 1 month | (2) 2 months | (3) 3 months | (4) 6 months | (5) 9 months |
| scheduled raise | 0.97** | 0.98** | 0.93** | 0.95** | 0.78** |
| | (0.03) | (0.05) | (0.06) | (0.08) | (0.13) |
| constant | 0.03** | 0.06** | 0.11** | 0.16** | 0.30** |
| | (0.01) | (0.01) | (0.01) | (0.02) | (0.03) |
| Number of observations | 6005 | 5617 | 5499 | 4440 | 3844 |

Entries are coefficients from regressions of observed wage growth on the scheduled raise. Wage growth is defined as $w_t - w_0$ where $w_0$ is the initial wage and $w_t$ is the employee's wage $t$ months after the minimum wage increase. Estimation samples consist of all employees who remain employed during the indicated window. Parentheses contain robust standard errors clustered by store. † significant at 10%; * significant at 5%; ** significant at 1%.

## Table A2. Regression discontinuity estimates from models for predicted separations

| Separation window: | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| **1 month** | 0.08** | 0.04 | 0.04 | 0.01 | 0.04 | 0.04 | 0.03 | 0.05 | 0.05 |
| | (0.03) | (0.03) | (0.03) | (0.02) | (0.03) | (0.03) | (0.03) | (0.03) | (0.05) |
| **2 months** | 0.11** | 0.06† | 0.05 | 0.01 | 0.05 | 0.05 | 0.05 | 0.04 | 0.12† |
| | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.04) | (0.06) |
| **3 months** | 0.12** | 0.07* | 0.06† | 0.01 | 0.06† | 0.05 | 0.05 | 0.03 | 0.11† |
| | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.04) | (0.06) |
| **6 months** | 0.13** | 0.08† | 0.06 | 0.01 | 0.06 | 0.04 | 0.06 | 0.03 | 0.10 |
| | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.05) | (0.05) | (0.06) | (0.09) |
| **9 months** | 0.17** | 0.10* | 0.06 | 0.02 | 0.06 | 0.04 | 0.07 | 0.04 | 0.03 |
| | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.07) | (0.09) |
| Number of observations | 6473 | 6427 | 6427 | 6427 | 6427 | 6427 | 6427 | 5254 | 2466 |
| Linear own wage control | Y | Y | Y | | Y | Y | Y | Y | Y |
| ZIP code fixed effects | | Y | Y | Y | Y | Y | | Y | Y |
| 5-cent wage dummy | | | Y | Y | Y | Y | Y | Y | |
| Stacked model | | | | Y | | | | | |
| Quadratic own wage | | | | | Y | Y | | | |
| Cubic own wage | | | | | | Y | | | |
| Store fixed effects | | | | | | | Y | | |
| Donut hole | | | | | | | | Y | |
| 5-cent wages only | | | | | | | | | Y |

Note: Entries are regression coefficients from linear probability models of predicted separation within 1, 2, 3, 6 or 9 months from the day of the minimum wage increase. Model specifications in columns 1-6 correspond to those in columns 1-6 of Table 2; columns 7-9 correspond to columns 8-10 of Table 2 except that column 8 above does not include controls for worker and store-level coworker characteristics. Predicted separations are constructed from a model that includes all workers and store-level controls included in columns 7 and 8 of Table 2 (see section 4.1 and Table 2 note for details). Parentheses contain robust standard errors clustered by store. † significant at 10%; * significant at 5%; ** significant at 1%.

**Table A3. RD and MRD baseline models for separations with alternative methods for inference**

| | RD estimates for own-wage response | | | | | MRD estimates for own- and peer-wage responses | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Dependent variable = 1 if separated within:* | | | | | *Dependent variable = 1 if separated within:* | | | | |
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** | **(7)** | **(8)** | **(9)** | **(10)** |
| | **1 month** | **2 months** | **3 months** | **6 months** | **9 months** | **1 month** | **2 months** | **3 months** | **6 months** | **9 months** |
| coefficient on own raise | -0.089 | -0.461 | -0.515 | -0.614 | -0.570 | -0.084 | -0.462 | -0.549 | -0.660 | -0.577 |
| Std. errors clustered by: | | | | | | | | | | |
| Store | (0.153) | (0.184) | (0.196) | (0.231) | (0.244) | (0.151) | (0.182) | (0.194) | (0.228) | (0.240) |
| ZIP code | (0.141) | (0.164) | (0.176) | (0.215) | (0.236) | (0.146) | (0.168) | (0.183) | (0.217) | (0.240) |
| State | (0.133) | (0.155) | (0.173) | (0.181) | (0.189) | (0.140) | (0.160) | (0.180) | (0.179) | (0.190) |
| Wage | (0.122) | (0.144) | (0.154) | (0.213) | (0.281) | (0.128) | (0.154) | (0.163) | (0.218) | (0.277) |
| coefficient on peer raise | | | | | | 0.295 | 0.745 | 0.891 | 0.655 | 0.351 |
| Std. errors clustered by: | | | | | | | | | | |
| Store | | | | | | (0.230) | (0.273) | (0.294) | (0.346) | (0.352) |
| ZIP code | | | | | | (0.230) | (0.286) | (0.299) | (0.313) | (0.363) |
| State | | | | | | (0.230) | (0.206) | (0.240) | (0.348) | (0.379) |
| Wage | | | | | | (0.208) | (0.290) | (0.315) | (0.341) | (0.384) |
| Number of observations | 6691 | 6691 | 6691 | 6691 | 6691 | 58660 | 58660 | 58660 | 58660 | 58660 |

Note: Estimates from models of separations with controls as in Table 2, column3 and Table 3, column 3. Standard errors clustered at the store level are the same as those reported in Tables 2 and 3. In the following rows, clusters are defined by the 3-digit ZIP code, by the state, or by discrete values of the running variable (initial wage).

## Table A4. Alternative models for 3-month separation response to changes in own wage

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| **A. Without zip code fixed effects** | | | | | | | |
| own wage | -0.22 | -0.24 | -0.32† | -0.24 | -0.14 | -0.20 | -0.34 |
| | (0.14) | (0.15) | (0.17) | (0.18) | (0.18) | (0.19) | (0.28) |
| **B. With zip code fixed effects** | | | | | | | |
| own wage | -0.48* | -0.50** | -0.53** | -0.47* | -0.43† | -0.43† | -0.57† |
| | (0.19) | (0.19) | (0.20) | (0.22) | (0.24) | (0.24) | (0.34) |
| Number of employees | 6643 | 6643 | 6643 | 6643 | 6643 | 6643 | 6643 |
| 5-cent wage control | | Y | Y | Y | Y | Y | Y |
| Worker & store controls | | | Y | Y | | Y | Y |
| Quadratic slope | | | | Y | | | Y |
| Unequal slopes | | | | Y | Y | Y | Y |

Note: Entries are regression coefficients from linear probability models of separation within 3 months from the day of the minimum wage increase. All entries show coefficients on a dummy for own wages at or above the nearest pay-step threshold from a "stacked" model that controls linearly (or quadritically in columns 4 and 7) for the distance from own initial wage to the nearest threshold. Columns 4, 5, 6, and 7, the slopes on the distance to the threshold are allowed to be unequal. In columns 3, 4, 6, and 7, worker controls are: a dummy for each month of tenure, age and age-squared, gender and race dummies, an indicator for full-time status, size of the most recent merit raise, and the median household income in the employee's residential ZIP code; and store controls are: total number of entry-level employees on the day of the minimum wage increase, average employee age, average employee wage, the fraction who received a scheduled raise, the fraction who received a merit raise in July of the same year, and the fraction whose initial wage is a multiple of $.05. See section 4.1 for explanations of the controls in other models. The estimation sample in columns 1-7 includes all employees who received a scheduled raise on the day of the minimum wage increase and who had received a merit raise in July of the sample year (see section 3.2 for details). Parentheses contain robust standard errors clustered by store. † significant at 10%; * significant at 5%; ** significant at 1%.

**Table A5. Estimates of separation response from stacked RD and MRD models using alternate bandwidths**

| | RD | | | | MRD | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| bandwidth: | ± $0.07 | ± $0.06 | ± $0.05 | ± $0.04 | ± $0.07 | ± $0.06 | ± $0.05 | ± $0.04 |
| **1 month** | | | | | | | | |
| own wage | 0.01 | -0.01 | -0.05 | 0.03 | -0.02 | -0.01 | -0.03 | 0.01 |
| | (0.15) | (0.15) | (0.12) | (0.29) | (0.16) | (0.16) | (0.17) | (0.22) |
| peer average wage (2SLS) | | | | | 0.17 | 0.14 | 0.15 | -0.78 |
| | | | | | (0.19) | (0.19) | (0.19) | (1.13) |
| **2 month** | | | | | | | | |
| own wage | -0.42* | -0.42* | -0.42** | -0.65* | -0.58** | -0.58** | -0.60** | -0.59* |
| | (0.17) | (0.18) | (0.15) | (0.32) | (0.19) | (0.19) | (0.20) | (0.28) |
| peer average wage (2SLS) | | | | | 0.76** | 0.75** | 0.78** | -0.90 |
| | | | | | (0.23) | (0.23) | (0.22) | (1.54) |
| **3 month** | | | | | | | | |
| own wage | -0.50** | -0.48* | -0.47** | -0.61† | -0.73** | -0.74** | -0.79** | -0.92** |
| | (0.19) | (0.20) | (0.16) | (0.35) | (0.21) | (0.21) | (0.22) | (0.30) |
| peer average wage (2SLS) | | | | | 0.95** | 0.96** | 1.02** | -0.77 |
| | | | | | (0.24) | (0.25) | (0.24) | (1.68) |
| **6 month** | | | | | | | | |
| own wage | -0.60** | -0.61** | -0.47* | -0.74† | -0.80** | -0.85** | -0.87** | -0.88* |
| | (0.22) | (0.23) | (0.19) | (0.43) | (0.24) | (0.25) | (0.25) | (0.35) |
| peer average wage (2SLS) | | | | | 0.85** | 0.92** | 0.95** | -0.70 |
| | | | | | (0.28) | (0.29) | (0.27) | (1.78) |
| **9 month** | | | | | | | | |
| own wage | -0.59* | -0.63** | -0.48* | -1.22** | -0.73** | -0.77** | -0.77** | -0.65† |
| | (0.24) | (0.24) | (0.19) | (0.45) | (0.26) | (0.26) | (0.27) | (0.37) |
| peer average wage (2SLS) | | | | | 0.62* | 0.70* | 0.70* | -1.04 |
| | | | | | (0.29) | (0.30) | (0.28) | (1.91) |
| Number of employees | 6691 | 6039 | 5227 | 3430 | 6528 | 6494 | 6461 | 5903 |
| Number of observations | | | | | 58600 | 56304 | 53594 | 28992 |

Note: Columns 1 and 5 reproduce the stacked RD and MRD model estimates shown in column 4 of Tables 2 and 3 respsecively (see notes to Tables 2 and 3). Columns 2-4 show estimates from the model in column 1 using samples that are limited to narrower bandwidths above and below the paystep threshold (as indicated in the column headings). Similarly, columns 6-8 show estimates from the model in column 5 using narrower bandwidths for the peer wage. (In columns 5-8, the sample is conditioned only on the range of the peer wage, not the own wage.) Parentheses contain robust standard errors clustered by store. † significant at 10%; * significant at 5%; ** significant at 1%.

**Table A6. MRD first-stage and reduced-form estimates of separation response to changes in individual peer wages**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| **First stage (peer average wage)** | 0.42** | 0.36** | 0.34** | 0.06** | 0.29** | 0.25** | 0.35** | 0.31** | 0.30** | 0.40** |
| | (0.02) | (0.02) | (0.02) | (0.00) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| **Reduced-form models for separation within:** | | | | | | | | | | |
| **1 month** | 0.15† | 0.09 | 0.10 | 0.01 | 0.16* | 0.12 | 0.08 | 0.08 | -0.06 | 0.18† |
| | (0.08) | (0.07) | (0.08) | (0.01) | (0.08) | (0.08) | (0.08) | (0.07) | (0.12) | (0.10) |
| **2 month** | 0.34** | 0.21* | 0.25** | 0.05** | 0.32** | 0.27** | 0.22* | 0.17* | 0.16 | 0.29* |
| | (0.10) | (0.09) | (0.09) | (0.01) | (0.09) | (0.10) | (0.09) | (0.08) | (0.14) | (0.12) |
| **3 month** | 0.41** | 0.27** | 0.30** | 0.06** | 0.36** | 0.30** | 0.27** | 0.20* | 0.25† | 0.32* |
| | (0.11) | (0.09) | (0.10) | (0.01) | (0.10) | (0.10) | (0.10) | (0.09) | (0.15) | (0.13) |
| **6 month** | 0.35** | 0.18 | 0.22† | 0.05** | 0.27* | 0.24* | 0.18 | 0.17 | 0.17 | 0.27† |
| | (0.12) | (0.11) | (0.12) | (0.02) | (0.11) | (0.12) | (0.12) | (0.11) | (0.17) | (0.16) |
| **9 month** | 0.21† | 0.05 | 0.12 | 0.04* | 0.16 | 0.09 | 0.08 | 0.10 | 0.13 | 0.15 |
| | (0.12) | (0.11) | (0.12) | (0.02) | (0.12) | (0.12) | (0.12) | (0.11) | (0.17) | (0.16) |
| Number of employees | 58660 | 58660 | 58660 | 58660 | 58660 | 58660 | 58660 | 58660 | 38401 | 43216 |
| Number of observations | 6528 | 6528 | 6528 | 6528 | 6528 | 6528 | 6528 | 6528 | 6294 | 6220 |
| Linear own & peer initial wage | Y | Y | Y | | Y | Y | Y | Y | Y | Y |
| ZIP code fixed effects | | Y | Y | Y | Y | Y | Y | | Y | Y |
| 5-cent & peer merit dummies | | | Y | Y | Y | Y | Y | Y | Y | |
| Stacked model | | | | Y | | | | | | |
| Quadratic own & peer initial wage | | | | | Y | Y | | | | |
| Cubic own & peer initial wage | | | | | | Y | | | | |
| Worker, peer + store controls | | | | | | | Y | Y | | |
| Store fixed effects | | | | | | | | Y | | |
| Donut hole, peer wage | | | | | | | | | Y | |
| 5-cent only, peer wage | | | | | | | | | | Y |

Note: First-stage (top row) and reduced-form estimates for MRD models of peer effects as in Table 3. All entries except those in column 4 are coefficients on peer wage from models that control for a smooth function of peer initial wage with a separate intercept and slope in each year. Column 4 shows coefficients on a dummy for peer wages at or above the nearest pay-step threshold from a "stacked" model that controls linearly for the distance from peer initial wage to the nearest threshold. To make these estimates comparable to those from the non-stacked models, they need to be multiplied by $.10 (the size of the wage discontinuity). See Table 3 note and text for details on model specifications. Parentheses contain robust standard errors clustered on store. † significant at 10%; * significant at 5%; ** significant at 1%.

## Table A7. Estimates from MRD models for predicted separations

| Separation window: | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| **1 month** | | | | | | | | | |
| own wage | 0.07* | 0.04 | 0.04 | -0.02 | 0.04 | 0.04 | 0.04 | 0.03 | 0.05 |
| | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) |
| peer average wage (2SLS) | 0.25** | 0.12** | 0.08 | 0.03 | 0.08 | 0.08 | 0.06 | -0.04 | 0.10† |
| | (0.05) | (0.04) | (0.05) | (0.04) | (0.06) | (0.09) | (0.05) | (0.08) | (0.06) |
| **2 month** | | | | | | | | | |
| own wage | 0.07* | 0.04 | 0.04 | -0.02 | 0.04 | 0.03 | 0.04 | 0.05 | 0.04 |
| | (0.04) | (0.03) | (0.03) | (0.04) | (0.03) | (0.04) | (0.04) | (0.04) | (0.04) |
| peer average wage (2SLS) | 0.31** | 0.16** | 0.14* | 0.05 | 0.14* | 0.03 | 0.10† | 0.02 | 0.15* |
| | (0.06) | (0.05) | (0.06) | (0.04) | (0.07) | (0.16) | (0.06) | (0.10) | (0.06) |
| **3 month** | | | | | | | | | |
| own wage | 0.09* | 0.06† | 0.04 | -0.02 | 0.04 | 0.03 | 0.05 | 0.05 | 0.05 |
| | (0.04) | (0.03) | (0.03) | (0.04) | (0.03) | (0.03) | (0.04) | (0.04) | (0.04) |
| peer average wage (2SLS) | 0.30** | 0.18** | 0.09 | 0.03 | 0.08 | -0.02 | 0.09 | -0.04 | 0.10 |
| | (0.06) | (0.05) | (0.06) | (0.04) | (0.07) | (0.07) | (0.06) | (0.11) | (0.06) |
| **6 month** | | | | | | | | | |
| own wage | 0.10* | 0.07 | 0.06 | -0.02 | 0.06 | 0.04 | 0.07 | 0.08 | 0.07 |
| | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) |
| peer average wage (2SLS) | 0.42** | 0.28** | 0.12† | 0.04 | 0.10 | -0.08 | 0.15* | -0.05 | 0.16† |
| | (0.07) | (0.07) | (0.07) | (0.06) | (0.09) | (0.39) | (0.08) | (0.14) | (0.08) |
| **9 month** | | | | | | | | | |
| own wage | 0.15** | 0.10† | 0.05 | -0.00 | 0.05 | 0.04 | 0.09† | 0.07 | 0.07 |
| | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.06) | (0.05) |
| peer average wage (2SLS) | 0.44** | 0.26** | 0.01 | -0.05 | -0.02 | -0.16 | 0.11 | -0.20 | 0.07 |
| | (0.08) | (0.07) | (0.08) | (0.06) | (0.10) | (0.13) | (0.08) | (0.15) | (0.09) |
| Number of employees | 6312 | 6312 | 6312 | 6312 | 6312 | 6312 | 6312 | 6,085 | 6,010 |
| Number of observations | 58660 | 58660 | 58660 | 58660 | 58660 | 58660 | 58660 | 38401 | 43216 |
| Linear own & peer initial wage | Y | Y | Y | | Y | Y | Y | Y | Y |
| ZIP code fixed effects | | Y | Y | Y | Y | Y | | Y | Y |
| 5-cent & peer merit dummies | | | Y | Y | Y | Y | Y | Y | |
| Stacked model (see note) | | | | Y | | | | | |
| Quadratic own & peer initial wage | | | | | Y | Y | | | |
| Cubic own & peer initial wage | | | | | | Y | | | |
| Store fixed effects | | | | | | | Y | | |
| Donut hole, peer wage (see note) | | | | | | | | Y | |
| 5-cent only, peer wage (see note) | | | | | | | | | Y |

Note: Entries are estimated effects of increases in own wage and in average peer wage on the predicted probability of separation. Predicted separations are constructed from a model that includes all worker, peer and store-level controls included in columns 7 and 8 of Table 3 (see section 4.1 and Table 3 note for details). Model specifications in columns 1-6 correspond to those in columns 1-6 of Table 3; columns 7-9 correspond to columns 8-10 of Table 3 except that column 8 above does not include controls for worker, peer and store-level coworker characteristics. Parentheses contain robust standard errors clustered by store. † significant at 10%; * significant a 5%; ** significant at 1%.

## Table A8. Alternative models for 3-month separation response to changes in own wage and peer average wage

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **A. Without zip code fixed effects** | | | | | | | | | | | | |
| own wage | -0.40* | -0.41* | -0.49* | -0.48* | -0.50* | -0.58** | -0.57** | -0.57** | -0.50* | -0.49* | -0.44† | -0.74† |
| | (0.20) | (0.21) | (0.21) | (0.21) | (0.21) | (0.20) | (0.20) | (0.20) | (0.22) | (0.24) | (0.23) | (0.39) |
| peer average wage (2SLS) | 1.14** | 0.93* | 0.73* | 0.89* | 0.88* | 0.89** | 0.83** | 0.88** | 0.86* | 0.95† | 0.89† | 1.29 |
| | (0.34) | (0.36) | (0.37) | (0.40) | (0.43) | (0.25) | (0.24) | (0.27) | (0.38) | (0.50) | (0.52) | (0.94) |
| First-stage F stat | | | | | | 62.83 | 66.38 | 65.75 | 32.34 | 9.83 | 15.03 | 15.03 |
| **B. With zip code fixed effects** | | | | | | | | | | | | |
| own wage | -0.61** | -0.61** | -0.66** | -0.64** | -0.68** | -0.73** | -0.73** | -0.74** | -0.65** | -0.56* | -0.56* | -0.69† |
| | (0.21) | (0.22) | (0.22) | (0.22) | (0.22) | (0.21) | (0.21) | (0.21) | (0.23) | (0.23) | (0.24) | (0.37) |
| peer average wage (2SLS) | 0.87* | 0.82* | 0.77† | 1.08* | 0.89† | 0.97** | 0.94** | 0.87** | 0.78* | 0.78 | 0.67 | 0.62 |
| | (0.38) | (0.40) | (0.41) | (0.44) | (0.49) | (0.26) | (0.25) | (0.25) | (0.37) | (0.73) | (0.57) | (0.75) |
| First-stage F stat | | | | | | 52.30 | 64.30 | 72.47 | 27.19 | 5.47 | 10.29 | 10.29 |
| Number of employees | 5912 | 5912 | 5912 | 5912 | 5912 | 5912 | 5912 | 5912 | 5912 | 5912 | 5912 | 5912 |
| Number of observations | 5912 | 5912 | 5912 | 5912 | 5912 | 58660 | 58660 | 58660 | 58660 | 58660 | 58660 | 58660 |
| Linear in means model (control for average peer wage) | Y | Y | Y | Y | Y | | | | | | | |
| Stacked model (control for distance from own and peer threshold) | | | | | | Y | Y | Y | Y | Y | Y | Y |
| 5-cent wage & peer merit dummies | | Y | Y | Y | Y | | Y | Y | Y | Y | Y | Y |
| Worker, peer & store controls | | | Y | Y | Y | | | Y | Y | | Y | Y |
| Quadratic slope | | | | Y | | | | | Y | | | Y |
| Cubic Slope | | | | | Y | | | | | | | |
| Unequal slopes | | | | | | | | | | Y | Y | Y |

Note: Estimates in the top panel are from regressions without 3-digit ZIP code fixed effects, while estimates from the bottom panel do include ZIP code fixed effects. Columns 1-5 are from a linear-in-means models with worker-level data that control for peer average initial wage and squares and cubes thereof, as indicated. In this model, dummies for 5-cent peer wages and peers with merit raises (columns 2-5), and controls for peer and store-level coworker characteristics (columns 3-5), are averages across all peers and/or coworkers. Columns 6-12 are from stacked MRD models of peer effects using worker-peer-pair level data as in Table 3. See also Table 3 note. Parentheses contain robust standard errors clustered on store. † significant at 10%; * significant at 5%; ** significant at 1%.

## Table A9. MRD estimates of quit response to changes in own wage and peer average wage

| Separation Window: | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| **1 month** | | | | | | | | | | |
| own wage | -0.13 | -0.23* | -0.23* | -0.20† | -0.22* | -0.23* | -0.22* | -0.26* | -0.28* | -0.21† |
| | (0.10) | (0.11) | (0.11) | (0.11) | (0.11) | (0.11) | (0.11) | (0.12) | (0.11) | (0.12) |
| peer average wage (2SLS) | 0.36* | 0.25† | 0.29† | 0.30* | 0.46* | 0.15 | 0.26 | 0.24 | -0.12 | 0.40* |
| | (0.14) | (0.15) | (0.16) | (0.13) | (0.19) | (0.42) | (0.16) | (0.17) | (0.25) | (0.18) |
| Number of employees | 6105 | 6105 | 6105 | 6105 | 6105 | 6105 | 6105 | 6105 | 5885 | 5819 |
| Number of observations | 54716 | 54716 | 54716 | 54716 | 54716 | 54716 | 54716 | 54716 | 35803 | 40299 |
| **2 month** | | | | | | | | | | |
| own wage | -0.33* | -0.51** | -0.51** | -0.58** | -0.49** | -0.50** | -0.51** | -0.57** | -0.58** | -0.52** |
| | (0.15) | (0.15) | (0.15) | (0.16) | (0.15) | (0.15) | (0.15) | (0.17) | (0.16) | (0.17) |
| peer average wage (2SLS) | 0.75** | 0.50* | 0.60** | 0.73** | 0.89** | 0.29 | 0.54* | 0.36 | 0.45 | 0.60* |
| | (0.19) | (0.20) | (0.22) | (0.20) | (0.26) | (0.30) | (0.22) | (0.23) | (0.34) | (0.25) |
| Number of employees | 5935 | 5935 | 5935 | 5935 | 5935 | 5935 | 5935 | 5935 | 5722 | 5660 |
| Number of observations | 52967 | 52949 | 52949 | 52949 | 52949 | 52949 | 52949 | 52913 | 34610 | 39029 |
| **3 month** | | | | | | | | | | |
| own wage | -0.32† | -0.55** | -0.58** | -0.72** | -0.56** | -0.58** | -0.59** | -0.64** | -0.60** | -0.59** |
| | (0.17) | (0.17) | (0.17) | (0.19) | (0.17) | (0.17) | (0.17) | (0.19) | (0.18) | (0.19) |
| peer average wage (2SLS) | 0.83** | 0.61** | 0.68** | 0.86** | 0.95** | 0.72* | 0.64* | 0.40 | 0.71† | 0.61* |
| | (0.22) | (0.23) | (0.26) | (0.22) | (0.31) | (0.32) | (0.25) | (0.26) | (0.40) | (0.29) |
| Number of employees | 5841 | 5841 | 5841 | 5841 | 5841 | 5841 | 5841 | 5841 | 5630 | 5572 |
| Number of observations | 52098 | 52080 | 52080 | 52080 | 52080 | 52080 | 52080 | 52043 | 34085 | 38355 |
| **6 month** | | | | | | | | | | |
| own wage | -0.41† | -0.63** | -0.67** | -0.78** | -0.64** | -0.68** | -0.71** | -0.72** | -0.58* | -0.79** |
| | (0.22) | (0.22) | (0.23) | (0.24) | (0.23) | (0.24) | (0.23) | (0.24) | (0.25) | (0.24) |
| peer average wage (2SLS) | 0.94** | 0.66* | 0.69* | 0.84** | 0.99* | -0.12 | 0.66* | 0.55 | 0.69 | 0.68† |
| | (0.29) | (0.32) | (0.35) | (0.29) | (0.40) | (1.37) | (0.34) | (0.34) | (0.53) | (0.39) |
| Number of employees | 5372 | 5372 | 5372 | 5372 | 5372 | 5372 | 5372 | 5372 | 5181 | 5122 |
| Number of observations | 47659 | 47643 | 47643 | 47643 | 47643 | 47643 | 47643 | 47607 | 31174 | 35149 |
| **9 month** | | | | | | | | | | |
| own wage | -0.46† | -0.72** | -0.73** | -0.86** | -0.70** | -0.73** | -0.74** | -0.94** | -0.61* | -0.88** |
| | (0.25) | (0.26) | (0.27) | (0.28) | (0.27) | (0.27) | (0.27) | (0.29) | (0.30) | (0.29) |
| peer average wage (2SLS) | 0.73* | 0.36 | 0.47 | 0.77* | 0.72 | -0.10 | 0.46 | 0.22 | 0.32 | 0.47 |
| | (0.32) | (0.34) | (0.39) | (0.32) | (0.45) | (0.54) | (0.38) | (0.39) | (0.59) | (0.45) |
| Number of employees | 5027 | 5027 | 5027 | 5027 | 5027 | 5027 | 5027 | 5027 | 4846 | 4792 |
| Number of observations | 44641 | 44622 | 44622 | 44622 | 44622 | 44622 | 44622 | 44587 | 29144 | 32936 |
| Linear own & peer initial wage | Y | Y | Y | | Y | Y | Y | Y | Y | Y |
| ZIP code fixed effects | | Y | Y | Y | Y | Y | Y | | Y | Y |
| 5-cent & peer merit dummies | | | Y | Y | Y | Y | Y | Y | Y | |
| Stacked model (see note) | | | | Y | | | | | | |
| Quadratic own & peer initial wage | | | | | Y | Y | | | | |
| Cubic own & peer initial wage | | | | | | Y | | | | |
| Worker, peer + store controls | | | | | | | Y | Y | | |
| Store fixed effects | | | | | | | | Y | | |
| Donut hole, peer wage (see note) | | | | | | | | | Y | |
| 5-cent only, peer wage (see note) | | | | | | | | | | Y |

Note: Entries are estimated effects of increases in own wage and in average peer wage on the probability of quitting within 1, 2, 3, 6 or 9 months from the day of the minimum wage increase. Model specifications are the same as those in Table 3 (see Table 3 note). The estimation samples exclude workers terminate employment for a reason other than quitting within the specified interval (i.e. non-quit separations are treated as censored). Parentheses contain robust standard errors clustered by store. † Significant at 10%; * significant at 5%; ** significant at 1%.

**Table A10. Estimates from 2SLS MRD models for probability of being in quits sample (not having separated for non-quit reason)**

| Separation Window: | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| **1 month** | | | | | | | | | | |
| own wage | -0.04 | -0.12 | -0.14 | -0.17 | -0.15 | -0.16 | -0.10 | -0.15 | -0.18 | -0.16 |
| | (0.11) | (0.11) | (0.12) | (0.14) | (0.12) | (0.12) | (0.12) | (0.13) | (0.13) | (0.13) |
| peer average wage (2SLS) | -0.03 | -0.03 | -0.05 | 0.11 | -0.16 | 0.13 | -0.00 | -0.13 | 0.08 | -0.12 |
| | (0.14) | (0.16) | (0.17) | (0.16) | (0.20) | (0.22) | (0.17) | (0.18) | (0.31) | (0.20) |
| **2 month** | | | | | | | | | | |
| own wage | 0.03 | -0.01 | -0.02 | 0.05 | -0.03 | -0.00 | 0.02 | -0.08 | -0.11 | -0.05 |
| | (0.13) | (0.13) | (0.14) | (0.15) | (0.14) | (0.14) | (0.14) | (0.15) | (0.15) | (0.15) |
| peer average wage (2SLS) | -0.16 | -0.13 | -0.20 | -0.09 | -0.33 | 0.25 | -0.13 | -0.34† | -0.14 | -0.21 |
| | (0.16) | (0.18) | (0.20) | (0.17) | (0.22) | (0.30) | (0.19) | (0.21) | (0.35) | (0.23) |
| **3 month** | | | | | | | | | | |
| own wage | 0.06 | 0.05 | 0.03 | 0.10 | 0.02 | 0.05 | 0.06 | -0.04 | -0.07 | 0.02 |
| | (0.14) | (0.14) | (0.14) | (0.16) | (0.14) | (0.15) | (0.14) | (0.15) | (0.16) | (0.15) |
| peer average wage (2SLS) | -0.26 | -0.22 | -0.30 | -0.21 | -0.42† | 0.15 | -0.23 | -0.43* | -0.23 | -0.29 |
| | (0.18) | (0.19) | (0.21) | (0.18) | (0.24) | (0.32) | (0.20) | (0.22) | (0.36) | (0.25) |
| **6 month** | | | | | | | | | | |
| own wage | 0.15 | 0.14 | 0.11 | 0.20 | 0.10 | 0.13 | 0.15 | 0.04 | -0.01 | 0.14 |
| | (0.18) | (0.18) | (0.19) | (0.20) | (0.19) | (0.19) | (0.19) | (0.20) | (0.20) | (0.20) |
| peer average wage (2SLS) | -0.10 | 0.02 | -0.14 | -0.22 | -0.23 | 0.33 | -0.01 | -0.29 | -0.04 | -0.21 |
| | (0.23) | (0.24) | (0.27) | (0.23) | (0.30) | (0.36) | (0.25) | (0.28) | (0.45) | (0.31) |
| **9 month** | | | | | | | | | | |
| own wage | 0.05 | 0.03 | 0.01 | 0.10 | -0.00 | 0.03 | 0.05 | -0.06 | -0.01 | 0.04 |
| | (0.19) | (0.19) | (0.20) | (0.21) | (0.20) | (0.20) | (0.19) | (0.21) | (0.21) | (0.21) |
| peer average wage (2SLS) | 0.10 | 0.17 | 0.00 | -0.09 | -0.09 | 0.56 | 0.16 | -0.29 | -0.25 | -0.01 |
| | (0.25) | (0.26) | (0.29) | (0.25) | (0.33) | (0.44) | (0.28) | (0.31) | (0.49) | (0.34) |
| Number of employees | *6528* | *6528* | *6528* | *6528* | *6528* | *6528* | *6528* | *6528* | *6294* | *6220* |
| Number of observations | *58660* | *58660* | *58660* | *58660* | *58660* | *58660* | *58660* | *58660* | *38401* | *43216* |
| Linear own & peer initial wage | Y | Y | Y | | Y | Y | Y | Y | Y | Y |
| ZIP code fixed effects | | Y | Y | Y | Y | Y | Y | | Y | Y |
| 5-cent & peer merit dummies | | | Y | Y | Y | Y | Y | Y | Y | |
| Stacked model (see note) | | | | Y | | | | | | |
| Quadratic own & peer initial wage | | | | | Y | Y | | | | |
| Cubic own & peer initial wage | | | | | | Y | | | | |
| Worker, peer + store controls | | | | | | | Y | Y | | |
| Store fixed effects | | | | | | | | Y | | |
| Donut hole, peer wage (see note) | | | | | | | | | Y | |
| 5-cent only, peer wage (see note) | | | | | | | | | | Y |

Note: Entries are estimated effects of increases in own wage and in average peer wage on the probability of remaining in the analysis sample for the models of quits shown in Appendix Table A9; i.e., the probability that a worker has not terminated employment for a reason other than quitting within the specified interval. Model specifications are the same as those in Table 3 (see Table 3 note). Parentheses contain robust standard errors clustered by store. Parentheses contain robust standard errors clustered by store. † significant at 10%; * significant at 5%; ** significant at 1%.

**Table A11. Estimates from 2SLS MRD models for predicted quits**

| Separation window: | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| **1 month** | | | | | | | | | |
| own wage | 0.07** | 0.04** | 0.03+ | -0.02 | 0.03+ | 0.02 | 0.03* | 0.03* | 0.03* |
| | (0.02) | (0.01) | (0.01) | (0.01) | (0.01) | (0.02) | (0.01) | (0.02) | (0.01) |
| peer average wage (2SLS) | 0.13** | 0.07** | 0.02 | 0.01 | 0.02 | 0.00 | 0.02 | -0.04 | 0.05 |
| | (0.03) | (0.02) | (0.03) | (0.02) | (0.03) | (0.15) | (0.03) | (0.04) | (0.03) |
| Number of employees | 6105 | 6105 | 6105 | 6105 | 6105 | 6105 | 6105 | 5885 | 5819 |
| Number of observations | 54716 | 54716 | 54716 | 54716 | 54716 | 54716 | 54716 | 35803 | 40299 |
| **2 month** | | | | | | | | | |
| own wage | 0.06* | 0.03 | 0.02 | -0.02 | 0.03 | 0.01 | 0.03 | 0.04* | 0.03 |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| peer average wage (2SLS) | 0.15** | 0.05 | 0.05 | 0.03 | 0.05 | -0.04 | 0.03 | 0.01 | 0.05 |
| | (0.04) | (0.03) | (0.04) | (0.03) | (0.04) | (0.12) | (0.03) | (0.06) | (0.04) |
| Number of employees | 5935 | 5935 | 5935 | 5935 | 5935 | 5935 | 5935 | 5722 | 5660 |
| Number of observations | 52967 | 52949 | 52949 | 52949 | 52949 | 52949 | 52913 | 34610 | 39029 |
| **3 month** | | | | | | | | | |
| own wage | 0.06* | 0.05+ | 0.04 | -0.02 | 0.04 | 0.03 | 0.04+ | 0.06* | 0.04 |
| | (0.03) | (0.02) | (0.02) | (0.03) | (0.02) | (0.02) | (0.02) | (0.03) | (0.03) |
| peer average wage (2SLS) | 0.13** | 0.07+ | 0.02 | 0.02 | 0.01 | -0.09+ | 0.01 | -0.02 | 0.01 |
| | (0.04) | (0.04) | (0.04) | (0.03) | (0.05) | (0.05) | (0.04) | (0.07) | (0.05) |
| Number of employees | 5841 | 5841 | 5841 | 5841 | 5841 | 5841 | 5841 | 5630 | 5572 |
| Number of observations | 52098 | 52080 | 52080 | 52080 | 52080 | 52080 | 52043 | 34085 | 38355 |
| **6 month** | | | | | | | | | |
| own wage | 0.08* | 0.06+ | 0.03 | -0.04 | 0.03 | 0.02 | 0.05 | 0.06+ | 0.04 |
| | (0.04) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.04) | (0.03) |
| peer average wage (2SLS) | 0.34** | 0.25** | 0.04 | 0.03 | 0.02 | -0.11+ | 0.07 | -0.01 | 0.04 |
| | (0.06) | (0.05) | (0.06) | (0.04) | (0.07) | (0.07) | (0.05) | (0.10) | (0.06) |
| Number of employees | 5372 | 5372 | 5372 | 5372 | 5372 | 5372 | 5372 | 5181 | 5122 |
| Number of observations | 47659 | 47643 | 47643 | 47643 | 47643 | 47643 | 47607 | 31174 | 35149 |
| **9 month** | | | | | | | | | |
| own wage | 0.13** | 0.08+ | 0.02 | -0.03 | 0.02 | 0.01 | 0.07+ | 0.06 | 0.04 |
| | (0.05) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.05) | (0.04) |
| peer average wage (2SLS) | 0.44** | 0.27** | -0.06 | -0.06 | -0.08 | -0.18 | 0.05 | -0.15 | -0.03 |
| | (0.08) | (0.07) | (0.07) | (0.05) | (0.08) | (0.16) | (0.07) | (0.14) | (0.08) |
| Number of employees | 5027 | 5027 | 5027 | 5027 | 5027 | 5027 | 5027 | 4846 | 4792 |
| Number of observations | 44641 | 44622 | 44622 | 44622 | 44622 | 44622 | 44587 | 29144 | 32936 |
| Linear own & peer initial wage | Y | Y | Y | | Y | Y | Y | Y | Y |
| ZIP code fixed effects | | Y | Y | Y | Y | Y | | Y | Y |
| 5-cent & peer merit dummies | | | Y | Y | Y | Y | Y | Y | |
| Stacked model (see note) | | | | Y | | | | | |
| Quadratic own & peer initial wage | | | | | Y | Y | | | |
| Cubic own & peer initial wage | | | | | | Y | | | |
| Worker, peer + store controls | | | | | | | Y | | |
| Store fixed effects | | | | | | | Y | | |
| Donut hole, peer wage (see note) | | | | | | | | Y | |
| 5-cent only, peer wage (see note) | | | | | | | | | Y |

Note: Entries are estimated effects of increases in own wage and in average peer wage on the predicted probability of quiting. Predicted quits are constructed from a model that includes all worker, peer and store-level controls included in columns 7 and 8 of Appendix Table A9. Model specifications in columns 1-6 correspond to those in columns 1-6 of Appendix Table A9; columns 7-9 correspond to columns 8-10 of Appendix Table A9 except that column 8 above does not include controls for worker, peer and store-level coworker characteristics. Parentheses contain robust standard errors clustered by store. † significant at 10%; * significant at 5%; ** significant at 1%.

**Table A12. Separation response to an increase in peer average wage, for various peer definitions based on initial wage proximity**

| | *Maximum distance of peer's initial wage from employee's initial wage:* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Separation window:** | **$0.10** | **$0.20** | **$0.30** | **$0.40** | **$0.50** | **$0.60** | **$0.70** | **$0.80** | **store** |
| **1 month** | 0.04 | 0.09 | 0.30 | 0.16 | 0.30 | 0.21 | 0.23 | 0.17 | 0.21 |
| | (0.21) | (0.20) | (0.23) | (0.32) | (0.38) | (0.43) | (0.47) | (0.45) | (0.44) |
| **2 months** | 0.11 | 0.37 | 0.75 | 0.72 | 1.02 | 0.91 | 0.94 | 0.81 | 0.85 |
| | (0.25) | (0.24) | (0.27) | (0.36) | (0.44) | (0.51) | (0.54) | (0.51) | (0.50) |
| **3 months** | 0.18 | 0.55 | 0.89 | 0.88 | 1.28 | 1.15 | 1.05 | 0.97 | 0.96 |
| | (0.27) | (0.25) | (0.29) | (0.39) | (0.48) | (0.55) | (0.59) | (0.56) | (0.55) |
| **6 months** | 0.21 | 0.27 | 0.66 | 0.81 | 0.90 | 0.71 | 0.71 | 0.40 | 0.37 |
| | (0.32) | (0.31) | (0.35) | (0.45) | (0.56) | (0.63) | (0.66) | (0.62) | (0.60) |
| **9 months** | 0.24 | 0.21 | 0.35 | 0.37 | 0.47 | 0.38 | 0.36 | -0.04 | -0.08 |
| | (0.33) | (0.33) | (0.35) | (0.47) | (0.57) | (0.64) | (0.67) | (0.63) | (0.62) |
| MSPE (out of sample) | 1.13 | 0.98 | 0.65 | 0.84 | 1.08 | 1.19 | 1.30 | 1.25 | 1.21 |
| Number of employees | 5776 | 6385 | 6528 | 6575 | 6593 | 6607 | 6613 | 6614 | 6616 |
| Number of observations | 26810 | 45672 | 58660 | 67972 | 74116 | 78368 | 81133 | 82732 | 84035 |
| fraction of all potential peers | 0.34 | 0.57 | 0.72 | 0.83 | 0.89 | 0.94 | 0.97 | 0.98 | 1.00 |

Note: Entries are estimates for the 1, 2, 3, 6 and 9 month separation responses to an increase in the average peer wage, where peer groups are defined using alternative wage bands for the maximum gap in initial wages between the worker and the peer. Peer-wage responses are estimated using two-stage MRD models that include the baseline set of controls as in Table 3, column 3. MSPE is the average mean squared prediction error when using an estimate based on the indicated peer-group definition to predict out of sample the estimate based on all potential peers in the store (see Online Appendix E for details). Parentheses contain robust standard errors clustered by store. † Significant at 10%; * significant at 5%; ** significant at 1%.

**Table A13. Estimated separation response to an increase in peer average wage, for alternative peer-group definitions**

| Peer Group Definition: | Separation window: 1 mo | 2 mos | 3 mos | 6 mos | 9 mos | number of observations (peer-pairs) | number of employees | fraction of all potential peers |
|---|---|---|---|---|---|---|---|---|
| **coworkers within $.30 of initial wage (baseline)** | 0.29 | 0.74** | 0.89** | 0.65† | 0.35 | 58660 | 6528 | 0.72 |
| | (0.23) | (0.27) | (0.29) | (0.35) | (0.35) | | | |
| **coworkers with initial wages closest to employee:** | | | | | | | | |
| closest 5 coworkers | 0.19 | 0.41 | 0.49† | 0.42 | 0.51 | 40297 | 6616 | 0.62 |
| | (0.23) | (0.26) | (0.29) | (0.33) | (0.34) | | | |
| closest 10 coworkers | 0.26 | 0.65* | 0.66* | 0.40 | 0.37 | 59921 | 6616 | 0.80 |
| | (0.27) | (0.30) | (0.33) | (0.37) | (0.38) | | | |
| closest 15 coworkers | 0.29 | 0.79* | 0.86* | 0.53 | 0.38 | 69116 | 6616 | 0.87 |
| | (0.33) | (0.37) | (0.40) | (0.45) | (0.45) | | | |
| closest 20 coworkers | 0.32 | 0.89* | 0.94* | 0.62 | 0.44 | 73747 | 6616 | 0.89 |
| | (0.34) | (0.39) | (0.42) | (0.47) | (0.47) | | | |
| **coworkers similar on other dimensions:** | | | | | | | | |
| similar in age (age difference < 5 years) | 0.49 | 0.77† | 0.71 | 0.84 | 0.30 | 56339 | 6087 | 0.67 |
| | (0.38) | (0.46) | (0.49) | (0.56) | (0.57) | | | |
| similar tenure (both employed >8 months or ≤8 months) | 0.34 | 0.30 | 0.43 | -0.03 | 0.28 | 37086 | 6270 | 0.46 |
| | (0.32) | (0.38) | (0.42) | (0.49) | (0.49) | | | |
| same merit raise status (peer also got merit raise) | 0.47 | 0.66† | 0.68† | 0.05 | 0.11 | 33613 | 6260 | 0.42 |
| | (0.32) | (0.37) | (0.40) | (0.46) | (0.49) | | | |
| **coworkers within fixed geographic proximity:** | | | | | | | | |
| live within 6 miles of employee's ZIP code | 0.03 | 0.31 | 0.24 | 0.05 | -0.04 | 33291 | 5436 | 0.42 |
| | (0.27) | (0.31) | (0.33) | (0.38) | (0.39) | | | |
| live within 9 miles of employee's ZIP code | 0.24 | 0.63† | 0.51 | 0.32 | 0.14 | 48826 | 5854 | 0.60 |
| | (0.31) | (0.35) | (0.37) | (0.42) | (0.43) | | | |
| live within 12 miles of employee's ZIP code | 0.26 | 0.66 | 0.65 | 0.48 | 0.23 | 58250 | 6025 | 0.71 |
| | (0.37) | (0.43) | (0.46) | (0.50) | (0.51) | | | |

Note: Entries are estimates for the 1, 2, 3, 6 and 9 month separation responses to an increase in the average peer wage from two-stage MRD models for peer groups defined using alternative definitions based on wages, age, tenure, merit pay raise status, and geography, as indicated. MRD models include baseline set of controls as in Table 3, model 3. Parentheses contain robust standard errors clustered by store. † significant at 10%; * significant at 5%; ** significant at 1%.

**Table A14. Heterogeneity in estimated separation response to an increase in peer average wage, by initial wage gap**

| Initial wage gap (own wage – peer wage): | Separation window: 1 mo | 2 mos | 3 mos | 6 mos | 9 mos | number of observations (peer-pairs) | number of employees | fraction of all potential peers |
|---|---|---|---|---|---|---|---|---|
| **Panel A** | | | | | | | | |
| Under 0.30 | 0.43 | 1.02 | 1.06 | 0.35 | -0.50 | 9679 | 2200 | 0.30 |
| | -0.62 | -0.70 | -0.80 | -0.89 | -0.97 | | | |
| -0.30 to -0.16 | 0.35 | 0.56 | 0.95* | 0.39 | -0.17 | 9553 | 3302 | 0.22 |
| | -0.29 | -0.36 | -0.40 | -0.45 | -0.46 | | | |
| -0.15 to -0.01 | 0.39 | 0.62* | 0.70* | 0.76* | 0.66† | 12299 | 4136 | 0.24 |
| | -0.27 | -0.30 | -0.31 | -0.37 | -0.39 | | | |
| 0.01 to 0.15 | 0.01 | -0.01 | 0.01 | -0.09 | 0.06 | 20395 | 4653 | 0.32 |
| | -0.24 | -0.28 | -0.30 | -0.35 | -0.37 | | | |
| 0.16 to 0.30 | 0.18 | 0.32 | 0.18 | -0.47 | -0.68 | 11624 | 3094 | 0.27 |
| | -0.30 | -0.35 | -0.39 | -0.45 | -0.49 | | | |
| Over 0.30 | -0.47 | -0.61 | -0.49 | -0.34 | 0.16 | 15656 | 2705 | 0.38 |
| | -0.34 | -0.40 | -0.44 | -0.49 | -0.50 | | | |
| **Panel B** | | | | | | | | |
| -0.01 or below | 0.58† | 1.21** | 1.39** | 0.98* | 0.31 | 31594 | 5145 | 0.25 |
| | -0.33 | -0.39 | -0.41 | -0.46 | -0.47 | | | |
| 0.01 or above | -0.02 | 0.13 | 0.16 | -0.26 | -0.06 | 47735 | 5414 | 0.33 |
| | -0.26 | -0.30 | -0.32 | -0.37 | -0.38 | | | |
| **Panel C** | | | | | | | | |
| -0.30 to -0.01 | 0.39 | 0.74* | 0.94** | 0.63† | 0.22 | 21885 | 4987 | 0.23 |
| | -0.25 | -0.29 | -0.31 | -0.36 | -0.36 | | | |
| 0.01 to 0.30 | 0.06 | 0.14 | 0.15 | -0.18 | -0.17 | 32050 | 5238 | 0.30 |
| | -0.22 | -0.26 | -0.28 | -0.32 | -0.34 | | | |

Note: Entries are estimates for the 1, 2, 3, 6 and 9 month separation responses to an increase in the average peer wage from two-stage MRD models for alternative peer groups. In Panel A, six groups were constructed by partitioning all potential worker-peer pairs by the initial wage gap between the worker and the peer. In Panel B, 2 groups were constructed by partioning all potential worker-peer pairs by initial wage gap. In Panel C, we restrict the sample to worker-peer pairs with a maximal $0.30 gap in initial wages. All MRD models include baseline set of controls as in Table 3, model 3. Parentheses contain robust standard errors clustered by store. † significant at 10%; * significant at 5%; ** significant at 1%.

## Appendix B: Extension of the model with endogenous search intensity

In the model in section 2, relative pay concerns affect separation decisions by changing the value of the current job relative to an outside offer, and offers arrive at a fixed rate $\lambda$. We now consider the case where $\lambda$ is endogenous, and a decline in relative pay not only reduces the minimum value of an acceptable outside offer, but also increases the offer arrival rate by inducing workers to search harder. If we model $\lambda(e)$ as a function of search effort, $e$, with an (eventually) convex search cost, $c(e)$, then workers maximize:

$$U + \lambda(e) \times E\left(v_0 w + v(w - w_p) - v_0 w' \,|v_0 w + v(w - w_p) > v_0 w'\right) - c(e)$$

The first order condition is:

$$\frac{\lambda'(e)}{c'(e)} = E\left(w + \frac{v(w - w_p)}{v_0} - w' \middle| w + \frac{v(w - w_p)}{v_0} > w'\right)$$

The first order condition above defines the optimal $e^*$ and hence $\lambda(e^*)$. Depending on the functional form of the cost function $c(e)$, it is possible to have a corner solution with $e^* = 0$ when utility from the job $U$ is sufficiently high, or a maximum level $e^* = \overline{e}$ when $U$ is sufficiently low. In any case, $\lambda$ will be a (weakly) increasing function of the utility from the job measured in units of own-wage, $\frac{U}{v_0} = w + \frac{v(w-w_p)}{v_0}$.

Now the separation rate can be written as:

$$S(w, w_p) = \theta\delta + \lambda\left(w + \frac{v(w - w_p)}{v_0}\right)\left[1 - F\left(w + \frac{v(w - w_p)}{v_0}\right)\right]$$

Differentiating the separation rate with respect to $w$ and $w_p$ implies:

$$\begin{array}{rcl} \frac{\partial S(w,w_p)}{\partial w} & = & \left[-\lambda\left(w + \frac{v(w-w_p)}{v_0}\right) \cdot f\left(w + \frac{v(w-w_p)}{v_0}\right)\right. \\ & & \left. + \left(1 - F\left(w + \frac{v(w-w_p)}{v_0}\right)\right)\lambda'\left(w + \frac{v(w-w_p)}{v_0}\right)\right] \times \left(1 + \frac{v'(w-w_p)}{v_0}\right) \\ \frac{\partial S(w,w_p)}{\partial w_p} & = & -\left[-\lambda\left(w + \frac{v(w-w_p)}{v_0}\right) \cdot f\left(w + \frac{v(w-w_p)}{v_0}\right)\right. \\ & & \left. + \left(1 - F\left(w + \frac{v(w-w_p)}{v_0}\right)\right)\lambda'\left(w + \frac{v(w-w_p)}{v_0}\right)\right] \times \left(\frac{v'(w-w_p)}{v_0}\right) \end{array} \quad (1)$$

As in the case of constant $\lambda$, the ratio of the two separation responses still recovers the compensating differential for the relative pay gap:

$$\alpha(w - w_p) = -\frac{\frac{\partial S(w,w_p)}{\partial w_p}}{\frac{\partial S(w,w_p)}{\partial w}} = \frac{v'(w_g)}{v_0 + v'(w_g)} \tag{2}$$

Likewise, the gap constant response is still the sum of the own-wage and peer-wage effects, and is equal to:

$$\begin{aligned} \frac{\partial S(w,w_g)}{\partial w} \quad = \quad & -\lambda\left(w + \tfrac{v(w-w_p)}{v_0}\right) \cdot f\left(w + \tfrac{v(w-w_p)}{v_0}\right) \\ & + \left(1 - F\left(w + \tfrac{v(w-w_p)}{v_0}\right)\right) \lambda'\left(w + \tfrac{v(w-w_p)}{v_0}\right) \end{aligned}$$

Different from before, the separation response now depends on how the offer arrival rate, $\lambda$, changes with search intensity. For example, if there is a fixed cost to searching, small relative wage changes may produce large increases in separations, while further changes in wages may have smaller marginal effects. This suggests caution in extrapolating our estimates to predict responses to much larger wage increases.

## Appendix C: Ruling Out Precise Manipulation of Wages

The round number bunching of wages in our sample (Appendix Figure A1) raises the concern that managers manipulated merit raises to ensure that the scheduled raise would bump certain workers up to a higher pay step–thus potentially invalidating the RD design. To assess this concern, we stack the thresholds and in Figure C1 we plot the frequency distribution of $r_{iy}$ (the distance from own wage to the nearest threshold). There are clear spikes not only at the thresholds but also at values ± \$0.05 from a threshold.

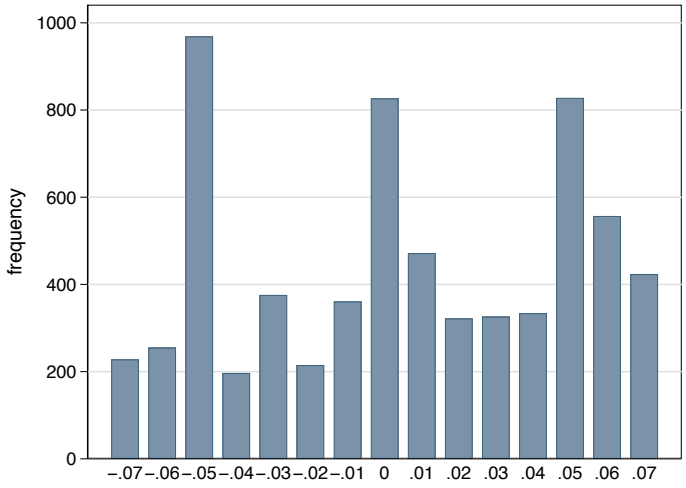



Figure C1: Histogram of Distance to Nearest Threshold

Note: Figure plots frequency distribution of the distance from initial wages in our sample to the nearest pay-step threshold. Based on estimation sample of 6,691 initial wages.

To formally test for excess bunching at the thresholds, we regress the initial wage frequency (using the unstacked data) on a 5-cent dummy and a dummy for being at a threshold. Table C1 reports the results. While the 5-cent dummy coefficient is substantial and statistically significant (with a $t$-statistic of 5.28), the threshold dummy is negative in sign, close to zero in magnitude, and not statistically significant (with a $t$-statistic of 0.31). Since manipulation would cause spikes at the thresholds but not elsewhere, this pattern is inconsistent with manipulation as the main cause of the bunching.

| | |
|---|---|
| Constant (not a 5-cent multiple) | 0.009 |
| | (0.001) |
| 5-cent multiple | 0.014 |
| | (0.003) |
| Threshold wage | -0.001 |
| | (0.004) |
| Number of observations | 178 |

Table C1: Estimate of Excess Mass at Threshold Wages

Note: Sample consists of 178 wage-year observations. Dependent variable is the share of observations in the estimation sample in a given year that have the same initial wage. Entries are coefficients from regressions of the wage share on a dummy variable indicating wages that are five-cent multiples and a dummy variable for wages at a pay-step threshold. Parentheses contain standard errors.

More direct evidence against manipulation is seen in Figure C2, which shows the average size of the merit raise by the distance from the threshold. The average merit raise is very similar on both sides of the threshold, and thus it does not appear that merit raises have been topped up in order to ensure that favored employees receive bigger raises.

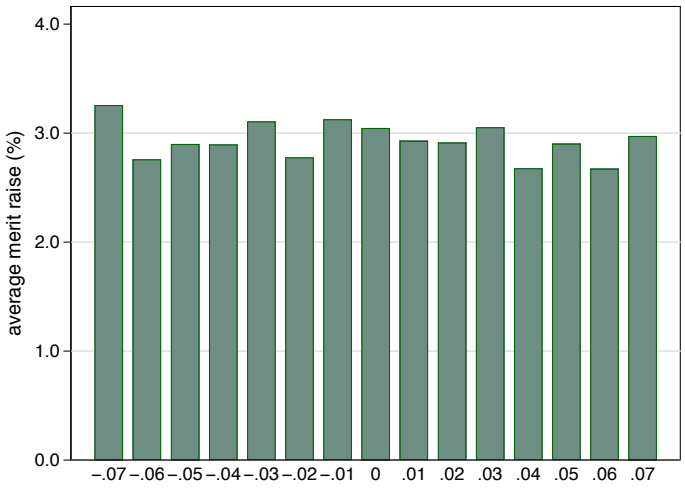



Figure C2: Size of Recent Merit Raise (%), by Distance to Nearest Threshold

Note: Figure plots the average merit raise received during the merit raise cycle in the previous June by the distance from the initial wage to the nearest pay-step threshold. Based on estimation sample of 6,691 initial wages.

## Appendix D: Comparison of Multi-Dimensional RD and Split-Sample RD Approaches to Estimating Peer Effects

To illustrate the difference between the MRD approach for estimating peer effects and the Wald Estimator based on a split-sample RD (SSRD),we consider a simplified setting in which each worker $i$ has a single peer $j$. Using the "stacked RD" framework, we define the own- and peer-wage running variables as: $r_i = w_{0i} - T_i^k$ and $r_j = w_{0j} - T_j^k$,where $T_i^k$ ($T_j^k$) is the threshold nearest to the worker's (peer's) initial wage. Each running variable ranges from -7 to +7, and the own (peer) raise jumps discontinuously at 0. We classify worker-peer pairs into four cases $Xx$ where $X = H, L$ represents whether the worker receives a high ($H$) or low raise ($L$), while $x = h, l$ represents whether the peer receives a high ($h$) or low ($l$) raise. For simplicity we also assume there are equal numbers of peer-pairs in each category.

In an RD framework, identification effectively comes from observations near the discontinuity thresholds. To highlight the role of the discontinuities in each of our models, we define the left and the right limits around the own-wage threshold as $Ll^o$ and $Hl^o$ when the peer is below the threshold ($r_j < 0$) and as $Lh^o$ and $Hh^o$ when the peer wage is above it ($r_j \geqslant 0$). Similarly, the left and right limits around the peer-wage thresholds are respectively, $Ll^p$ and $Lh^p$ when the own wage is below the threshold ($r_i < 0$) and $Hl^p$ and $Hh^p$ when it is above ($r_i \geqslant 0$). Using this notation, we can write the MRD estimators as follows:

- MRD own-wage effect: $\frac{1}{0.10} \times \left(\frac{Hh^o - Lh^o}{2} + \frac{Hl^o - Ll^o}{2}\right)$
- MRD peer-wage effect: $\frac{1}{0.10} \times \left(\frac{Lh^p - Ll^p}{2} + \frac{Hh^p - Hl^p}{2}\right)$

In this simple setup, the MRD peer-effect estimator is the mean difference between cases where the peer raise is high versus when it's low, averaging across workers whose own raises are high and low.

By contrast, the SSRD peer-effect estimate is based on comparing the RD estimates for the own-wage effect in (1) cases where own and peer raises are similar (either both high or both low) to (2) cases were the raises differ between worker and peer. It can be written:

- SSRD peer-wage effect: $\frac{1}{0.10} \times \left(\frac{Hh^o - Ll^o}{2} - \frac{Hl^o - Lh^o}{2}\right) = \frac{1}{0.10} \times \left(\frac{Lh^o - Ll^o}{2} + \frac{Hh^o - Hl^o}{2}\right)$

As the comparison makes clear, the expressions for the MRD and SSRD peer-wage estimates would be equivalent if, instead of using the limits around the own- and peer-

wage thresholds, we simply used the mean value of each quadrant $Xx$. Therefore, if worker-peer pairs were randomly assigned to the four quadrants and we did not need to rely on the discontinuities for identification, then the MRD and SSRD peer-effect estimates would be identical.

Since we do not have random assignment and must use RD designs for identification, the MRD and SSRD peer effect estimates use somewhat different variation and are based on different parts of the joint distribution of own and peer wages. This is illustrated in Figure D1, which plots the joint support of own and peer wage running variables and highlights the observations near each of the thresholds. Notably, the SSRD does not exploit discontinuities in peer wages for identification; it is based on *all* observations near the *own*-wage cutoff. As a result, a causal interpretation of the SSRD estimate requires the auxiliary assumption that assignment of peers to $h$ versus $l$ is as good as random near the *own*-wage threshold. In contrast, the MRD is based only on observations close to the *peer*-wage threshold and identification does not require random assignment of peers near the *own*-wage threshold.

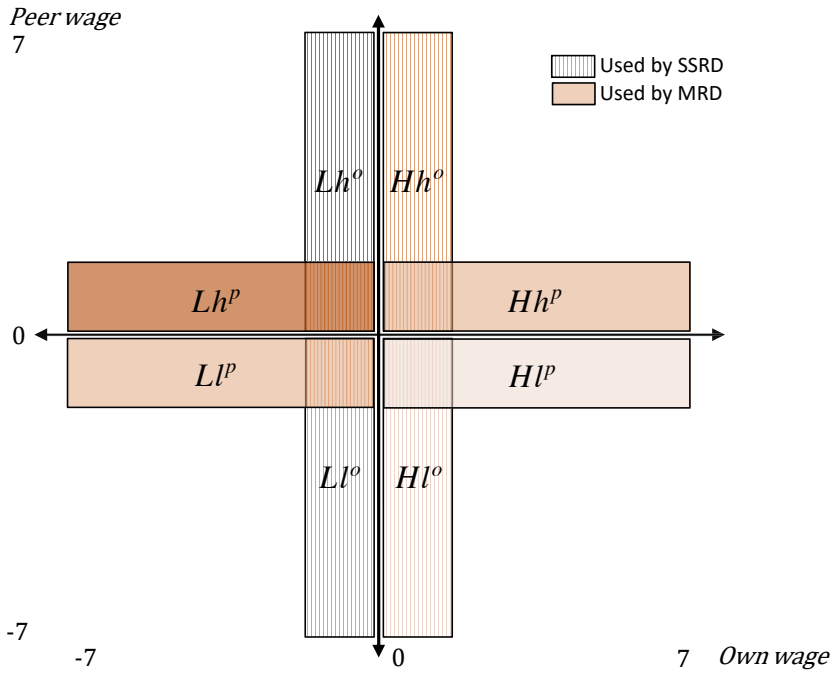



Figure D1: Identifying Variation Used in MRD versus SSRD Estimation of Peer Effect

## Appendix E: Cross-Validation Procedure to Define Peer Group

As discussed in Sections 5.1 and 5.6.1, a definition of peers that is too narrow will lead to attenuation of the estimated peer effect. In contrast, too broad a definition will tend to make the estimate imprecise by reducing identifying variation. The bias-variance trade-off was illustrated in Figure 7, which showed the estimated peer-wage effects on 3-month separations, for peer groups based on all "potential peers" (coworkers in the same job and store who qualify for a scheduled raise) and on subsets of these potential peers who initially earned within \$0.10, \$0.20, \$0.30,...,\$0.80 of the worker's own initial wage. The corresponding estimates were reported in Appendix Table A12. The visual evidence in Figure 7 suggested that the \$0.30 wage band does a good job of resolving the bias-variance trade-off. Here, we provide a more formal justification for our choice of the \$0.30 using a cross-validation procedure that uses the store-wide estimate (with all potential peers) as a benchmark.

A natural criterion for choosing the wage band that best resolves the bias-variance trade-off is to minimize the mean squared prediction error (MSPE). For example, if we take the "full-store" estimate of 0.96 (for the 3-month separation effect) as being "correct," then the in-sample results from Appendix Table A12 show that the \$0.30 estimate would have a bias of $-0.07(= 0.89 - 0.96)$ but would nevertheless be preferred to the (unbiased) store-wide estimate because it has a much smaller variance.[1]

While illustrative, these calculations are based on two estimates that are both coming from the same sample, along with the assumption that we know the true bias. To avoid these limitations, we devise a rigorous test using cross-validation where we assess how well each peer definition can predict out of sample the "full-store" peer effect estimate based on all potential peers. For each iteration $k$, we randomly split the sample of stores in half into a "training sample" and a "test sample." First, we fit the MRD model using peer definitions based on alternative wage bands, and we estimate $\hat{\beta}^{WB}_{P,k,training}$ where $WB \in \{\$0.10, \$0.20, ..., \$0.80, store\}$. Then we fit the MRD model in the test sample using all eligible coworkers in the store and estimate $\hat{\beta}^{store}_{P,k,test}$. We repeat this 300 times and calculate an average mean squared prediction error: $MSPE^{WB} = \frac{1}{300}\sum_{k=1}^{300}\left[\left(\hat{\beta}^{store}_{P,k,test} - \hat{\beta}^{WB}_{P,k,training}\right)^2\right]$.

Figure E1 plots the values of $MSPE^{WB}$ against the wage band width. The relationship is roughly U-shaped and the $MSPE$ is minimized at \$0.30. This implies that even if we are guaranteed an unbiased estimate of the peer effect by using all potential peers

[1] $MSPE = bias^2 + variance = 0.09$ for the \$0.30 estimate and 0.30 for the store-wide estimate.

in the store, we do better (in the sense of lower out-of-sample $MSPE$) by restricting attention to peers within \$0.30 of each worker than by using any other wage band definition, including the full-store definition itself. This is the basis on which we choose to define the peer group as those earning within ±\$0.30 of the worker.

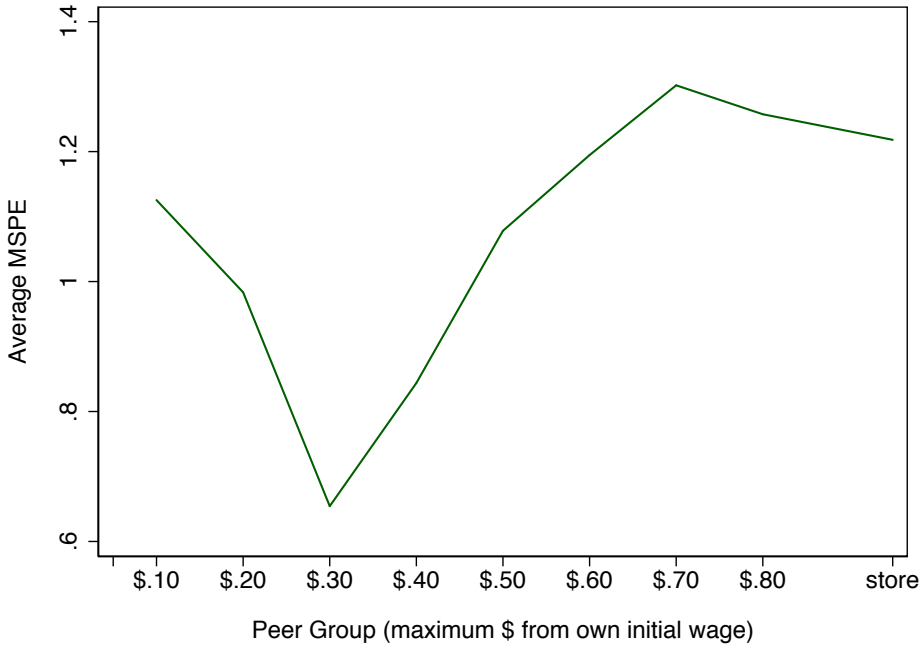



Figure E1: Mean Squared Prediction Error for Out-of-Sample Prediction of Full-Store Peer Effect

Note: The figure plots the average mean squared prediction error when using an estimate of the peer-wage effect based on a "training sample" and the indicated peer-group definition to predict the estimated peer-wage effect on 3-month separations based on a "test sample" and the "full-store" peer definition (i.e., all potential peers). The test and training samples are constructed by randomly splitting the full sample of stores in half, and the procedure is repeated 300 times. The average mean squared prediction error is constructed by averaging the squared deviation between the test and training sample estimates across the 300 iterations. All estimates are from the MRD model with the baseline set of controls as in Table 3, column 3.

## Appendix F: Estimation of Bounds for the Effect of Peer Wage on Own Future Raise

Table F1 presents MRD models for the effect of peer wages on future wage growth, defined as the change in log own wage from the day after the raise through the next merit raise cycle 10 months later. Column 1 reports the estimate for workers who remain in the sample at least 10 months. The peer-wage coefficient is small and positive (0.074) and not statistically significant. Hence, there is no indication of a decline in observed future raise at the peer-wage discontinuity. However, since fewer that half of the workers in our sample are still at the firm after 10 months, the estimate in column 1 may be biased due to non-random attrition.

To account for non-random attrition, we estimate bounds for the future raise by modifying the procedure in Lee (2009) for application to a RD context. If treatment (defined as $r_j > 0$) leads to a $b$ percentage point increase in the separation rate, then a lower bound for the RD can be obtained by calculating the conditional mean $E(Y_{ij}|r_j^- = 0, Y_{ij} > Q_\tau, D_j = 0)$ for the left limit of the threshold, and comparing it to the unconditional mean $E(Y_{ij}|r_j^+ = 0, D_j = 1)$ for the right limit (see Dong 2017 and Kim 2016). Here $Q_\tau$ is the $\tau^{th}$ quantile of future raise $Y_{ij}$ at the left of the peer wage threshold, and $\tau = \frac{b}{1-E(S|r_{j^-},D_j=0)}$ is the ratio of the effect of treatment on separation to the survival rate of the untreated group to the left of the threshold. For the upper bound, we need to estimate $E(Y_{ij}|r_j^- = 0, Y < Q_{1-\tau}, D_j = 0)$ for the left limit of the threshold instead. We implement this procedure by trimming the left side of the peer threshold (i.e., those with $r_j < 0$) by the appropriate amount either from the top or the bottom of the future raise distribution, and then estimating our stacked MRD model. Since a \$0.10 higher peer average raise increases the 10 month separation by around 0.045, and the average 10-month separation rate to the left of the peer wage threshold is 0.557, we trim $\frac{0.045}{.557} = 0.102$ or approximately 10 percent of the sample. For the lower bound, we exclude observations with $r_j < 0$ and $Y_{ij} < Q_{10}$; for the upper bound, we exclude the observations with $r_j < 0$ and $Y_{ij} > Q_{90}$. Under each of these bounding assumptions, we separately estimate the MRD model with the future change in log wage as the outcome.

The results are shown in columns 2 and 3 of Table F1. The lower bound estimate is -0.063 (column 2) and not statistically different from zero. This point estimate predicts that if all of one's peers received a \$0.10 larger raise, the worker's future raise would be at most 0.6 percentage points smaller. The upper bound (column 3) is quite large at

0.48; however, it is not very meaningful in our context as it cannot explain why workers whose peers got bigger raises would be more likely to separate.

| | (1) | (2) | (3) |
|---|---|---|---|
| | Estimate conditional on staying | Lower bound | Upper bound |
| peer average wage (2SLS) | 0.074 | -0.063 | 0.479** |
| | (0.079) | (0.091) | (0.076) |
| Number of employees | 3240 | 3232 | 3217 |
| Number of observations | 31919 | 30514 | 30744 |
| Full sample of stayers | Y | | |
| Stayers left of peer wage threshold trimmed from below | | Y | |
| Stayers left of peer wage threshold trimmed from above | | | Y |

Table F1: Stacked MRD estimates of wage growth from day after minimum wage increase to day after next merit raise

Note: Entries are estimated effects of increases in average peer wage on future wage growth, defined as the change in log wage 10 months from the day of the minimum wage increase. The estimates use the same stacked MRD model as Table 3, column 4 (see Table 3 note). In column 1, the estimation samples includes all workers and peers employed 10 months after the minimum wage increase. In column 2, the bottom 10% of the workers left of the peer-wage threshold with the smallest future wage growth are excluded, producing a lower bound of the 2SLS estimate. In column 3, the top 10% of workers left of the peer-wage threshold with the highest future wage growth are excluded, producing an upper bound for the 2SLS estimate. Parentheses contain robust standard errors clustered by store. † significant at 10%; * significant at 5%; ** significant at 1%.

## References

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