Partial Test of Biological Sex on the Swedish Labour Market

Sara Moricz

June 22, 2013

Master Thesis in Economics, Lund University, Sweden
Supervisor: Petter Lundborg

Abstract

Testosterone is the main androgen affecting sexual differentiation in-utero. According to the twin testosterone transfer hypothesis, a female fetus sharing uterus with a male is exposed to higher testosterone levels. Likewise, a male fetus sharing uterus with another male is exposed to higher levels. In this short thesis, wages of twins in opposite-sexed pairs are compared to wages of twins in same-sexed pairs, to entangle the possible effect of biological sex on the labour market. However, the effects in the current research set-up also include possible socialization effects of being raised with a male or female sibling, which could be migrated by controlling with non-twin sibling couples. The sample investigated is twins born in Sweden between 1935-1958, from the Swedish Twin Registry, to which income register data has been matched from 1968-2007. The results for females indicate that having a twin brother increase wage and the results for males suggest that having a twin brother decrease wage. The original idea of investigating the testosterone transfer hypothesis on the labour market is from a working paper by Gielen, Holmes and Myers (2013).

1 Introduction

Sweden is frequently viewed as one of the most equal societies. However, previous research summaries as that the wage gap between men and women in the same type of job is not large in Sweden compared to other countries, but men have more highly paid jobs than women. Authors refer to the Swedish labour market as sex-segregated; men are more prevalent in the higher-paid private sector and women are clustered in the lower-paid public sector (Meyersson Milgrom, Petersen and Snartland 2001, Albrecht, Björklund and Vroman 2003, Statistics Sweden 2004, Wahlberg 2008).[1] Typically male-dominated occupations are such as computer professionals, motor-vehicle drivers and construction workers, and female-dominated occupations are such as cleaners, preschool teachers and nurses (Carlsson and Rooth 2008).

Furthermore, the Swedish sex-segregated labour market will not soon become a characteristic of the past. As of 2012, women are markedly overrepresented in nursing and preschool teacher degrees, whereas males to a somewhat smaller extent are overrepresented in degrees related to technical subjects (Swedish National Agency for Higher Education, 2013). In the 21:st century, indications exist of people being preferred by employers solely based on their gender. Edin and Lagerström (2006) find that employers contact male applicants to a higher degree for positions in male-dominated occupations and Carlsson and Rooth (2008) find that employers contact females applicants to a higher degree for positions in female-dominated occupations.[2]

Another characteristic of the Swedish labour market is that wage setting largely are performed by unions, which traditionally have been dominated by males. A report from the Ministry of Enterprise, Energy and Communications (2000) calls for upgrading the

[1]Arai, Nekby, and Skogman Thoursie (2004) has also shown that average wage is lower in female-dominated occupations.

[2]Edin and Lagerström (2006) found an insignificant effect regarding female-dominated occupations, whereas Carlsson and Rooth (2008) found an insignificant effect regarding male-dominated occupations. The later's result is in contrast with the findings of Åslund and Skans (2007), whose result can be interpreted as that men are hired to a higher degree in the female-dominated public sector.

status of female-dominated occupations, and refer to specific jobs as having a wage set in a discriminatory manner.

Why do females and males choose different jobs, with related differential wages? Does it exist sex-specific utility in different kind of work-tasks, e.g. above what is possibly culturally determined? Or the other way around, does the labour market prize possibly biologically male and female features differently?

This thesis empirically investigates the equilibrium of supply and demand factors related to biological sex differences on the Swedish labour market. The main benefit of the current method is that it investigates if there is any specific biological female or male features that make individuals select and be selected into specific jobs and wage levels. The method refrains from measuring possible labour market discrimination as conventionally conceptualized, such as if females are hired or paid to a lesser extent than males. Naturally, there is the interpretational issues that the choice of education and job type is made early in life and the relative wage of one job type to another change in the course of an individual's work life, while job decision most likely are sticky.

How would one assign the treatment of being a male or female solely based on biological differences, e.g. above what is possibly culturally determined? Testosterone is the main androgen[3] affecting sexual differentiation in-utero. According to the twin testosterone transfer hypothesis, a female fetus sharing uterus with a male is exposed to higher testosterone levels. Likewise, a male fetus sharing uterus with another male is exposed to higher levels (Tapp, Maybery and Whitehouse 2011). In simple terms, twins could function as a proxy for "male-like" females and "super-manly" males, in a biological sense. Accumulated evidence of the twin testosterone transfer hypothesis is available (Tapp, Maybery and Whitehouse 2011), but the hypothesis has been criticized (Cohen-Bendahan et al. 2005b). Thus, the simple answer to the question of treatment is that you cannot randomize sex independent of gender, but what we can do is to look at some unknown change in the influence of the level of testosterone to approximate biological

[3]a broad medical term for hormones affecting sexual differentiation.

male features. The original idea of investigating the testosterone transfer hypothesis on the labour market is from a working paper by Gielen, Holmes and Myers (2013).

To entangle the possible effect of biological sex on the labour market is, in this short thesis, wages of twins in opposite-sexed pairs compared to wages of twins in same-sexed pairs. A drawback in the current research set-up is that the estimates also reflect possible socialization effects, which could be migrated by using a control group of non-twin sibling couples. Socialization effects refers to that individuals might develop differently dependent on their co-sibling. The sample investigated is twins born in Sweden between 1935-1958, from the Swedish Twin Registry, to which income register data has been matched from 1968-2007. From the income data, wage is approximated by excluding individuals with low income, a method shown to be successful in estimating earnings regressions by Antelius and Björklund (2000). However, my pseudo-test indicates that the approximation might be invalid in this specific setting, specifically as hours worked of individuals in opposite and same-sexed pairs might differ. This constitutes the second drawback of the method used. The results for females indicate that having a twin brother increase wage by 2 percent per year compared to having a twin sister. The results for males suggest that having a twin brother decrease wage by 2 percent per year compared to having a twin sister. In straightforward language, being a "male-like" female yields benefits on the labour market and being a "manly" male yields drawbacks, interpreted according to the testosterone transfer hypothesis.

The thesis proceeds as follows: Firstly, some Swedish policies related to gender differences, the twin testosterone transfer hypothesis and interaction effects are explained. Secondly, the data and the empirical method is presented. Thirdly, the results follows alongside analysis of related aspects. Lastly, a conclusion is presented.

2 Background

2.1 Swedish policy related to gender

The Swedish taxation system was transformed in 1971 from taxing household income to individual taxation. About the same time, in 1974, parental leave was introduced, which since 1995 have been modified to intentionize males to take out parental leave.[4] Furthermore, the public provision of childcare has expanded continuously, and was especially pronounced in 1980s (Angelov et al. 2013). Those reforms have most likely contributed to increased female labour supply, which has increased from approximately 60 percent in 1970 to 80 percent in 2007 (Statistics Sweden 2010).

Furthermore, in 1974 women took out 99.5 percent of total days of parental leave, whereas the equivalent number nowadays is roughly 80 percent (SOU 2005, Statistics Sweden 2010). Public provision of childcare has increased from approximately providing care to 5-10 percent of children in relevant ages in the 1970s, to about 70 percent nowadays. However, informal, including piece-meal governmentally-sponsored childcare, have existed before and parallel to the child care system referred to by those numbers (Bergqvist and Nyberg 2001, Statistics Sweden 2010).

In 1979 legislation pertaining to equal pay between the genders was first introduced, which subsequently has been reformed. It is legal to give preference to the underrepresented gender in hiring-decisions if qualifications are equal (Åslund and Skans 2007).

[4]In its initial form of 1974 parental leave included employment protection during the absence, a replacement rate of 90 percent and 180 days of leave (roughly 8 months) to share between the parents. Before 1974 some limited form of parental leave existed for women only (SOU 2005). This was introduced in 1937, provided job protection during the absence, and was reformed successively (Meyersson Milgrom, Petersen and Snartland 2001). Since 1974 the replacement rate and days of leave have varied trough successive reforms. In 1995, days of parental leave was reserved for the father and mother respectively, and through a reform 2002, a couple have nowadays roughly 270 days (roughly one year) to share between them and each individual have additionally 60 days (roughly 3 months) each to take out parental leave, with a replacemen rate of 80 percent (The Swedish Social Insurance Agency 2013).

2.2 The twin testosterone transfer hypothesis

The twin testosterone transfer hypothesis postulates that twin individuals are affected by sharing uterus with either a same or different-sexed fetus, due to the exposure of prenatal androgens, and that this affects various traits relating to sexual differentiation. In simple terms; the "most biological potent" androgen is testosterone, and male fetuses produce higher testosterone levels in utero which are postulated to transmits to the twin, whereas female fetuses produce little testosterone. In turn, female fetuses produce as much estrogen as male fetuses do and thus it is the production of testosterone that determines sexual differentiation, what I have termed "biological sex" (Cohen-Bendahan et al. 2005b, Tapp, Maybery, and Whitehouse 2011).

Cohen-Bendahan et al. (2005b) highlight that although female fetuses sharing utero with a male one are affected by the higher level of testosterone, the female fetuses are born as females and thus is the "testosterone effect" most likely more pronounced in specific prenatal sensitive periods. In extension this mean that certain biological features are more likely to be affected by sharing utero with a same or opposite-sexed fetuses, whereas other traits are less likely to be affected.

Tapp, Maybery, and Whitehouse's (2011) review conclude that studies show that females in opposite-sexed twin pairs exhibit more "male-like" biological features than females in same-sexed pairs. More specifically this is shown on outcomes that should not be affected by socialization effects; otoacoustic emissions (McFadden 1993, McFadden et al. 1996), tooth size (Dempsey et al. 1999), expressive vocabulary size of young children (Galsworthy et al. 2000, Van Hulle et al. 2004) and brain volume of children (Peper et al. 2009), but not on autistic symptomatology (Ho et al. 2005).[5] Further-

[5] The line of reason is that those variables are affected by prenatal androgens, i.e. exhibit a difference between men and women, and cannot be affected by environmental factors. For example, otoacoustic emissions, sounds produced by the inner ear as a response to another sound, are more prevalent among women and is a physiological process not affected by environmental factors. Tapp, Maybery, and Whitehouse (2011) furthermore state that it has been shown that expressive vocabulary size and brain volume exhibit a marked gender difference early in life, although in adulthood the relationship is confounded by environmental factors.

more, Heil et al. (2011) report that comparing visuo-spatial test scores in adulthood across twin pairs, while controlling with closely-spaced non-twin sibling, support that females in opposite-sexed pairs score better than females in same-sexed pairs.[6] Tapp, Maybery, and Whitehouse's (2011) review also indicate that males in same-sexed pairs might exhibit more "male-like" biological features than males in opposite-sexed pairs. It has been observed on autistic symptomatology (Ho et al. 2005), expressive vocabulary size of young children (Galsworthy et al. 2000, Van Hulle et al. 2004) and brain volume of children (Peper et al. 2009), but not on otoacoustic emissions (McFadden 1993, McFadden et al. 1996) and tooth size (Dempsey et al. 1999). Thus, Tapp, Maybery, and Whitehouse (2011) argue that accumulated empirical evidence of the testosterone transfer mechanism exist, but that the effect on males is more uncertain since it have been less researched. Cohen-Bendahan et al.'s (2005b) earlier and less extensive review is more skeptical, and the authors argue that publication bias might drive the empirical establishment of the twin testosterone transfer hypothesis.

Translated to the current framework, it could be that the females in opposite-sexed pairs are more "male-like" than average females, and possibly that males in same-sexed pairs are more "male-like" than average males. However, how large would those effects be on earnings? Gielen, Holmes and Myers (2013) use the exposure of prenatal androgens of twin pairs as a proxy for testosterone on earnings in the Netherlands in 2009, while controlling for socialization effects by using closely-spaced non-twin siblings. They find that wages of women are unaffected by having a male twin, whereas males have greater wages of 1.1 percent by having a male twin.

2.3 Socialization effects

In the current research set-up socialization effects, a term I reconceptualize and redefine below, are not controlled for. Interaction effects refer to that outcomes might differ

[6]The line of reasoning is that men have been shown to score better on visuo-spatial tests, and by controlling with closely-spaced non-twin siblings the authors find an effect for females in mixed-sexed pairs above possible socialization effects.

for individuals dependent on their co-sibling's gender due to interaction during the upbringing, that parents might treat children dependent on the co-sibling's gender and that parents might wish to have additional children dependent on the sex-composition of previous children. Those, in this context unwanted effects, can be controlled for by using a control group of closely-spaced non-twin siblings. This method is the best available, but not perfect, since children born in the same point in time, e.g. twins, might affect the various socialization channels differently than children born in different time points, e.g. closely-spaced non-twin siblings. The various types of socialization effects are presented in turn.

Firstly, individual differences in opposite and same-sexed pairs might arise since the individuals in the various pair-types interact during the upbringing. For example, females in opposite-sexed pair might due to interacting with a twin brother during the upbringing be more "male-like". The best evidence would be on socialization in itself. However, research on interaction between opposite and same-sexed siblings is limited and provide mixed evidence (Minnett, Vandell and Santrock 1983, Howe et al. 2002). The second best evidence comes from a branch of research that use the difference between individuals in opposite and same-sexed twin couples on behavioral outcome variables. Thus, the research design captures both the various possible socialization effects (interaction during the upbringing, differential parental treatment, and sex-composition) and the possible effect of testosterone transfer in utero. A tentative summary of socialization effects is that females in mixed-sexed pairs might exhibit behavioral traits more prevalent among males in the specific place and time periods in which the studies are conducted. Furthermore, socialization effects possibly outweigh the testosterone transfer mechanism for males, so that males in opposite-sexed couples show behaviors more typical, and males in same-sexed couples behaviors less typical, for males in the specific time periods and places studied. The latter evidence is very limited, and the statement should be interpreted with great caution.

Females in opposite-sexed pairs compared to females in same-sexed pairs exhibit more sensation-seeking in adulthood (Resnick et al. 1993, Cohen- Bendahan et al. 2005a, Slutske et al. 2011), higher levels of aggression (Cohen- Bendahan et al. 2005a), and are more rule-breaking (Loehlin and Martin, 2000). However, no significant difference is found on variety of other behavioral traits in these studies, such as worriedness (Loehlin and Martin, 2000). Tapp, Maybery, and Whitehouse (2011) view those evidence as significant masculinizing of females in opposite-sexed pairs. Loehlin and Martin (2000) show that males in mixed-sexed pairs are more rule-breaking than males in same-sexed couples, and provide inconclusive evidence of that males in opposite-sex pair are possibly more or less worried than males in male-male pairs. However, no significant difference is found between males in the two groups on sensation-seeking in adulthood in Resnick et al.'s (1993) study and on other behavioral dimensions in Loehlin and Martin's (2000) study. Tapp, Maybery, and Whitehouse (2011) conclude that behavioral studies on males in opposite and same-sexed pairs provide evidence contrary to the testosterone transfer hypothesis or find insignificant differences. Furthermore, no significant difference is found across pair types regarding toy preferences (Henderson and Berenbaum 1997, Rodgers et al. 1998).

Thus, if socialization effects are substantial the above-mentioned studies indicate that females in opposite-sexed pairs exhibit behavioral traits more prevalent among males in the specific place and time periods in which the studies are conducted. The evidence regarding males across the two different pair types is very limited, and should be interpreted with caution, but indicate that socialization effects possibly counteract the testosterone transfer mechanism.

Secondly, parents might treat children differently dependent on their co-sibling. Often this aspect is framed as that having a brother drain resources from a sibling compared to having a sister and is typically investigated in societies with preferences for males (an important article in regard to this and the previous channel is Bucher and Case 1994). It is not discussed alot in the Swedish context to my knowledge, which might be because the Swedish educational system is tuition free and liquidity constraints are migrated by a public subsidy and loan system.

What evidence exist of the difference across sibling pair types on earnings in Sweden? Björklund et al. (2004) find no significant effect of sibling sex-composition, conditional on the number of children, for the Swedish general population, except that females with only female siblings have 1.5 percent higher earnings. The estimate is based on older cohorts than used in this thesis, namely cohort 1951-1968, and for income earned 1987, 1990, 1993 and 1996.[7] Thus, disregarding the testosterone transfer mechanism, from those two channels one would expect that females in opposite-sexed pairs has lower wage than female in same-sexed pairs. Furthermore, no difference in wage is expected among males.

Thirdly, parents have been shown to have a preference for mixed-sexed sibling dyads (Angrist and Evans 1998 use this as an instrument for family size). Anderson et al. (2006) show that Swedish parents are more likely to have a third child if the firstborn and secondborn are of the same sex. By using data on the whole Swedish population from 1925, the authors show that women are 20-25 percent more likely to have a third child if the previous two birth resulted in same-sexed siblings, as compared to opposite-sexed siblings. The inability to control for this channel in this thesis result in estimates that partly reflect the effect of family size. It is expected that fewer resources is spent on each child, with negative effects for earnings, the larger the number of children. Björklund et al. (2004) present earning differentials between individuals with one or two siblings of 3 percent for males and 2 percent for women, conditional on sibling sex-composition. Thus, disregarding the testosterone transfer mechanism, from this channel one would expect that individuals in same-sexed pair on average have lower wage than individuals in opposite-sexed pairs. The direction of bias generated in the current research set-up is discussed in section 3.2.

[7] Gielen, Holmes and Myers (2013) report no significant difference across females and males in opposite and same-sexed closely-spaced sibling pairs in their study of the Netherlands in 2009.

3 Data and method

3.1 Data

The Swedish Twin Registry have continuously sampled all same-sexed twins born in Sweden by taking information from birth registrations, and have in the last decade added opposite-sexed twin pairs. My data sample consist of all same-sexed monozygotic (MZ) and dizygotic (DZ) twins of the cohorts born 1926-1958 in Sweden conditional upon them being alive and living in Sweden in 1972. However, opposite-sexed twins are only included conditional on being alive and living in Sweden in 1998. To this income data is linked from 1968 until 2007, which is register based data from Statistics Sweden.

The best solution to the sample-selection problem of conditionality upon being alive is to get better data, as this is available. In the meantime, a partial solution to get an internally valid sample is to exclude all MZ and DZ same-sexed twins which died between 1972-1998 from the original sample. Death dates are from the death registers held by the National Board of Welfare. Also, all twins whoms co-twin has deceased are excluded, to yield comparative individuals. The latter measure is necessary as which individual of a same-sexed twin pair to include in the final estimation sample is randomized (so only one twin of each same-sexed pair is included). For estimation 43,374 individuals remain. It exist 5,465 males and females in opposite-sexed pairs respectively, and after randomization 7,783 males in male-male pairs and 8,439 females in female-female pairs. Appendix section B.1 display how the sample is constructed in detail.

Next, the issue related to external validity can be migrated, but not solved. The population is now conditional on being alive in 1998; for an individual born in the oldest cohort, 1926, this translates to reaching 72 years of age. The age one has to reach to be included in the conditional population is steep-wise decreasing for younger cohorts. Life expectancy at birth for the oldest cohort of 1926 is 62 years, and thus the individuals in the conditional population for this cohort are to a high degree more healthy than the average individual born in 1926 (Statistics Sweden, 2011). Health can be thought to affect wage through a variety of channels. As one move towards younger cohorts, the conditional population is more generalizable. Individuals born 1958, the youngest cohort, is included in the conditional population upon being 40 years old.[8] Thus, analysis will foremost be based on cohorts 1947-1958, but some estimations are also performed for cohorts 1935-1946. The former is "a less healthy population" than the latter, to migrate the external validity problem. The sample, divided according to the various cohort groups for the main estimation, is presented in appendix section B.1.

The income data is transformed to constant SEK in 2007 years price level. To approximate wage from the income data, I use incomes, excluding income generated by self-employment, above the limit of 130 000 SEK, a method shown to be successful in estimating earnings regressions from Swedish register data by Antelius and Björklund (2000).[9] In the current context, wage can be inferred from income under the assumption that individuals in opposite and same-sexed pairs work the same amount of hours in a year. The validity of this assumption is discussed later. One possible solution to circumvent this assumption is to get data on wage, which to my knowledge exists for subsamples of the current population and time period.

Robustness checks are made by excluding the twin pairs for which at least one individual's wage for at least one year is among the top 20 wage observations recorded during the period. Further robustness checks are made since what is measured as income in the register based data change during the time series. Income from 1974 include benefits, but benefits are not reported separately until 1981. Thus, robustness checks are made by comparing the relevant dependent variables including and excluding benefits from 1981. How the various dependent variables have been constructed is presented in detail in appendix section B.2, and descriptive statistics is presented in appendix A.

[8]The "breaking point" in this dimension is cohort 1935, whoms individuals are included in the conditional population upon being 63 years and whoms life expectancy at birth is 64 years (Statistics Sweden, 2011). Life expectancy numbers reported here is for males, as female life expectancy is higher this do not invalidate the line of reasoning.

[9]100 000 SEK in 1999, Antelius and Björklund's limit, is equal to 127 870 SEK in 2007.

3.2 Method

The baseline econometric framework is utterly simple, I compare means, but in the standard regression framework. Individuals in same-sexed couples have been randomized so that only one twin in each same-sexed couple is included, so independencies between twin pairs do not need to be taken into account. The specification is run for either females or males, so that means are compared between individuals in opposite and same-sexed twin pairs for females and males respectively. Thus;

$$Y = c + B * D + \epsilon$$

where Y is an outcome variable in logarithmic form, c is the constant, D is a dummy variable taking the value one (1) for individuals in mixed-sexed pairs and ϵ is the error term. It is common to apply the logarithmic transformation to wage data, which yield the benefits of interpreting the estimates of B as percentage changes and reducing the influence of outliers.[10] In the various specifications that follow Y is either logarithmic wage in the year indicated or the average of logarithmic wage for the time period indicated. (Except for the pseudo-test of wage approximation were income is used as the dependent variable).

The main benefit of the method is that biological sex differences and not cultural gender differences is investigated. Furthermore, labour market discrimination in the standard sense is not captured since persons of the same gender are compared. For example, females in mixed-sexed pairs are compared to females in same-sexed pairs, which do not capture labour market discrimination under the plausible assumption that discrimination is equally spread between the two pair-types.

[10]The careful reader can note that for small changes the coefficients can directly be interpreted as fractions, whereas one for larger changes should translate/intpret the coefficients. I follow the previous littrature when I only present the coefficients directly as fractions, with is highly suitable as a translation/interpretation would yield the same result.

The inability to use a control group of closely-spaced non-twin siblings introduce socialization effects in the presented estimates. In other words, in the current set-up biological sex differences are not possible to entangle from the effect of being raised with a male or female sibling, which for females mean that the effect possibly include more "male-like" behavior and for males include less "male-like" behavior. In which direction might the bias go, as compared to evaluating only the twin testosterone transfer mechanism? Due to the socialization effects discussed previously, the estimate for males is expected to be downward biased, since individuals in male-male pairs for the reason of parental preferences for mixed-sexed sibling dyads are expected to have lower wage (viewed from the point of being a same-sexed pair, what we are interested in). Furthermore, the bias for females goes in opposite directions. The differential outcomes due to the co-sibling's sex render a downward bias, since females in mixed-pairs are expected to have lower wage due to interaction during the upbringing and/or the male sibling sapping resources, and the parental preference for mixed-sexed sibling dyads render an upward bias, since individuals in female-female pairs for the reason of parental preferences for mixed-sexed sibling dyads are expected to have lower wage (viewed from the point of being a opposite-sexed pair, what we are interested in).

4 Result and analysis

4.1 Pseudo-test of wage approximation

An assumption for wage to be validly approximated from income is that individuals in opposite and same-sexed pairs work the same amount of hours in a year. Foremost, hours worked is likely to be dependent on reproductive choice, which can be dependent on pair-type. Angelov et al. (2013) estimate that the within-couple male-female gender gap in income increases 35 percent 15 years after child birth. Therefore, average income for individuals in opposite and same-sexed pairs are compared, which gauge the aspect of hours worked, besides being utterly interesting in its own right. I reason that one can infer from differences in average income if hours worked is different in approximated wage (incomes above 130 000 SEK), specifically as ones number of children most likely affect hours worked even if participating in the labour market. For example, if individuals in opposite-pairs have more children and/or are "at home" more, average income would be lower for this group.

What evidence exists of the reproductive choice of individuals in mixed and same-sexed twin couples? Studies indicate that females in opposite and same-sexed couples have no significant difference regarding the number of children and age at first delivery in developed countries (Loehlin and Martin 1998, Rose et al. 2002, Medland et al. 2008). Furthermore, Lummaa et al. (2007) find by using Finish data from the 19:th century, e.g. before modern medicine and contraception, that females in opposite-sexed pairs have less children and higher age of first delivery. In the same study, no significant difference is found across males. Extrapolating this information we can expect that reproductive characteristics are similar for women in opposite and same-sexed couples. Nevertheless, the decisions of work time can differ, especially as the prenatal level of testosterone is used to approximate biological male features across pair-types.

The difference in average income between individuals in opposite and same-sexed couples is displayed in table 1. In the first specification (1) the average of nearly the entire life-time income for cohort 1947 and cohort 1948 is compared across pair-types. Both the estimate for females and males show that individuals in opposite-pairs have average income that is 2 percent insignificantly higher a year than individuals in same-sexed couples. In specification (2) is average income compared for cohort 1947-1958, the most generalizable cohorts with respect to conditionality upon being alive in 1998. The dependent variable is the average income from 1971 to 2007. Both opposite and same-sexed individuals are born each year, and thus I reason that a comparison between people at different ages over the time period is valid. For example, during this time period individuals in cohort 1947 are 31-60 years old, whereas the individuals in cohort 1958 are 20-49 years old. Specification (2) present that average income is significantly higher for females and males in mixed-sexed pairs, with approximately 5 percent for females and 4 percent for males. Qualitatively the same findings are shown in specification (3) for cohort 1935-1946. Thus, the findings indicate that hours worked possibly

Table 1: Income differences in opposite and same-sexed pairs

Specification	(1) Cohort 1947-1948 mean income 1968-2007 ages 20/21-59/60	(2) Cohort 1947-1958 mean income 1972-2007 ages 20/31-49/60	(3) Cohort 1935-1946 mean income 1968-1995 ages 22/33-49/60
Females			
Female in opposite pair	3,879.31	8,591.20***	4,618.57***
	(4,091.65)	(1,660.80)	(1,748.17)
Constant	148,722.13***	156,541.79***	122,124.36***
	(2,523.64)	(1,056.89)	(1,102.22)
As a fraction	0.0261	0.0549	0.0378
Observations	1,154	5,872	5,426
Males			
Male in opposite pair	5,089.33	8,224.34**	10,770.30***
	(5,836.63)	(3,332.00)	(3,255.59)
Constant	218,894.59***	227,100.59***	216,517.55***
	(3,688.89)	(2,110.01)	(2,113.38)
As a fraction	0.0233	0.0362	0.0497
Observations	1,099	5,930	5,121

Income measured in 2007 SEK. Standard errors in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

differ between the two groups. Foremost, I base this conclusion on the linkage that more children possibly lead to less or more hours worked, even if participating in the labour market.

In sum, the proper interpretation of the estimates gained in the further analysis is that they represent differences in income between individuals in the various pair-types conditional on income being above 130 000 SEK. I will continue to refer to wage to denote the conditional income distribution, but interpret the estimates as including possibly differential choices regarding hours worked.

If logarithmic average income is used as the dependent variable instead, the estimates shown in table 1 are some percentage points higher, since people who continuously have zero income are excluded (not shown). The estimates are not sensitive to the exclusion of outliers (not shown). Furthermore, when income including and excluding benefit is compared from 1981 the estimates change as a maximum thousand SEK, but is the same in all other regards (not shown).

4.2 Biological sex and approximated wage

The difference in wage profiles between individuals in opposite and same-sexed pairs, for females and males respectively, is displayed in Table 2. In those estimations wage is summarized across a larger span of individuals' work-life by taking the average of logarithmic wage, while ignoring missing values of logarithmic wage for specific years. This is done to limit the influence of individuals' various choices regarding when and how much to participate in the labour market, while it still keeps the influence of those choices' direct effect on wage. Thus, another way to view those estimations is that they compare real wage growth between individuals in opposite and same-sexed pairs.

Females in opposite-sexed pairs have a higher wage profile than females in same-sexed pairs, as summarized by table 2. In specification (1) the estimate for cohort 1947-1958 is displayed, which is the most generalizable sample. Specification (1) shows that females in opposite-sexed pairs earn approximately 2 percent more per year than females in same-sexed pairs, or, if wage is equivalent, that they work 2 percent more. If one reasons according to the testosterone transfer hypothesis, one can conclude that the labour market seem to reward females with more "male-like" attributes. Specification (2) displays that females in mixed-sexed pairs born 1935-1946 earn/work approximately 1 percent more per year that females in same-sexed pairs born those years, but the estimate is insignificant. As roughly the same age spans are included, the result point to that the difference between females in mixed and same-sexed couples get enhanced by being born later in time or by being on the labour market later in time.

Males in opposite-sexed pairs have higher wage per year than males in same-sexed

Table 2: Wage profile differences between opposite and same-sexed pairs

Specification	(1) Cohort 1947-1958 mean wage 1972-2007 ages 20/31-49/60	(2) Cohort 1935-1946 mean wage 1968-1995 ages 22/33-49/60
Females		
Female in opposite pair	0.02***	0.01
	(0.01)	(0.01)
Constant	12.18***	12.09***
	(0.00)	(0.00)
Observations	5,533	3,967
Males		
Male in opposite pair	0.02***	0.04***
	(0.01)	(0.01)
Constant	12.40***	12.36***
	(0.00)	(0.01)
Observations	5,644	4,119

Wage measured in 2007 SEK. Standard errors in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1. Please consult Table B.2 to see details of sample sizes.

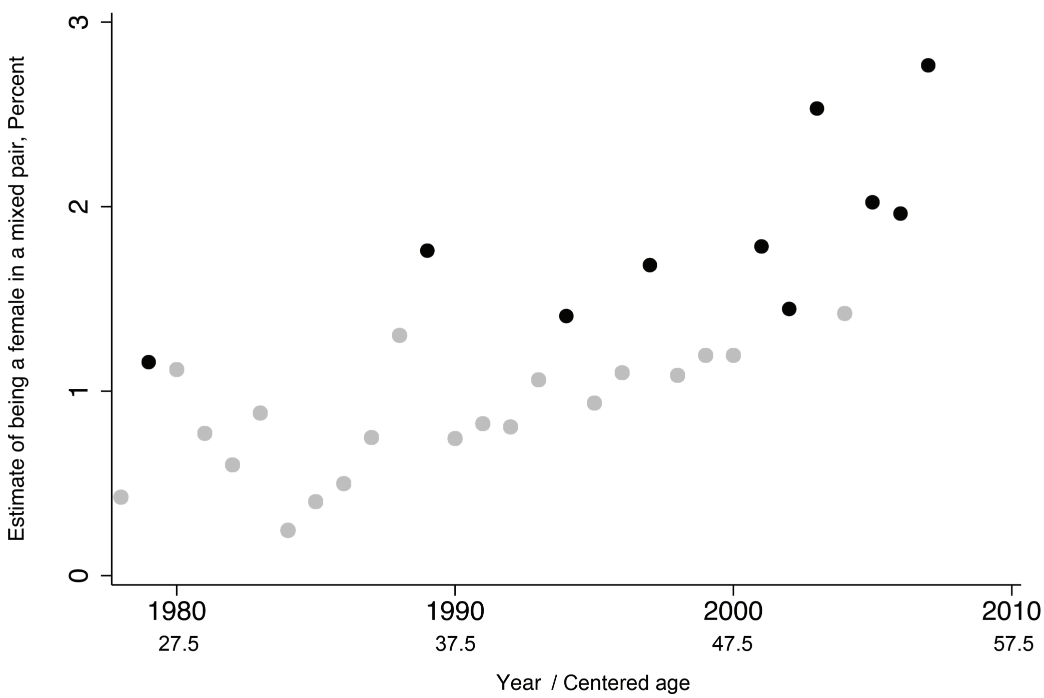
pairs, as displayed in Table 2. The estimate for cohort 1947-1958 indicate that wage is approximately 2 percent higher per year for males in opposite-sexed pairs, compared to males in same-sexed pairs, or that opposite-pair males work a maximum of 2 percent more if wages are equal. The equivalent number for cohort 1935-1946 is 4 percent. If one wish to make a point under the umbrella of the testosterone transfer hypothesis, males do not seem to be rewarded for "male-like" attributes on the labour market. Furthermore, the difference possibly seems to be less by being born later in time or by being on the labour market later in time.

Importantly, the current set-up do not allow to control for socialization effects between twins. Thus, the estimates should be interpreted as including both the possible effect of the testosterone transfer hypothesis and the various socialization channels. However, for interpretation, being treated with having a sister or brother is valued by the labour market and/or one work longer hours if one have an opposite-sexed twin sibling.

The estimates shown in table 2 is robust for excluding a few twin pairs where one twin have ridiculously high wage (e.g. the exclusion of outliers, not shown). Furthermore, quantitatively the same result is given when one compare wage and wage exc. benefits from 1981 (not shown). Interestingly, if one use the whole time series of the average of logarithmic wage, the estimates are equivalent to the ones shown in table 2, with two exceptions (not shown). The estimate for females born 1935-1946 becomes significant and the estimate for males born 1935-1946 decreases, which then included people in their 50-60s on the labour market 1996-2007.

Estimated differences in wage between females, born 1947-1958, in the various pair types is shown for each specific year in figure 1. The estimates are found in their conventional form in appendix A, table A.3. The dependent variable is logarithmic wage in each year, as indicated by the figure. The y-axis display the estimates measured as how much higher wage a female in a mixed pair on average earn in percent, and/or how much more hours a female in a mixed pair work, compared to a female in same-sexed pair. Grey dots represent insignificant estimates, whereas black dots represent significant estimates. On the x-axis “centered-age” is displayed, which is the mean age of the various cohorts at that year. Again, since both type of twins are born each

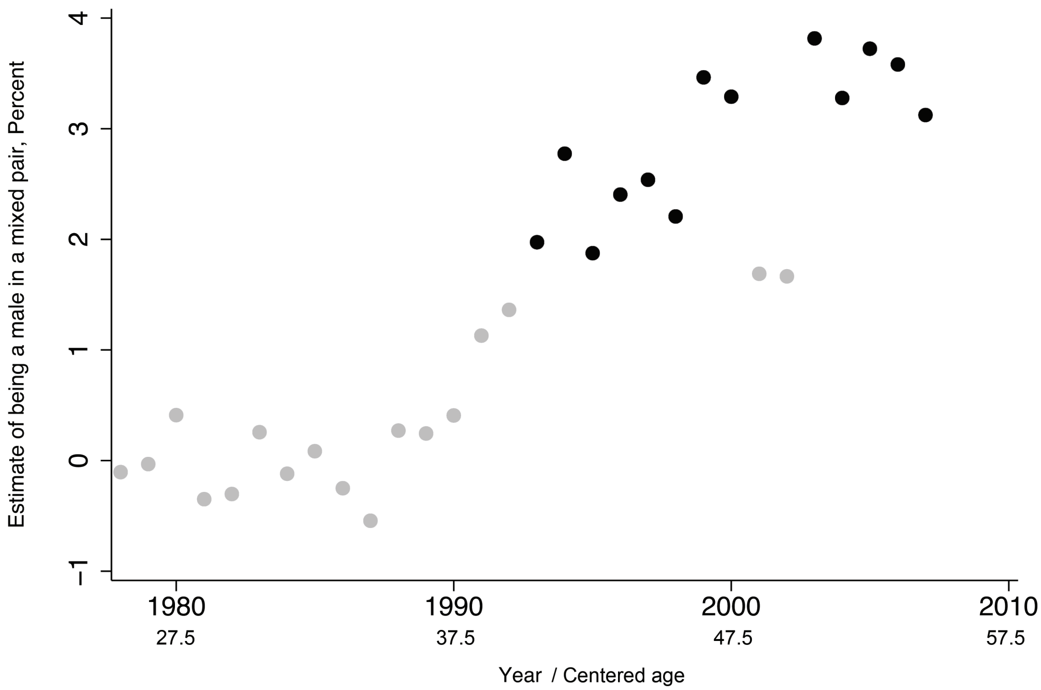
Figure 1: Estimates of females over time, born 1947-1958



year, I reason that a comparison with differential ages is valid. From figure 1 one can quickly conclude that the estimates are significant mostly from 2000. For example, in 2007 females in opposite-sexed pairs earned close to 3 percent more than females in same-sexed pairs, and/or work up to 3 percent longer hours. Importantly, difference in hours worked arising due to differential reproductive decisions in the two groups would likely arise earlier in the time series when the women of cohort 1947-1958 are more likely to have young children. Thus, findings by year strengthen the interpretation of approximated wage as not including great differences in hours worked. Furthermore, the "wage-profile"- findings for women in table 2 is driven by that the difference between pair types increase over time or the life cycle.

In figure 2 the estimates for males is shown. The estimates are found in their conventional form in appendix A, table A.4. The pattern for men is similar as to women,

Figure 2: Estimates of males over time, born 1947-1958



but even clearer. From the beginning of the 1990s men in opposite-sexed pairs have significantly higher wage than men in same-sexed pairs. For example, in 2007, males in opposite-sexed pairs earned approximately 3 percent more than males in same-sexed pairs. Importantly, the interpretation of the wage approximation is strengthened as that the difference in incomes is largest when the men of cohort 1947-1958 have older children. Also, the "wage-profile"- findings of men in table 2 is driven by a difference between pair types that increase over time or the life cycle for the 1947-1958 cohorts. One interesting idea regarding the aspect of time, is that the difference between individuals in opposite and same-sexed pairs might be due to structural adjustment in the Swedish economy, as the differences are most pronounced from the end of the 1990s.

The estimates presented in figure 1 and figure 2 are robust to exclusion of outliers (not shown). What's more, the estimates change when wage exc. benefits is the dependent variable, but the pattern is equivalent. The estimates with wage exc. benefits are presented in appendix A, figure A.1, figure A.2, table A.5 and table A.6.

5 Conclusion

The preferred estimate indicates that females in mixed-sexed twin pairs have 2 percent higher wage compared to females in same-sexed twin pair. As the current research set-up do not allow to control for socialization effects between twins, inference must be based on the additional assumption that Björklund et al.'s (2004) result is generalizable, also to the twin setting. The point estimates for females found in this thesis is too large to be explained by the likely socialization effect of differential outcomes dependent on the co-sibling's sex and parental preferences for mixed-sexed sibling dyads, as compared with the point estimates of Björklund et al. (2004). In addition, inference is uncertain since the point estimates of approximated wage to some unknown extent can reflect hours worked. Nevertheless, the result indicates that females due to being born females chose or are chosen into jobs with less rewards. The preferred estimate for males indicates that males in same-sexed twin pairs earn on average 2 percent less than males in a opposite-sexed couples. By assuming that Björklund et al.'s (2004) result is generalizable, the finding indicates a lesser negative difference when the effect of sibling-sex composition is taken into account, but cannot explain the whole extent of the negative difference. Thus, the result show that males due to being born males chose or are chosen into jobs with less rewards. Therefore, the overall findings indicate that it exists gender-specific utility in different kind of work-tasks, above what is possible culturally determined, and that the labour market adjust to those utility-levels. Or the other way around, the labour market may prize "biological male and female qualities" differently. In sum, the labour market value "biologically male features" in females and disvalue "biologically male features" in males.

References

The first part of this reference list refer all other literature except empirical research of the twin testosterone transfer hypothesis, which follows later.

Standard literature references

Albrecht, J., Björklund, A., and Vroman, S., 2003. “Is There a Glass Ceiling in Sweden?”. *Journal of Labor Economics*, 21:1, 145-177.

Anderson, G., Hank, K., Rönsen, M., and Vikat, A., 2006. “Gendering Family Composition: Sex Preferences for Children and Childbearing Behavior in the Nordic Countries”. *Demography*, 43:2, 255-267.

Angelov, N., Johansson, P. and Lindahl, E., 2013. “Is the persistent gender gap in income and wages due to unequal family responsibilities?”. IAFU Working Paper Series 2013:3.

Angrist, J. D. , and Evans, W. N., 1998. "Children and Their Parents’ Labor Supply: Evidence from Exogenous Variation in Family Size". *The American Economic Review*, 88:3, 450-477.

Antelius, J., and Björklund, A., 2000. “How reliable are register data for studies of the return on schooling? An examination of Swedish data”. *Scandinavian Journal of Educational Research*, 44: 4, 341–355.

Arai, M., Nekby, L., and Skogman Thoursie, P., 2004. “Is it what you do or where you work that matters most? Gender composition and the gender wage gap revisited”. Research Papers in Economics No. 2004:10 from Stockholm University.

Bergqvist, C., and Nyberg, A., 2001. “Den svenska barnomsorgsmodellen – kontinuitet och förändring under 1990-talet” in SOU 2001:52 (Statens Offentliga Utredningar), “*Välfärdstjänster i omvandling*”, p. 239-287. (in Swedish)

Björklund, A., Eriksson, T., Jäntti, M., Raaum, O., Österbacka, E. 2004. "Family structure and labor market success: the influence of siblings and birth order on the earnings of young adults in Norway, Finland, and Sweden", in Corak, M., (ed) "*Generational income mobility in North America and Europe*", Cambridge: Cambridge University Press, p. 207-255.

Butcher, K.F., and Case, A. 1994. "The effect of sibling sex composition on women's education and earnings." *The Quarterly Journal of Economics*, 109:3, 531-563.

Carlsson, M., and Rooth, D-O., 2008. "An Experimental Study of Sex Segregation in the Swedish Labour Market: Is Discrimination the Explanation?". IZA Discussion Paper No. 3811.

Cohen-Bendahan, C.C.C., van de Beek, C., Berenbaum, S.A., 2005b. "Prenatal sex hormone effects on child and adult sex-typed behavior: methods and findings". *Neuroscience & Biobehavioral Reviews*, 29:2, 353–384.

Edin, P-A., and Lagerström, J., 2006. "Blind dates: quasi-experimental evidence on discrimination". IAFU Working Paper Series 2006:4.

Gielen, A., Holmes, J., and Myers, C., 2013. "Testosterone and the gender wage gap", forthcoming.

Howe, N., Rinaldi,C., Jennings, M., Petrakos, H., 2002. "No! The Lambs Can Stay Out Because They Got Cozies: Constructive and Destructive Sibling Conflict, Pretend Play, and Social Understanding". *Child Development*, 73:5, 1460–1473.

Meyersson Milgrom, E. M., Petersen, T., and Snartland, V., 2001. "Equal Pay for Equal Work? Evidence from Sweden and a Comparison with Norway and the U.S." The Scandinavian Journal of Economics, 103:4, 559-583.

Ministry of Enterprise, Energy and Communications (Näringsdepartementet), 2000. "Att synliggöra löneskillnader mellan kvinnor och män". (in Swedish)

Minnett, A., Vandell, D. and Santrock, J., 1983. "The Effects of Sibling Status on Sibling Interaction: Influence of Birth Order, Age Spacing, Sex of Child, and Sex of Sibling". *Child Development*, 54, 1064-1072.

Lichtenstein, P., De Faire, U., Floderus, B., Svartengren, M., Svedberg, P., & Pedersen, N. L., 2002. "The Swedish 2007-04-27 21 Twin Registry: A unique resource for clinical, epidemiological and genetic studies". *Journal of Internal Medicine*, 252, 184-205.

SOU, 2005. "Fakta om föräldrarförsäkringen" in SOU 2005:73 (Statens Offentliga Utredningar), "*Reformerad föräldraförsäkring - Kärlek, omvårdnad, trygghet*", p.107-139. (in Swedish)

Statistics Sweden, 2004. "Löneskillnader mellan kvinnor och män i Sverige". (in Swedish)

Statistics Sweden, 2010. "På tal om kvinnor och män 2010". (in Swedish)

Statistics Sweden, 2011. Source data at homepage "Befolkning: Demografisk analys: Livslängd: Återstående medellivslängd för kvinnor och män 1900-2010. Åldern 0, 30, 50, 65 och 85". Accessed 2013-05-08 from: www.scb.se. (in Swedish)

Swedish National Agency for Higher Education (Högskoleverket), 2013. Source data at homepage "Statistik: Statistik om högskolan: Jämställdhet: Yrkesexamensprogram". Accessed 2013-05-12 from: www.hsv.se. (in Swedish)

Tapp, A., Maybery, M., and Whitehouse, A., 2011. "Evaluating the twin testosterone transfer hypothesis: A review of the empirical evidence". *Hormones and Behavior*, 60, 713–722.

The Swedish Social Insurance Agency (Försäkringskassan), 2013. "Broschyrer och faktablad: Faktablad: Föräldrapenning". Accessed 2013-05-12 from: www.forsakringskassan.se. (in Swedish)

Wahlberg, R., 2008. "The Gender Wage Gap across the Wage Distribution in the Private and Public Sectors". Univeristy of Gothenburg Working Paper in Economics No 317.

Åslund, O., and Skans, O., 2007. "Do anonymous job application procedures level the playing field?". IAFU Working Paper Series 2007:31.

References for empirical literature on the twin testosterone transfer hypothesis

Cohen-Bendahan, C.C.C., Buitelaar, J.K., van Goozen, S.H.M., Orlebeke, J.F., Cohen-Kettenis, P.T., 2005a. "Is there an effect of prenatal testosterone on aggression and other behavioral traits? A study comparing same-sex and opposite-sex twin girls." *Hormones and Behavior*, 47:2, 230–237.

Dempsey, P.J., Townsend, G.C., Richards, L.C., 1999. "Increased tooth crown size in females with twin brothers: evidence for hormonal diffusion between human twins in utero." *American Journal of Human Biology*, 11:5, 577–586.

Galsworthy, M.J., Dionne, G., Dale, P.S., Plomin, R., 2000. "Sex differences in early verbal and non-verbal cognitive development." *Developmental Science*, 3:2, 206–215.

Heil, M., Kavsek, M., Rolke, B., Beste, C., Jansen, P., 2011. "Mental rotation in female fraternal twins: evidence for intra-uterine hormone transfer?". *Biological Psychology*, 86:1, 90–93.

Henderson, B.A., and Berenbaum, S.A., 1997. "Sex-typed play in opposite-sex twins". *Developmental Psychobiology*, 31:2, 115-123.

Ho, A., Todd, R.D., Constantino, J.N., 2005. "Brief report: autistic traits in twins vs. non- twins — a preliminary study." *Journal of Autism and Developmental Disorders*, 35:1, 129–133.

Loehlin, J.C., and Martin, N.G., 1998. "A comparison of adult female twins from opposite- sex and same-sex pairs on variables related to reproduction." *Behavior Genetics*, 28:1, 21–27.

Loehlin, J.C., and Martin, N.G., 2000. "Dimensions of psychological masculinity–femininity in adult twins from opposite-sex and same-sex pairs." *Behavior Genetics*, 30:1, 19–28.

Lummaa, V., Pettay, J.E., Russell, A.F., 2007. "Male twins reduce fitness of female co- twins in humans." *Proceedings of the National Academy of Sciences of the United States of America* 104:26, 10915–10920.

McFadden, D., 1993. "A masculinizing effect on the auditory systems of human females having male co-twins." *Proceedings of the National Academy of Sciences of the United States of America*, 90:24, 11900-11904.

McFadden, D., Loehlin, J.C., Pasanen, E.G., 1996. "Additional findings on heritability and prenatal masculinization of cochlear mechanisms: click-evoked otoacoustic emissions." *Hearing Research*, 97, 102–119.

Medland, S.E., Loehlin, J.C., Willemsen, G., Hatemi, P.K., Keller, M.C., Boomsma, D.I., Eaves, L.J., Martin, N.G., 2008. "Males do not reduce the fitness of their female co-twins in contemporary samples." *Twin Research and Human Genetics*, 11:5, 481–487.

Peper, J.S., Brouwer, R.M., van Baal, G., Schnack, H., Leeuwen, M., Boomsma, D., Kahn, R., Pol, H., 2009. "Does having a twin brother make for a bigger brain?" *European Journal of Endocrinology*, 160, 739–746.

Resnick, S.M., Gottesman, I.I., McGue, M., 1993. "Sensation seeking in opposite-sex twins: an effect of prenatal hormones?". *Behavior Genetics*, 23:4, 323-329.

Rodgers, C.S., Fagot, B.I., Winebarger, A., 1998. "Gender-typed toy play in dizygotic twin pairs: a test of hormone transfer theory." *Sex Roles*, 39, 173–184.

Rose, R.J., Kaprio, J., Winter, T., Dick, D.M., Viken, R.J., Pulkkinen, L., Koskenvuo, M., 2002. "Femininity and fertility in sisters with twin brothers: Prenatal androgenization? Cross-sex socialization?". *Psychological Science*, 13:1, 263–267.

Slutske, W.S., Bascom, E.N., Meier, M.H., Medland, S.E., Martin, N.G., 2011. "Sensation seeking in females from opposite- versus same-sex twin pairs: hormone transfer or sibling imitation?" *Behavior Genetics*, 41, 533–542.

Van Hulle, C.A., Goldsmith, H.H., Lemery, K.S., 2004. "Genetic, environmental, and gender effects on individual differences in toddler expressive language." *Language & Hearing Research*, 47:4, 904-12.

Appendix

A Additional output

Table A.1: Pooled descriptive statistics

	N	mean	sd	p50	skewness	kurtosis
Pooled						
Income	1.399e+06	190,994	153,780	184,942	27.27	3,789
Income exc. self-employment	1.399e+06	183,344	155,518	181,431	26.25	3,620
Income exc. benefits	932,417	200,486	171,765	189,268	28.99	3,642
Income exc. self-employment and benefits	932,417	192,714	174,053	185,623	27.82	3,453
Wage	962,931	243,025	150,656	214,104	41.11	5,905
Wage exc. benefits	651,141	253,659	173,450	221,104	39.47	4,958
Females						
Income	711,657	146,221	98,663	148,540	4.178	200.1
Income exc. self-employment	711,657	142,380	99,733	146,172	3.844	182.7
Income exc. benefits	474,630	157,329	102,929	156,635	5.185	247.1
Income exc. self-employment and benefits	474,630	153,003	104,468	154,021	4.772	223.9
Wage	406,034	206,742	78,239	190,536	12.80	795.6
Wage exc. benefits	288,300	212,806	86,115	194,560	13.05	756.7
Males						
Income	687,196	237,360	183,934	219,026	31.24	3,720
Income exc. self-employment	687,196	225,766	188,134	215,112	29.10	3,400
Income exc. benefits	457,787	245,230	212,543	225,760	30.06	3,125
Income exc. self-employment and benefits	457,787	233,886	216,929	221,638	28.28	2,881
Wage	556,897	269,479	181,997	234,290	39.22	4,752
Wage exc. benefits	362,841	286,119	213,816	246,200	36.75	3,815

Table A.2: Pooled percentiles

	p1	p5	p10	p25	p50	p75	p90	p95	p99
Pooled									
Income	0	0	32,119	116,884	184,942	242,262	317,714	388,360	630,591
Income exc. self-employment	0	0	2,516	104,512	181,431	239,137	313,645	382,590	619,915
Income exc. benefits	0	0	36,002	120,863	189,268	253,501	336,550	416,952	681,214
Income exc. self-employment and benefits	0	0	2,957	108,937	185,623	250,362	332,845	412,166	672,369
Wage	132,481	141,978	152,595	178,007	214,104	268,085	348,565	428,903	689,113
Wage exc. benefits	132,523	142,166	153,210	180,313	221,104	281,543	371,115	460,913	745,345
Females									
Income	0	0	5,982	85,228	148,540	199,725	251,640	292,536	415,059
Income exc. self-employment	0	0	0	78,580	146,172	198,192	249,647	290,064	409,911
Income exc. benefits	0	0	19,579	96,821	156,635	209,152	265,554	309,943	447,638
Income exc. self-employment and benefits	0	0	2,538	90,974	154,021	207,286	263,406	307,412	443,130
Wage	131,331	136,743	143,210	161,920	190,536	229,850	282,029	325,039	471,767
Wage exc. benefits	131,385	137,034	143,823	163,705	194,560	238,390	294,920	340,818	504,948
Males									
Income	0	27,951	88,494	170,683	219,026	280,860	373,171	464,752	753,806
Income exc. self-employment	0	0	21,164	161,972	215,112	276,765	367,838	457,597	738,748
Income exc. benefits	0	3,988	64,980	168,163	225,760	295,871	399,797	500,115	816,235
Income exc. self-employment and benefits	0	0	3,401	156,971	221,638	292,122	394,922	494,224	805,531
Wage	136,291	154,363	168,191	194,916	234,290	295,782	392,688	488,706	785,336
Wage exc. benefits	136,365	155,546	170,682	200,628	246,200	315,733	426,158	531,370	864,624

Table A.3: Estimates for females over time, born 1947-1958

Year	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
femalemixed	0.00	0.01*	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.02**	0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Constant	12.07***	12.09***	12.08***	12.06***	12.06***	12.05***	12.06***	12.05***	12.08***	12.10***	12.11***	12.14***	12.16***	12.14***	12.15***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
Observations	2,811	2,949	2,895	2,757	2,759	2,740	2,829	2,937	3,168	3,468	3,750	3,948	4,022	3,933	4,136

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
femalemixed	0.01	0.01*	0.01	0.01	0.02**	0.01	0.01	0.01	0.02**	0.01*	0.02***	0.01	0.02**	0.02**	0.03***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Constant	12.15***	12.16***	12.16***	12.21***	12.24***	12.27***	12.31***	12.34***	12.36***	12.38***	12.38***	12.40***	12.42***	12.44***	12.45***
	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	4,196	4,323	4,409	4,562	4,652	4,778	4,848	4,855	4,819	4,815	4,983	4,981	4,955	4,922	4,904

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

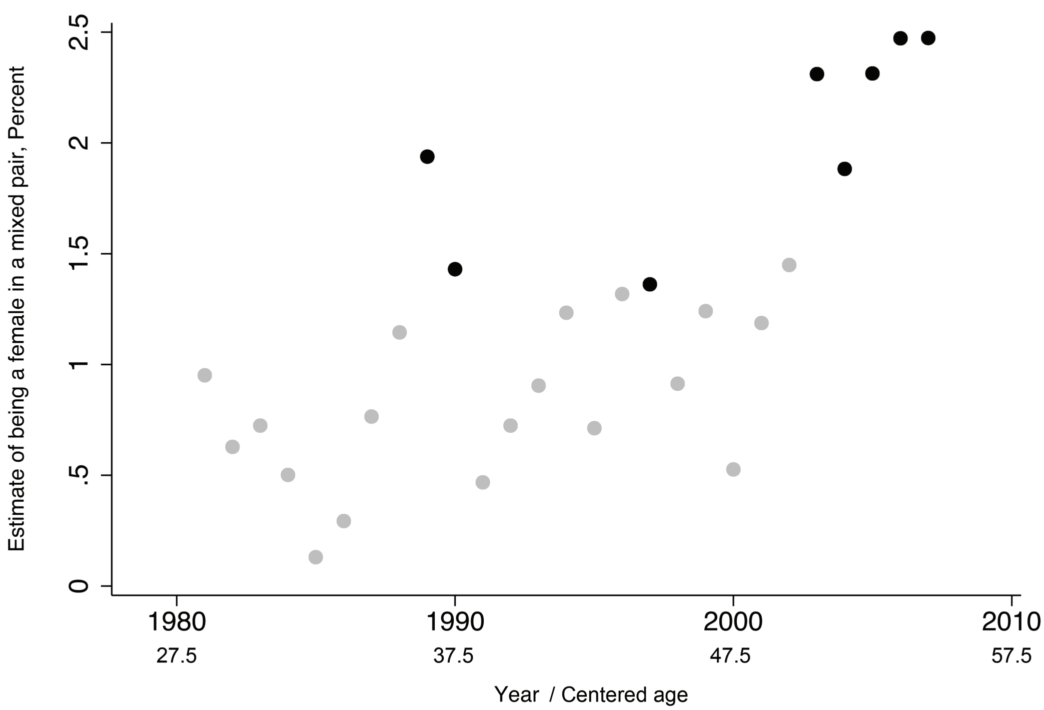
Table A.4: Estimates for males over time, born 1947-1958

Year	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
malemixed	-0.00	-0.00	0.00	-0.00	-0.00	0.00	-0.00	0.00	-0.00	-0.01	0.00	0.00	0.00	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Constant	12.21***	12.24***	12.22***	12.22***	12.23***	12.22***	12.25***	12.27***	12.31***	12.36***	12.40***	12.45***	12.47***	12.44***	12.44***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	4,337	4,585	4,700	4,688	4,750	4,756	4,843	4,907	4,986	5,017	5,089	5,147	5,162	5,093	5,102

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
malemixed	0.02**	0.03***	0.02*	0.02**	0.03**	0.02**	0.03***	0.03***	0.02	0.02	0.04***	0.03***	0.04***	0.04***	0.03**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Constant	12.42***	12.43***	12.45***	12.49***	12.52***	12.56***	12.58***	12.62***	12.64***	12.66***	12.63***	12.65***	12.68***	12.68***	12.70***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	5,085	5,028	5,028	5,014	5,022	5,022	5,031	5,006	4,990	4,957	5,109	5,091	5,055	5,006	4,973

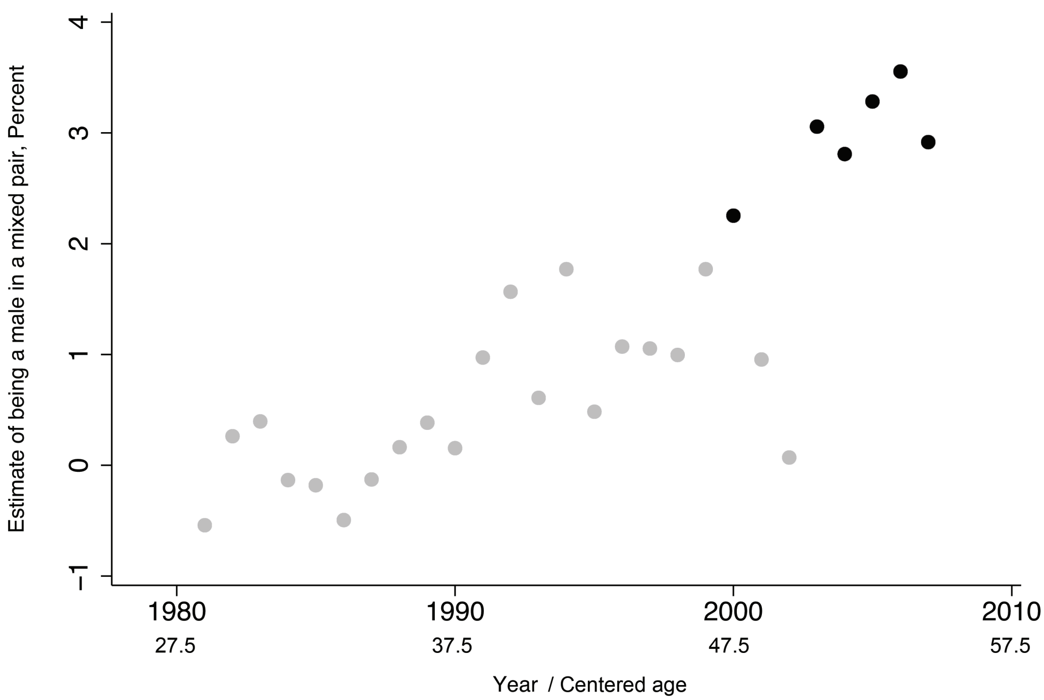
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figure A.1: Estimates for females over time, born 1947-1958, exc. benefits



The table of estimates and adherent material is found in table A.5.

Figure A.2: Estimates for males over time, born 1947-1958, exc. benefits



The table of estimates and adherent material is found in table A.6.

Table A.5: Estimates for females over time, born 1947-1958, exc. benefits

Year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
femalemixed	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.02**	0.01*	0.00	0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Constant	12.05***	12.05***	12.04***	12.05***	12.05***	12.07***	12.09***	12.10***	12.13***	12.14***	12.13***	12.15***	12.15***	12.17***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
Observations	2,585	2,599	2,531	2,630	2,658	2,901	3,165	3,347	3,574	3,667	3,634	4,054	3,803	3,907
Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	
femalemixed	0.01	0.01	0.01*	0.01	0.01	0.01	0.01	0.01	0.02**	0.02**	0.02**	0.02**	0.02**	
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	
Constant	12.17***	12.21***	12.25***	12.28***	12.31***	12.34***	12.36***	12.38***	12.38***	12.40***	12.42***	12.43***	12.45***	
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	
Observations	3,995	4,167	4,293	4,383	4,411	4,406	4,388	4,381	4,533	4,540	4,548	4,571	4,594	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.6: Estimates for males over time, born 1947-1958, exc. benefits

Year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
malemixed	-0.01	0.00	0.00	-0.00	-0.00	-0.00	-0.00	0.00	0.00	0.00	0.01	0.02	0.01	0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Constant	12.20***	12.21***	12.21***	12.24***	12.26***	12.30***	12.34***	12.38***	12.43***	12.45***	12.43***	12.44***	12.45***	12.46***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	4,520	4,588	4,623	4,709	4,763	4,838	4,872	4,911	4,979	5,003	4,932	5,060	4,600	4,541
Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	
malemixed	0.00	0.01	0.01	0.01	0.02	0.02*	0.01	0.00	0.03**	0.03**	0.03**	0.03***	0.03**	
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	
Constant	12.48***	12.52***	12.55***	12.58***	12.60***	12.64***	12.66***	12.67***	12.64***	12.67***	12.68***	12.69***	12.71***	
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	
Observations	4,619	4,638	4,628	4,688	4,683	4,694	4,699	4,652	4,787	4,765	4,778	4,766	4,791	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

B Sample, Data etc.

B.1 Sample construction

In Table B.1 display how the sample of individuals is constructed for the testosterone transfer evaluation. Firstly, same-sexed MZ and DZ twins who died before 1998 are excluded, which amounts to 2,234. Secondly, when linked to the income registers 7 individuals yield missing value, probably due to their emigration from Sweden (as zero income is recorded in the registers). Thirdly, the individuals whoms co-twin has deceased as of 1998 or been excluded due to missing income are also excluded from the sample, which amounts to 5,644 individuals. Fourthly, one opposite-sexed twin pair consisting of two female twins, maybe due to one of them changing gender or a coding error, and those two individuals are excluded. Thus, it remains 43,374 individuals which amounts to 21,687 twin pairs.

Table B.1: Sample construction for testosterone transfer evaluation

	Included	Excluded
1. MZ & DZ twins deceased before 1998	49,027	2,234
2. Income	49,020	7
3. Co-twin	43,376	5,644
4. Changed gender or coding error	43,374	2

In table B.2 is the sample for the testosterone transfer hypothesis and wage outlined in detail, so one can see the effective sample sizes included in estimations in table 2.

Table B.2: Effective sample sizes for average of logarithmic wage

	Same-sexed pairs			Opposite-sexed pairs	Total
	MZ	DZ	Unknown		
Females					
Cohort 1935-1946	898	1,283	186	1,600	3,967
Cohort 1947-1958	1,288	1,771	196	2,278	5,533
Males					
Cohort 1935-1946	843	1,245	270	1,761	4,119
Cohort 1947-1958	1,142	1,897	326	2,279	5,644

B.2 Data manipulation

The following income variables are formed. All are transformed so if negative values of income arise when subtracting pensions, self-employment or benefits, the income variable take the value zero.

- Income including pensions from 1974= Income ("Sammanräknad förvärvsinkomst")
- Income= Income including pensions from 1974 - Pensions ("Deklarerad pension")
- Income exc. self-employment= Income - Self-employment ("Inkomst av näringsverksamhet")
- Income exc. benefits= Income - Sickness insurance ("Sjukpenning") - Unemployment insurance and benefit ("Arbetsmarknadsstöd och Kontant arbetsmarknadsstöd")
- Income exc. self-employment and benefits= Income exc. self-employment - Sickness insurance ("Sjukpenning") - Unemployment insurance and benefit ("Arbetsmarknadsstöd och Kontant arbetsmarknadsstöd")

- Wage=Income exc. self-employment $>$ 130 000 SEK
- Wage exc. benefits=Income exc. self-employment and benefits $>$ 130 000 SEK