

*Supplementary material to:*

**“Parental responses to public investments in children: Evidence from a maximum class size rule”**

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This document provides supplementary material to our paper “Parental responses to public investments in children: Evidence from a maximum class size rule”.

Table B1 shows descriptive statistics for the samples of (students in) one school districts in the ETF-data, all districts in the ETF-data and all districts in the country. One-school districts are, in general, very similar to other districts in the country. They differ along one dimension, however: they tend to be located in cities, as opposed to rural areas, to a greater extent. The second and third columns in the table show that the districts sampled in the ETF-data are very similar to all districts in the country.

Tables B2 and B3 examine whether covariates balance, separately for low-income and high-income households. Since we are cutting the sample in half, one might expect more instances where a single covariate is not balanced across thresholds in comparison to Table 1 of the main text. Some of this we also see in these tables. Because of these small-sample issues, we think it is more relevant to look at the aggregate statistics, such as the F-tests reported in Tables B2 and B3 or the predicted achievement scores shown in Figure 4 of the main text. None of the F-tests reject the hypotheses that covariates are balanced across thresholds. The p-values of the F-tests reported in the 4th to last rows range from 0.102 to 0.661.

Tables B4-B7 are analogous to Tables A4-A5 of the main text. They examine whether the results are robust to the specification of the control function, when low-income and high-income households are analyzed separately. If we disregard the results in columns (6) of each table, which we think is too flexible relative to the variation in the data, the results are remarkably robust to the specification of the control function. We consistently find that only high-income parents respond to an increase in class size by helping their children more with homework. Analogously, we consistently find that only low-income children find the teacher harder to understand when there is an increase in class-size. Tables B6 and B7 also shows that the precision of the first stage does not vary to any significant degree across the two income groups.

Tables B8, B9 and B10 report estimates for different bandwidths. The first columns in these tables repeat results reported in the paper for a sub-set of outcomes. The second columns of each table restrict the bandwidth to 10 pupils. We cannot reduce the bandwidth further since below +/- 10 pupils the first stage becomes too weak; with +/-10 pupils, the first-stage F-statistics range from 9.53 to 10.93 which is borderline for being considered a weak first stage. In all relevant aspects, we find that the results are robust to reducing the bandwidth.

Table B11 compares estimates from the main specification in the paper with estimates from the main specification in Fredriksson et al. (2013). Results are presented for different outcome variables and for different subsamples. The results from the two specifications are very similar. Notice, in particular, that the results we high-lighted in our previous paper, i.e., the wage and the earnings effects, stay the same and that the estimates become more precise with the current specification than with our previous specification.

## References

Fredriksson, P., Öckert, B., and Oosterbeek, H. (2013). Long-term effects of class size. *Quarterly Journal of Economics*, 128(1):249–285.

**Table B1.** Descriptive statistics, 1967-82 birth cohorts

| Variable<br>[#pupils]  | ETF-sample              |                      | Population           |
|--|-------------------------|----------------------|----------------------|
|  | One-school<br>districts | All districts        | All districts        |
| Female<br>[6,009; 31,590; 429,153]                           | 0.495<br>(0.500)        | 0.488<br>(0.500)     | 0.486<br>(0.500)     |
| Immigrant<br>[6,009; 31,590; 429,153]                        | 0.066<br>(0.248)        | 0.052<br>(0.223)     | 0.058<br>(0.234)     |
| Mother's years of education<br>[6,009; 31,590; 423,627]      | 11.195<br>(2.742)       | 10.978<br>(2.698)    | 10.956<br>(2.668)    |
| Father's years of education<br>[6,009; 31,590; 417,263]      | 11.067<br>(3.053)       | 10.702<br>(2.972)    | 10.664<br>(2.963)    |
| Family income<br>[6,009; 31,590; 429,153]                    | 434,938<br>(213,052)    | 416,847<br>(190,490) | 414,547<br>(193,019) |
| City<br>[6,009; 31,590; 422,130]                             | 0.498<br>(0.500)        | 0.311<br>(0.463)     | 0.273<br>(0.445)     |
| Town<br>[6,009; 31,590; 422,130]                             | 0.252<br>(0.434)        | 0.281<br>(0.450)     | 0.298<br>(0.457)     |
| Rural area<br>[6,009; 31,590; 422,130]                       | 0.250<br>(0.433)        | 0.408<br>(0.491)     | 0.429<br>(0.495)     |
| School enrollment, grade 4<br>[6,009; 31,590; 425,812]       | 61.269<br>(23.581)      | 51.623<br>(28.914)   | 48.315<br>(26.600)   |
| Class size, grades 4-6<br>[6,009; 31,590; 425,812]           | 24.121<br>(3.642)       | 23.842<br>(4.135)    | 23.540<br>(4.736)    |
| Academic achievement<br>[N=4,707; N=24,774]                  | 0.032<br>(1.002)        | 0.000<br>(1.000)     | NA                   |
| Parents help child with homework<br>[N=5,107; N=27,493]      | 0.798<br>(0.401)        | 0.806<br>(0.395)     | NA                   |
| Pupil thinks it is easy to understand<br>[N=2,719; N=16,040] | 0.873<br>(0.333)        | 0.856<br>(0.351)     | NA                   |

**Table B2.** Balancing of covariates, low-income parents

|                              | Academic achievement (1) | Above 1st threshold (2) | Above 2nd threshold (3) | Above 3rd threshold (4) | p-value (5) |
|------------------------------|--------------------------|-------------------------|-------------------------|-------------------------|-------------|
| Female                       | 0.0850*<br>(0.0436)      | 0.0023<br>(0.0033)      | 0.0031<br>(0.0048)      | 0.0033**<br>(0.0016)    | 0.0293      |
| Month of birth               | -0.0180***<br>(0.0068)   | -0.0006<br>(0.0005)     | 0.0001<br>(0.0008)      | -0.0000<br>(0.0003)     | 0.6681      |
| Immigrant                    | -0.1928**<br>(0.0771)    | 0.0015<br>(0.0050)      | 0.0134<br>(0.0165)      | -0.0014<br>(0.0037)     | 0.6688      |
| Mother's years of education  | 0.0535***<br>(0.0106)    | -0.0009<br>(0.0009)     | 0.0014<br>(0.0016)      | -0.0005<br>(0.0006)     | 0.3402      |
| Father's years of education  | 0.0465***<br>(0.0089)    | -0.0017<br>(0.0012)     | -0.0006<br>(0.0014)     | 0.0002<br>(0.0008)      | 0.1323      |
| Family income (SEK 100,000s) | 0.0322<br>(0.0201)       | 0.0004<br>(0.0022)      | -0.0008<br>(0.0041)     | 0.0004<br>(0.0009)      | 0.7871      |
| Mother's age at birth        | 0.0145***<br>(0.0034)    | -0.0001<br>(0.0004)     | 0.0002<br>(0.0008)      | -0.0001<br>(0.0002)     | 0.9876      |
| Number of siblings           | -0.0518***<br>(0.0132)   | -0.0010<br>(0.0013)     | -0.0010<br>(0.0025)     | -0.0016*<br>(0.0009)    | 0.2530      |
| Parents separated, age 9     | -0.1683***<br>(0.0502)   | -0.0010<br>(0.0044)     | -0.0047<br>(0.0060)     | 0.0004<br>(0.0025)      | 0.8740      |
| <i>p</i> -value of F-test    | 0.0000                   | 0.6612                  | 0.5073                  | 0.5126                  |             |
| Number of students           | 2,194                    | 2,846                   | 2,846                   | 2,846                   |             |
| Number of districts×cohorts  | 186                      | 200                     | 200                     | 200                     |             |
| Number of clusters           | 79                       | 81                      | 81                      | 81                      |             |

*Note:* The estimates are based on representative samples of individuals with high-income parents born in 1967, 1972, 1977 or 1982 in one-school districts. Academic achievement is standardized. Columns (1) – (5) report results of OLS regressions on the variables listed in the rows. These regressions also include the following control variables: fixed effects for enrollment segment, linear controls for school district enrollment interacted with threshold, and municipality-by-cohort fixed effects. Above 1st/2nd/3rd threshold are indicators equaling unity if school district enrollment in 4th grade exceeds the 1st/2nd/3rd threshold of the class size rule. Independent variables are pre-determined parent and student characteristics. The *p*-value reported at the bottom of the columns is for an F-test of the joint significance of the variables listed in the table. Each row of column (6) reports a *p*-value from separate OLS regressions of the pre-determined variable (listed in the corresponding row) on the instrument, and the same set of control variables as in columns (1)–(5). The *p*-value is for a t-test of the significance of the class size instruments. Standard errors adjusted for clustering by enrollment count are in parentheses. \*\*\*/\*\*/\*=the estimates are significantly different from zero at the 1/5/10 percent level, respectively.

**Table B3.** Balancing of covariates, high-income parents

|                              | Academic<br>achievement<br>(1) | Above 1st<br>threshold<br>(2) | Above 2nd<br>threshold<br>(3) | Above 3rd<br>threshold<br>(4) | p-value<br>(5) |
|------------------------------|--------------------------------|-------------------------------|-------------------------------|-------------------------------|----------------|
| Female                       | 0.0181<br>(0.0336)             | 0.0001<br>(0.0029)            | -0.0048<br>(0.0045)           | 0.0045**<br>(0.0022)          | 0.3449         |
| Month of birth               | -0.0294***<br>(0.0048)         | -0.0009<br>(0.0007)           | 0.0008<br>(0.0007)            | -0.0002<br>(0.0005)           | 0.4136         |
| Immigrant                    | -0.3010**<br>(0.1278)          | 0.0089<br>(0.0120)            | -0.0158<br>(0.0180)           | 0.0101<br>(0.0093)            | 0.5963         |
| Mother's years of education  | 0.0635***<br>(0.0076)          | 0.0002<br>(0.0008)            | 0.0006<br>(0.0009)            | 0.0001<br>(0.0008)            | 0.7220         |
| Father's years of education  | 0.0473***<br>(0.0093)          | 0.0016**<br>(0.0008)          | -0.0025*<br>(0.0014)          | 0.0005<br>(0.0008)            | 0.2215         |
| Family income (SEK 100,000s) | 0.0282***<br>(0.0083)          | -0.0010<br>(0.0021)           | 0.0044**<br>(0.0020)          | -0.0034**<br>(0.0014)         | 0.2517         |
| Mother's age at birth        | 0.0055<br>(0.0052)             | -0.0002<br>(0.0005)           | 0.0007<br>(0.0007)            | -0.0005<br>(0.0005)           | 0.8922         |
| Number of siblings           | -0.0403**<br>(0.0189)          | 0.0009<br>(0.0022)            | 0.0014<br>(0.0030)            | 0.0022<br>(0.0022)            | 0.3850         |
| Parents separated, age 9     | -0.0777*<br>(0.0437)           | 0.0046<br>(0.0064)            | -0.0023<br>(0.0085)           | -0.0096<br>(0.0072)           | 0.3800         |
| <i>p</i> -value of F-test    | 0.0000                         | 0.5899                        | 0.1023                        | 0.1383                        |                |
| Number of students           | 2,513                          | 3,163                         | 3,163                         | 3,163                         |                |
| Number of districts×cohorts  | 181                            | 197                           | 197                           | 197                           |                |
| Number of clusters           | 76                             | 80                            | 80                            | 80                            |                |

*Note:* The estimates are based on representative samples of individuals born in 1967, 1972, 1977 or 1982 in one-school districts. Academic achievement is standardized. Columns (1) – (5) report results of OLS regressions on the variables listed in the rows. These regressions also include the following control variables: fixed effects for enrollment segment, linear controls for school district enrollment interacted with threshold, and municipality-by-cohort fixed effects. Above 1st/2nd/3rd threshold are indicators equaling unity if school district enrollment in 4th grade exceeds the 1st/2nd/3rd threshold of the class size rule. Independent variables are pre-determined parent and student characteristics. The *p*-value reported at the bottom of the columns is for an F-test of the joint significance of the variables listed in the table. Each row of column (6) reports a *p*-value from separate OLS regressions of the pre-determined variable (listed in the corresponding row) on the instrument, and the same set of control variables as in columns (1)–(5). The *p*-value is for a t-test of the significance of the class size instruments. Standard errors adjusted for clustering by enrollment count are in parentheses. \*\*\*/\*\*/\*=the estimates are significantly different from zero at the 1/5/10 percent level, respectively.

**Table B4.** IV estimates of class size, low-income parents, different enrollment controls

| Model                                    | (1)                    | (2)                    | (3)                    | (4)                    | (5)                    | (6)                 |
|--|------------------------|------------------------|------------------------|------------------------|------------------------|---------------------|
| [#pupils; #districtsxcohorts; #clusters] |                        |                        |                        |                        |                        |                     |
| Class size grades 4-6<br>[2194; 186; 80] | -0.0840***<br>(0.0230) | -0.0744***<br>(0.0203) | -0.0661***<br>(0.0177) | -0.0594***<br>(0.0158) | -0.0618***<br>(0.0151) | -0.0153<br>(0.0377) |
| Class size grades 4-6<br>[2371; 196; 82] | -0.0009<br>(0.0062)    | 0.0012<br>(0.0060)     | 0.0000<br>(0.0053)     | -0.0037<br>(0.0048)    | -0.0017<br>(0.0051)    | -0.0021<br>(0.0066) |
| Class size grades 4-6<br>[1243; 83; 52]  | -0.0180***<br>(0.0053) | -0.0132***<br>(0.0037) | -0.0138***<br>(0.0042) | -0.0171***<br>(0.0047) | -0.0208***<br>(0.0040) | -0.0092<br>(0.0105) |
| <u>Enrollment controls</u>               |                        |                        |                        |                        |                        |                     |
| Polynomials:                             |                        |                        |                        |                        |                        |                     |
| - 1st order                              | ✓                      |                        | ✓                      |                        | ✓                      |                     |
| - 2nd order                              |                        | ✓                      |                        | ✓                      |                        | ✓                   |
| Interacted with thresholds               |                        |                        | ✓                      | ✓                      | ✓                      | ✓                   |
| Interacted with segments                 |                        |                        |                        |                        | ✓                      | ✓                   |

*Note:* The estimates are based on representative samples of individuals with low-income parents born in 1967, 1972, 1977 or 1982 in one-school districts. Average class size in grades 4-6 is instrumented by indicators for being above 1st, 2nd, or 3rd threshold of the class size rule. All models include fixed effects for school district enrollment in grade 4, municipality-by-cohort fixed effects, gender, dummy variables for month of birth, dummy variables for mother's and father's educational attainment, parental income, mother's age at child's birth, indicators for being a first or second generation Nordic immigrant, indicators for being a first or second generation non-Nordic immigrant, an indicator for having separated parents, and the number of siblings. Standard errors adjusted for clustering by enrollment count are in parentheses. \*\*\*/\*\*/\*=the estimates are significantly different from zero at the 1/5/10 percent level, respectively.

**Table B5.** IV estimates of class size, high-income parents, different enrollment controls

| Model                                    | (1)                   | (2)                   | (3)                   | (4)                 | (5)                  | (6)                    |
|--|-----------------------|-----------------------|-----------------------|---------------------|----------------------|------------------------|
| [#pupils; #districtsxcohorts; #clusters] |                       |                       |                       |                     |                      |                        |
| Class size grades 4-6<br>[2513; 181; 77] | -0.0346**<br>(0.0170) | -0.0291*<br>(0.0163)  | -0.0203<br>(0.0149)   | -0.0247<br>(0.0172) | -0.0215<br>(0.0173)  | -0.0901***<br>(0.0292) |
| Class size grades 4-6<br>[2736; 193; 80] | 0.0114**<br>(0.0055)  | 0.0145***<br>(0.0053) | 0.0154***<br>(0.0046) | 0.0087<br>(0.0055)  | 0.0118**<br>(0.0051) | 0.0073<br>(0.0075)     |
| Class size grades 4-6<br>[1476; 83; 52]  | 0.0008<br>(0.0047)    | 0.0031<br>(0.0039)    | 0.0025<br>(0.0040)    | -0.0005<br>(0.0055) | 0.0003<br>(0.0050)   | 0.0073<br>(0.0097)     |
| <u>Enrollment controls</u>               |                       |                       |                       |                     |                      |                        |
| Polynomials:                             |                       |                       |                       |                     |                      |                        |
| - 1st order                              | ✓                     |                       | ✓                     |                     | ✓                    |                        |
| - 2nd order                              |                       | ✓                     |                       | ✓                   |                      | ✓                      |
| Interacted with thresholds               |                       |                       | ✓                     | ✓                   | ✓                    | ✓                      |
| Interacted with segments                 |                       |                       |                       |                     | ✓                    | ✓                      |

*Note:* The estimates are based on representative samples of individuals with high-income parents born in 1967, 1972, 1977 or 1982 in one-school districts. Average class size in grades 4-6 is instrumented by indicators for being above 1st, 2nd, or 3rd threshold of the class size rule. All models include fixed effects for school district enrollment in grade 4, municipality-by-cohort fixed effects, gender, dummy variables for month of birth, dummy variables for mother's and father's educational attainment, parental income, mother's age at child's birth, indicators for being a first or second generation Nordic immigrant, indicators for being a first or second generation non-Nordic immigrant, an indicator for having separated parents, and the number of siblings. Standard errors adjusted for clustering by enrollment count are in parentheses. \*\*\*/\*\*/\*=the estimates are significantly different from zero at the 1/5/10 percent level, respectively.

**Table B6.** First-stage estimates, low-income parents, different enrollment controls

|                             | (1)                  | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  |
|-----------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Above 1st threshold         | -5.987***<br>(1.501) | -8.127***<br>(1.620) | -9.433***<br>(0.943) | -8.609***<br>(1.496) | -8.810***<br>(1.274) | -9.302***<br>(2.295) |
| Above 2nd threshold         | -5.888***<br>(0.979) | -5.245***<br>(0.932) | -4.858***<br>(1.005) | -7.838***<br>(1.262) | -6.713***<br>(1.033) | -7.739***<br>(1.607) |
| Above 3rd threshold         | -5.679***<br>(1.196) | -2.458<br>(2.124)    | -4.385***<br>(1.395) | -2.419<br>(2.669)    | -3.151<br>(2.321)    | -0.067<br>(3.199)    |
| F-test for instruments      | 15.25                | 17.46                | 39.56                | 34.80                | 36.38                | 12.42                |
| <u>Enrollment controls</u>  |                      |                      |                      |                      |                      |                      |
| Polynomials:                |                      |                      |                      |                      |                      |                      |
| - 1st order                 | √                    |                      | √                    |                      | √                    |                      |
| - 2nd order                 |                      | √                    |                      | √                    |                      | √                    |
| Interacted with thresholds  |                      |                      | √                    | √                    | √                    | √                    |
| Interacted with segments    |                      |                      |                      |                      | √                    | √                    |
| Number of pupils            | 2,846                | 2,846                | 2,846                | 2,846                | 2,846                | 2,846                |
| Number of districts×cohorts | 200                  | 200                  | 200                  | 200                  | 200                  | 200                  |
| Number of clusters          | 82                   | 82                   | 82                   | 82                   | 82                   | 82                   |

*Note:* The estimates are based on representative samples of individuals with low-income parents born in 1967, 1972, 1977 or 1982 in one-school districts. All models include fixed effects for school district enrollment in grade 4, municipality-by-cohort fixed effects, gender, dummy variables for month of birth, dummy variables for mother's and father's educational attainment, parental income, mother's age at child's birth, indicators for being a first or second generation Nordic immigrant, indicators for being a first or second generation non-Nordic immigrant, an indicator for having separated parents, and the number of siblings. Standard errors adjusted for clustering by enrollment count are in parentheses. \*\*\*/\*/\*\*/=the estimates are significantly different from zero at the 1/5/10 percent level, respectively.



**Table B7.** First-stage estimates, high-income parents, different enrollment controls

|                             | (1)                  | (2)                  | (3)                   | (4)                  | (5)                  | (6)                   |
|-----------------------------|----------------------|----------------------|-----------------------|----------------------|----------------------|-----------------------|
| Above 1st threshold         | -7.055***<br>(1.272) | -8.937***<br>(1.457) | -10.590***<br>(0.860) | -9.796***<br>(1.492) | -9.838***<br>(1.280) | -10.260***<br>(1.801) |
| Above 2nd threshold         | -6.558***<br>(0.958) | -5.856***<br>(0.927) | -5.506***<br>(1.217)  | -8.368***<br>(1.048) | -7.271***<br>(0.901) | -8.183***<br>(1.315)  |
| Above 3rd threshold         | -6.520***<br>(1.015) | -3.431**<br>(1.668)  | -5.042***<br>(1.323)  | -2.772<br>(2.783)    | -3.881<br>(2.352)    | -0.340<br>(3.628)     |
| F-test for instruments      | 19.86                | 21.20                | 57.62                 | 44.54                | 43.70                | 25.39                 |
| <u>Enrollment controls</u>  |                      |                      |                       |                      |                      |                       |
| Polynomials:                |                      |                      |                       |                      |                      |                       |
| - 1st order                 | ✓                    |                      | ✓                     |                      | ✓                    |                       |
| - 2nd order                 |                      | ✓                    |                       | ✓                    |                      | ✓                     |
| Interacted with thresholds  |                      |                      | ✓                     | ✓                    | ✓                    | ✓                     |
| Interacted with segments    |                      |                      |                       |                      | ✓                    | ✓                     |
| Number of pupils            | 3,163                | 3,163                | 3,163                 | 3,163                | 3,163                | 3,163                 |
| Number of districts×cohorts | 197                  | 197                  | 197                   | 197                  | 197                  | 197                   |
| Number of clusters          | 81                   | 81                   | 81                    | 81                   | 81                   | 81                    |

*Note:* The estimates are based on representative samples of individuals with high-income parents born in 1967, 1972, 1977 or 1982 in one-school districts. All models include fixed effects for school district enrollment in grade 4, municipality-by-cohort fixed effects, gender, dummy variables for month of birth, dummy variables for mother's and father's educational attainment, parental income, mother's age at child's birth, indicators for being a first or second generation Nordic immigrant, indicators for being a first or second generation non-Nordic immigrant, an indicator for having separated parents, and the number of siblings. Standard errors adjusted for clustering by enrollment count are in parentheses. \*\*\*/\*/\*\*/=the estimates are significantly different from zero at the 1/5/10 percent level, respectively.

**Table B8.** First-stage and IV-estimates, different bandwidths

| Bandwidth                              | All  | +/- 10 pupils          |
|--|--|------------------------|
| <u>First-stage estimates</u>           |  |                        |
| Above 1st threshold                    | -10.0429***<br>(0.8999)                      | -9.6638***<br>(1.7943) |
| Above 2nd threshold                    | -5.2013***<br>(1.0690)                       | -3.0770**<br>(1.4686)  |
| Above 3rd threshold                    | -4.6836***<br>(1.3049)                       | -4.0900**<br>(1.7282)  |
| F-test for instruments                 | 47.89  | 9.80                   |
| #pupils; #districts×cohorts; #clusters | 6009; 200; 82                                | 3861; 128; 52          |
| <u>IV-estimates</u>                    |  |                        |
|  | Academic achievement                         |                        |
| Class size grades 4-6                  | -0.0441***<br>(0.0122)                       | -0.0465*<br>(0.0275)   |
| #pupils, #districts×cohorts, #clusters | 4707; 187; 80                                | 2878; 117; 51          |
|  | Parents help child with homework             |                        |
| Class size grades 4-6                  | 0.0086**<br>(0.0043)                         | 0.0082<br>(0.0053)     |
| #pupils; #districts×cohorts; #clusters | 5107; 197; 82                                | 3260; 126; 52          |
|  | Easy to understand when the teacher explains |                        |
| Class size grades 4-6                  | -0.0055***<br>(0.0019)                       | -0.0114<br>(0.0067)    |
| #pupils, #districts×cohorts, #clusters | 2719; 83; 52                                 | 1688; 49; 30           |

*Note:* The estimates are based on representative samples of individuals born in 1967, 1972, 1977 or 1982 in one-school districts. All models include fixed effects for school district enrollment in grade 4, municipality-by-cohort fixed effects, gender, dummy variables for month of birth, dummy variables for mother's and father's educational attainment, parental income, mother's age at child's birth, indicators for being a first or second generation Nordic immigrant, indicators for being a first or second generation non-Nordic immigrant, an indicator for having separated parents, and the number of siblings. Standard errors adjusted for clustering by enrollment count are in parentheses. \*\*\*/\*\*/\*=the estimates are significantly different from zero at the 1/5/10 percent level, respectively.

**Table B9.** First-stage and IV-estimates, low-income parents, different bandwidths

| Bandwidth                              | All  | +/- 10 pupils          |
|--|--|------------------------|
| <u>First-stage estimates</u>           |  |                        |
| Above 1st threshold                    | -9.4332***<br>(0.9433)                       | -8.7950***<br>(1.5673) |
| Above 2nd threshold                    | -4.8579***<br>(1.0049)                       | -2.7858**<br>(1.3639)  |
| Above 3rd threshold                    | -4.3845***<br>(1.3955)                       | -4.2557**<br>(1.6909)  |
| F-test for instruments                 | 39.56  | 10.93                  |
| #pupils; #districts×cohorts; #clusters | 2846; 200; 82                                | 1863; 128; 52          |
| <u>IV-estimates</u>                    |  |                        |
|  | Academic achievement                         |                        |
| Class size grades 4-6                  | -0.0661***<br>(0.0177)                       | -0.0495**<br>(0.0203)  |
| #pupils, #districts×cohorts, #clusters | 2194; 186; 80                                | 1369; 116; 51          |
|  | Parents help child with homework             |                        |
| Class size grades 4-6                  | 0.0000<br>(0.0053)                           | 0.0051<br>(0.0067)     |
| #pupils; #districts×cohorts; #clusters | 2371; 196; 82                                | 1535; 125; 52          |
|  | Easy to understand when the teacher explains |                        |
| Class size grades 4-6                  | -0.0138***<br>(0.0042)                       | -0.0284**<br>(0.0112)  |
| #pupils, #districts×cohorts, #clusters | 1243; 83; 52                                 | 788; 49; 30            |

*Note:* The estimates are based on representative samples of individuals with low-income parents born in 1967, 1972, 1977 or 1982 in one-school districts. All models include fixed effects for school district enrollment in grade 4, municipality-by-cohort fixed effects, gender, dummy variables for month of birth, dummy variables for mother's and father's educational attainment, parental income, mother's age at child's birth, indicators for being a first or second generation Nordic immigrant, indicators for being a first or second generation non-Nordic immigrant, an indicator for having separated parents, and the number of siblings. Standard errors adjusted for clustering by enrollment count are in parentheses. \*\*\*/\*\*/\*=the estimates are significantly different from zero at the 1/5/10 percent level, respectively.

**Table B10.** First-stage and IV-estimates, high-income parents, different bandwidths

| Bandwidth                              | All  | +/- 10 pupils           |
|--|--|-------------------------|
| <u>First-stage estimates</u>           |  |                         |
| Above 1st threshold                    | -10.5888***<br>(0.8599)                      | -10.7288***<br>(2.0108) |
| Above 2nd threshold                    | -5.5061***<br>(1.2172)                       | -3.4817*<br>(1.7965)    |
| Above 3rd threshold                    | -5.0423***<br>(1.3234)                       | -3.6997*<br>(2.0325)    |
| F-test for instruments                 | 57.62  | 9.53                    |
| #pupils; #districts×cohorts; #clusters | 3163; 197; 81                                | 1998; 125; 51           |
| <u>IV-estimates</u>                    |  |                         |
|  | Academic achievement                         |                         |
| Class size grades 4-6                  | -0.0203<br>(0.0149)                          | -0.0233<br>(0.0332)     |
| #pupils, #districts×cohorts, #clusters | 2513; 181; 77                                | 1509; 113; 49           |
|  | Parents help child with homework             |                         |
| Class size grades 4-6                  | 0.0154***<br>(0.0046)                        | 0.0160**<br>(0.0062)    |
| #pupils; #districts×cohorts; #clusters | 2736; 193; 80                                | 1725; 124; 51           |
|  | Easy to understand when the teacher explains |                         |
| Class size grades 4-6                  | 0.0025<br>(0.0040)                           | 0.0107<br>(0.0113)      |
| #pupils, #districts×cohorts, #clusters | 1476; 83; 52                                 | 900; 49; 30             |

*Note:* The estimates are based on representative samples of individuals with high-income parents born in 1967, 1972, 1977 or 1982 in one-school districts. All models include fixed effects for school district enrollment in grade 4, municipality-by-cohort fixed effects, gender, dummy variables for month of birth, dummy variables for mother's and father's educational attainment, parental income, mother's age at child's birth, indicators for being a first or second generation Nordic immigrant, indicators for being a first or second generation non-Nordic immigrant, an indicator for having separated parents, and the number of siblings. Standard errors adjusted for clustering by enrollment count are in parentheses. \*\*\*/\*\*/\*=the estimates are significantly different from zero at the 1/5/10 percent level, respectively.

**Table B11.** IV-estimates of class size, comparing specifications

| Outcome<br>[#pupils in current; #pupils in QJE]        | Current specification  |                        |                       | QJE-specification      |                        |                     |
|--|------------------------|------------------------|-----------------------|------------------------|------------------------|---------------------|
|  | All                    | Low-income             | High-income           | All                    | Low-income             | High-income         |
| Cognitive ability, age 13<br>[N=5,197; N=5,116]        | -0.0268**<br>(0.0116)  | -0.0560***<br>(0.0151) | -0.0025<br>(0.0141)   | -0.0330**<br>(0.0146)  | -0.0598***<br>(0.0204) | -0.0092<br>(0.0144) |
| Non-cognitive ability, age 13<br>[N=4,740; N=4,681]    | -0.0177<br>(0.0113)    | -0.0136<br>(0.0160)    | -0.0215*<br>(0.0118)  | -0.0265**<br>(0.0118)  | -0.0338**<br>(0.0170)  | -0.0183<br>(0.0125) |
| Academic achievement, age 16<br>[N=5,400; N=5,318]     | -0.0267***<br>(0.0085) | -0.0477***<br>(0.0135) | -0.0061<br>(0.0106)   | -0.0233***<br>(0.0101) | -0.0388***<br>(0.0135) | -0.0037<br>(0.0156) |
| Years of schooling, ages 27-42<br>[N=5,669; N=5,588]   | -0.0318<br>(0.0234)    | -0.0305<br>(0.0285)    | -0.0216<br>(0.0328)   | -0.0545*<br>(0.0256)   | -0.0497*<br>(0.0295)   | -0.0448<br>(0.0372) |
| P(Bachelor's degree), ages 27-42<br>[N=5,669; N=5,588] | -0.0058<br>(0.0043)    | -0.0011<br>(0.0046)    | -0.0093<br>(0.0068)   | -0.0076*<br>(0.0043)   | -0.0051<br>(0.0054)    | -0.0105<br>(0.0068) |
| Earnings, ages 27-42<br>[N=6,009; N=5,920]             | -0.0149**<br>(0.0057)  | -0.0072<br>(0.0071)    | -0.0188**<br>(0.0083) | -0.0117*<br>(0.0061)   | -0.0082<br>(0.0084)    | -0.0124<br>(0.0092) |
| P(earnings>0), ages 27-42<br>[N=6,009; N=5,920]        | -0.0035<br>(0.0022)    | -0.0071**<br>(0.0029)  | 0.0005<br>(0.0022)    | -0.0016<br>(0.0024)    | -0.0064*<br>(0.0034)   | 0.0041<br>(0.0029)  |
| ln(Wage), ages 27-42<br>[N=3,227; N=3,185]             | -0.0065***<br>(0.0022) | -0.0047<br>(0.0039)    | -0.0074**<br>(0.0031) | -0.0063*<br>(0.0033)   | -0.0031<br>(0.0035)    | -0.0081<br>(0.0051) |
| Number of districts×cohorts                            | 200                    | 200                    | 200                   | 191                    | 191                    | 191                 |

*Note:*The estimates are based on representative samples of individuals born in 1967, 1972, 1977 or 1982 in one-school districts. All ability measures are standardized. The educational outcomes are measured in 2009, while the labor market outcomes have been averaged over the 2007-2009 period. Earnings effects (and their standard errors) are divided by average earnings level to facilitate interpretation. The ln(wage) estimates are restricted to wage-earners. Average class size in grades 4-6 is instrumented by indicators for being above 1st, 2nd, or 3rd threshold of the class size rule in columns (1) – (3). In columns (4) – (6), average class size in grades 4-6 is instrumented by an indicator for being above any threshold of the class size rule. All models include the following controls for school district enrollment in grade 4: fixed effects for enrollment segment; linear controls for enrollment which are interacted with threshold. In columns (4) – (6), the controls for enrollment are also interacted with segment. In addition all models include the following baseline controls: municipality-by-cohort fixed effects, gender, dummy variables for month of birth, dummy variables for mother's and father's educational attainment, parental income, mother's age at child's birth, indicators for being a first or second generation Nordic immigrant, indicators for being a first or second generation non-Nordic immigrant, an indicator for having separated parents, and the number of siblings. Standard errors adjusted for clustering by enrollment count are in parentheses. \*\*\*/\*\*/\*=the estimates are significantly different from zero at the 1/5/10 percent level, respectively.