**Supplementary Material**

**Male Twin Live Births Following Unconditional Cash Transfers in Alaska: A Time-Series Analysis**

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**Supplementary Figure S1: Monthly count of male and female twin and singleton live births in Alaska**

**Supplementary Figure S2: Expected or fitted values (ARIMA signature) of monthly odds of male twin live births in Alaska, 1980-2019.**

**Supplementary Figure S3: ARIMA-derived residuals of monthly odds of male twin live births and timing, magnitude of PFD payments in Alaska, 1980-2019.**

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**Table S1. Results from ARIMA time-series analysis of monthly odds of female twin live births as a function of PFD month and amount (in $1000s) and autocorrelation, Alaska, 1980-2019.**

|  |  |  |
| --- | --- | --- |
| **Variables** | **Coefficient** | **Standard error** |
| PFD month and amount (in $1000s) |  |  |
| Lag 2 (2 months post PFD disbursement) | 0.002 | 0.001 |
| Lag 3 (3 months post PFD disbursement) | 0.001 | 0.001 |
| Lag 4 (4 months post PFD disbursement) | -0.001 | 0.001 |
| Lag 5 (5 months post PFD disbursement) | 0.000 | 0.001 |
| Lag 6 (6 months post PFD disbursement) | 0.001 | 0.001 |
| Autocorrelation parameters |  |  |
| AR 1 | 0.096 | 0.046 |
| AR 2 | 0.129 | 0.046 |
| AR 6 | 0.174 | 0.046 |
| Constant | 0.0264\*\*\* | 0.001 |

\*p < 0.05, \*\*p < 0.01, \*\*\*p<0.001; two-tailed test

AR = AutoRegression

October” effect on the patterning of male twinning in Alaska (Supplement Table S2). Examination of ARIMA-derived outcome residuals shows absence of autocorrelation (supplement Figure S2). Exposure lags of 7-11 months do not exhibit statistically detectable relations with the outcome (Supplement Table S3).

**Table S2. Results from ARIMA time-series analysis of monthly odds of male twin live births as a function PFD payment month and autocorrelation, Alaska, 1980-2019.**

|  |  |  |
| --- | --- | --- |
| **Variables** | **Coefficient** | **Standard error** |
| PFD month (binary indicator) |  |  |
| Lag 2 (2 months post PFD disbursement) | 0.001 | 0.002 |
| Lag 3 (3 months post PFD disbursement) | 0.001 | 0.002 |
| Lag 4 (4 months post PFD disbursement) | 0.001 | 0.002 |
| Lag 5 (5 months post PFD disbursement) | 0.0004 | 0.002 |
| Lag 6 (6 months post PFD disbursement) | -0.002 | 0.002 |
| Autocorrelation parameters |  |  |
| AR 4 | 0.121\* | 0.045 |
| AR 5 | 0.145\*\* | 0.045 |
| AR 6 | 0.140\*\* | 0.045 |
| Constant | 0.025\*\*\* | 0.001 |

\*p < 0.05, \*\*p < 0.01, \*\*\*p<0.001; two-tailed test

AR = AutoRegression

**Table S3. Results from ARIMA time-series analysis of monthly odds of male twin live births as a function of 7–11-month lags of PFD month and amount (in $1000s) and autocorrelation, Alaska, 1980-2019.**

|  |  |  |
| --- | --- | --- |
| **Variables** | **Coefficient** | **Standard error** |
| PFD month and amount (in $1000s) |  |  |
| Lag 7 (7 months post PFD disbursement) | -0.0002 | 0.002 |
| Lag 8 (8 months post PFD disbursement) | 0.001 | 0.002 |
| Lag 9 (9 months post PFD disbursement) | 0.001 | 0.002 |
| Lag 10 (10 months post PFD disbursement) | 0.000 | 0.002 |
| Lag 11(11 months post PFD disbursement) | -0.001 | 0.002 |
| Autocorrelation parameters |  |  |
| AR 4 | 0.121\* | 0.045 |
| AR 5 | 0.145\*\* | 0.045 |
| AR 6 | 0.139\*\* | 0.045 |
| Constant | 0.0251\*\*\* | 0.001 |

\*p < 0.05, \*\*p < 0.01, \*\*\*p<0.001; two-tailed test

AR = AutoRegression

**Supplement Table S4. Results from ARIMA time-series analysis of monthly odds of male twin live births as a function 3-month lag of PFD month and amount (in $1000s) and autocorrelation, Alaska, 1980-2019.**

|  |  |  |
| --- | --- | --- |
| **Variables** | **Coefficient** | **Standard error** |
| PFD month and amount (in $1000s) |  |  |
| Lag 3 (3 months post PFD disbursement) | 0.002\* | 0.0008 |
| Autocorrelation parameters |  |  |
| AR 4 | 0.123\*\* | 0.045 |
| AR 5 | 0.146\*\* | 0.045 |
| AR 6 | 0.132\*\* | 0.045 |
| Constant | 0.025\*\*\* | 0.0008 |

\*p < 0.05, \*\*p < 0.01, \*\*\*p<0.001; two-tailed test

AR = AutoRegression

**Supplement Table S5: Description of key population-level time-series studies examining the association between macrosocial exposures and male twin live births**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Study citation** | **Study population** | **Exposure** | **Outcome** | **Exposure lags tested** | **Null rejected for exposure lag** | **Estimated coefficient (standard error) for statistically detectable exposure lag(s) at α≤0.05** |
| Karasek, D., Goodman, J., Gemmill, A., Falconi, A., Hartig, T., Magganas, A. and Catalano, R., 2015. Twins less frequent than expected among male births in risk averse populations. *Twin Research and Human Genetics*, *18*(3), pp.314-320. | Sweden (population-wide study) | Consumer confidence index | Odds of male twin live births | 1-8 months | 2 | -0.0012 (0.0006) |
| Catalano, R.A., Goldman-Mellor, S., Karasek, D.A., Gemmill, A., Casey, J.A., Elser, H., Bruckner, T.A. and Hartig, T., 2020. Collective optimism and selection against male twins in utero. *Twin Research and Human Genetics*, *23*(1), pp.45-50. | Sweden (population-wide study) | Suicide deaths among reproductive-aged females | Odds ratio of male twin live births | 1-8 months | 4 | -0.004 (0.002) |
| Bruckner, T.A., Bustos, B., Margerison, C., Gemmill, A., Casey, J. and Catalano, R., 2023. Selection in utero against male twins in the United States early in the COVID‐19 pandemic. *American Journal of Human Biology*, *35*(3), p.e23830. | United States (population-wide study) | Onset of COVID-19 pandemic | Male twin live birth secondary sex ratio | 1-6 months | 1,3,4 | -0.0008 (0.0004) |
| Singh, P., Gailey, S., Das, A. and Bruckner, T.A., 2023. National trends in suicides and male twin live births in the US, 2003 to 2019: an updated test of collective optimism and selection in utero. *Twin research and human genetics*, *26*(6), pp.353-360. | United States (population-wide study) | Suicide deaths | ratio of male twins to male singleton live births | 2-6 months | 6 | -0.005 (0.002) |
| Stolte, A., Gemmill, A., Lee, H., Bustos, B., Casey, J.A., Bruckner, T.A. and Catalano, R.A., 2024. Male twinning after the 2008 Obama election: A test of symbolic empowerment. *Social Science & Medicine*, *356*, p.117131. | United States (population-wide study) | 2008 Obama election | Non-Hispanic male twin births per 1000 live births | 1-9 months | 6,9 | 1.57 per 1000 live births (0.54) |