How do women count?

A note on gender specific age heaping differences in the 16th-19th century

Peter Földvári[1]

Bas van Leeuwen[2]

Jieli van Leeuwen

The role of human capital for economic growth is nowadays largely uncontested. One often used indicator of human capital in the pre-1900 period is age heaping. In this note, we argue that age heaping among women depends on their marital status. We find that married women heap significantly less than unmarried women. This seems to indicate that a percentage of women adapts their age to that of their husband, hence biasing the Whipple index. Since this bias is different over time and across countries, a consistent comparison of female age heaping can only be made by focussing on unmarried women.

[1] University of Debrecen (Hungary), Utrecht University (the Netherlands)
[2] University of Warwick (UK), Free University and Utrecht University (the Netherlands)

I

The role of human capital in economic growth is nowadays mostly uncontested.[3] Recently, research in this field also started to focus on the effect of gender inequality in education on economic growth, often finding a negative relation.[4] However, for the pre-1900 period, data on human capital are scarce and researchers have to revert to proxies. The last decades, age heaping started to fullfill that role.[5] Age heaping describes the phenomenon that people with a lower level of human capital/numeracy tend to roud off their ages to multiples of 5, i.e. 25, 30, 35 etc. Clearly, a higher level of age heaping, indicates less human capital or a less strict numeracy. Hence, most studies find a strongly negative effect between literacy and age heaping.[6] Following the general trend in the literature, gender specific age heaping studies start to become increasingly numerous.[7]

In this note, we argue that age heaping can be a misleading measure of numeracy if one does not takes its interrelatedness with marriage into account. We find that the age heaping differences between the two genders are much lower in case of married couples than in the case of the non-married population.

There are basically two possible explanations for this phenomenon: either married couples tend to report similar age (women are heaping on the age of their husband or report that they are a fixed number of years younger/older, thereby strongly biasing the Whipple index as measure of numeracy), or marriage has a profound impact on someone's ability to deal with numbers (or perhaps better counting spouses are preferred). Since very few people would argue in favour of the second option, especially because the same patterns can also be

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[3] See, for example Schultz, 'Investment in Human Capital,'; Becker, *Human Capital,*; Lucas, 'On the Mechanics of Economic Development,'; Romer, 'Endogenous Technological Change,'.
[4] For example, Barro and Lee, 'Sources of economic growth'; Dollar and Gatti, 'Gender Inequality, Income and Growth'; Klasen . 'Low Schooling for Girls, Slower Growth for All?'.
[5] Mokyr, *Why Ireland Starved;* Crayen and Baten, 'Numeracy, Inequality, Age Heaping, and Economic Growth'; A'Hearn, Baten and Crayen, 'Quantifying Quantitative Literacy'; Clark, *A Farewell to Alms.*
[6] Nagi, Stockwell, and Snavley, 'Digit Preference and Avoidance in the Age Statistics of Some Recent African Censuses'; Crayen and Baten, 'Global Trends in Numeracy 1820-1949'.
[7] De Moor and Van Zanden, 'Uit fouten kun je leren'; Manzel and Baten (2008): "The Development of Numeracy in Colonial and Post-Colonial Latin America (1640-1949)".

found in countries with an almost universal marriage rate for women like China, we opt for the first one, and argue that less numerate married individuals (largely women[8]) show a tendency to adjust their age to that of their spouses, thereby reflecting a lower age heaping, than what one would expect based on their real ability to count. As a result, it is advisable that one rather uses data of non-married people to draw conclusions regarding the gender differences in numeracy else one will underestimate age heaping for women.[9]

In the next section, we start with a comparison within Europe using surveys from different periods stretching over 400 years. It is impossible to test directly the measure of age heaping within marriage caused by heaping to the age of the spouse since we do not know the joint distribution of the ages of the spouses. Therefore, we have to test our hypothesis indirectly by assessing whether married individuals heap less than their non-married counterparts. This difference is indicative of heaping within marriage. Section 3 than continues with a cross cultural comparison, comparing data on China, Latin America, and Europe. We end with a brief conclusion.

II

One of the first censuses where we can test above hypothesis is from the Catasto of Toscane in 1427, a detailed recording of the population of Toscane.[10] We divide the sample into the city Florence and the "countryside" of Toscane under the assumption that age heaping must be lower in the city than in the countryside. For an empirical proof, we apply independent

[8] In general, women have a higher age heaping that is associated with a lower level of numeracy. See for example De Moor and Van Zanden, 'Uit fouten kun je leren', p. 71.

[9] For example De Moor and Van Zanden, 'Uit fouten kun je leren', p. 71 and 75 also found that age heaping among women was about equal to that of men, even though literacy (as calculated by the number of people able to sign their names) was considerably lower for women. They approach this problem by suggesting that women deliberately exaggregate their level of illiteracy so as not to fall out of tone with their husbands who could not write. In this note, we look at this from an opposite perspective and argue that, because etheir information is partly based on marriage certificates, it is likely that women adapt their ages to that of their husbands, hence downward biasing their age heaping.

[10] Herlihy and Klapisch-Zuber, *Les Toscans Et Leur Familles*, pp. 656-663.

two-sample t-tests (with unequal variances assumed) to find out if the age heaping depends on marital status and if the relationship of the two genders is affected by marriage.

Table 1 shows that female age heaping is bigger than male age heaping, suggesting that women had a lower numeracy. However, we also find that female age heaping is significantly smaller for married women than for unmarried women, while for men this difference is statistically insignificant. This in turn suggest that it are the women, who adapt their ages to those of their husbands, and apparently to ages not ending at -0 or -5, which

Table 1 about here

Table 2 about here

would be picked up by the standard age heaping measures. Also, as expected, age heaping is higher in the countryside of Toscane than in Florence, although the remaining pattern remains the same.

The same pattern can be found for other countries and time periods as well. In the Poor Census of Norwich (England) of 1570[11] we find that married women heap considerably less than non-married women, while this difference for men is statistically insignificant.

Table 3 about here

Further we find that the difference in heaping among men and women in the total population is not statistically significant. However, if married women indeed heap to the age of their husbands, the actual heaping of women in Norwich must be those of unmarried women, i.e. 328.9. This is significantly higher than those of men (238.1), hence, the picture suggested by the total population is misleading.

[11] Pound (ed.), *The Norwich census of the poor, 1570* .

Even after the start of modern censuses and the introduction of mass formal education[12], we find this pattern. Tables 4 and 5 provide this information for England 1851 and Norway 1865. In both censusses, we find again that married women heap less than

Table 4 about here

Table 5 about here

unmarried women, but that there is no difference for men. One difference is that this pattern start slowly to become insignificant, because of increase of mass education, and increases in numeracy.

It could be argued that this pattern is caused by difference in ages between married and unmarried men and women. For example, if the average age of married women is much lower than that of unmarried women at a time when numeracy increases, one expects that age heaping among married women to be lower. However, Table 6 shows that, even though there

Table 6 about here

exist age differences, the differenes are so small that this cannot be considered a plausible argument. Furthermore, we find both positive and negative age difference which lead both to the same result: married women heap less than unmarried women.

III

We have seen for several European countries that married women apparently heap less than non-married women and that, unsurprisingly, this difference apparently decreases over time with the advent of formal education. However, the question remains if this result is also

[12] Ramirez and Boli, 'The Political Construction of Mass Schooling', pp. 2-17; Boli, *New Citizens for a New Society;* Nuhoglu Soysal and Strang, 'Construction of the First Mass education Systems', pp. 277-288.

applicable to non-European countries. It could be argued that, in non-western countries, women tend to heap more/or less to the ages of their husbands partly due to different preferences in heaping (such as different “preferred” years) or because of higher age differences between spouses.

We use the census of the USA in 1880[13] to test this hypothesis, not only because this is a 100% sample of the US population of that year, but also because the census makes a distinction by country of birth. We have only a couple of groups for which there are enough observations to carry out formal tests. Those countries are, for the Caribbean region, Cuba, while Mexico is taken for Central America. We treat South America as one region although most Souther American immigrants were from Chile. The East Asian immigrants were from China and Hong Kong.

The results are given in below tables. When we take the whole USA, there is not much difference with the European countries, mainly because the majority of the population was

Table 7 about here

from European descent and hence, shared comparable cultural values: women heap more than men and married women heap considerably less than non-married women. Indeed, the picture suggested by Table 7 is similar to the British census of 1851: both genders seems to heap less within marriage, even though this magnitude of this difference is much lower in case of men. One should not forget however, that with such a extremely large sample, almost any null hypothesis can be rejected at 1%.

More interestingly, we did the same exercise for several Latin American and Asian regions. In the case of married people, we only took those couples from the sample where

[13] North Atlantic Population Project, *NAPP: Complete Count Microdata*. NAPP Version 2.0 [computer files].

both partners were born in the country of origin. This ensured that either they married in their country of origin, or at least that they shared the same cultural values. We find for all regions that age heaping among women in marriage is considerably lower than that for unmarried

Table 8 about here

Table 9 about here

Table 10 about here

women, while this is not the case for men. However, we also find that this difference in age heaping between married and unmarried women is bigger in Europe than in Latin America and, even more so, East Asia.

This may have cultural explanations. For example, in the case of China it is a general finding that Han people had a relatively good accuracy in reporting their age even in the 19th century. It has also frequently been asserted that in East Asia there is a preference for certain years, like the years of the dragon or the pig, both supposed to bring good luck. If this means an age heaping to certain "favourable" years or rather the timing of births is not obvious, even though modern data, due to the availability of modern contraceptives, seems to suggest the latter.[14] If East Asian immigrant indeed had different preferences for reporting their ages, one can expect lower heaping among women to the ages of their husband, especially when it is measured with the standard Whipple index. However, we tried to find a pattern outside the standard age heaping and could not find one.[15] Still, Table 10 shows that Chinese male and female age heaping is practically identical in the total population. However, married women have a significantly (at 5%) lower age heaping. This requires another explanation.

[14] Jowett and Li, 'Age - heaping: contrasting patterns from China'.

[15] The same point has been made by Baten *et al.*, 'Evolution of Living Standards and Human Capital in China in 18-20th Century', p. 15, note 19..

Besides the cultural aspect, a more general explanation for different age heaping in marriage may be the age difference in marriage. In general, as can also be seen in Table 11, non-Western countries had a larger age difference in marriage than those with European origin, a fact that De Moor and Van Zanden attribute to the European marriage Pattern.[16] This implies that adjusting the bride's age to the husband could have been much less convenient

Table 11 about here

when ages at marriage differed more.

We make a very tentative comparison between the difference in age heaping between married and not married women and the reported age difference of the spouses in below figure. Clearly, the number of observations does not warrant a thorough conclusion. Also,

Figure 1 about here

other factors play a role. For example, we need to leave out observations from the late 19th century Europe (Britain and Norway), since then mass formal education had already been introduced in Europe, which makes the curve shift to the left. However, we still find a seeming relationship between the "improvement" of age heaping of women by marriage and the reported age difference of the couples.

This finding implies that in cross-cultural comparisons, no matter if it is because of age differences in marriage or because of other factors, one should take non-married women (for men it does not make a difference) or else the results will be biased in favour of non-European countries that had a higher age difference at marriage and, hence a relatively lower

[16] De Moor and Van Zanden, 'Girlpower', p. 18.

difference between married and non-married women in heaping. For example, in Norwich the difference of heaping between married and non-married women was 65.8 and 52.6 respectively, a ratio of 1.25. For the 19th century China, with a way higher age difference at marriage, these data were 39.4 and 37.9, i.e. a ratio of 1.04.

IV

We find that married women heap significantly less than unmarried women. We test this development over time and find that, although married women heap significantly less than non-married women, the age heaping difference among married and non-married men is usually not significant. This leads to two possible conclusions: either only smarter women married (which seems untenable), or married women had the tendency to adapt their ages to those of their husbands. Since men, on average, had lower age heaping, this reduced the observed age heaping among married women as well. This implies that, if one wants to calculate actual age heaping among women, one should preferably use data on non-married women, or else one will underestimate age heaping.

This finding also has important consequences for cross-cultural comparisons. In some regions (such as South America and East Asia) married women seem to heap relatively less to the ages of their husband and, hence, the gap in age heaping between married and non-married women is smaller. Explanations may be diverse. However, an alternative explanation might be a higher age difference among marriage partners. If the age difference is large (largely outside Europe), heaping towards the age of ones husband becomes increasingly unlikely. Whatever the reason, this finding implies that also in cross cultural comparison of age heaping among women, one should again rely on data on non-married women. Else one find in regions like East Asia or South America that gender inequality (and age heaping among women) is bigger than in most other countries, which is largely because of the age heaping among women in the other countries is partially hidden due to age adjustment within marriage.

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Table 1

Age heaping and gender by marital status, Florence, 1427

	number of observations	Age heaping female (1)	Age heaping male (2)	age heaping non-married (3)	age heaping married (4)	t-stat of difference	P value of H1: (1)<(2)	P value of H1: (1)≠(2)	P value of H1: (1)>(2)
total population	11914	253.2	205.2	-	-	10.5	1.000	0.000	0.000
married population	9789	234.2	206.6	-	-	5.51	1.000	0.000	0.000
non-married population	2125	306.8	188.5	-	-	9.00	1.000	0.000	0.000
total population	11914	-	-	283.2	220.1	10.3	1.000	0.000	0.000
Men	5442	-	-	188.5	206.6	-1.47	0.070	0.141	0.930
Women	6472	-	-	306.8	234.2	10.5	1.000	0.000	0.000

Source: Herlihy and Klapisch-Zuber, *Les Toscans Et Leur Familles*, pp. 656-663.

Table 2

Age heaping and gender by marital status, Toscane 1427

	number of observations	Age heaping female (1)	age heaping male (2)	age heaping non-married (3)	age heaping married (4)	t-stat of difference	P value of H1: (1)<(2)	P value of H1: (1)≠(2)	P value of H1: (1)>(2)
total population	94667	306.8	282.8			14.5	1.000	0.000	0.000
married population	84519	293.7	282.7			6.24	1.000	0.000	0.000
non-married population	10148	374.4	285.3			13.6	1.000	0.000	0.000
total population	94667			357.5	288.3	28.7	1.000	0.000	0.000
Men	43924			285.3	282.7	0.42	0.662	0.676	0.338
Women	50743			374.4	293.7	28.9	1.000	0.000	0.000

Source: Herlihy and Klapisch-Zuber, *Les Toscans Et Leur Familles*, pp. 656-663.

Table 3

Age heaping and gender by marital status, Norwich 1570

	number of observations	Age heaping female (1)	age heaping male (2)	age heaping non-married (3)	age heaping married (4)	t-stat of difference	P value of H1: (1)<(2)	P value of H1: (1)≠(2)	P value of H1: (1)>(2)
total population	1065	282.1	296.1			-0.91	0.182	0.364	0.818
married population	856	263.0	299.0			-2.13	0.017	0.034	0.983
non-married population	209	327.1	238.1			1.52	0.929	0.141	0.071
total population	1065			318.2	280.4	2.02	0.978	0.044	0.022
Men	434			238.1	299.0	-1.07	0.149	0.298	0.851
Women	630			328.9	263.0	3.13	0.999	0.002	0.001

Source: Pound (ed.), *The Norwich census of the poor, 1570* .

Table 4

Age heaping and gender by marital status, England and Wales 1851

	number of observations	Age heaping female (1)	age heaping male (2)	age heaping non-married (3)	age heaping married (4)	t-stat of difference	P value of H1: (1)<(2)	P value of H1: (1)≠(2)	P value of H1: (1)>(2)
total population	172107	127.1	125.6			1.43	0.924	0.153	0.076
married population	106364	122.1	124.8			-2.04	0.021	0.041	0.980
non-married population	65743	134.5	127.2			4.25	1.000	0.000	0.000
total population	172107			131.2	123.4	7.19	1.000	0.000	0.000
Men	82539			127.2	124.8	1.51	0.934	0.132	0.066
Women	89568			134.5	122.1	8.33	1.000	0.000	0.000

Source: North Atlantic Population Project, *NAPP: Complete Count Microdata*. NAPP Version 2.0 [computer files].

Table 5
Age heaping and gender by marital status, Norway 1865

	number of observations	Age heaping	age heaping	age heaping	age heaping	t-stat of difference	P value	P value	P value

		female (1)	male (2)	non-married (3)	married (4)		of H1: (1)<(2)	of H1: (1)≠(2)	of H1: (1)>(2)
total population	123534	124.2	120.1	-	-	3.40	0.999	0.001	0.000
married population	49149	118.8	119.0	-	-	-0.14	0.445	0.890	0.555
non-married population	74385	126.6	121.1	-	-	3.33	0.999	0.001	0.000
Total population	123534	-	-	124.7	118.9	4.60	1.000	0.000	0.000
Men	54927	-	-	121.2	119.0	1.15	0.876	0.249	0.124
Women	68607	-	-	126.6	118.8	4.42	1.000	0.000	0.000

Source: North Atlantic Population Project, *NAPP: Complete Count Microdata*. NAPP Version 2.0 [computer files].

Table 6

Overview of age difference among married and unmarried persons

Survey	N	mean age non-married(1)	mean age married (2)	Difference (1)-(2)	t-test	P value of H1: (1)<(2)	P value of H1: (1)≠(2)	P value of H1: (1)>(2)
Florence 1427	11914	47.7	40.5	7.2	27.7	1.000	0.000	0.000
Toscane 1427	94667	48.6	40.7	7.9	68.9	1.000	0.000	0.000
Norwich 1570	1065	46.9	41.2	5.7	6.81	1.000	0.000	0.000
Belgium 1795 (only women)	15508	38.6	41.1	-2.5	-13.02	0.000	0.000	1.000
England and Wales 1851	172107	36.3	39.6	-3.3	-58.7	0.000	0.000	1.000
Great Britain 1881	2548954	37.0	39.5	-2.5	-170	0.000	0.000	1.000
Norway 1865	751846	35.1	41.7	-6.6	-260	0.000	0.000	1.000

Source: Florence and Toscane: Herlihy and Klapisch-Zuber, *Les Toscans Et Leur Familles*, pp. 656-663; Norwich: Pound (ed.), *The Norwich census of the poor, 1570* ; Belgium: De Moor and Van Zanden, 'Uit fouten kun je leren', pp. 55-86 (data obtained by personal correspondence); Norway and England and Wales (1851) and Britain (1881): North Atlantic Population Project, *NAPP: Complete Count Microdata*. NAPP Version 2.0 [computer files].

Table 7

Age heaping and gender by marital status, USA (whole population) 1880

	number of observations	Age heaping female (1)	Age heaping male (2)	age heaping non-married (3)	age heaping married (4)	t-stat of difference	P value of H1: (1)<(2)	P value of H1: (1)≠(2)	P value of H1: (1)>(2)
total population	4993217	148.2	144.5	-	-	18.3	1.000	0.000	0.000
married population	3460530	140.1	142.0	-	-	-7.62	0.000	0.000	1.000
non-married population	1532687	149.6	169.5	-	-	51.9	1.000	0.000	0.000
total population	49993217	-	-	157.9	141.1	75.4	1.000	0.000	0.000
Men	2670596	-	-	149.6	142.0	25.8	1.000	0.000	0.000
Women	2322621	-	-	169.5	140.1	85.7	1.000	0.000	0.000

Source: North Atlantic Population Project, *NAPP: Complete Count Microdata*. NAPP Version 2.0 [computer files].

Table 8

Age heaping and gender by marital status, USA (Cuban origin) 1880

	Number of observations	Age heaping female (1)	age heaping male (2)	age heaping non-married (3)	age heaping married (4)	t-stat of difference	P value of H1: (1)<(2)	P value of H1: (1)≠(2)	P value of H1: (1)>(2)
total population	1771	154.6	158.3	-	-	-0.33	0.371	0.742	0.629
married population	1184	140.3	152.3	-	-	-0.90	0.183	0.367	0.817
non-married population	587	184.5	170.1	-	-	0.72	0.764	0.473	0.236
total population	1771	-	-	176.3	147.0	2.47	0.993	0.014	0.007
Men	995	-	-	170.1	152.3	1.13	0.872	0.257	0.128
Women	776	-	-	184.5	140.3	2.44	0.993	0.015	0.007

Source: North Atlantic Population Project, *NAPP: Complete Count Microdata*. NAPP Version 2.0 [computer files].

Table 9

Age heaping and gender by marital status, USA (Mexican origin) 1880

	number of observations	Age heaping	Age heaping	age heaping	age heaping	t-stat of difference	P value	P value	P value

		female (1)	male (2)	non-married (3)	married (4)		of H1: (1)<(2)	of H1: (1)≠(2)	of H1: (1)>(2)
Total population	12712	232.1	214.9	-	-	3.84	1.000	0.000	0.000
Married population	5953	216.8	224.6	-	-	-1.21	0.113	0.225	0.887
Non-married population	6759	251.8	208.3	-	-	6.78	1.000	0.000	0.000
Total population	12712	-	-	222.9	220.8	0.47	0.681	0.638	0.319
Men	7527	-	-	208.3	224.6	-2.80	0.003	0.005	0.997
Women	5185	-	-	251.8	216.8	5.00	1.000	0.000	0.000

Source: North Atlantic Population Project, *NAPP: Complete Count Microdata*. NAPP Version 2.0 [computer files].

Table 10

Age heaping and gender by marital status, USA (East Asian origin) 1880

	number of observations	Age heaping female (1)	age heaping male (2)	age heaping non-married (3)	age heaping married (4)	t-stat of difference	P value of H1: (1)<(2)	P value of H1: (1)≠(2)	P value of H1: (1)>(2)
Total population	62651	197.8	197.2	-	-	0.11	0.544	0.912	0.456
Married population	2734	189.5	197.2	-	-	-0.83	0.204	0.408	0.796
Non-married population	59917	205.6	197.2	-	-	1.22	0.889	0.221	0.111
Total population	62651	-	-	197.4	193.7	0.78	0.783	0.434	0.217
Men	60067	-	-	197.2	197.2	-0.002	0.499	0.998	0.501
Women	2584	-	-	205.6	189.5	1.67	0.953	0.095	0.047

Source: North Atlantic Population Project, *NAPP: Complete Count Microdata*. NAPP Version 2.0 [computer files].

Table 11

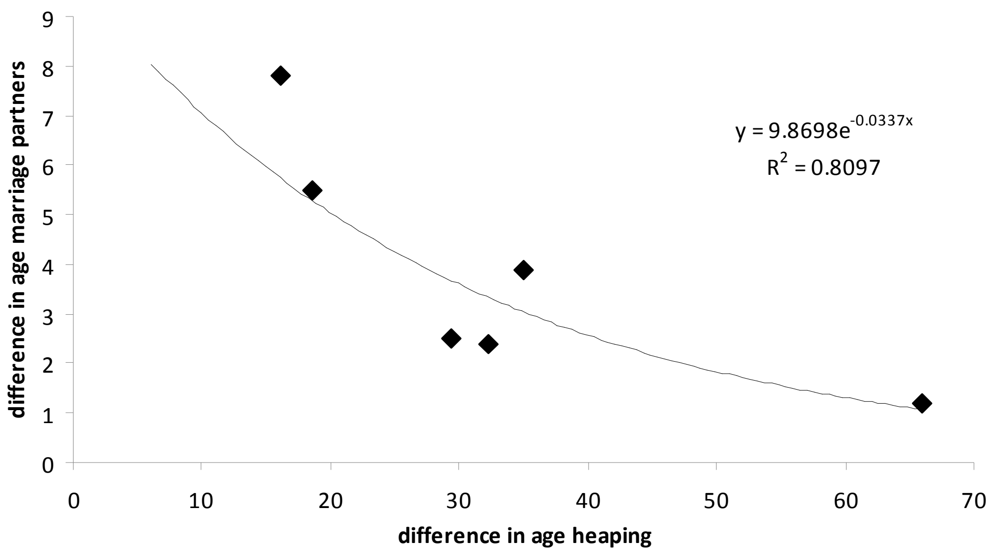
Overview of age difference among married partners

Survey	N	mean age female (1)	mean age male (2)	Difference (1)-(2)	t-test	P value of H1: (1)<(2)	P value of H1: (1)≠(2)	P value of H1: (1)>(2)
USA 1880 (Total)	3460530	37.1	39.6	-2.5	-230	0.000	0.000	1.000
USA 1880 (Mexicans)	5953	36.1	40.0	-3.9	-15.8	0.000	0.000	1.000
USA 1880 (Carribeans)	2854	36.1	38.5	-2.4	-6.70	0.000	0.000	1.000
USA 1880 (South Americans)	742	38.3	43.8	-5.5	-8.36	0.000	0.000	1.000
USA 1880 (East Asians)	2734	32.1	39.9	-7.8	-25.9	0.000	0.000	1.000
Norwich 1570	856	40.6	41.8	-1.2	-1.64	0.051	0.102	0.949
Great Britain 1851	106364	39.0	40.1	-1.1	-17.5	0.000	0.000	1.000
Great Britain 1881	1599321	38.9	40.1	-1.2	-76.3	0.000	0.000	1.000
Norway 1865	456969	41.0	42.4	-1.4	-51.8	0.000	0.000	1.000

Source: North Atlantic Population Project, *NAPP: Complete Count Microdata*. NAPP Version 2.0 [computer files].

Figure 1

Relation between age difference in marriage and heaping of women in marriage



Source: table 1-3; 7-11