Online Appendix

Fertility and the Personal Exemption: Comment

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A Replication Data

The general fertility rate, value of the personal exemption, and the female wage series which was constructed by Whittington, Alm and Peters (1990) to measure the real change in average female wages, were each reported in the paper's appendix. The introduction of the birth control pill and U.S. involvement in World War II are simple binary variables that equal one after 1963 for the birth control pill and between 1941-1945 for World War II.

Male and Asset Income

The male and asset income series is a measure of average family income less female earnings. While this series was not reported in the appendix of Whittington et al. (1990), it was recorded in a letter from Leslie Whittington to Brigitte Madrian. Whittington et al. derived these data for 1913-1948 from Historical Statistics Series D722-727 and D830-844 by calculating a male-to-average earnings ratio, and multiplying this by the average earnings. Years 1949-1955 were derived in the same manner, but used data from the CPS Series P-60 on median earnings. Years 1956-1984 are directly from CPS Series P-60. Nonwage income was obtained from the 1988 Economic Report of the President by subtracting Compensation from National Income, dividing by the population, and multiplying by average family size. The series is adjusted for inflation and is included as a measure of the income effect on fertility. The year to which the series is normalized is not reported.

Unemployment

Whittington et al. (1990) do not report their source for the annual national unemployment series. Unemployment rates for 1929 to 1984 are obtained from the Statistical Abstract of the United States: 2003, Mini-Historical Series HS-29 (U.S. Census Bureau 2003). Unemployment rates from 1913 to 1928 are obtained from Lebergott (1964) Table A-3. While there is overlap of certain years between the two sources of unemployment data, we found that this method gave us the best match of the mean and standard deviation reported in Whittington et al.

Infant Mortality

Infant mortality data from 1915 to 1984 are obtained from the Statistical Abstract of the United States Mini-Historical Series HS-13 (U.S. Census Bureau 2003) and measure the number of children who die before reaching their first birthday (excluding fetal deaths), per thousand children born. However, no data appears to be available before 1915 and Whittington et al. do not record the source or give any indication of what values they used for 1913 and 1914. Some studies cite an estimated infant mortality rate of 200 in the early 1700s and then use a linear extrapolation for years between 1700 and 1915. Because the measured infant mortality rate for 1915 is 99.9, it is likely that Whittington et al. simply used values of 100 for both 1913 and 1914. Doing so closely matches their reported mean and standard deviation.

Immigration

The immigration series is listed as the immigration of the at-risk group as a fraction of the resident at-risk group. We assume that the at-risk group is the age group 16-44.[1] We use the

[1] Defining the at-risk group as females aged 16-44 requires making an assumption that the percent of immigrants that are female is uncorrelated with the percent of immigrants that are aged 16-44, and yields a series that does not match the reported moments in Whittington et al. (1990).

original source material as provided in the previous correspondence from Leslie Whittington. For 1913-1970, immigration by age is obtained from the Historical Statistics of the United States: Colonial Times to 1970 Series C 138-142, and population totals by age come from Series A 29-42 of the same volume (U.S. Census Bureau 1975). The source of the remaining data for 1971-1984 is listed as various years of the Statistical Abstract; we use the Historical Statistics of the United States: Millenium Edition Online (U.S. Census Bureau 2006).[2]

Reconstructed 1913-1984 Data Series

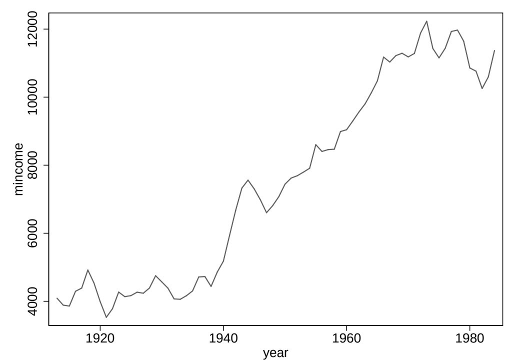
Year	Fertility Rate	Personal Exemption	Male & Asset Income	Unemploy-ment	Infant Mortality	Age 16-44 Immigration	Female Wage
1913	124.7	0	4,090	0.043	100.0	0.02086	0.461
1914	126.6	0	3,887	0.079	100.0	0.02043	0.458
1915	125.0	0	3,860	0.085	99.9	0.00504	0.467
1916	123.4	0	4,294	0.051	101.0	0.00450	0.492
1917	121.0	19.27	4,388	0.046	93.8	0.00434	0.503
1918	119.8	23.94	4,920	0.014	100.9	0.00157	0.554
1919	111.2	20.07	4,536	0.014	86.6	0.00197	0.548
1920	117.9	15.33	3,990	0.052	85.8	0.00608	0.627
1921	119.8	34.32	3,529	0.117	75.6	0.01141	0.657
1922	111.2	36.65	3,782	0.067	76.2	0.00403	0.681
1923	110.5	25.83	4,271	0.024	77.1	0.00723	0.720
1924	110.9	27.34	4,136	0.050	70.8	0.00948	0.738
1925	106.6	22.85	4,167	0.032	71.7	0.00389	0.712
1926	102.6	21.13	4,268	0.018	73.3	0.00410	0.713
1927	99.8	24.61	4,237	0.033	64.6	0.00450	0.717
1928	93.8	31.96	4,390	0.042	68.7	0.00403	0.747
1929	89.2	27.29	4,751	0.032	67.6	0.00359	0.737
1930	89.2	18.40	4,570	0.087	64.6	0.00301	0.738
1931	84.6	14.91	4,386	0.159	61.6	0.00113	0.735
1932	81.7	28.36	4,070	0.236	57.6	0.00038	0.702
1933	76.3	31.95	4,059	0.249	58.1	0.00025	0.786
1934	78.5	33.91	4,164	0.217	60.1	0.00031	0.972
1935	77.2	36.98	4,304	0.201	55.7	0.00037	0.959
1936	75.8	50.12	4,716	0.169	57.1	0.00038	0.928
1937	77.1	42.79	4,727	0.143	54.4	0.00055	0.981
1938	79.1	32.22	4,437	0.190	51.0	0.00075	0.988
1939	77.6	36.53	4,857	0.172	48.0	0.00086	1.000
1940	79.9	53.33	5,179	0.146	47.0	0.00070	1.043

[2]The ages for which data are available differ slightly over the years. The number of immigrants prior to 1918 was reported for 14-44 year olds. From 1940-1944, the reported age category was 16-45, and from 1971 onwards, 15-44 year-olds were reported. We do not attempt any correction for these differences.

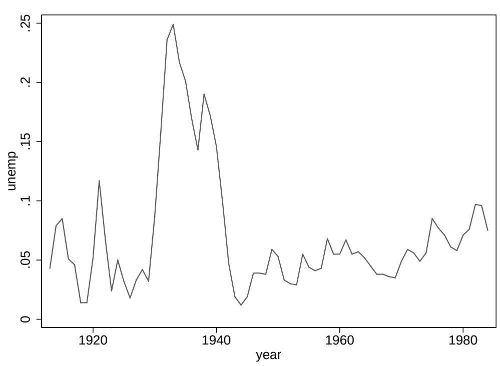
Year	Fertility Rate	Personal Exemption	Male & Asset Income	Unemploy-ment	Infant Mortality	Age 16-44 Immigration	Female Wage
1941	83.4	102.49	5,936	0.099	45.3	0.00048	1.084
1942	91.5	137.70	6,678	0.047	40.4	0.00027	1.147
1943	94.3	141.20	7,327	0.019	40.4	0.00023	1.278
1944	88.4	243.83	7,561	0.012	39.8	0.00028	1.351
1945	85.9	238.40	7,304	0.019	38.3	0.00038	1.358
1946	101.9	193.16	6,983	0.039	33.8	0.00129	1.359
1947	113.3	168.90	6,604	0.039	32.2	0.00152	1.368
1948	107.3	149.79	6,811	0.038	32.0	0.00167	1.405
1949	107.1	147.05	7,076	0.059	31.3	0.00183	1.323
1950	106.2	163.10	7,442	0.053	29.2	0.00225	1.239
1951	111.5	178.14	7,622	0.033	28.4	0.00179	1.235
1952	113.9	189.43	7,691	0.030	28.4	0.00235	1.287
1953	115.2	186.51	7,797	0.029	27.8	0.00162	1.423
1954	118.1	165.46	7,910	0.055	26.6	0.00198	1.404
1955	118.5	170.57	8,603	0.044	26.4	0.00227	1.661
1956	121.2	171.00	8,404	0.041	26.0	0.00299	1.669
1957	122.9	165.12	8,458	0.043	26.3	0.00299	1.729
1958	120.2	158.66	8,470	0.068	27.1	0.00231	1.746
1959	118.8	162.19	8,989	0.055	26.4	0.00232	1.765
1960	118.0	158.28	9,043	0.055	26.0	0.00237	1.776
1961	117.2	160.71	9,298	0.067	25.3	0.00236	1.739
1962	112.2	161.58	9,563	0.055	25.3	0.00247	1.777
1963	108.5	161.61	9,802	0.057	25.2	0.00263	1.812
1964	105.0	142.73	10,125	0.052	24.8	0.00244	1.855
1965	96.6	134.60	10,481	0.045	24.7	0.00243	1.903
1966	91.3	133.94	11,178	0.038	23.7	0.00240	1.859
1967	87.6	133.80	11,032	0.038	22.4	0.00258	1.918
1968	85.7	145.10	11,221	0.036	21.8	0.00321	1.979
1969	86.5	142.62	11,290	0.035	20.9	0.00253	2.063
1970	87.9	130.58	11,183	0.049	20.0	0.00261	2.064
1971	81.8	132.99	11,284	0.059	19.1	0.00262	2.057
1972	73.4	144.85	11,882	0.056	18.5	0.00268	2.094
1973	69.2	140.87	12,231	0.049	17.7	0.00269	2.061
1974	68.4	130.49	11,429	0.056	16.7	0.00259	2.034
1975	66.0	122.36	11,154	0.085	16.1	0.00245	2.103
1976	65.8	120.08	11,434	0.077	15.2	0.00247	2.170
1977	66.8	116.11	11,930	0.071	14.1	0.00277	2.187
1978	65.5	118.98	11,972	0.061	13.8	0.00363	2.277
1979	67.2	132.93	11,646	0.058	13.1	0.00274	2.206
1980	68.4	123.17	10,857	0.071	12.6	0.00310	2.136
1981	67.4	119.31	10,765	0.076	11.9	0.00342	2.106
1982	67.3	102.04	10,255	0.097	11.5	0.00339	2.173
1983	65.8	92.49	10,595	0.096	11.2	0.00324	2.216
1984	65.4	83.90	11,370	0.075	10.8	0.00309	2.240

Figure A-1: Replication Series 1913–1984

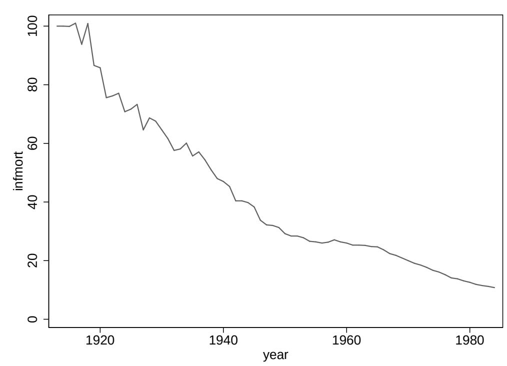
(a) Personal Exemption



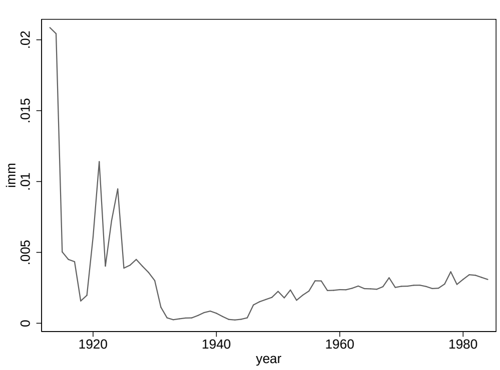
(b) Male and Asset Income



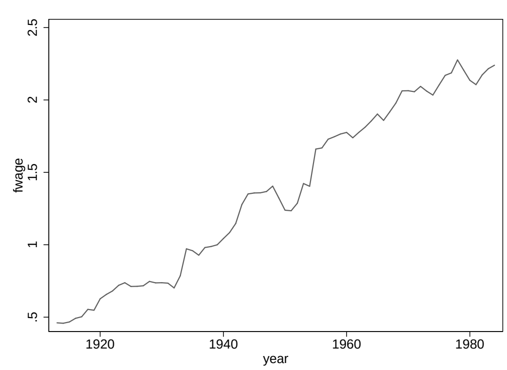
(c) Unemployment



(d) Infant Mortality



(e) Immigration



(f) Female Wage

B Extended and Updated Data

General Fertility Rate

For our extended data series, we use the general fertility rate in years 1913-1959 from the Datapedia of the United States (Kurian 2001) and years 1960-2005 from the National Vital Statistics Report (Martin et al. 2005). The general fertility rate series reported in the Datapedia match that reported in Whittington et al. (1990) in all but two years; however, the National Vital Statistics Report's general fertility rates differ slightly in several years. Since we believe the National Vital Statistics Report to have the most current and reliable fertility data, we use these data for all years they are available.

Child Tax Benefits

The value of the personal exemption for a parent claiming a child as a dependent is calculated by multiplying the statutory amount of the personal exemption by the marginal tax rate. From 1913 to 1916, there was no personal exemption for dependents. Starting in 1917, a personal exemption for dependents was introduced and set at $200, one fifth of the personal exemption for an individual. In 1944, the separate category for dependents was removed; the personal exemption for a dependent was equal to the personal exemption for the taxpayer or a spouse.[3]

Because the value of the personal exemption depends on the marginal tax rate, an average marginal tax rate for each year is needed. Whittington et al. (1990) use an arithmetic average marginal statutory income tax rate weighted by adjusted gross income (AGI) that was first introduced by Barro and Sahasakul (1983) and then updated to include all years from 1916

[3]The personal exemption level series is commonly available. We used the series provided by the tax policy center, online at http://www.taxpolicycenter.org.

to 1983 in Barro and Sahasakul (1986).[4] Stephenson (1998) updated the series to 1994.[5] We use the Barro and Sahasakul methodology to extend the average marginal tax rate series to 2005 using data from the IRS Statistics of Income.[6] The IRS tables report the number of taxpayers and the amount of income at each marginal tax rate. Using this data, we take the arithmetic average weighted by AGI to update the Barro-Sahasakul statutory marginal tax rate series. Some of the AGI cells in the IRS data are negative and are dropped from the calculation.

The value of the personal exemption is not the only tax benefit for a parent claiming a child as a dependent. To calculate the total benefit, we add the tax value of the Earned Income Tax Credit (EITC) and the Child Tax Credit (CTC) to the value of the personal exemption. Unlike the additional personal exemption that can be claimed by nearly every taxpayer with a dependent child, the EITC can only be claimed by taxpayers in a specific income range. Thus, rather than calculate the tax value of these benefits for a taxpayer in the particular situation, we take the real value of all benefits from these tax provisions and divide by the number of children to produce an average benefit level. The value of the personal exemption and the total value of benefits are the same until the mid 1970's when these tax provisions are introduced. The tax expenditure on the EITC and CTC were gathered from the OMB *Analytical Perspectives, Budget of the United States Government* Tables 5-1 and 19-1 from various years.

Male and Asset Income

We construct a revised male and asset income data series, using more recently available data. From 1947-2005, male income data were obtained from the Historical Income Table P-

[4]As noted by Whittington et al., Barro and Sahasakul calculate the average marginal tax rate starting in 1916 because this is when the IRS statistics of income data become available. However, since between 1913 and 1916 the personal exemption for dependents was zero, no values for the value of the personal exemption series are missing.

[5]Stephenson notes that the average marginal tax rates reported by Barro and Sahasakul (1986) for 1981 and 1983 are slightly different than the values that he calculates. Stephenson attributes the difference to Barro and Sahasakul's use of preliminary statistics of income data.

[6]See http://www.irs.gov/pub/irs-soi/04in01tr.xls.

53 constructed by the U.S. Census Bureau.[7] Male income data before 1947 were constructed by estimating the equation

$$MaleIncome_t = \alpha_0 + \beta_0 MedianIncome_t + \epsilon_t \tag{A-1}$$

for years 1947-2005, and using these estimated coefficients to impute male income from median income prior to 1947[8]. The series that Whittington et al. (1990) used includes asset income, which was obtained from two additional sources: the Statistics of Income for years 1916-1936, and the National Income and Product Accounts for years 1929-2005. Finally, the series was adjusted to 2005 dollars.

Other Series

As in the unemployment series for replication, unemployment data after 1929 is obtained from the Bureau of Labor Statistics. The infant mortality series is also extended to 2005 using the same source as the replication data, the U.S. Census Bureau.

For years 1986-2005, the Department of Homeland Security publishes the number of immigrants by age and gender in the Yearbook of Immigration Statistics. These reports are available on the Department of Homeland Security's website.[9] These data were appended to the immigration data used for replication.

While the constructed female wage series was used for replication purposes, for our later analysis, we obtain female wages for 1973-2005 from the Economic Policy Institute and estimate a scaling factor which is applied to Whittington et al. (1990)'s series to fill in the values from 1913-1972.

[7] See http://www.census.gov/hhes/www/income/histinc/incpertoc.html.

[8] Median income from 1913-1960 is from Lebergott (1964). Using the overlapping years 1947-1960, a scaling factor was estimated and applied to the imputed male income series to make the transition between the two series smooth

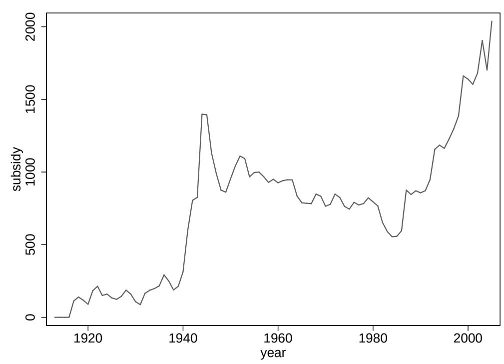
[9] See http://www.dhs.gov/ximgtn/statistics/publications/yearbook.shtm.

Complete 1913-2005 Data

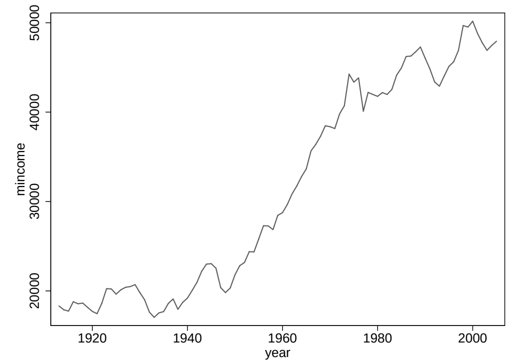
Year	Fertility Rate	Child Tax Benefits	Male Income	Unemploy-ment	Infant Mortality	Age 16-44 Immigration	Female Wage
1913	124.7	0	18,309.34	0.043	100.0	0.01455	2.159
1914	126.6	0	17,886.99	0.079	100.0	0.01505	2.145
1915	125.0	0	17,737.60	0.085	99.9	0.00459	2.187
1916	123.4	0	18,786.45	0.051	101.0	0.00374	2.304
1917	121.0	112.91	18,559.87	0.046	93.8	0.00376	2.356
1918	119.8	139.68	18,632.94	0.014	100.9	0.00142	2.594
1919	111.2	117.41	18,160.82	0.014	86.6	0.00169	2.562
1920	117.9	89.84	17,704.93	0.052	85.8	0.00543	2.936
1921	119.8	183.30	17,451.41	0.117	75.6	0.01062	3.077
1922	111.2	213.90	18,617.67	0.067	76.2	0.00436	3.189
1923	110.5	150.76	20,249.26	0.024	77.1	0.00626	3.372
1924	110.9	159.89	20,218.60	0.050	70.8	0.00800	3.456
1925	106.6	133.92	19,634.65	0.032	71.7	0.00364	3.334
1926	102.6	123.58	20,122.23	0.018	73.3	0.00379	3.339
1927	99.8	143.67	20,401.31	0.033	64.6	0.00398	3.358
1928	93.8	187.31	20,484.62	0.042	68.7	0.00388	3.498
1929	89.3	159.89	20,699.47	0.032	67.6	0.00369	3.451
1930	89.2	107.59	19,807.67	0.087	64.6	0.00324	3.456
1931	84.6	87.37	18,999.14	0.159	61.6	0.00137	3.442
1932	81.7	165.36	17,625.68	0.236	57.6	0.00049	3.287
1933	76.3	186.29	17,043.05	0.249	58.1	0.00031	3.681
1934	78.5	198.21	17,536.04	0.217	60.1	0.00038	4.552
1935	77.2	216.68	17,682.97	0.201	55.7	0.00046	4.491
1936	75.8	292.25	18,606.59	0.169	57.1	0.00047	4.346
1937	77.1	249.55	19,093.16	0.143	54.4	0.00064	4.594
1938	79.1	188.37	17,941.25	0.190	51.0	0.00087	4.627
1939	77.6	213.57	18,711.81	0.172	48.0	0.00093	4.683
1940	79.9	312.48	19,190.55	0.146	47.0	0.00077	4.884
1941	83.4	600.51	20,055.10	0.099	45.3	0.00054	5.076
1942	91.5	805.16	20,946.84	0.047	40.4	0.00032	5.371
1943	94.3	825.79	22,196.92	0.019	40.4	0.00028	5.985
1944	88.8	1,398.17	22,995.08	0.012	39.8	0.00035	6.327
1945	85.9	1,394.23	23,045.00	0.019	38.3	0.00051	6.359
1946	101.9	1,131.74	22,541.69	0.039	33.8	0.00199	6.364
1947	113.3	989.64	20,363.85	0.039	32.2	0.00198	6.406
1948	107.3	875.20	19,809.01	0.038	32.0	0.00207	6.580
1949	107.1	861.62	20,323.56	0.059	31.3	0.00214	6.196
1950	106.2	953.00	21,795.75	0.053	29.2	0.00239	5.802
1951	111.5	1,041.10	22,819.57	0.033	28.4	0.00189	5.783
1952	113.9	1,109.89	23,177.59	0.030	28.4	0.00255	6.027
1953	115.2	1,092.80	24,385.18	0.029	27.8	0.00189	6.664
1954	118.1	967.06	24,359.67	0.055	26.6	0.00219	6.575
1955	118.5	996.90	25,817.02	0.044	26.4	0.00245	7.778
1956	121.2	999.48	27,291.53	0.041	26.0	0.00315	7.816
1957	122.9	967.46	27,266.51	0.043	26.3	0.00321	8.097

Year	Fertility Rate	Child Tax Benefits	Male Income	Unemploy-ment	Infant Mortality	Age 16-44 Immigration	Female Wage
1958	120.2	928.52	26,854.98	0.068	27.1	0.00271	8.176
1959	118.8	950.33	28,446.68	0.055	26.4	0.00269	8.265
1960	118.0	926.36	28,753.13	0.055	26.0	0.00274	8.317
1961	117.1	940.58	29,653.57	0.067	25.3	0.00269	8.144
1962	112.0	946.75	30,843.61	0.055	25.3	0.00277	8.322
1963	108.3	945.86	31,734.30	0.057	25.2	0.00298	8.485
1964	104.7	835.38	32,786.44	0.052	24.8	0.00289	8.687
1965	96.3	788.64	33,657.01	0.045	24.7	0.00289	8.912
1966	90.8	784.82	35,673.43	0.038	23.7	0.00281	8.706
1967	87.2	782.37	36,400.13	0.038	22.4	0.00303	8.982
1968	85.2	848.54	37,302.76	0.036	21.8	0.00375	9.268
1969	86.1	833.35	38,471.56	0.035	20.9	0.00284	9.661
1970	87.9	764.46	38,369.11	0.049	20.0	0.00286	9.666
1971	81.6	777.95	38,162.67	0.059	19.1	0.00284	9.633
1972	73.1	848.01	39,802.10	0.056	18.5	0.00291	9.806
1973	68.8	824.75	40,713.68	0.049	17.7	0.00291	9.951
1974	67.8	763.57	44,256.83	0.056	16.7	0.00280	9.730
1975	66.0	744.68	43,358.02	0.085	16.1	0.00264	9.773
1976	65.0	791.32	43,829.38	0.077	15.2	0.00269	9.869
1977	66.8	773.18	40,102.89	0.071	14.1	0.00297	9.856
1978	65.5	783.04	42,210.55	0.061	13.8	0.00384	10.103
1979	67.2	822.46	41,978.00	0.058	13.1	0.00290	10.346
1980	68.4	794.77	41,766.75	0.071	12.6	0.00329	10.322
1981	67.3	766.59	42,185.98	0.076	11.9	0.00363	10.248
1982	67.3	652.93	41,977.79	0.097	11.5	0.00356	10.275
1983	65.7	590.33	42,543.73	0.096	11.2	0.00331	10.414
1984	65.5	554.90	44,132.05	0.075	10.8	0.00318	10.514
1985	66.3	557.36	44,941.38	0.072	10.6	0.00329	10.573
1986	65.4	595.69	46,223.44	0.070	10.4	0.00334	10.844
1987	65.8	875.91	46,272.96	0.062	10.1	0.00336	11.126
1988	67.3	845.45	46,748.23	0.055	10.0	0.00354	11.229
1989	69.2	871.13	47,289.59	0.053	9.8	0.00646	11.220
1990	70.9	856.96	46,044.02	0.056	9.2	0.00891	11.251
1991	69.3	871.46	44,831.14	0.068	8.9	0.00760	11.299
1992	68.4	947.29	43,371.91	0.075	8.5	0.00530	11.389
1993	67.0	1,156.60	42,906.69	0.069	8.4	0.00518	11.514
1994	65.9	1,185.21	44,043.06	0.061	8.0	0.00453	11.420
1995	64.6	1,163.34	45,117.02	0.056	7.6	0.00397	11.347
1996	64.1	1,226.65	45,635.49	0.054	7.3	0.00517	11.394
1997	63.6	1,298.14	46,908.29	0.049	7.2	0.00449	11.682
1998	64.3	1,386.90	49,689.69	0.045	7.2	0.00364	11.969
1999	64.4	1,661.61	49,516.12	0.042	7.1	0.00357	12.076
2000	65.9	1,639.81	50,168.74	0.040	6.9	0.00505	12.325
2001	65.3	1,603.90	48,822.69	0.047	6.8	0.00653	12.589
2002	64.8	1,680.93	47,774.14	0.058	7.0	0.00631	12.906
2003	66.1	1,905.71	46,914.04	0.060	6.9	0.00406	12.929
2004	66.3	1,701.83	47,459.20	0.055	6.8	0.00568	12.912
2005	66.7	2,038.01	47,932.25	0.061	6.7	0.00663	12.816

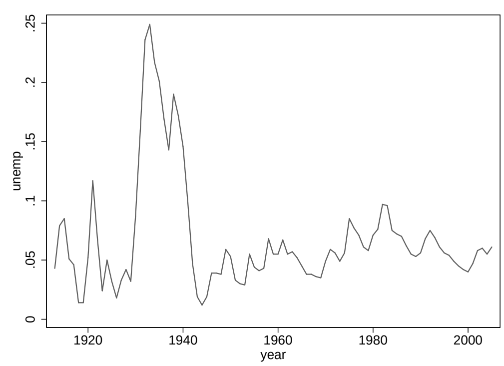
Figure B-1: Extended and Updated Series, 1913–2005



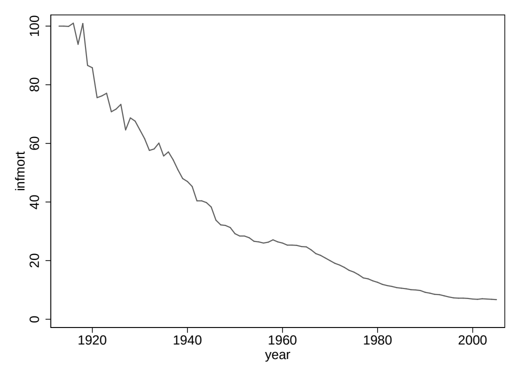
(a) Child Tax Subsidy



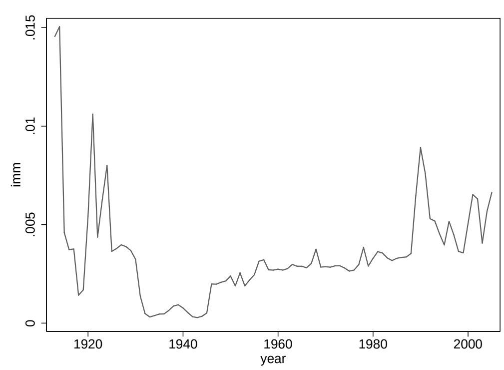
(b) Male and Asset Income



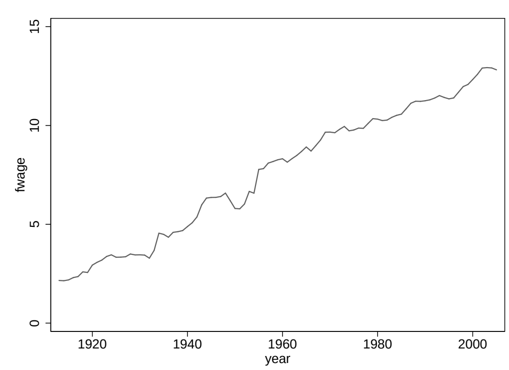
(c) Unemployment



(d) Infant Mortality



(e) Immigration



(f) Female Wage

C Cointegration Test Results

We performed a variety of cointegration tests, both residual-based and systems-based, to determine if there is evidence for a long-run relationship. In this section we highlight just the main results for brevity. It is important to note that the indicator for the availability of the birth-control pill acts as a structural break and so we chose our tests to accomodate this (known) break point. The tests considered in this section are those of Westerlund and Edgerton (2006), Arai and Kurozumi (2007), and Saikkonen and Lütkepohl (2000).[10]

Westerlund and Edgerton (2006)

Westerlund and Edgerton (2006) introduce two residual-based tests constructed with a null hypothesis of no cointegration. To construct the test statistics we chose the maximum lag length by the sample-size dependent rule, $K = \left\lfloor 4\,(T/\,100)^{2/9} \right\rfloor$, where $\lfloor \cdot \rfloor$ is the greatest lesser integer function. In our case, $K = 3$, however, increasing the number of lags did not alter the conclusions of either test. To estimate an appropriate long-run variance we chose to use a Bartlett kernel and follow Westerlund and Edgerton by choosing the bandwidth equal to K (the results were insensitive to alternative bandwidth choices). The values of the test statistics t_C and ϕ_C may be found below. For both tests the null hypothesis is that no cointegrating relationship exists and both tests reject for small values of the test statistic. For reference, the 5% and 10% critical values of the test statistic t_C are -3.02 and -2.74, respectively. The 5% and 10% critical values of the test statistic ϕ_C are -15.05 and -18.21, respectively. It is clear that the values of t_C and ϕ_C are very far from their critical regions.

[10] The percentiles for our design were unavailable in the original sources. The percentiles for all tests were computed by generating 50,000 draws from the discrete-time approximation (based on 2,000 steps) to the limiting random variables.

Lags	0	1	2	3
		Personal Exemption		
t_C	-1.237	-1.659	-1.620	-1.821
ϕ_C	-3.642	-4.925	-4.878	-5.561
		Personal Exemption + CTC		
t_C	-1.275	-1.706	-1.635	-1.813
ϕ_C	-3.798	-5.128	-4.995	-5.616
		Personal Exemption + CTC + EITC		
t_C	-1.279	-1.714	-1.644	-1.819
ϕ_C	-3.822	-5.166	-5.037	-5.652

Arai and Kurozumi (2007)

The Arai and Kurozumi (2007) test is also a residual-based test. However, this test is constructed with a null hypothesis of cointegration. The test is based on the residuals from a least-squares regression augmented with both leads and lags of the differenced regressors (excluding deterministic terms). We chose a maximum lag (and lead) length by the sample-size dependent rule of $K = \lfloor 4(T/100)^{1/4} \rfloor$, which yields $K = 3$. To estimate an appropriate long-run variance we again chose to use a Bartlett kernel but considered three choices for the bandwidth parameter, $l_4 = K$, $l_{12} = \lfloor 12(T/100)^{1/4} \rfloor$, and a data-dependent choice l_a (see Arai and Kurozumi for further details). The values of the test statistics may be found below. The null hypothesis is that of a cointegrating relationship and the test rejects for large values of the test statistic. For reference, the 5% and 10% critical values of the test are 0.039 and 0.047, respectively. The test results are sensitive to the choice of number of leads and lags and bandwidth choice. For less than three leads and lags the null hypothesis of cointegration is rejected at the 5% level. However, when the number of leads and lags is equal to three, the null hypothesis of cointegration is no longer rejected for the bandwidth choices l_4 and l_a.

Lags	0	1	2	3
	Personal Exemption			
Bandwidth: l_4	0.097	0.084	0.061	0.034
Bandwidth: l_{12}	0.073	0.068	0.056	0.051
Bandwidth: l_a	0.077	0.071	0.059	0.037
	Personal Exemption + CTC			
Bandwidth: l_4	0.108	0.088	0.063	0.034
Bandwidth: l_{12}	0.077	0.076	0.065	0.050
Bandwidth: l_a	0.080	0.075	0.062	0.034
	Personal Exemption + CTC + EITC			
Bandwidth: l_4	0.110	0.080	0.058	0.033
Bandwidth: l_{12}	0.073	0.068	0.056	0.051
Bandwidth: l_a	0.086	0.076	0.058	0.036

Saikkonen and Lütkepohl (2000)

We also use the systems-based, likelihood-ratio test of Saikkonen and Lütkepohl (2000). The null hypothesis is for r cointegrating vectors in the system against an alternative that there are more than r cointegrating vectors. The test rejects for large values of the test statistic. The critical values change for each value of r and so are listed in the table.

The results for different definitions of the child tax subsidy variable are shown below. For tests of size 5%, the null hypothesis that $r = 0$ is not rejected for a single lag. Including further lag lengths results in a rejection of the null hypothesis that $r = 0$ but a failure to reject the null hypothesis that $r = 1$. This suggests that there is, at most, one cointegrating vector for these variables. However, when we remove the primary variables of interest and run the test excluding the subsidy and general fertility rate variables, the test results are unchanged for each lag choice. This pattern is also repeated for tests of size 10% at all lag lengths except 2. This result suggests that there exists a cointegrating relationship, but between variables other than the variables of interest.

				Critical Values	
Lags	1	2	3	95%	90%
Personal Exemption					
$r = 0$	85.8	121.5	135.8	119.3	114.3
$r = 1$	61.7	70.4	85.1	90.8	86.3
$r = 2$	43.6	49.2	58.0	66.2	62.4
Personal Exemption + CTC					
$r = 0$	79.7	126.9	136.4	119.3	114.3
$r = 1$	55.5	76.2	83.0	90.8	86.3
$r = 2$	35.7	57.0	57.4	66.2	62.4
Personal Exemption + CTC + EITC					
$r = 0$	81.2	120.8	138.5	119.3	114.3
$r = 1$	55.8	77.9	86.1	90.8	86.3
$r = 2$	35.7	57.1	61.0	66.2	62.4
No Child Tax Subsidy or Fertility Variables					
$r = 0$	44.0	66.3	90.2	66.2	62.4
$r = 1$	25.1	32.8	41.4	45.3	42.1
$r = 2$	11.3	16.7	20.2	28.6	25.9

D Other Specifications

In this section we consider estimation of more general, dynamic models which may be motivated from a number of perspectives. For example, it is well-known that autocorrelation correction may be inappropriate in time series models in general (see, for example, Davidson and MacKinnon (1993)). As a consequence we also provide results on the estimation of a number of autoregressive distributed lag models (ADL), each with a single lagged dependent variable, up to four lags in the chosen tax subsidy series, and up to one lag in the other explanatory variables. The parameter of interest is the long-run coefficient associated with the measure of tax benefits. To generate estimates of the long-run coefficient and their associated standard errors we use the transformation of Bewley (1979) as advocated by Pesaran and Shin (1999). Finally, we reserve the first five observations for the construction of lagged variables so that the various model specifications are directly comparable. The estimated long-run coefficient for each tax subsidy series and each model are reported in Table D-1. Panel A of Table D-1 uses the updated data for the 1913-1984 period while Panel B uses the updated data for the full 1913-2005 period. Each cell reports the long-run coefficient from a separate regression where the model number indicates the number of lags in the tax subsidy series. We include the results for three different measures of child tax benefits: the personal exemption only; the personal exemption combined with the child tax credit; and the personal exemption, the child tax credit and the EITC. During the 1913-1984 period, the child tax credit was not available so this measure is excluded. Restricting to the pre-1984 data, we find large positive estimates of the long-run coefficient. These estimates are not statistically significant once more than two lags of the child tax subsidy series are included. When the time period is extended to 2005, the estimates of the long-run coefficient drop in magnitude substantially, particularly when more than two lags of the child tax subsidy series are included or alternative measures of the child tax subsidy are considered. Only one of the twelve estimates is statistically significant at the 10 percent level.

With up to four lags in the tax subsidy series and up to two lags in all other explanatory variables there are more than 1,200 potential model specifications. For each model we calculated the Bayesian information criterion (BIC). The BIC has been shown to perform well as a model-selection criterion in ADL models (see, for example, Pesaran and Shin (1999) or Panopoulou and Pittis (2004)). Of the ten models which produced the smallest values for the BIC, the long-run coefficient is rarely significant for broad measures of the child tax subsidy.

Table D-1: Autoregressive Distributed Lag Model Results

Panel A: 1913-1984 Data

Child Subsidy Measure	(1)	(2)	(3)	(4)
Personal Exemption	0.045	0.062	0.044	0.043
	(0.025)*	(0.030)**	(0.036)	(0.039)
Personal Exemption + EITC	0.046	0.064	0.044	0.042
	(0.027)*	(0.033)*	(0.039)	(0.043)

Panel B: 1913-2005 Data

Child Subsidy Measure	(1)	(2)	(3)	(4)
Personal Exemption	0.033	0.043	0.022	0.020
	(0.023)	(0.026)*	(0.033)	(0.037)
Personal Exemption + CTC	0.025	0.031	0.012	0.010
	(0.020)	(0.023)	(0.027)	(0.030)
Personal Exemption + CTC + EITC	0.014	0.017	0.003	0.002
	(0.017)	(0.018)	(0.021)	(0.022)

Standard errors in parentheses.
Variables expressed in constant 2005 dollars.
* significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level

Each coefficient represents the estimated long-run coefficient of the child subsidy measure on the general fertility rate in an autoregressive distributed lag model with a lagged dependent variable and current and lagged values of all independent variables on the right-hand side. Only current values of Pill and World War II included. All analysis was done with the updated data series. Panel A child subsidy measures do not include the Child Tax Credit because it did not exist during the sample period. The column number signifies the number of lags of the child subsidy measure included in the model.

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