**Online Data Appendix**

|  |
| --- |
| Table DA1: Variable definitions and sources |
| **Variable** | **Description** | **Main source** |
| Literacy Rate 15-19 | Youngsters aged 15-19 able to read (at least) over total youngsters of the same age. For 1891 figures are linear interpolations from 1881 and 1901. | National censuses (various years). |
| Gross Enrolment Rate, or Rate (GER) | All pupils enrolled in primary schools regardless of age and including repeaters, as a share of primary-school-age children (6–10). Computed for public and private education, female and male. | Inquiries on primary education for pupils enrolled, and national censuses for school-age children (various years).  |
| School efficacy (GER-LIT Gap) | The difference between the GER and literacy for the same cohort, measured in percentage points. Literacy refers to the year $t$, while the GER concerns $t-1$ (the same cohort).  | See above.  |
| Class size | Number of children (males and females) in primary school age divided by the total number of primary-school teachers. Computed for public and private education, female and male. | Inquiries on primary education for teachers, and national censuses for school-age children (various years). The inquiries are Ministero della Pubblica Istruzione (1865), Ministero della Pubblica Istruzione (1872), Ministero di Agricoltura, Industria e Commercio – Direzione della Statistica Generale del Regno (1881), and Ministero della Pubblica Istruzione (1910). When inquiries were not available, we relied on year-specific statistics regularly published on primary schooling, e.g. for 1891 and 1901.  |
| School expenditure per pupil  | Total municipal expenditure for education per pupil enrolled. Total expenditure includes teachers’ salaries, maintenance, the construction of new buildings and other, minor items. Figures are in Lire, at constant (1911) prices. Figures were only available concerning public education. | Municipal budgets (various years) and inquiries on primary education.  |
| Primary-school density  | Number of municipal primary schools divided by the territory of each province (squared kilometres). Computed for public and private education, female, and male (plus mixed schools once introduced). | Inquiries on primary education and national censuses.  |
| Density Evening and Sunday schools | Number of evening and Sunday schools divided by the territory of each province (squared kilometres). | Inquiries on primary education and national censuses.  |
| Latitude | Latitude of the main city of the province in decimal degrees | *Passim*. |
| Longitude | Longitude of the main city of the province in decimal degrees. | *Passim*. |
| Temperature | Provincial averages obtained from yearly data concerning the period 2000-2009, in Celsius degrees. | *Passim*. |
| Rainfall | Provincial averages obtained from yearly data concerning the period 2000-2009, in mm. | *Passim*. |
| Urbanization rate | Population living in cities with more than 30,000 inhabitants as a share of total residents | Nuvolari and Vasta (2017).  |
| Population density  | Number of residents divided by the territory of each province (squared kilometres).  | National censuses. |
| Dependency ratio | Children (0–10) plus people 65+ divided by the total number of residents.  | National censuses. |
| Infant mortality rate | The number of dead children aged 0-5 over the total number of live births in the same year. Data for 1891 refer to 1890. Data for 1901 and 1911 are estimated by interpolation with data on 1921, from regional figures. | National censuses and annual issues of vital statistics. |
| Height | Average height at age 20 of military conscripts. | A’Hearn and Vecchi (2017). |
| Share of labour force in agriculture  | Number of people employed in agriculture divided by total labour force.  | Missiaia (2014). |
| Rate of outward migration  | Emigrants as a share of total population (residents). | Yearbook on Italian Migration, *Annuario della emigrazione italiana dal 1876 al 1925* (Commissariato Generale dell’Emigrazione 1926), and Carpi (1874) for the 1871 figures. |
| Migration index (cohort) | The ratio between the number of youngsters (aged 15-19) and the number of children (aged 5-9) ten years before (same cohort). | National censuses (various years). |
| Industrial VA per capita | Industrial value added (constant prices 1911) divided by the total population (residents). | Own elaboration on Ciccarelli and Fenoaltea (2013). |
| Electoral franchise  | Ratio between the number of local electors and total males older than 21. Local electors are those entitled to vote in provincial and municipal elections. | Cappelli (2016), elaborated from electoral statistics (various years). |
| Parental literacy rate | Share of spouses who were able to sign wedding acts, smoothed on three years and centred at the years of the censuses to avoid potential short-run measurement distortions. Computed for grooms and brides separately. The age of spouses averaged 25 – 30 years old.  | Marriage registries reported in vital statistics (various years).  |
| Real wages | Real wages are computed as welfare ratios (WRs), that is, the annual earnings of an unskilled worker divided by the cost of a subsistence basket for a family. | Federico, Nuvolari and Vasta (2019). |
| High VA / low VA industries | The ratio between industrial value added produced by high capital intensive (in terms of horse-power per worker - HP/L) sectors and the one produced within low capital intensive ones . | Our elaboration on Basile and Ciccarelli (2018). Data were kindly provided by the authors.  |
| Patents  | Number of patents per million inhabitants | Nuvolari and Vasta (2017). |
| Index of land inequality (c. 1871) | The share of large landowners on the total number of landowners. | Cappelli (2017). |
| Literacy rate (CW) 1831 | Literacy rate of adults aged 30-40 in 1831. | Ciccarelli and Weisdorf (2019).  |
| Pre-unitary schooling measures | The GER and class size.  | Vigo (1971) and Genovesi (1998). |

**Further methodological notes**

Rate of outward migration: Emigration rates are smoothed by considering a ten-year average centred on the year concerned. For example, for 1911, we relied on an average pertaining to 1906-1915. For 1871, we relied on the period 1869-1873, as pre-1876 data are only available for those years. Data are from Carpi (1874).

Pre-unification schooling variables: the GER and class size are available at the province level but for a reduced number of provinces, because of missing observations. Data are mainly taken from Vigo (1971) and relate to various years over the pre-unification period ranging from 1824 to 1858. More specifically: 1850 for the Kingdom of Sardinia, 1830 for Lombardy, 1824 for Venetia, 1841 for the Granduchy of Tuscany, 1835-36 for the Continental Kingdom of Two Sicilies, 1858 for the Papal States, 1835 for the Duchy of Lucca, and 1833 for the Duchy of Parma.

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**Online Appendix**

Table A1-a: Descriptive Statistics, 1871 – 1911.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **N** | **Mean** | **SD** | **Min** | **Max** | **Mean** | **SD** | **Min** | **Max** | **Mean** | **SD** | **Min** | **Max** | **Mean** | **SD** | **Min** | **Max** | **Mean** | **SD** | **Min** | **Max** |
| *1871 - 1911* |  | *1871* | *1881* | *1891* | *1901* | *1911* |
| Literacy rate 15-19 | 69 | 34.4 | 19.4 | 9.5 | 79.5 | 42.8 | 22.2 | 13.8 | 88.9 | 51.5 | 22.5 | 19.8 | 92.6 | 60.2 | 23.1 | 25.6 | 96.3 | 72.1 | 20.0 | 36.4 | 98.7 |
| *Lag 1: 1861-1901* |  | *1861* | *1871* | *1881* | *1891* | *1901* |
| GER (total) | 69 | 53.3 | 37.5 | 8.1 | 160.7 | 65.4 | 36.6 | 21.4 | 187.8 | 87.7 | 35.5 | 37.6 | 171.8 | 91.5 | 33.2 | 46.2 | 178.2 | 94.8 | 30.7 | 43.2 | 162.7 |
| Class size (total) | 69 | 32.1 | 7.9 | 16.9 | 48.9 | 36.5 | 8.6 | 23.4 | 61.6 | 39.7 | 8.8 | 22.1 | 65.5 | 40.5 | 7.8 | 27.2 | 63.0 | 42.0 | 7.4 | 29.9 | 62.6 |
| Expenditure per pupil (public) | 69 | 28.7 | 16.1 | 6.1 | 95.4 | 29.7 | 15.3 | 8.5 | 96.2 | 22.1 | 7.9 | 9.5 | 46.4 | 25.5 | 8.5 | 8.4 | 49.6 | 27.9 | 7.3 | 14.0 | 49.4 |
| Primary-school density (total) | 69 | 148.4 | 139.1 | 19.7 | 727.0 | 158.2 | 143.6 | 22.2 | 985.9 | 231.8 | 257.1 | 33.8 | 1899.6 | 254.5 | 270.9 | 37.9 | 2093.8 | 270.4 | 271.1 | 41.8 | 2042.2 |
| GER (private) | 69 | 7.1 | 8.4 | 0.0 | 56.4 | 6.6 | 5.6 | 0.1 | 25.9 | 7.0 | 6.5 | 0.2 | 36.8 | 6.2 | 5.5 | 0.7 | 31.0 | 5.6 | 4.4 | 0.9 | 21.1 |
| Class size (private) | 65 | 18.0 | 6.6 | 9.2 | 47.2 | 19.4 | 6.3 | 9.9 | 56.3 | 20.7 | 4.3 | 13.5 | 32.6 | 19.6 | 3.5 | 12.7 | 30.1 | 19.0 | 4.8 | 9.6 | 39.3 |
| Primary-school density (private) | 69 | 41.5 | 85.6 | 0.0 | 625.8 | 34.7 | 65.0 | 0.2 | 490.6 | 52.3 | 144.5 | 1.3 | 1022.5 | 48.9 | 136.2 | 0.8 | 1082.6 | 45.8 | 108.6 | 1.2 | 854.6 |
| *Controls (1871 - 1911)* |  | *1871* | *1881* | *1891* | *1901* | *1911* |
| Density of Evening and Sunday schools | 69 | 65.5 | 57.8 | 10.7 | 293.5 | 73.9 | 66.1 | 13.4 | 391.2 | 28.8 | 27.4 | 2.0 | 151.1 | 22.3 | 24.4 | 1.4 | 103.2 | 49.0 | 53.0 | 2.0 | 258.5 |
| Population density | 69 | 118.4 | 107.0 | 22.0 | 853.0 | 126.7 | 115.7 | 24.0 | 931.0 | 134.9 | 124.4 | 27.0 | 1001.0 | 143.0 | 133.3 | 29.0 | 1071.0 | 157.1 | 154.3 | 32.0 | 1228.0 |
| Urbanization rate (30,000+) | 69 | 13.7 | 16.0 | 0.0 | 81.9 | 14.4 | 16.2 | 0.0 | 80.7 | 15.5 | 16.5 | 0.0 | 79.9 | 17.2 | 17.1 | 0.0 | 79.7 | 17.9 | 17.1 | 0.0 | 78.6 |
| Dependency ratio | 69 | 29.4 | 1.3 | 27.0 | 33.0 | 27.3 | 1.2 | 24.0 | 31.0 | 28.7 | 1.2 | 25.0 | 32.0 | 29.8 | 1.5 | 27.0 | 34.0 | 29.2 | 1.8 | 25.0 | 34.0 |
| Infant mortality rate | 69 | 41.8 | 6.0 | 34.6 | 64.3 | 38.5 | 6.0 | 27.9 | 55.8 | 34.6 | 5.3 | 24.6 | 48.5 | 30.0 | 4.6 | 22.4 | 41.2 | 25.7 | 5.0 | 16.8 | 36.9 |
| Height | 69 | 162.8 | 1.9 | 159.0 | 166.0 | 163.5 | 1.9 | 160.0 | 167.0 | 163.7 | 1.9 | 160.0 | 168.0 | 164.0 | 2.0 | 160.0 | 167.0 | 165.1 | 2.0 | 161.0 | 168.0 |
| Share of LF in agriculture | 69 | 54.9 | 12.6 | 11.2 | 83.5 | 53.3 | 12.7 | 10.9 | 92.3 | 57.9 | 12.5 | 13.0 | 93.8 | 62.4 | 13.3 | 15.0 | 95.3 | 58.5 | 13.4 | 10.7 | 79.5 |
| Industrial VA p.c. | 69 | 48.9 | 15.6 | 26.0 | 91.1 | 55.7 | 19.3 | 29.3 | 113.9 | 65.0 | 26.1 | 33.0 | 149.8 | 74.2 | 33.6 | 34.4 | 189.6 | 103.3 | 51.5 | 44.6 | 283.9 |
| Electoral franchise  | 69 | 17.7 | 8.3 | 8.8 | 42.6 | 22.5 | 8.9 | 12.0 | 50.5 | 29.2 | 11.7 | 13.7 | 67.9 | 36.7 | 13.3 | 18.3 | 76.7 | 43.3 | 14.0 | 22.0 | 82.3 |
| Outward migration rate | 69 | 5.2 | 9.7 | 0.1 | 64.7 | 4.4 | 7.7 | 0.0 | 43.5 | 8.2 | 12.2 | 0.0 | 69.2 | 14.1 | 14.4 | 1.5 | 96.3 | 17.9 | 10.7 | 3.6 | 68.0 |
| Migration proxy (pop. ratio) | 69 | 88.2 | 5.0 | 72.8 | 102.0 | 89.9 | 4.9 | 75.3 | 108.1 | 88.0 | 4.5 | 77.0 | 103.2 | 86.1 | 4.7 | 77.4 | 102.4 | 89.1 | 8.7 | 57.6 | 109.7 |

Table A1-b: Descriptive Statistics, time-invariant variables.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable | N | Mean | SD | Min | Max |
| Literacy 1831 | 69 | 26.2 | 11.5 | 10 | 55 |
| Pre-Unification GER | 50 | 25.1 | 19.2 | 2.38 | 91.3 |
| Pre-Unification class size | 50 | 29.3 | 12.7 | 7.31 | 56.3 |
| Latitude | 69 | 42.7 | 2.62 | 37 | 46.1 |
| Longitude | 69 | 12 | 2.47 | 7.33 | 18.1 |
| Average temperature | 69 | 13.7 | 2.5 | 6.1 | 18.3 |
| Average rainfall | 69 | 775 | 109 | 465 | 1103 |

Table A2: Education Production Function: GER capped at 100 percent, and literacy capped at 90 percent; panel estimates, 1871-1911

|  |  |  |
| --- | --- | --- |
|   | (1) | (2) |
| Panel | FE | FE |
| Variables | GER-LIT Gap (GER<100) | GER-LIT Gap (LIT<90) |
|   |   |   |
| Class size (total) | 0.463\*\*\* | 0.698\*\*\* |
|  | (0.167) | (0.143) |
| Expenditure per pupil (public) | -0.132\* | -0.146\* |
|  | (0.067) | (0.078) |
| Primary-school density (total) | 0.045\*\*\* | 0.053\*\*\* |
|  | (0.012) | (0.012) |
| Density of Evening and Sunday schools | -0.006 | 0.022 |
|  | (0.026) | (0.021) |
|  |  |  |
| Control variables | Y | Y |
| Province FE (69) | Y | Y |
| Year dummies | Y | Y |
| Macro-region FE (4) | N | N |
| Observations | 212 | 313 |
| Adjusted R-squared | 0.716 | 0.670 |
| Robust standard errors in parentheses |
| \*\*\* p<0.01, \*\* p<0.05, \* p<0.1 |

Table A3: Education Production Function: alternative correlates, panel estimates, 1871-1911

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|   | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Model | FE | FE | FE | FE | Pooled OLS | FE | FE | FE | FE | Pooled OLS |
| Variables | GER (total) | GER (total) | GER (total) | GER (total) | GER (total) | GER-LIT Gap | GER-LIT Gap | GER-LIT Gap | GER-LIT Gap | GER-LIT Gap |
|  |  |  |  |  |  |   |  |  |  |  |
| Class size (total) | 1.364\*\*\* | 1.497\*\*\* | 1.483\*\*\* | 1.479\*\*\* | 1.454\*\*\* | 0.681\*\*\* | 0.711\*\*\* | 0.704\*\*\* | 0.723\*\*\* | 0.598\*\*\* |
|  | (0.199) | (0.218) | (0.216) | (0.219) | (0.148) | (0.144) | (0.127) | (0.125) | (0.124) | (0.110) |
| Expenditure per pupil (public) | -0.116 | -0.103 | -0.114 | -0.149 | 0.023 | -0.170\*\* | -0.164\*\* | -0.163\*\* | -0.172\*\* | -0.176\*\*\* |
|  | (0.114) | (0.114) | (0.116) | (0.105) | (0.087) | (0.072) | (0.072) | (0.073) | (0.066) | (0.062) |
| Primary-school density (total) | 0.060\*\*\* | 0.066\*\*\* | 0.067\*\*\* | 0.069\*\* | 0.089\*\*\* | 0.052\*\*\* | 0.052\*\*\* | 0.051\*\*\* | 0.053\*\*\* | 0.056\*\*\* |
|  | (0.021) | (0.025) | (0.023) | (0.027) | (0.027) | (0.013) | (0.013) | (0.013) | (0.013) | (0.020) |
| Density of Evening and Sunday schools | 0.011 | 0.007 | -0.001 | 0.010 | 0.047\*\*\* | 0.012 | 0.010 | 0.008 | 0.014 | 0.023 |
|  | (0.017) | (0.015) | (0.015) | (0.016) | (0.012) | (0.016) | (0.017) | (0.017) | (0.017) | (0.015) |
| Male parental literacy | 0.935\*\*\* |  |  |  |  | -0.062 |  |  |  |  |
|  | (0.185) |  |  |  |  | (0.181) |  |  |  |  |
| Female parental literacy | -0.083 |  |  |  |  | 0.096 |  |  |  |  |
|  | (0.121) |  |  |  |  | (0.137) |  |  |  |  |
| Real wages (FNV basket) |  | 3.143 |  |  |  |   | 0.542 |  |  |  |
|  |  | (3.776) |  |  |  |   | (2.889) |  |  |  |
| High-to-low value added (industry) |  |  | 7.511\* |  |  |   |  | 2.003 |  |  |
|  |  |  | (4.037) |  |  |   |  | (3.367) |  |  |
| Patents per million inhabitants |  |  |  | 0.105\* |  |   |  |  | 0.063\* |  |
|  |  |  |  | (0.057) |  |   |  |  | (0.035) |  |
| Land inequality 1871 |  |  |  |  | -0.022 |   |  |  |  | 0.024 |
|  |  |  |  |  | (0.037) |   |  |  |  | (0.029) |
|  |  |  |  |  |  |   |  |  |  |  |
| Control variables | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Year dummies | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Province FE (69) | Y | Y | Y | Y | N | Y | Y | Y | Y | N |
| Macro-regional FE (5) | N | N | N | N | Y | N | N | N | N | Y |
| Observations | 345 | 345 | 345 | 345 | 345 | 345 | 345 | 345 | 345 | 345 |
| Adjusted R-squared | 0.848 | 0.827 | 0.829 | 0.832 | 0.929 | 0.634 | 0.634 | 0.634 | 0.639 | 0.787 |
| Robust standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1 |

Notes: all models are with FE and year dummies, except Columns 5 and 10, where we only include macro-regional FE (5 macro-regions) to allow the inclusion of a variable for land inequality in c. 1871 (time invariant). All geographic controls (latitude, longitude, average temperature and rainfall) are included in the Pooled-OLS specifications. Sources: see Table DA1 above.

Table A4: Cross-section regressions by gender, females.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|   | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Dependent variable: | GER females | GER-LIT Gap females |
| Year | 1871 | 1881 | 1891 | 1901 | 1871 | 1881 | 1891 | 1901 | 1911 |
|  |  |  |  |  |   |  |  |  |  |
| Class size (females) | 0.922\*\*\* | 1.780\*\*\* | 1.767\*\*\* | 1.876\*\*\* | 0.475\*\*\* | 0.350 | 0.876\*\*\* | 0.699\*\*\* | 0.666\*\*\* |
|  | (0.205) | (0.290) | (0.339) | (0.338) | (0.160) | (0.221) | (0.208) | (0.198) | (0.242) |
| Expenditure per pupil (public) | -0.069 | -0.039 | 0.054 | 0.032 | -0.190 | -0.512\*\*\* | -0.320 | 0.091 | 0.156 |
|  | (0.154) | (0.262) | (0.242) | (0.304) | (0.137) | (0.141) | (0.225) | (0.151) | (0.273) |
| Primary-school density (females) | 0.220\*\* | 0.167\* | 0.287\*\*\* | 0.238\*\*\* | 0.199\*\*\* | 0.168\*\* | 0.142\*\* | 0.114\*\* | 0.105\*\* |
|  | (0.098) | (0.089) | (0.075) | (0.083) | (0.065) | (0.063) | (0.056) | (0.047) | (0.049) |
| Density of Evening and Sunday schools | 0.063 | 0.065 | 0.225\*\*\* | 0.104 | -0.020 | -0.041 | 0.048 | 0.159\*\*\* | -0.020 |
|  | (0.054) | (0.049) | (0.063) | (0.070) | (0.065) | (0.049) | (0.061) | (0.040) | (0.020) |
|  |  |  |  |  |   |  |  |  |  |
| Control variables | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Observations | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 |
| Adjusted R-squared | 0.904 | 0.928 | 0.913 | 0.898 | 0.718 | 0.721 | 0.751 | 0.723 | 0.648 |
| Robust standard errors in parentheses |
| \*\*\* p<0.01, \*\* p<0.05, \* p<0.1 |

Notes: the controls include latitude, longitude, average temperature, average rainfall, population density, the urbanization rate, the dependency ratio, infant mortality rate, height, the share of labour force employed in agriculture, industrial VA per capita, the outward migration rate, electoral franchise, and the migration proxy based on population ratios.

Table A5: Cross-section regressions by gender, males.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|   | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Dependent variable: | GER males | GER-LIT Gap males |
| Year | 1871 | 1881 | 1891 | 1901 | 1871 | 1881 | 1891 | 1901 | 1911 |
|  |  |  |  |  |   |  |  |  |  |
| Class size (males) | 1.274\*\*\* | 0.465 | 0.174 | 0.090 | 0.662\*\* | 0.981\*\*\* | 0.338 | 0.169 | 0.020 |
|  | (0.352) | (0.289) | (0.179) | (0.075) | (0.295) | (0.290) | (0.245) | (0.137) | (0.068) |
| Expenditure per pupil (public) | -0.142 | -0.203 | -0.083 | 0.049 | -0.106 | -0.265 | -0.344 | -0.077 | 0.027 |
|  | (0.199) | (0.276) | (0.293) | (0.298) | (0.128) | (0.188) | (0.228) | (0.184) | (0.259) |
| Primary-school density (males) | 0.235\*\* | 0.154\*\* | 0.224\*\*\* | 0.142\*\* | 0.237\*\*\* | 0.270\*\*\* | 0.129\*\* | 0.142\*\*\* | 0.068\* |
|  | (0.102) | (0.073) | (0.074) | (0.061) | (0.064) | (0.093) | (0.060) | (0.049) | (0.040) |
| Density of Evening and Sunday schools | 0.023 | 0.110\*\* | 0.228\*\*\* | 0.191\*\*\* | -0.002 | 0.016 | 0.090 | 0.235\*\*\* | -0.034 |
|  | (0.042) | (0.046) | (0.077) | (0.068) | (0.045) | (0.044) | (0.080) | (0.047) | (0.023) |
|  |  |  |  |  |   |  |  |  |  |
| Control variables | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Observations | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 |
| Adjusted R-squared | 0.934 | 0.915 | 0.898 | 0.894 | 0.815 | 0.813 | 0.785 | 0.725 | 0.720 |
| Robust standard errors in parentheses |
| \*\*\* p<0.01, \*\* p<0.05, \* p<0.1 |

Notes: see Table A4.